Data Science AI Workbench Documentation

Release 5.8.1

Anaconda Inc.

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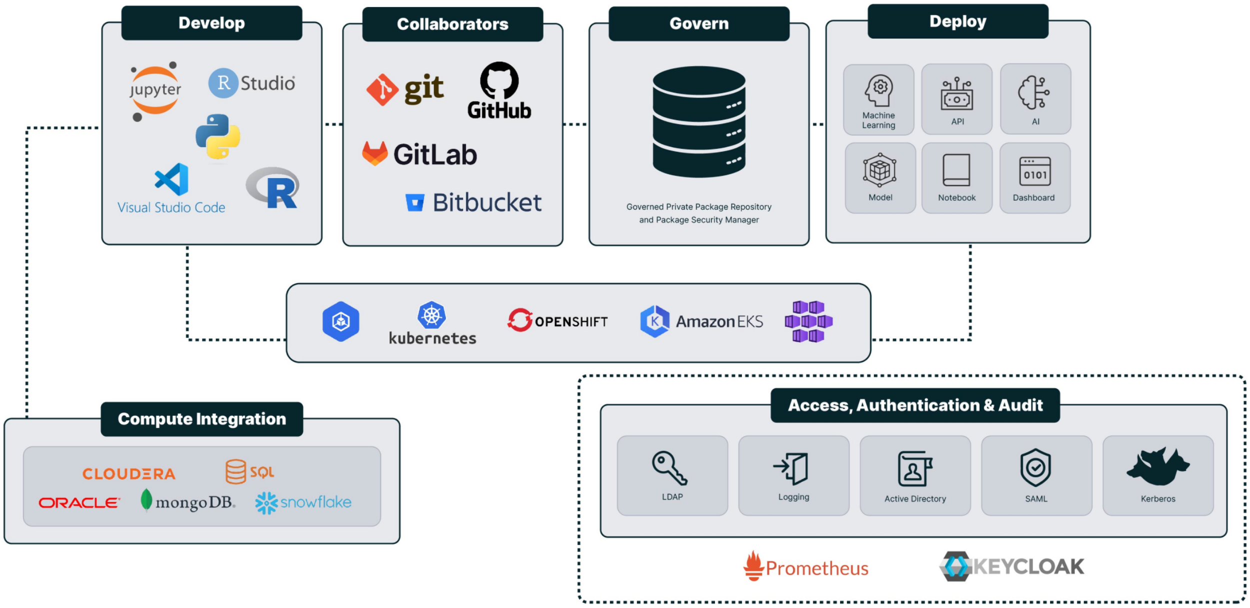
CONTENTS

Workbench is an enterprise-ready, secure and scalable data science platform that empowers teams to govern data science assets, collaborate and deploy their data science projects.

With Workbench, you can do the following:

- **Develop**: ML/AI pipelines in a central development environment that scales from laptops to thousands of nodes
- **Govern**: Complete reproducibility from laptop to cluster with the ability to configure access control
- **Automate**: Model training and deployment on scalable, container-based infrastructure



CHAPTER

ONE

PREPARING AN ENVIRONMENT FOR WORKBENCH

This section provides guidance on preparing your environment before you install Data Science & AI Workbench.

Anaconda's instructions assume that the cluster itself has already been provisioned. Our preparation guide provides you with the details you need to verify that your cluster meets the basic requirements to operate Workbench, and to provision the storage and networking resources required to run the application.

Preparing your Kubernetes environment for Workbench.

Existing customers who rely on Anaconda's Gravity Kubernetes stack can find instructions for *preparing their environment for installation here*.

1.1 Preparing a K3s environment for Workbench

Determining the resource requirements for a Kubernetes cluster depends on a number of different factors, including what type of applications you will be running, the number of users that are active at once, and the workloads you will be managing within the cluster. Data Science & AI Workbench's performance is tightly coupled with the health of your Kubernetes stack, so it is important to allocate enough resources to manage your users' workloads. Generally speaking, your system should contain at least 1 CPU, 1GB of RAM, and 5GB of disk space for each project session or deployment.

1.1.1 Hardware requirements

Anaconda's hardware recommendations ensure a reliable and performant Kubernetes cluster.

The following are minimum specifications for the control plane and worker nodes, as well as the entire cluster.

Control plane node	Minimum
CPU	16 cores
RAM	64GB
Disk space in `/opt/anaconda`	500GB
Disk space in `/var/lib/rancher`	300GB
Disk space in `/tmp` or `$TMPDIR`	50GB

Note:

- Disk space reserved for `/var/lib/rancher` is utilized as additional space to accommodate upgrades. Anaconda recommends having this available during installation.

- The /var/lib/rancher volume *must be mounted on local storage*. Core components of Kubernetes run from this directory, some of which are extremely intolerant of disk latency. Therefore, Network-Attached Storage (NAS) and Storage Area Network (SAN) solutions are not supported for this volume.
- Anaconda recommends that you set up the /opt/anaconda and /var/lib/rancher partitions using Logical Volume Management (LVM) to provide the flexibility needed to accommodate future expansion.
- Disk space reserved for /opt/anaconda is utilized for project and package storage (including mirrored packages).

Worker node	Minimum
CPU	16 cores
RAM	64GB
Disk space in /var/lib/rancher	300GB
Disk space in /tmp or $TMPDIR	50GB

Note: When installing Workbench on a system with multiple nodes, verify that the clock of each node is in sync with the others prior to installation. Anaconda recommends using the Network Time Protocol (NTP) to synchronize computer system clocks automatically over a network. For step-by-step instructions, see How to Synchronize Time with Chrony NTP in Linux.

1.1.2 Disk IOPS requirements

Nodes require a minimum of 3000 *concurrent* Input/Output operations Per Second (IOPS).

Note: Solid state disks are strongly recommended for optimal performance.

1.1.3 Cloud performance requirements

Requirements for running Workbench in the cloud relate to compute power and disk performance.

Minimum specifications:

- CPU: 8 vCPU
- Memory: 32GB RAM

Recommended specifications:

- CPU: 16 vCPU
- Memory: 64GB RAM

1.1.4 Operating system requirements

Please see the official K3s documentation for information on supported operating systems.

Caution:

- You *must* remove Docker or Podman from the server, if present.

1.1.5 Security requirements

- If your Linux system utilizes an antivirus scanner, ensure that the scanner excludes the `/var/lib/rancher` volume from its security scans.
- Installation requires that you have `sudo` access.
- RHEL instances must disable `nm-cloud-setup`.

Disabling nm-cloud-setup

Disable `nm-cloud-setup` by running the following command:

```
systemctl disable nm-cloud-setup.service nm-cloud-setup.timer
```

- Nodes running CentOS or RHEL must ensure that Security Enhanced Linux (SELinux) is set to either `disabled` or `permissive` mode in the `/etc/selinux/config` file.

Tip: Check the status of SELinux by running the following command:

```
getenforce
```

Configuring SELinux

1. Open the `/etc/selinux/config` file using your preferred file editor.
2. Find the line that starts with `SELINUX=` and set it to either `disabled` or `permissive`.
3. Save and close the file.
4. Reboot your system for changes to take effect.

1.1.6 Network requirements

Please see the official K3s documentation regarding network requirements.

1.1.7 Firewall Requirements

It is recommended to remove OS-level firewalls altogether. If that is not possible, review the K3s requirements on how to configure the firewall for your OS.

Mirroring with a firewall

If you plan to use online package mirroring, allowlist the following domains in your network's firewall settings:

- `repo.anaconda.com`
- `anaconda.org`
- `conda.anaconda.org`
- `binstar-cio-packages-prod.s3.amazonaws.com`

To use Workbench in conjunction with Anaconda Navigator in online mode, allowlist the following sites in your network's firewall settings as well:

- `https://repo.anaconda.com` — For use of older versions of Navigator and conda
- `https://conda.anaconda.org` — For use of conda-forge and other channels on Anaconda.org
- `google-public-dns-a.google.com (8.8.8.8:53)` — To check internet connectivity with Google Public DNS.

1.1.8 TLS/SSL certificate requirements

Workbench uses certificates to provide transport layer security for the cluster. Self-signed certificates are generated during the initial installation. Once installation is complete, you can configure the platform to use your organizational TLS/SSL certificates.

You can purchase certificates commercially or generate them using your organization's internal public key infrastructure (PKI) system. When using an internal PKI-signed setup, the CA certificate is inserted into the Kubernetes secret.

In either case, the configuration will include the following:

- A certificate for the root certificate authority (CA)
- An intermediate certificate chain
- A server certificate
- A certificate private key

For more information about TLS/SSL certificates, see *Updating TLS/SSL certificates*.

1.1.9 DNS requirements

Workbench assigns unique URL addresses to deployments by combining a dynamically generated universally unique identifier (UUID) with your organization's domain name, like this: `https://uuid001.anaconda.yourdomain.com`.

This requires the use of wildcard DNS entries that apply to a set of domain names such as `*.anaconda.yourdomain.com`.

For example, if you are using the domain name `anaconda.yourdomain.com` with a control plane node IP address of `12.34.56.78`, the DNS entries would be as follows:

```
anaconda.yourdomain.com IN A 12.34.56.78
*.anaconda.yourdomain.com IN A 12.34.56.78
```

Note: The wildcard subdomain's DNS entry points to the Workbench control plane node.

The control plane node's hostname and the wildcard domains must be resolvable with DNS from the control plane node, worker nodes, and the end user's machines. To ensure the control plane node can resolve its own hostname, distribute any `/etc/hosts` entries to the K3s environment.

Caution: If `dnsmasq` is installed on the control plane node or any worker nodes, you'll need to remove it from all nodes *prior to installing Workbench*.

Verify `dnsmasq` is disabled by running the following command:

```
sudo systemctl status dnsmasq
```

If necessary, stop and disable `dnsmasq` by running the following commands:

```
sudo systemctl stop dnsmasq
sudo systemctl disable dnsmasq
```

1.1.10 Helm chart

Helm is a tool used by Workbench to streamline the creation, packaging, configuration, and deployment of the application's configurations. It combines all of the config map objects into a single reusable package called a Helm chart. This chart contains all the necessary resources to deploy the application within your cluster. These resources include `.yaml` configuration files, services, secrets, and config maps.

For K3s, Workbench includes a `values.k3s.yaml` file that overrides the default values in the top-level Helm chart. Make additions and modifications to this file with your current cluster configurations at this time.

Note: These default configurations are meant for a single-tenant cluster. If you are utilizing a multi-tenant cluster, modify the `rbac` parameters where present to scope to the `namespace` only.

Helm `values.k3s.yaml` template

Note: This template is heavily commented to guide you through the parameters that usually require modification.

```
# This values.yaml template is intended to be customized
# for each installation. Its values *augment and override*
# the default values found in Anaconda-Enterprise/values.yaml.

global:
  # global.hostname -- The fully qualified domain name (FQDN) of the cluster.
  # @section -- Global Common Parameters
  hostname: "anaconda.example.com"
```

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```
  # global.version -- (string) The application version; defaults to `Chart.
↪AppVersion`.
  # @section -- Global Common Parameters
  version:

  # Uncomment for OpenShift only
  # dnsServer: dns-default.openshift-dns.svc.cluster.local

  # The UID under which to run the containers (required)
  runAsUser: 1000

  # Docker registry information
  image:
    # Repository for Workbench images.
    # Trailing slash required if not empty
    server: "aedev/"
    # A single pull secret name, or a list of names, as required
    pullSecrets:

  # Global Service Account Settings
  serviceAccount:
    # global.serviceAccount.name -- Service account name
    # @section -- Global RBAC Parameters
    name: "anaconda-enterprise"

# If the DNS record for the hostname above resolves to an
# address inaccessible from the cluster, supply a valid
# IP address for the ingress or load balancer here.
privateIP: ""

# rbac
serviceAccount:
  # serviceAccount.create -- Controls the creation of the service account
  # @section -- RBAC Parameters
  create: true
rbac:
  # rbac.create -- Controls the creation and binding of rbac resources. This␣
↪excludes ingress.
  # See `.Values.ingress.install` for additional details on managing rbac for␣
↪that resource
  # type.
  # @section -- RBAC Parameters
  create: true

# generateCerts -- Generate Self-Signed Certificates.
# `load`: use the certificates in Anaconda-Enterprise/certs.
# `skip`: do nothing; assume the secrets already exist.
# Existing secrets are always preserved during upgrades.
# @section -- TLS / SSL Secret Management
generateCerts: "generate"
```

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```
# Keycloak LDAPS Settings
# truststore: path to your truststore file containing custom CA cert
# truststore_password: password of the truststore
# truststore_seret: name of secret used for the truststore such as anaconda-
↪enterprise-truststore
keycloak:
  # keycloak.truststore -- Java Truststore File
  # @section -- Keycloak Parameters
  truststore: ""

  # keycloak.truststore_password -- Java Truststore Password
  # @section -- Keycloak Parameters
  truststore_password: ""

  # keycloak.truststore_secret -- Java Truststore Secret
  # @section -- Keycloak Parameters
  truststore_secret: ""

  # keycloak.tempUsername --
  # Important note: these have an effect only during
  # initial installation. If an administrative user
  # already exists, these values are ignored.
  # @section -- Keycloak Parameters
  tempUsername: "admin"

  # keycloak.tempPassword --
  # Important note: these have an effect only during
  # initial installation. If an administrative user
  # already exists, these values are ignored.
  # @section -- Keycloak Parameters
  tempPassword: "admin"

ingress:
  # ingress.className -- (string) If an existing ingress controller is being␣
↪used, this
  # must match the ingress.className of that controller.
  # Cannot be empty if ingress.install is true.
  # @section -- Ingress Parameters
  className: "traefik"

  # ingress.install -- Ingress Install Control.
  # `false`: an existing ingress controller will be used.
  # `true`: install an ingress controller in this namespace.
  # @section -- Ingress Parameters
  install: false

  # ingress.installClass -- IngressClass Install Control.
  # `false`: an existing IngressClass resource will be used.
  # `true`: create a new IngressClass in the global namespace.
  # Ignored if ingress.install is `false`.
  # @section -- Ingress Parameters
  installClass: false
```

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```
  # ingress.labels -- `.metadata.labels` for the ingress.
  # If your ingress controller requires custom labels to be
  # added to ingress entries, list them here as a dictionary
  # of key/value pairs.
  # @section -- Ingress Parameters
  labels: {}

  # If your ingress requires custom annotations to be added
  # to ingress entries, they can be included here. These
  # will be added to any existing annotations in the chart.
  # For all ingress entries
  global: {}
  # For the master ingress only
  system: {}
  # For sessions and deployments only
  user: {}

# To configure an external Git repository, uncomment this section and fill
# in the relevant values. For more details, consult this page:
# https://enterprise-docs.anaconda.com/en/latest/admin/advanced/config-repo.
↪html
#
# git:
#   type: github-v3-api
#   name: Github.com Repo
#   url: https://api.github.com/
#   credential-url: https://api.github.com/anaconda-test-org
#   organization: anaconda-test-org
#   repository: {owner}-{id}
#   username: somegituser
#   auth-token: 98bcf2261707794b4a56f24e23fd6ed771d6c742
#   http-timeout: 60
#   disable-tls-verification: false
#   create-args: {}

# As discussed in the documentation, you may use the same
# persistent volume for both storage resources. If so, make
# sure to use the same pvc: value in both locations.
storage:
  create: true
  pvc: "anaconda-storage"
persistence:
  pvc: "anaconda-storage"

# TOLERATIONS / AFFINITY
# Please work with the Anaconda team for assistance
# to configure these settings if you need them.

tolerations:
  # For all pods
  global: []
```

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```
  # For system pods, except the ingress
  system: []
  # For the ingress daemonset alone
  ingress: []
  # For user pods
  user: []

affinity:
  # For all pods
  global: {}
  # For system pods, except the ingress
  system: {}
  # For the ingress daemonset alone
  ingress: {}
  # For user pods
  user: {}

# By default, all ops services are enabled for k3s installations.
# Consult the documentation for details on how to configure each service.

opsDashboard:
  enabled: true
opsMetrics:
  enabled: true
opsGrafana:
  enabled: true
```

1.1.11 Pre-installation checklist

Anaconda has created this pre-installation checklist to help you verify that you have properly prepared your environment prior to installation.

K3s pre-installation checklist

All nodes in the cluster meet *the minimum or recommended specifications* for CPU, RAM, and disk space.

All nodes in the cluster meet *the minimum IOPS required* for reliable performance.

All cluster nodes are operating the same OS version, and *the OS is supported*.

NTP is being used to *synchronize computer system clocks*, and all nodes are in sync.

The user account performing the installation has `sudo` access on all nodes and is not a root user.

The system meets *all K3s network requirements*.

The *firewall is either disabled or configured correctly*.

If necessary, the *domains required* for *online* package mirroring have been allowlisted.

The final *TLS/SSL certificates <k3s_tls_ssl_reqs>* to be installed with Workbench have been obtained, including the private keys.

The Workbench `A` or `CNAME` domain record is fully operational and points to the IP address of the control plane node.

The wildcard DNS entry for Workbench is also fully operational and points to the IP address of the control plane node. More information about the wildcard DNS requirements can be found *here*.

The `/etc/resolv.conf` file on all the nodes *does not* include the `rotate` option.

Any existing installations of Docker (and `dockerd`), `dnsmasq`, and `lxd` have been removed from all nodes, as they will conflict with Workbench.

1.2 Preparing a BYOK8s environment for Workbench

Determining the resource requirements for a Kubernetes cluster depends on a number of different factors, including what type of applications you are going to be running, the number of users that are active at once, and the workloads you will be managing within the cluster. *Data Science & AI Workbench's performance is tightly coupled with the health of your Kubernetes stack*, so it is important to allocate enough resources to manage your users workloads.

Anaconda's hardware recommendations ensure a reliable and performant Kubernetes cluster. However, most requirements are likely to be superseded by the requirements imposed by your existing Kubernetes cluster, whether that is an on-premise cluster that is configured to support multiple tenants or a cloud offering.

To install Workbench successfully, your systems must meet or exceed the requirements listed below. Anaconda has created a pre-installation checklist to help prepare you for installation. The checklist helps you verify that your cluster is ready to install Workbench, and that the necessary resources are reserved. Anaconda's Implementation team will review the checklist with you prior to your installation.

1.2.1 Supported Kubernetes versions

Workbench is compatible with Kubernetes API versions `1.15-1.28`. If your version of Kubernetes utilizes the API at these versions, you can install Workbench!

Workbench has been successfully installed on the following Kubernetes variants:

On-Premise variants

- Vanilla Kubernetes
- VMWare Tanzu
- RedHat OpenShift
- Google Anthos

Cloud variants

- Amazon Elastic Kubernetes Service (EKS)
- Microsoft Azure Kubernetes Service (AKS)
- Google Kubernetes Service (GKE)
- RedHat OpenShift on AWS (ROSA)

Aside from the basic requirements listed on this page, Anaconda also offers *environment-specific recommendations* for you to consider.

1.2.2 Administration server

Installation requires a machine with direct access to the target Kubernetes cluster and Docker registry. Anaconda refers to this machine as the Administration Server. Anaconda recommends that you identify a machine to be your Administration Server that will remain available for ongoing management of the application once installed. It is useful for this server to be able to mount the storage volumes as well.

The following software must be installed on the Administration Server:

- `Helm` version 3.2+
- The Kubernetes CLI tool - `kubectl`
- (OpenShift only) The OpenShift `oc` CLI tool
- (Optional) The `watch` command line tool
- (Optional) The `jq` command line tool

Administration server setup

You can obtain all of the tools you need for your Administration Server by installing the `ae5-conda` environment. This environment already contains `helm`, `kubectl`, `oc`, `jq`, and a number of other useful Workbench management utilities. To install the environment:

1. Download the environment.
2. If necessary, move the environment to the Administration Server.
3. Open a terminal shell and install the environment by running the following command:

   ```
   bash ae5-conda-latest-Linux-x86_64.sh
   ```

4. Follow the prompts, then restart your terminal.
5. (Optional) Add the environment to your `PATH`.

1.2.3 CPU, memory, and nodes

- Minimum node size: 8 CPU cores, 32GB RAM
- Recommended node size: 16 CPU cores, 64GB RAM (or more)
- Recommended oversubscription (limits/requests ratio) 4:1
- Minimum number of worker nodes: 3

Minimally sized nodes should be reserved for test environments with low user counts and small workloads. Any development or production environment should meet or exceed the recommended requirements.

Workbench utilizes node labels and taints and tolerations to ensure that workloads run on the appropriate nodes. Anaconda recommends identifying any necessary affinity (which nodes a workload runs on based on its applied labels) or toleration settings prior to installation.

1.2.4 Resource profiles

Resource profiles available to platform users for their sessions and deployments are created by the cluster administrator. Each resource profile can be customized for the amount of CPU, memory, and (optionally) GPU resources available. Anaconda recommends determining what resource profiles you will require prior to installation. For more information, see *Configuring workload resource profiles*.

1.2.5 Namespace, service account, RBAC

Workbench should be installed in a namespace that is *not occupied* by any other applications, including other instances of Workbench. Create a service account for the namespace with sufficient permissions to complete the helm installation and enable the dynamic resource provisioning Workbench performs during normal operation.

Workbench requires more permissions than would normally be given to an application that only requires `read-only` access to the Kubernetes API. However, with the exception of the ingress controller, all necessary permission grants are limited to the application namespace. Please speak with the Anaconda Implementation team about any questions you may have regarding these permissions.

RBAC template

The following `Role` and `RoleBinding` pair can be used to grant sufficient permissions to the Service Account.

```
# Replace <SERVICE_ACCOUNT> with the name of your service account
# Replace <NAMESPACE> with the namespace reserved for Workbench
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
name: <SERVICE_ACCOUNT>
namespace: <NAMESPACE>
rules:
- verbs: [ "get", "list" ]
    apiGroups: [ "" ]
    resources: [ "namespaces", "pods/log", "events" ]
- verbs: [ "create", "delete", "get", "list", "patch", "update", "watch" ]
    apiGroups: [ "" ]
    resources: [ "configmaps", "secrets", "pods", "persistentvolumeclaims", "endpoints",
↪"services" ]
- verbs: [ "create", "delete", "get", "list", "patch", "update", "watch" ]
    apiGroups: [ "apps" ]
    resources: [ "deployments", "replicasets", "statefulsets" ]
- verbs: [ "create", "delete", "get", "list", "patch", "update", "watch" ]
    apiGroups: [ "batch" ]
    resources: [ "jobs", "cronjobs" ]
- verbs: [ "create", "delete", "get", "list", "patch", "update", "watch" ]
    apiGroups: [ "extensions" ]
    resources: [ "deployments", "replicasets" ]
- verbs: [ "create", "delete", "get", "list", "patch", "update", "watch" ]
    apiGroups: [ "networking.k8s.io" ]
    resources: [ "ingresses" ]
- verbs: [ "create", "delete", "get", "list", "patch", "update", "watch" ]
    apiGroups: [ "route.openshift.io" ]
    resources: [ "routes", "routes/custom-host" ]
```

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```
- verbs: [ "get",  "list" ]
    apiGroups: [ "" ]
    resources: [ "serviceaccounts", "roles" ]
---
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
name: <SERVICE_ACCOUNT>
namespace: <NAMESPACE>
roleRef:
apiGroup: rbac.authorization.k8s.io
kind: Role
name: <SERVICE_ACCOUNT>
subjects:
- kind: ServiceAccount
    name: <SERVICE_ACCOUNT>
```

Note: Recent versions of OpenShift no longer allow granting direct access to the `anyuid` Security Context Constraint (SCC), or any other default SCC. Instead, access grants are defined within the role.

Example `anyuid` SCC configuration

```
- verbs:
    - use
apiGroups:
    - security.openshift.io
resources:
    - securitycontextconstraints
resourceNames:
    - anyuid
```

If you want to use the Anaconda-supplied ingress, it is also necessary to grant a small number of additional, cluster-wide permissions. This is because the ingress controller expects to be able to monitor ingress-related resources across all namespaces.

Ingress controller permissions

The following is a minimal `ClusterRole` and `ClusterRoleBinding` pair that has grants the ingress controller sufficient permissions to run without warnings:

```
# Ingress Controller Permissions
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: <SERVICE_ACCOUNT>-ingress
  annotations:
    anaconda-rbac: "true"
rules:
```

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```
  - verbs: [ "create", "delete", "get", "list"]
    apiGroups: [ "*" ]
    resources: [ "ingressclasses" ]
  - verbs: [ "patch", "create" ]
    apiGroups: [ "*" ]
    resources: ["events"]
  - verbs: ["list", "watch"]
    apiGroups: ["*"]
    resources: [ "secrets", "endpoints", "ingresses", "endpointslices", "services", "pods
↪" ]
---

apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: <SERVICE_ACCOUNT>-ingress
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: <SERVICE_ACCOUNT>
subjects:
  - kind: ServiceAccount
    name: <SERVICE_ACCOUNT>
    namespace: <NAMESPACE>
```

If you want to use the Kubernetes Dashboard and resource monitoring services included with Workbench, you must include additional permissions for each service.

> **Note:** You must establish permissions for *both* Prometheus *and* kube-state-metrics to utilize Worbench's resource monitoring features.

Kubernetes dashboard permissions

```
# Dashboard - Application
kind: Role
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: <RELEASE_NAME>-dashboard
  namespace: <NAMESPACE>
rules:
  # Allow Dashboard to get, update and delete Dashboard exclusive secrets.
  - apiGroups: [ "" ]
    resources: [ "secrets" ]
    resourceNames: [ "kubernetes-dashboard-key-holder", "kubernetes-dashboard-certs",
↪"kubernetes-dashboard-csrf" ]
    verbs: [ "get", "update", "delete" ]
    # Allow Dashboard to get and update 'kubernetes-dashboard-settings' config map.
  - apiGroups: [ "" ]
    resources: [ "configmaps" ]
```

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```
    resourceNames: [ "kubernetes-dashboard-settings" ]
    verbs: [ "get", "update" ]
    # Allow Dashboard to get metrics.
  - apiGroups: [ "" ]
    resources: [ "services" ]
    resourceNames: [ "heapster", "dashboard-metrics-scraper" ]
    verbs: [ "proxy" ]
  - apiGroups: [ "" ]
    resources: [ "services/proxy" ]
    resourceNames: [ "heapster", "http:heapster:", "https:heapster:", "dashboard-metrics-
↪scraper", "http:dashboard-metrics-scraper" ]
    verbs: [ "get" ]
---

# Dashboard - Application
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: <RELEASE_NAME>-dashboard
  namespace: <NAMESPACE>
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: Role
  name: <RELEASE_NAME>-dashboard
subjects:
  - kind: ServiceAccount
    name: <SERVICE_ACCOUNT>
    namespace: <NAMESPACE>
---

# Dashboard - Application (Bound with RoleBinding for namespace scoping)
kind: ClusterRole
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: <RELEASE_NAME>-dashboard-metrics
rules:
  # Allow Metrics Scraper to get metrics from the Metrics server
  - apiGroups: [ "metrics.k8s.io" ]
    resources: [ "pods", "nodes" ]
    verbs: [ "get", "list", "watch" ]
---

# Dashboard - Namespace
kind: Role
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: <RELEASE_NAME>-dashboard-namespace
  namespace: <NAMESPACE>
rules:
  # Allow Dashboard to manage resources within the namespace.
  - verbs: [ "get", "list", "watch", "patch", "update", "delete", "create" ]
    apiGroups: [ "*" ]
```

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```
    resources:
      # Workloads
      - "cronjobs"
      - "daemonsets"
      - "deployments"
      - "jobs"
      - "pods"
      - "pods/log"
      - "pods/exec"
      - "replicasets"
      - "replicationcontrollers"
      - "statefulsets"
      # Services
      - "ingresses"
      - "ingressclasses"
      - "services"
      # Config and Storage
      - "configmaps"
      - "persistentvolumeclaims"
      - "secrets"
      - "storageclasses"
      # Cluster
      - "clusterrolebindings"
      - "clusterroles"
      - "events"
      - "namespaces"
      - "networkpolicies"
      - "nodes"
      - "persistentvolumes"
      - "rolebindings"
      - "roles"
      - "serviceaccounts"
---

# Dashboard - Namespace
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: <RELEASE_NAME>-dashboard-namespace
  namespace: <NAMESPACE>
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: Role
  name: <RELEASE_NAME>-dashboard-namespace
subjects:
  - kind: ServiceAccount
    name: <SERVICE_ACCOUNT>
    namespace: <NAMESPACE>
---

# Dashboard - Application Metrics
apiVersion: rbac.authorization.k8s.io/v1
```

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```
kind: RoleBinding
metadata:
  name: <RELEASE_NAME>-dashboard-metrics-namespace
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: <RELEASE_NAME>-dashboard-metrics
subjects:
  - kind: ServiceAccount
    name: <SERVICE_ACCOUNT>
    namespace: <NAMESPACE>
```

Prometheus permissions

```
# Prometheus Common Permissions
kind: ClusterRole
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: <RELEASE_NAME>-prometheus
  namespace: <NAMESPACE>
rules:
  - verbs: [ "get", "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "nodes", "nodes/proxy", "nodes/metrics", "services", "endpoints", "pods
↪", "ingresses", "configmaps" ]
  - verbs: [ "get", "list", "watch"]
    apiGroups: [ "extensions",  "networking.k8s.io"]
    resources: [ "ingresses/status", "ingresses"]
  - verbs: [ "get" ]
    nonResourceURLs: [ "/metrics" ]
---

apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: <RELEASE_NAME>-prometheus
  namespace: <NAMESPACE>
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: <RELEASE_NAME>-prometheus
subjects:
  - kind: ServiceAccount
    name: <SERVICE_ACCOUNT>
    namespace: <NAMESPACE>
```

kube-state-metrics permissions

```
# Kubestatemetrics Exporter Namespace Binding
kind: Role
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: <RELEASE_NAME>-kubestatemetrics
  namespace: <NAMESPACE>
rules:
  - verbs: [ "list", "watch" ]
    apiGroups: [ "certificates.k8s.io" ]
    resources: ["certificatesigningrequests"]
  - verbs: [ "list", "watch" ]
    apiGroups: [""]
    resources: ["configmaps"]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "batch" ]
    resources: [ "cronjobs" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "extensions", "apps" ]
    resources: [ "daemonsets" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "extensions", "apps"]
    resources: [ "deployments" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [""]
    resources: [ "endpoints" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "autoscaling" ]
    resources: [ "horizontalpodautoscalers" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "extensions", "networking.k8s.io" ]
    resources: [ "ingresses" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "batch" ]
    resources: ["jobs"]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "coordination.k8s.io" ]
    resources: [ "leases" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "limitranges" ]
  - verbs: ["list", "watch"]
    apiGroups: [ "admissionregistration.k8s.io" ]
    resources: [ "mutatingwebhookconfigurations" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "namespaces" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "networking.k8s.io" ]
    resources: [ "networkpolicies" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
```

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```
    resources: [ "nodes" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "persistentvolumeclaims" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "persistentvolumes" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "policy" ]
    resources: [ "poddisruptionbudgets" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "pods" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "extensions", "apps" ]
    resources: [ "replicasets" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "replicationcontrollers" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "resourcequotas" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "secrets" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "" ]
    resources: [ "services" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "apps" ]
    resources: [ "statefulsets" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "storage.k8s.io" ]
    resources: [ "storageclasses" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "admissionregistration.k8s.io" ]
    resources: [ "validatingwebhookconfigurations" ]
  - verbs: [ "list", "watch" ]
    apiGroups: [ "storage.k8s.io" ]
    resources: [ "volumeattachments" ]
---

kind: RoleBinding
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: <RELEASE_NAME>-kubestatemetrics
  namespace: <NAMESPACE>
subjects:
  - kind: ServiceAccount
    name: <SERVICE_ACCOUNT>
    namespace: <NAMESPACE>
roleRef:
```

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```
  apiGroup: rbac.authorization.k8s.io
  kind: Role
  name: <RELEASE_NAME>-kubestatemetrics
```

Caution: Please review these RBAC configurations with your Kubernetes administrator. While it is *possible* to further reduce these scopes, doing so is likely to prevent normal operation of Workbench.

1.2.6 Security

Preparing your Kubernetes cluster to install Workbench involves configuring your environment in a way that both supports the functionality of Workbench and adheres to security best practices.

Workbench containers can be run using any fixed, non-zero UID, making the application compatible with an OpenShift Container Platform (OCP) restricted SCC, or an equivalent non-permissive Kubernetes security context. This reduces the risk to your systems if the container is compromised.

However, in order to enable the Authenticated Network File System (NFS) capability, allowing user containers to access external, authenticated fileshares (storage servers), user pods must be permitted to run as root (UID 0).

Note: This configuration runs containers in a privileged state to determine and assign the authenticated group memberships of the user running the container only. Once authentication is complete, the container drops down to a non-privileged state for all further execution.

Please speak with your Anaconda Implementation team for more information, and to see if it is possible for your application to avoid this requirement.

1.2.7 Storage

A standard installation of Workbench requires two Persistent Volume Claims (PVCs) to be *statically provisioned and bound prior to installation*. Anaconda strongly recommends a premium performance tier for provisioning your PVCs if the option is available. Expand the following sections for more information about the necessary volumes:

`anaconda-storage`

This volume contains:

- Anaconda's internal Postgres control database
- Anaconda's internal Git storage mechanism
- Anaconda's internal conda package repository

Note: If you are hosting conda packages outside of Workbench, the minimum size of your `anaconda-storage` volume must be at least *100GiB*.

However, if you intend to mirror conda packages into the Workbench repository, the `anaconda-storage` volume will need to be much larger to accommodate those packages. Anaconda recommends *at least 500GiB of storage*.

The `anaconda-storage` volume must support either the `ReadWriteOnce` or `ReadWriteMany` access mode.

> **Caution:** The `ReadWriteOnce` configuration requires that the `postgres`, `git-storage`, and `object-storage` pods run on the same node.

`anaconda-persistence`

This volume hosts Anaconda's managed persistence storage. It contains:

- Custom sample projects
- Custom conda environments
- User code and data

The `anaconda-persistence` volume requires `ReadWriteMany` access.

> **Caution:** The demands on the `anaconda-persistence` volume will continuously grow with usage. Anaconda recommends you provision *at least 1TiB of storage to start*.

It is possible to combine these into a single `PersistentVolumeClaim` to cover both needs, *as long as that single volume simultaneously meets the performance needs demanded by both*.

The root directories of these storage volumes must be writable by Workbench containers. This can be accomplished by configuring the volumes to be group writable by a single numeric GroupID (GID). Anaconda strongly recommends that this GID be `0`. This is the default GID assigned to Kubernetes containers. If this is not possible, supply the GID within the Persistent Volume specification as a `pv.beta.kubernetes.io/gid` annotation.

> **Caution:** To ensure that the data on these volumes is not lost if Workbench is uninstalled, do not change the `ReclaimPolicy` from its default value of `Retain`.

1.2.8 Ingress and firewall

Workbench is compatible with most ingress controllers that are commonly used with Kubernetes clusters. Because ingress controllers are a cluster-wide resource, Anaconda recommends that the controller be installed and configured prior to installing Workbench. For example, if your Kubernetes version falls within `1.19-1.26`, any ingress controller with full support for the `networking.k8s.io/v1` ingress API enables Workbench to build endpoints for user sessions and deployments.

> **Note:** If your cluster is fully dedicated to Workbench, you can configure the Helm chart to install a version of the NGINX Ingress controller, which is compatible with multiple variants of Kubernetes, including OpenShift. Anaconda's only modification to the stock NGINX container enables it to run without root privileges.

Your cluster configuration and firewall settings must allow all TCP traffic between nodes, particularly HTTP, HTTPS, and the standard Postgres ports.

> **Caution:** Healthy clusters can block inter-node communication, which disrupts the pods that Workbench requires to provision user workloads.

External traffic to Workbench will be funneled entirely through the ingress controller, through the standard HTTPS port `443`.

1.2.9 DNS/SSL

Workbench requires the following:

- A valid, fully qualified domain name (FQDN) reserved for Workbench.
- A DNS record for the FQDN, as well as a *wildcard* DNS record for its subdomains.

  Note: Both records must point to the IP address allocated by the ingress controller. If you are using an existing ingress controller, you may be able to obtain this address prior to installation. Otherwise, you must populate the DNS records with the address after the initial installation is complete.

- A valid *wildcard* SSL certificate covering the cluster FQDN and its subdomains. Installation requires both the public certificate and the private key.

  Note: If the certificate chain includes an intermediate certificate, the public certificate for the intermediate is required. The *scope* of the wildcard only requires `*.anaconda.company.com` to be covered, ensuring that all subdomains under this specific domain are included in the SSL certificate and DNS configuration.

- The public root certificate, if the above certificates were created with a private Certificate Authority (CA).

Warning: Wildcard DNS records and SSL certificates are *required* for correct operation of Workbench. If you have any objections to this requirement, speak with your Anaconda Implementation team.

1.2.10 Docker images

Anaconda strongly recommends that you copy the Workbench Docker images from our authenticated source repository on Docker Hub into your internal docker registry. This ensures their availability even if there is an interruption in connectivity to Docker Hub. This registry must be accessible from the Kubernetes cluster where Workbench is installed.

Caution: In an airgapped setting, this is *required*.

Docker images from the `aedev/` Docker Hub channel

Anaconda provides a more precise manifest, including version numbers and the credentials required to pull these images from our authenticated repository, prior to installation.

```
ae-app-proxy
ae-auth
ae-auth-api
ae-auth-escrow
ae-deploy
ae-docs
```

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```
ae-editor
ae-git-proxy
ae-git-storage
ae-object-storage
ae-operation-controller
ae-operation-create-project
ae-repository
ae-storage
ae-sync
ae-ui
ae-workspace
ae-wagonwheel
ae-auth-keycloak
ae-nginx-ingress-v1
ae-nginx-ingress-v1beta1
postgres:16.3
```

Note: Docker images used by Workbench are larger than many Kubernetes administrators are accustomed to. For more background, see *Docker image sizes*.

1.2.11 GPU Information

This release of Workbench supports up to Compute Unified Device Architecture (CUDA) `11.6` DataCenter drivers.

Anaconda has directly tested the application with the following GPU cards:

- Tesla V100 (recommended)
- Tesla P100 (adequate)

Theoretically, Workbench will work with any GPU card compatible with the CUDA drivers, as long as they are properly installed. Other cards supported by CUDA `11.6`:

- A-Series: NVIDIA A100, NVIDIA A40, NVIDIA A30, NVIDIA A10
- RTX-Series: RTX 8000, RTX 6000, NVIDIA RTX A6000, NVIDIA RTX A5000, NVIDIA RTX A4000, NVIDIA T1000, NVIDIA T600, NVIDIA T400
- HGX-Series: HGX A100, HGX-2
- T-Series: Tesla T4
- P-Series: Tesla P40, Tesla P6, Tesla P4
- K-Series: Tesla K80, Tesla K520, Tesla K40c, Tesla K40m, Tesla K40s, Tesla K40st, Tesla K40t, Tesla K20Xm, Tesla K20m, Tesla K20s, Tesla K20c, Tesla K10, Tesla K8
- M-Class: M60, M40 24GB, M40, M6, M4

Support for GPUs in Kubernetes is still a work in progress, and each cloud vendor provides different recommendations. For more information about GPUs, see *Understanding GPUs*.

1.2.12 Helm charts

Helm is a tool used by Workbench to streamline the creation, packaging, configuration, and deployment of the application's configurations. It combines all of the config map objects into a single reusable package called a Helm chart. This chart contains all the necessary resources to deploy the application within your cluster. These resources include `.yaml` configuration files, services, secrets, and config maps.

Helm `values.byok.*.yaml` templates

For customer-supplied Kubernetes environments, Workbench includes templated `values.byok.*.yaml` files that override the default values in the top-level Helm chart. These template files are heavily commented to guide you through configuring the parameters that most commonly require modifications.

If Workbench is the only application present within your cluster, use the single-tenant configurations. If Workbench shares the cluster with other applications, use the multi-tenant configurations. Choose the template that applies to your setup and make additions and modifications to the file with your current cluster configurations at this time.

Single-tenant

Note: Single-tenant clusters use the `values.byok.cluster.yaml` override file template.

```
# This values.yaml template is intended to be customized
# for each installation. Its values *augment and override*
# the default values found in Anaconda-Enterprise/values.yaml.

global:
  # global.hostname -- The fully qualified domain name (FQDN) of the cluster.
  # @section -- Global Common Parameters
  hostname: "anaconda.example.com"

  # global.version -- (string) The application version; defaults to `Chart.
↪AppVersion`.
  # @section -- Global Common Parameters
  version:

  # Uncomment for OpenShift only
  # dnsServer: dns-default.openshift-dns.svc.cluster.local

  # The UID under which to run the containers (required)
  runAsUser: 1000

  # Docker registry information
  image:
    # Repository for Workbench images.
    # Trailing slash required if not empty
    server: "aedev/"
    # A single pull secret name, or a list of names, as required
    pullSecrets:
```

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```
  # Global Service Account Settings
  serviceAccount:
    # global.serviceAccount.name -- Service account name
    # @section -- Global RBAC Parameters
    name: "anaconda-enterprise"

# If the DNS record for the hostname above resolves to an
# address inaccessible from the cluster, supply a valid
# IP address for the ingress or load balancer here.
privateIP: ""

# rbac
serviceAccount:
  # serviceAccount.create -- Controls the creation of the service account
  # @section -- RBAC Parameters
  create: true
rbac:
  # rbac.create -- Controls the creation and binding of rbac resources. This␣
↪excludes ingress.
  # See `.Values.ingress.install` for additional details on managing rbac for␣
↪that resource
  # type.
  # @section -- RBAC Parameters
  create: true

# generateCerts -- Generate Self-Signed Certificates.
# `load`: use the certificates in Anaconda-Enterprise/certs.
# `skip`: do nothing; assume the secrets already exist.
# Existing secrets are always preserved during upgrades.
# @section -- TLS / SSL Secret Management
generateCerts: "generate"

# Keycloak LDAPS Settings
# truststore: path to your truststore file containing custom CA cert
# truststore_password: password of the truststore
# truststore_seret: name of secret used for the truststore such as anaconda-
↪enterprise-truststore
keycloak:
  # keycloak.truststore -- Java Truststore File
  # @section -- Keycloak Parameters
  truststore: ""

  # keycloak.truststore_password -- Java Truststore Password
  # @section -- Keycloak Parameters
  truststore_password: ""

  # keycloak.truststore_secret -- Java Truststore Secret
  # @section -- Keycloak Parameters
  truststore_secret: ""

  # keycloak.tempUsername --
  # Important note: these have an effect only during
```

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```
  # initial installation. If an administrative user
  # already exists, these values are ignored.
  # @section -- Keycloak Parameters
  tempUsername: "admin"

  # keycloak.tempPassword --
  # Important note: these have an effect only during
  # initial installation. If an administrative user
  # already exists, these values are ignored.
  # @section -- Keycloak Parameters
  tempPassword: "admin"

ingress:
  # ingress.className -- (string) If an existing ingress controller is being␣
↪used, this
  # must match the ingress.className of that controller.
  # Cannot be empty if ingress.install is true.
  # @section -- Ingress Parameters
  className:

  # ingress.install -- Ingress Install Control.
  # `false`: an existing ingress controller will be used.
  # `true`: install an ingress controller in this namespace.
  # @section -- Ingress Parameters
  install: false

  # ingress.installClass -- IngressClass Install Control.
  # `false`: an existing IngressClass resource will be used.
  # `true`: create a new IngressClass in the global namespace.
  # Ignored if ingress.install is `false`.
  # @section -- Ingress Parameters
  installClass: false

  # ingress.labels -- `.metadata.labels` for the ingress.
  # If your ingress controller requires custom labels to be
  # added to ingress entries, list them here as a dictionary
  # of key/value pairs.
  # @section -- Ingress Parameters
  labels: {}

  # If your ingress requires custom annotations to be added
  # to ingress entries, they can be included here. These
  # will be added to any existing annotations in the chart.
  # For all ingress entries
  global: {}
  # For the master ingress only
  system: {}
  # For sessions and deployments only
  user: {}

# To configure an external Git repository, uncomment this section and fill
# in the relevant values. For more details, consult this page:
```

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```
# https://enterprise-docs.anaconda.com/en/latest/admin/advanced/config-repo.
↪html
#
# git:
#   type: github-v3-api
#   name: Github.com Repo
#   url: https://api.github.com/
#   credential-url: https://api.github.com/anaconda-test-org
#   organization: anaconda-test-org
#   repository: {owner}-{id}
#   username: somegituser
#   auth-token: 98bcf2261707794b4a56f24e23fd6ed771d6c742
#   http-timeout: 60
#   disable-tls-verification: false
#   create-args: {}

# As discussed in the documentation, you may use the same
# persistent volume for both storage resources. If so, make
# sure to use the same pvc: value in both locations.
storage:
  create: false
  pvc: "anaconda-storage"
persistence:
  pvc: "anaconda-storage"

# TOLERATIONS / AFFINITY
# Please work with the Anaconda team for assistance
# to configure these settings if you need them.

tolerations:
  # For all pods
  global: []
  # For system pods, except the ingress
  system: []
  # For the ingress daemonset alone
  ingress: []
  # For user pods
  user: []

affinity:
  # For all pods
  global: {}
  # For system pods, except the ingress
  system: {}
  # For the ingress daemonset alone
  ingress: {}
  # For user pods
  user: {}

# By default, all ops services are enabled for single-tenant BYOK␣
↪installations.
# Consult the documentation for details on how to configure each service.
```

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```

opsDashboard:
  enabled: true
opsMetrics:
  enabled: true
opsGrafana:
  enabled: true
```

Multi-tenant cluster configurations

Note: Multi-tenant clusters use the `values.byok.namespace.yaml` override file template.

```
# This values.yaml template is intended to be customized
# for each installation. Its values *augment and override*
# the default values found in Anaconda-Enterprise/values.yaml.

global:
  # global.hostname -- The fully qualified domain name (FQDN) of the cluster.
  # @section -- Global Common Parameters
  hostname: "anaconda.example.com"

  # global.version -- (string) The application version; defaults to `Chart.
↪AppVersion`.
  # @section -- Global Common Parameters
  version:

  # Uncomment for OpenShift only
  # dnsServer: dns-default.openshift-dns.svc.cluster.local

  # The UID under which to run the containers (required)
  runAsUser: 1000

  # Docker registry information
  image:
    # Repository for Workbench images.
    # Trailing slash required if not empty
    server: "aedev/"
    # A single pull secret name, or a list of names, as required
    pullSecrets:

  # Global Service Account Settings
  serviceAccount:
    # global.serviceAccount.name -- Service account name
    # @section -- Global RBAC Parameters
    name: "anaconda-enterprise"

  opsMetrics:
    # global.opsMetrics.ownNamespace -- Controls whether scraping rules target␣
↪release namespace or all namespaces.
```

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```
    ownNamespace: true

# If the DNS record for the hostname above resolves to an
# address inaccessible from the cluster, supply a valid
# IP address for the ingress or load balancer here.
privateIP: ""

# rbac
serviceAccount:
  # serviceAccount.create -- Controls the creation of the service account
  # @section -- RBAC Parameters
  create: false
rbac:
  # rbac.create -- Controls the creation and binding of rbac resources. This␣
↪excludes ingress.
  # See `.Values.ingress.install` for additional details on managing rbac for␣
↪that resource
  # type.
  # @section -- RBAC Parameters
  create: false

# generateCerts -- Generate Self-Signed Certificates.
# `load`: use the certificates in Anaconda-Enterprise/certs.
# `skip`: do nothing; assume the secrets already exist.
# Existing secrets are always preserved during upgrades.
# @section -- TLS / SSL Secret Management
generateCerts: "generate"

# Keycloak LDAPS Settings
# truststore: path to your truststore file containing custom CA cert
# truststore_password: password of the truststore
# truststore_seret: name of secret used for the truststore such as anaconda-
↪enterprise-truststore
keycloak:
  # keycloak.truststore -- Java Truststore File
  # @section -- Keycloak Parameters
  truststore: ""

  # keycloak.truststore_password -- Java Truststore Password
  # @section -- Keycloak Parameters
  truststore_password: ""

  # keycloak.truststore_secret -- Java Truststore Secret
  # @section -- Keycloak Parameters
  truststore_secret: ""

  # keycloak.tempUsername --
  # Important note: these have an effect only during
  # initial installation. If an administrative user
  # already exists, these values are ignored.
  # @section -- Keycloak Parameters
  tempUsername: "admin"
```

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```
  # keycloak.tempPassword --
  # Important note: these have an effect only during
  # initial installation. If an administrative user
  # already exists, these values are ignored.
  # @section -- Keycloak Parameters
  tempPassword: "admin"

ingress:
  # ingress.className -- (string) If an existing ingress controller is being␣
↪used, this
  # must match the ingress.className of that controller.
  # Cannot be empty if ingress.install is true.
  # @section -- Ingress Parameters
  className:

  # ingress.install -- Ingress Install Control.
  # `false`: an existing ingress controller will be used.
  # `true`: install an ingress controller in this namespace.
  # @section -- Ingress Parameters
  install: false

  # ingress.installClass -- IngressClass Install Control.
  # `false`: an existing IngressClass resource will be used.
  # `true`: create a new IngressClass in the global namespace.
  # Ignored if ingress.install is `false`.
  # @section -- Ingress Parameters
  installClass: false

  # ingress.labels -- `.metadata.labels` for the ingress.
  # If your ingress controller requires custom labels to be
  # added to ingress entries, list them here as a dictionary
  # of key/value pairs.
  # @section -- Ingress Parameters
  labels: {}

  # If your ingress requires custom annotations to be added
  # to ingress entries, they can be included here. These
  # will be added to any existing annotations in the chart.
  # For all ingress entries
  global: {}
  # For the master ingress only
  system: {}
  # For sessions and deployments only
  user: {}

# To configure an external Git repository, uncomment this section and fill
# in the relevant values. For more details, consult this page:
# https://enterprise-docs.anaconda.com/en/latest/admin/advanced/config-repo.
↪html
#
# git:
```

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```
#   type: github-v3-api
#   name: Github.com Repo
#   url: https://api.github.com/
#   credential-url: https://api.github.com/anaconda-test-org
#   organization: anaconda-test-org
#   repository: {owner}-{id}
#   username: somegituser
#   auth-token: 98bcf2261707794b4a56f24e23fd6ed771d6c742
#   http-timeout: 60
#   disable-tls-verification: false
#   create-args: {}

# As discussed in the documentation, you may use the same
# persistent volume for both storage resources. If so, make
# sure to use the same pvc: value in both locations.
storage:
  create: false
  pvc: "anaconda-storage"
persistence:
  pvc: "anaconda-storage"

# TOLERATIONS / AFFINITY
# Please work with the Anaconda team for assistance
# to configure these settings if you need them.

tolerations:
  # For all pods
  global: []
  # For system pods, except the ingress
  system: []
  # For the ingress daemonset alone
  ingress: []
  # For user pods
  user: []

affinity:
  # For all pods
  global: {}
  # For system pods, except the ingress
  system: {}
  # For the ingress daemonset alone
  ingress: {}
  # For user pods
  user: {}

# By default, all ops services are disabled for multi-tenant BYOK installations.
# Consult the documentation for details on how to enable and configure each service.

opsDashboard:
  enabled: false
```

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```
opsMetrics:
  enabled: false
opsGrafana:
  enabled: false
```

1.2.13 Pre-installation checklist

Anaconda has created this pre-installation checklist to help you verify that you have properly prepared your environment prior to installation.

Within this checklist, Anaconda provides some commands or command templates for you to run in order to verify a given requirement, along with a typical output from the command to give you an idea of the kind of information you should see. Run each of these commands, (modified as appropriate for your environment) and copy the outputs into a document. Send this document to your Anaconda implementation team so that they can verify your environment is ready before you begin the installation process.

BYOK8s pre-installation checklist

Verify that your *administration server* has been provisioned with appropriate versions of `kubectl`, `helm`, and other tools needed to perform installation and administration tasks by running the following command:

```
helm version
```

Here is an example response from the command:

```
version.BuildInfo{Version:"v3.7.1", GitCommit:
↪"1d11fcb5d3f3bf00dbe6fe31b8412839a96b3dc4", GitTreeState:"clean",␣
↪GoVersion:"go1.16.9"}
```

Verify that the *API version* of the Kubernetes cluster is between `1.15` and `1.28` by running the following command:

```
kubectl version
```

Here is an example response from the command:

```
Client Version: version.Info{Major:"1", Minor:"15", GitVersion:"v1.15.
↪12", GitCommit:"e2a822d9f3c2fdb5c9bfbe64313cf9f657f0a725",␣
↪GitTreeState:"clean", BuildDate:"2020-05-06T05:17:59Z", GoVersion:
↪"go1.12.17", Compiler:"gc", Platform:"linux/amd64"}
Server Version: version.Info{Major:"1", Minor:"15", GitVersion:"v1.15.
↪12", GitCommit:"e2a822d9f3c2fdb5c9bfbe64313cf9f657f0a725",␣
↪GitTreeState:"clean", BuildDate:"2020-05-06T05:09:48Z", GoVersion:
↪"go1.12.17", Compiler:"gc", Platform:"linux/amd64"}
```

Verify all nodes nodes on which Workbench will be installed have *sufficient CPU and memory allocations* by running the following command:

```
kubectl get nodes -o=jsonpath="{range .items[*]}{.metadata.name}{'\t'}
↪{.status.capacity.cpu}{'\t'}{.status.capacity.memory}{'\n'}{end}"
```

Here is an example response from the command:

```
10.234.2.18 16  65806876Ki
10.234.2.19 16  65806876Ki
10.234.2.20 16  65806876Ki
10.234.2.21 16  65806876Ki
10.234.2.6  16  65974812Ki
```

Verify that the *namespace* where Workbench will be installed has been created by running the following command:

```
# Replace <NAMESPACE> with the namespace you've reserved for Workbench
kubectl describe namespace <NAMESPACE>
```

Here is an example response from the command:

```
Name:         default
Labels:       <none>
Annotations:  <none>
Status:       Active
No resource quota.
No resource limits.
```

Verify the *service account* that will be used by Workbench during installation and operation has been created by running the following command:

```
# Replace <SERVICE_ACCOUNT> with the name of the service account you
↪'ve created for Workbench
kubectl describe sa <SERVICE_ACCOUNT>
```

Here is an example response from the command:

```
Name:                anaconda-enterprise
Namespace:           default
Labels:              <none>
Annotations:         <none>
Image pull secrets:  <none>
Mountable secrets:   anaconda-enterprise-token-cdmnf
Tokens:              anaconda-enterprise-token-cdmnf
Events:              <none>
```

(Openshift Only) Verify the Security Context Constraint (SCC) associated with the service account contains all of the necessary permissions by running the following command:

```
oc describe scc <SCC_NAME>
```

Here is an example response from the command:

```
Name:                           anyuid
Priority:                       10
Access:
  Users:                        <none>
  Groups:                       system:cluster-admins
```

Note: This example uses the `anyuid` SCC; however, the `restricted` SCC can also be used, as long as the `uid` range is known.

Verify the `ClusterRole` resource associated with the service account has the necessary permissions to facilitate installation and operation by running the following command:

```
# Replace <SERVICE_ACCOUNT> with the name of the service account you
↪'ve created for Workbench
kubectl describe clusterrole <SERVICE_ACCOUNT>-ingress
```

Here is an example response from the command:

```
Name:         anaconda-enterprise-ingress
Labels:       app.kubernetes.io/managed-by=Helm
              skaffold.dev/run-id=8d38b94a-ab82-49d7-a6fd-0bc0fb549d1c
Annotations:  meta.helm.sh/release-name: anaconda-enterprise
              meta.helm.sh/release-namespace: default
PolicyRule:
  Resources  Non-Resource URLs  Resource Names  Verbs
  ---------  -----------------  --------------  -----
  *.*        []                 []              [*]
             [*]                []              [*]
```

Note: The above example is fully permissive. See the *RBAC template* for more realistic configurations.

A numeric UID that will be used to run Workbench containers is reserved.

Note: Include the UID in your checklist results.

Verify that GID `0` is permitted by the security context.

Verify any *tolerations and/or node labels* required to permit Workbench to run on its assigned nodes have been identified by running the following command:

```
# This command returns information for tolerations only
kubectl get nodes -o=jsonpath='{range .items[*]}{.metadata.name}{"\t"}
↪{.spec.taints[*].key}{"\n"}{end}'``
```

Verify that a Persistent Volume Claim (PVC) has been created within the application namespace, referencing a statically provisioned Persistent Volume that meets the *storage requirements* for the `anaconda-storage` volume.

Command: `kubectl describe pvc anaconda-storage`:

```
Name:          anaconda-storage
Namespace:     default
StorageClass:  anaconda-storage
Status:        Bound
Volume:        anaconda-storage
Labels:        <none>
Annotations:   pv.kubernetes.io/bind-completed: yes
            pv.kubernetes.io/bound-by-controller: yes
```

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```
Finalizers:    [kubernetes.io/pvc-protection]
Capacity:      500Gi
Access Modes:  RWO
VolumeMode:    Filesystem
Mounted By:    anaconda-enterprise-ap-git-storage-6658575d6f-vxj4s
            anaconda-enterprise-ap-object-storage-76bcfc4d44-ctlhp
            anaconda-enterprise-postgres-c76869799-cbqzq
Events:        <none>
```

Verify a PVC has been created within the application namespace, referencing a statically provisioned Persistent Volume that meets the *storage requirements* for the `anaconda-persistence` volume by running the following command:

```
kubectl describe pvc anaconda-persistence
```

Here is an example response from the command:

```
Name:            anaconda-persistence
Labels:          <none>
Annotations:     pv.kubernetes.io/bound-by-controller: yes
Finalizers:      [kubernetes.io/pv-protection]
StorageClass:
Status:          Bound
Claim:           default/anaconda-persistence
Reclaim Policy:  Retain
Access Modes:    RWX
VolumeMode:      Filesystem
Capacity:        500Gi
Node Affinity:   <none>
Message:
Source:
    Type:      NFS (an NFS mount that lasts the lifetime of a pod)
    Server:    10.234.2.7
    Path:      /data/persistence
    ReadOnly:  false
Events:        <none>
```

The cluster is sized appropriately (CPU / Memory) for user workload, including consideration for "burst" workloads. For more information, see *Understanding Workbench system requirements*.

Resource Profiles have been determined, and created in the `values.yaml` file.

A domain name for the Workbench application has been identified.

Note: Please include this domain name in your checklist output.

If you are supplying your own ingress controller, verify it has already been installed, and its master IP address and `ingressClassName` value have been identified.

Note: Please include both the IP address ingress class name in your checklist output.

Verify the DNS records for both `anaconda.example.com` and `*.anaconda.example.com` have been created and point to the IP address of the ingress controller by running the following command:

```
ping test.anaconda.example.com
```

Here is an example response from the command:

```
PING test.anaconda.example.com (167.172.143.144): 56 data bytes
```

Note: If the ingress controller is to be installed with Workbench, this may not be possible. In such cases, it is sufficient to confirm that the networking team is prepared to establish these records immediately following installation.

A wildcard SSL secret for `anaconda.example.com` and `*.anaconda.example.com` has been created. The public and private keys for the main certificate, as well as the full public certificate chain, are accessible from the administration server.

Note: Please share the public certificate chain in your checklist output.

If the SSL secret was created using a private CA, verify the public root certificate has been obtained.

If you are using a private Docker registry, verify the full set of Docker images have been transferred to this registry.

If a pull secret is required to access the Docker images (whether from the standard Workbench Docker channel or the private registry) verify the secret has been created in the application namespace by running the following command:

```
# Replace <NAMESPACE> with the namespace you've reserved for Workbench
# Replace <PULL_SECRET_NAME> with the name for your pull secret
kubectl get secret -n <NAMESPACE> <PULL_SECRET_NAME>
```

1.3 Environment-specific recommendations

Each of these sections *augments* our *environment preparation guide* with recommendations specific to the vendor's offered environments.

Anaconda is committed to keeping these recommendations current. If you deviate from these recommendations, please share your changes with Anaconda so that we can confirm they do not compromise the operation of Data Science & AI Workbench, and keep our recommendations up-to-date.

1.3.1 Azure Kubernetes Service

This guide offers recommended configurations and settings unique to Azure Kubernetes Service (AKS). These should be used to augment the generic requirements offered on our *primary requirements page*.

Instance types

- Minimum: `Standard_D8s_v4`
- Recommended: `Standard_D16s_v4`

Storage

Unfortunately, we have found that Azure's built-in, managed Network File System (NFS) service, Azure Files NFS, does not provide an acceptable performance level for use with Data Science & AI Workbench. We have not yet had the opportunity to evaluate Azure NetApp Files.

For this reason, Anaconda recommends creating a separate Virtual Machine for hosting NFS storage. Follow the recommendations offered in *this document*, with these Azure-specific recommendations:

- The `Standard_D4s_v3` machine type is suitable for this purpose.
- Azure tightly couples disk size and IOPS performance. Anaconda recommends a minimum disk size of 1 TiB to ensure good performance.

Note: This server can be the administration server as well.

Network

Azure offers two different networking options for AKS clusters. Both approaches are compatible with Workbench, so the determination depends upon your larger networking needs.

Note: AKS uses a LoadBalancer which by default sets TCP idle timeouts to 4 minutes, and enables TCP resets. This may affect any user workload that depends on a continuous TCP connection.

GPUs

Please see this Azure guide for adding GPU resources to your AKS cluster.

1.3.2 Amazon Elastic Kubernetes Service

This guide offers recommended configurations and settings unique to AWS Elastic Kubernetes Service (EKS) in Data Science & AI Workbench. These should be used to augment the generic requirements offered on our *primary requirements page*.

Instance types

- Minimum: `m5.2xlarge`
- Recommended: `m5.4xlarge` or larger

Storage

EKS supports the use of both EBS and EFS storage for persistence. In theory, EBS can be employed for the `anaconda-storage` volume; but because EBS is limited to the `ReadWriteOnce` access mode, only EFS is acceptable for the `anaconda-persistence` volume. For this reason, Anaconda recommends provisioning a single volume that is large and performant enough to accommodate *both* storage requirements, to simplify management.

Please refer to the following pages for information on provisioning an EFS volume:

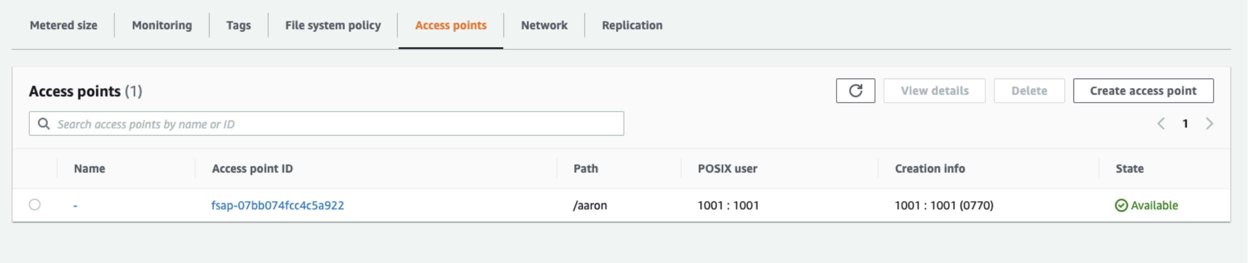
- Amazon EFS CSI driver
- Working with Amazon EFS Access Points
- CreationInfo

Anaconda recommends the following configuration parameters for this volume:

- `OwnerUid`: Anaconda recommends this be set to the same UID selected to run the Workbench containers.
- `OwnerGid`: Anaconda recommends a value of `0`, which simplifies access from Kubernetes containers whose primary group is `0` by default. If you choose a different GID, it will be necessary to incorporate that into the `PersistentVolume` specification.
- `Permissions`: `770` or `775`. It is important that the directory be group writable.

When defining the access controls for this volume, include both the EKS cluster and the administration server, so the latter can be used to manage the volume.

Note: You can create an EFS access point using the UID/GID defined above.



Access points (1)

	Name	Access point ID	Path	POSIX user	Creation info	State
○	-	fsap-07bb074fcc4c5a922	/aaron	1001 : 1001	1001 : 1001 (0770)	✓ Available

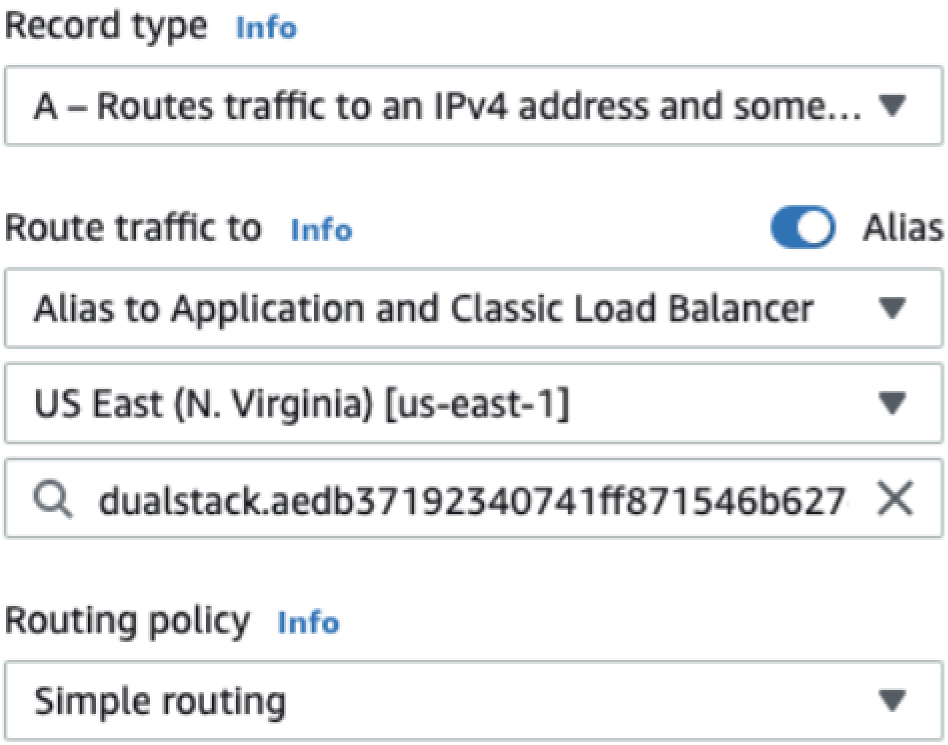
Network

If you are using the Ingress controller that ships with Workbench, *and* you are using an internal/private VPC or subnet you will need to add annotations to the ingress service:

```
kubectl edit svc/anaconda-enterprise-nginx-ingress
```

```
service.beta.kubernetes.io/aws-load-balancer-internal: 0.0.0.0/0
service.beta.kubernetes.io/aws-load-balancer-internal: "true"
```

Here is an example Route53 DNS configuration to the ingress.



Record type Info

A – Routes traffic to an IPv4 address and some…

Route traffic to Info — Alias

Alias to Application and Classic Load Balancer

US East (N. Virginia) [us-east-1]

dualstack.aedb37192340741ff871546b627

Routing policy Info

Simple routing

GPU Support

Please see this AWS guide for adding GPU resources to your EKS cluster.

1.3.3 Google Kubernetes Engine

This guide offers recommended configurations and settings unique to Google Kubernetes Engine (GKE) in Data Science & AI Workbench. These should be used to augment the generic requirements offered on our *primary requirements page*.

Instance types

- Minimum: `n2-standard-8`
- Recommended: `n2-standard-16` or larger

Storage

We have found that the Basic SSD and High Scale SSD performance tiers for Google Cloud Filestore provide competent performance for use with Workbench. The minimum storage sizes are 2.5TiB for the Basic SSD tier and 10TiB for the High Scale SSD Tier. Because Filestore volumes supports the `ReadWriteMany` access mode, a single volume can serve both the `anaconda-storage` and `anaconda-peristence` storage requirements.

Recommendations:

- Do not change the default export options. In particular, `squash-mode` should remain as `NO_ROOT_SQUASH`.
- When granting access to this volume, include not just the GKE cluster itself, but to the Administration server as well. This will enable the server to be used to initialize relevant directories, set permissions, perform backups, and so forth.
- The ownership of the root directory should be set to `<UID>:0`, where `<UID>` is the non-zero UID selected to run the Workbench containers.
- The permissions should be set to `770` or `775`; group writability is required.

GPU Support

Please see this guide for adding GPU resources to your GKE cluster.

1.3.4 OpenShift Container Platform

This guide offers recommended configurations and settings unique to the Openshift Container Platform (OCP) in Data Science & AI Workbench. These should be used to augment the generic requirements offered on our *primary requirements page*.

DNS / SSL

OpenShift imposes a unique subdomain structure to the applications that run on its clusters; e.g.:

```
anaconda.apps.openshift.example.com
*.anaconda.apps.openshift.example.com
```

When creating the SSL certificate, make sure that they are constructed for this multi-level domain name.

Note: Note that even though your OCP cluster might already be configured to serve SSL, Workbench still requires its own SSL certificate due to the usage of wildcards.

Helm chart customization

OpenShift uses a different DNS server address than the one assumed by default in the helm chart. To ensure that the application uses the proper address, add the following lines, respecting indentation, to your `values.yaml` overrides file:

```
git:
  default:
    proxy:
      dns-server: dns-default.openshift-dns.svc.cluster.local
```

1.3.5 RedHat OpenShift Service on AWS (ROSA)

This guide offers recommended configurations and settings to install Data Science & AI Workbench onto a Red Hat OpenShift Service on AWS (ROSA) cluster.

Instance types

- Minimum: `m5.2xlarge`
- Recommended: `m5.4xlarge` or larger

Storage

ROSA supports the use of both EBS and EFS storage for persistence. In theory, EBS can be employed for the `anaconda-storage` volume; but because EBS is limited to the `ReadWriteOnce` access mode, only EFS is acceptable for the `anaconda-persistence` volume. For this reason, Anaconda recommends provisioning a single volume that is large and performant enough to accommodate *both* storage requirements, to simplify management.

Please refer to the following pages for information on provisioning an EFS volume:

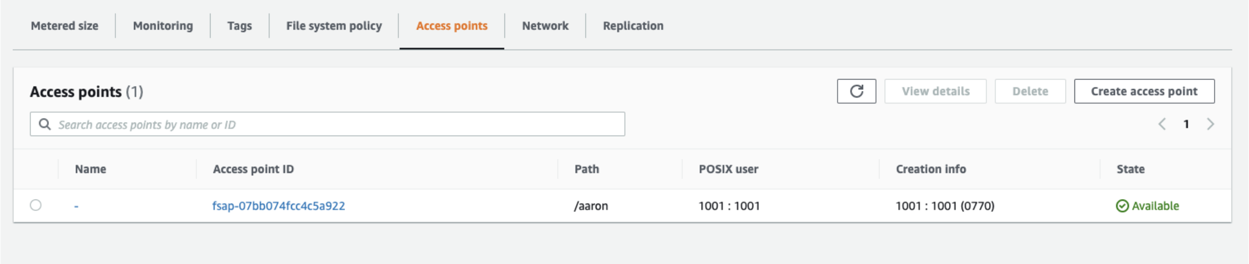
- Amazon EFS CSI driver
- Working with Amazon EFS Access Points
- CreationInfo

Anaconda recommends the following configuration parameters for this volume:

- `OwnerUid`: Anaconda recommends this be set to the same UID selected to run the Workbench containers.
- `OwnerGid`: Anaconda recommends a value of `0`, which simplifies access from Kubernetes containers whose primary group is `0` by default. If you choose a different GID, it will be necessary to incorporate that into the `PersistentVolume` specification.
- `Permissions`: `770` or `775`. It is important that the directory be group writable.

When defining the access controls for this volume, include both the ROSA cluster and the administration server, so the latter can be used to manage the volume.

Note: You can create an EFS access point using the UID/GID defined above.



Access points (1)

	Name	Access point ID	Path	POSIX user	Creation info	State
○	-	fsap-07bb074fcc4c5a922	/aaron	1001 : 1001	1001 : 1001 (0770)	✓ Available

DNS / SSL

OpenShift imposes a unique subdomain structure to the applications that run on its clusters; e.g.:

```
anaconda.apps.openshift.example.com
*.anaconda.apps.openshift.example.com
```

When creating the SSL certificate, make sure that they are constructed for this multi-level domain name.

Note: Note that even though your ROSA cluster may already be configured to serve SSL, Workbench will still require its own SSL certificate due to the usage of wildcards.

Helm chart customization

OpenShift uses a different DNS server address than the one assumed by default in the helm chart. To ensure that the application uses the proper address, add the following lines, respecting indentation, to your `values.yaml` overrides file:

```
git:
  default:
    proxy:
      dns-server: dns-default.openshift-dns.svc.cluster.local
```

1.3.6 NFS Storage Recommendations

A common mechanism for provisioning the storage required for Data Science & AI Workbench persistence involves the use of a Network File Server (NFS). This includes many cloud offerings such as Amazon EFS and Google Filestore and many on-premise NAS/SAN implementations. In this section, we provide specific recommendations for server- and client-side configuration. These recommendations should be used to augment the *general storage requirements* offered on our *install requirements page*.

Server recommendations

- If you are building a new machine to serve as your NFS server:
  - It should have at least 4 cores and 16GiB of RAM.
  - Increase the number of threads created by the NFS daemon to at least 64, to reduce the likelihood of contention between multiple users. For information on how to do this see your operating system documentation; for instance, this RedHat article.
  - If possible, use this file server as your *administration server* as well. This is a great way to manage and administer this persistence. If this is not possible, make sure to export the volume to the administration server as well as the Kubernetes cluster.
  - If you are intending to use the same server for both `anaconda-storage` and `anaconda-persistence`, then you should consolidate to a single PersistentVolume, as discussed in the *general storage requirements*.
- The use of premium storage tiers, and SSD-based storage in particular, is strongly recommended.
- In many environments, the performance of the volume (e.g., IOPS) is tightly coupled to the size of the disk. For this reason, Anaconda recommends *over-provisioning* the size of the disk to take advantage of this. In some environments, IOPS can be provisioned separately, but it can still be cost-effective to over-provision size instead.

- Anaconda recommends the use of the `async` export option.
- Anaconda recommends *against* the use of the `root_squash` option. While a seemingly sensible option for security reasons, in practice we find that it too often leads to unexpected permissions issues. That said, a similar and more reliable option is to use the `all_squash` option along with `anonuid` and `anonguid`. This effectively forces *all* remote access to be translated to the same UID and GID on the server. In summary, in order of preference, Anaconda recommends:
  - `no_root_squash` for maximum administration flexibility, and to allow the containers to utilize GID 0, the Kubernetes default.
  - `all_squash` / `anon_uid` / `anon_gid` for a reliable option that avoids UID 0 & GID 0;
  - `root_squash` only if there is no other alternative.
- To improve both security and performance, locate the file server on the same private subnet as the Kubernetes cluster, and limit the exports to that subnet.

Client recommendations

- When mounting the NFS share, Anaconda recommends overriding the default read and write block sizes by using the options `rsize=65536`, `wsize=65536`. The reason smaller block sizes are preferred is because the creation of conda environments frequently involves the manipulation of thousands of smaller files. Large block sizes result in significant inefficiency.
- We also recommend the use of the `noatime` option. This eliminates the updating of file *access* times over NFS, further reducing network overhead. Note that file *modification* times are still preserved.

Persistent Volume specifications

Encapsulating the client recommendations into the `PersistentVolume` and `PersistentVolumeClaim` specifications is relatively simple.

Begin with the following template, called (for instance) `pv.yaml`:

```
apiVersion: v1
kind: PersistentVolume
metadata:
  name: <NAME>
  annotations:
    pv.beta.kubernetes.io/gid: "<GID>"
spec:
  capacity:
    storage: 100Gi
  accessModes:
    - ReadWriteMany
  mountOptions:
    - rsize=65536
    - wsize=65536
    - noatime
  nfs:
    server: <ADDRESS>
    path: <PATH>
---
apiVersion: v1
```

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```
kind: PersistentVolumeClaim
metadata:
  name: <NAME>
spec:
  accessModes:
    - ReadWriteMany
  volumeName: <NAME>
  storageClassName: ""
  resources:
    requests:
      storage: 100Gi
```

Perform the following replacements:

- <NAME>: you can give this any name you wish, or adhere to our conventions of anaconda-storage and/or anaconda-persistence. This name will ultimately be supplied to the Helm chart values. Note that <NAME> appears in three places; use the same value for all.
- <GID>: this is the group ID which has write access to the volume. As discussed above, the recommended value is 0; but if you are forced to use root_squash or all_squash, make sure this has the value of the selected GID. *The quotes must be preserved.*
- <ADDRESS>: the FQDN or numeric IP address of the NFS server.
- <PATH>: the exported path from the NFS server.

The size entry in both resources does *not* need to be changed, even if your volume is (as is likely) significantly larger. All that matters in this case is that the values are the same.

Once this template is properly populated, you can create the resources with the command:

```
kubectl create -f pv.yaml
```

If you have allocated two different NFS volumes for anaconda-storage and anaconda-persistence, repeat this template for each.

Caution: When creating the Persistent Volume (PV) using NFS as the provider, specify your NFS version under mountOptions to avoid performance issues within your Kubernetes platform. For example:

```
mountOptions:
- hard
- nfsvers=3
- rsize=65536
- wsize=65536
- noatime
```

1.4 Preparing a Gravity environment for Workbench

Determining the resource requirements for a Kubernetes cluster depends on a number of different factors, including what type of applications you are going to be running, the number of users that are active at once, and the workloads you will be managing within the cluster. *Data Science & AI Workbench's performance is tightly coupled with the health of your Kubernetes stack*, so it is important to allocate enough resources to manage your users workloads. Generally speaking, your system should contain at least 1 CPU, 1GB of RAM, and 5GB of disk space for each project session or deployment.

To install Workbench successfully, your systems must meet or exceed the requirements listed below. Anaconda has created a pre-installation checklist to help prepare you for installation. The checklist verifies that your cluster has the necessary resources are reserved and is ready to install Workbench. Anaconda's Implementation team will review the checklist with you prior to your installation.

You can initially install Workbench on up to five nodes. Once initial installation is complete, you can add or remove nodes as needed. Anaconda recommends having *one master and one worker node per cluster*. For more information, see *Adding and removing nodes*.

For historical information and details regarding Anaconda's policies related to Gravity, see our *Gravity update policy*.

1.4.1 Hardware requirements

Anaconda's hardware recommendations ensure a reliable and performant Kubernetes cluster.

The following are minimum specifications for the master and worker nodes, as well as the entire cluster.

Master node	Minimum
CPU	16 cores
RAM	64GB
Disk space in /opt/anaconda	500GB
Disk space in /var/lib/gravity	300GB
Disk space in /tmp or $TMPDIR	50GB

Note:

- Disk space reserved for `/var/lib/gravity` is utilized as additional space to accommodate upgrades. Anaconda recommends having this available during installation.
- The `/var/lib/gravity` volume *must be mounted on local storage*. Core components of Kubernetes run from this directory, some of which are extremely intolerant of disk latency. Therefore, Network-Attached Storage (NAS) and Storage Area Network (SAN) solutions are not supported for this volume.
- Disk space reserved for `/opt/anaconda` is utilized for project and package storage (including mirrored packages).
- Anaconda recommends that you set up the `/opt/anaconda` and `/var/lib/gravity` partitions using Logical Volume Management (LVM) to provide the flexibility needed to accommodate easier future expansion.
- Currently `/opt` and `/opt/anaconda` *must* be an `ext4` or `xfs` filesystem, and *cannot* be an NFS mountpoint. Subdirectories of `/opt/anaconda` may be mounted through NFS. For more information, see *Mounting an external file share*.

Warning: Installations of Workbench that utilize an `xfs` filesystem *must* support `d_type` file labeling to work properly. To support `d-type` file labeling, set `ftype=1` by running the following command prior to installing Workbench.

This command will erase all data on the specified device! Make sure you are targeting the correct device and that you have backed up any important data from it before proceeding.

```
mkfs.xfs -n ftype=1 <PATH/TO/YOUR/DEVICE>
```

Worker node	Minimum
CPU	16 cores
RAM	64GB
Disk space in /var/lib/gravity	300GB
Disk space in /tmp or $TMPDIR	50GB

Note: When installing Workbench on a system with multiple nodes, verify that the clock of each node is in sync with the others prior to installation. Anaconda recommends using the Network Time Protocol (NTP) to synchronize computer system clocks automatically over a network. For step by step instructions, see How to Synchronize Time with Chrony NTP in Linux.

1.4.2 Disk IOPS requirements

Master and worker nodes require a minimum of 3000 *concurrent* Input/Output operations Per Second (IOPS).

Note: Hard disk manufacturers report *sequential* IOPS, which are different than *concurrent* IOPS. On-premise installations require servers with disks that support a minimum of 50 sequential IOPS. Anaconda recommends using Solid State Drive (SSD) or better.

1.4.3 Cloud performance requirements

Requirements for running Workbench in the cloud relate to compute power and disk performance. Make sure your chosen cloud platform meets these minimum specifications:

Amazon Web Services (AWS)

Anaconda recommends an instance type no smaller than `m4.4xlarge` for both master and worker nodes. You must have a minimum of 3000 IOPS.

Microsoft Azure

Anaconda recommends a VM size of `Standard D16s v3` (16 VCPUs, 64 GB memory).

Google Cloud Platform (GCP)

There are no unique requirements for installing Workbench on the Google Cloud Platform.

1.4.4 Operating system requirements

Workbench currently supports the following Linux versions:

- RHEL/CentOS 7.x, 8.x
- Ubuntu 16.04
- SUSE 12 SP2, 12 SP3, 12 SP5 (Requires you set `DefaultTasksMax=infinity` in `/etc/systemd/system.conf`)

Caution: Some versions of the RHEL 8.4 AMI on AWS are bugged due to a combination of a bad `ip rule` and the networkmanager service. Remove the bad rule and disable the networkmanager service prior to installation.

1.4.5 Security requirements

- If your Linux system utilizes an antivirus scanner, make sure the scanner excludes the `/var/lib/gravity` volume from its security scans.
- Installation requires that you have `sudo` access.
- Nodes running CentOS or RHEL must make sure that Security Enhanced Linux (SELinux) set to either `disabled` or `permissive` mode in the `/etc/selinux/config` file.

Tip: Check the status of SELinux by running the following command:

```
getenforce
```

Configuring SELinux

1. Open the `/etc/selinux/config` file using your preferred file editor.
2. Find the the line that starts with `SELINUX=` and set it to either `disabled` or `permissive`.
3. Save and close the file.
4. Reboot your system for changes to take effect.

1.4.6 Kernel module requirements

Kubernetes relies on certain functionalities provided by the Linux kernel. The Workbench installer verifies that the following kernel modules (required for Kubernetes to function properly) are present, and notifies you if any are not loaded.

Linux Distribution	Version	Required Modules
CentOS	7.2	bridge, ebtable_filter, ebtables, iptable_filter, iptable_nat, overlay
CentOS	7.3-7.7, 8.0	br_netfilter, ebtable_filter, ebtables, iptable_filter, iptable_nat, overlay
RedHat Linux	7.2	bridge, ebtable_filter, ebtables, iptable_filter, iptable_nat
RedHat Linux	7.3-7.7, 8.0	br_netfilter, ebtable_filter, ebtables, iptable_filter, iptable_nat, overlay
Ubuntu	16.04	br_netfilter, ebtable_filter, ebtables, iptable_filter, iptable_nat, overlay
Suse	12 SP2, 12 SP3, 12 SP5	br_netfilter, ebtable_filter, ebtables, iptable_filter, iptable_nat, overlay

Module Name	Purpose
bridge	Enables Kubernetes iptables-based proxy to operate
br_nerfilter	Enables Kubernetes iptables-based proxy to operate
overlay	Enables the use of the overlay or overlay2 Docker storage driver
ebtable_filter	Allows a service to communicate back to itself via internal load balancing when necessary
ebtables	Allows a service to communicate back to itself via internal load balancing when necessary
iptable_filter	Ensures the firewall rules set up by Kubernetes function properly
iptable_nat	Ensures the firewall rules set up by Kubernetes function properly

Note: Verify a module is loaded by running the following command:

```
# Replace <MODULE_NAME> with a module name
lsmod | grep <MODULE_NAME>
```

If the command produces a return, the module is loaded.

If necessary, run the the following command to load a module:

```
# Replace <MODULE_NAME> with a module name
sudo modprobe <MODULE_NAME>
```

Caution: If your system does not load modules at boot, you *must* run the following command—for each module—to ensure they are loaded on every reboot:

```
# Replace <MODULE_NAME> with a module name
sudo echo -e '<MODULE_NAME>' > /etc/modules-load.d/<MODULE_NAME>.conf
```

1.4.7 System control settings

Workbench requires the following Linux `sysctl` settings to function properly:

sysctl setting	Purpose
net.bridge.bridge-nf-call-iptables	Communicates with bridge kernel module to ensure Kubernetes iptables-based proxy operates
net.bridge.bridge-nf-call-ip6tables	Communicates with bridge kernel module to ensure Kubernetes iptables-based proxy operates
fs.may_detach_mount	Allows the unmount operation to complete even if there are active references to the filesystem remaining
net.ipv4.ip_forward	Required for internal load balancing between servers to work properly
fs.inotify.max_user_w	Set to 1048576 to improve cluster longevity

Note: If necessary, run the following command to enable a system control setting:

```
# Replace <SYSCTL_SETTING> with a system control setting
sudo sysctl -w <SYSCTL_SETTING>=1
```

To persist system settings on boot, run the following for each setting:

```
# Replace  <SYSCTL_SETTING> with a system control setting
sudo echo -e "<SYSCTL_SETTING> = 1" > /etc/sysctl.d/10-<SYSCTL_SETTING>.conf
```

1.4.8 GPU requirements

Workbench requires that you install a supported version of the NVIDIA Compute Unified Device Architecture (CUDA) driver *on the host OS of any GPU worked node*.

Currently, Workbench supports the following CUDA driver versions:

- CUDA `10.2`
- CUDA `11.2`
- CUDA `11.4`
- CUDA `11.6`

Note: Notify your Anaconda Implementation team member which CUDA version you intend to use, so they can provide the correct installer.

You can obtain the driver you need a few different ways.

- Use the package manager or the Nvidia runfile to download the file directly.
- For SLES, CentOS, and RHEL, you can get a supported driver using `rpm (local)` or `rpm (network)`.
- For Ubunutu, you can get a driver using `deb (local)` or `deb (network)`.

GPU deployments should use one of the following models:

- Tesla V100 (recommended)

- Tesla P100 (adequate)

Theoretically, Workbench will work with any GPU card compatible with the CUDA drivers, as long as they are properly installed. Other cards supported by CUDA `11.6`:

- A-Series: NVIDIA A100, NVIDIA A40, NVIDIA A30, NVIDIA A10
- RTX-Series: RTX 8000, RTX 6000, NVIDIA RTX A6000, NVIDIA RTX A5000, NVIDIA RTX A4000, NVIDIA T1000, NVIDIA T600, NVIDIA T400
- HGX-Series: HGX A100, HGX-2
- T-Series: Tesla T4
- P-Series: Tesla P40, Tesla P6, Tesla P4
- K-Series: Tesla K80, Tesla K520, Tesla K40c, Tesla K40m, Tesla K40s, Tesla K40st, Tesla K40t, Tesla K20Xm, Tesla K20m, Tesla K20s, Tesla K20c, Tesla K10, Tesla K8
- M-Class: M60, M40 24GB, M40, M6, M4

Support for GPUs in Kubernetes is still a work in progress, and each cloud vendor provides different recommendations. For more information about GPUs, see *Understanding GPUs*.

1.4.9 Network requirements

Workbench requires the following network ports to be *externally accessible*:

External ports

Port	Protocol	Description
80	TCP	Workbench UI (plaintext)
443	TCP	Workbench UI (encrypted)
32009	TCP	Operations Center Admin UI

These ports need to be externally accessible *during installation only*, and can be closed after completing the install process:

Install ports

Port	Protocol	Description
4242	TCP	Bandwidth checker utility
61009	TCP	Install wizard UI access required during cluster installation
61008, 61010, 61022-61024	TCP	Installer agent ports

The following ports are used for cluster operation, and *must be open internally, between cluster nodes*:

Cluster communication ports

Port	Protocol	Description
53	TCP and UDP	Internal cluster DNS
2379, 2380, 4001, 7001	TCP	Etcd server communication
3008-3012	TCP	Internal Workbench service
3022-3025	TCP	Teleport internal SSH control panel
3080	TCP	Teleport Web UI
5000	TCP	Docker registry
6443	TCP	Kubernetes API Server
6990	TCP	Internal Workbench service
7496, 7373	TCP	Peer-to-peer health check
7575	TCP	Cluster status gRPC API
8081, 8086-8091, 8095	TCP	Internal Workbench service
8472	UDP	Overlay network
9080, 9090, 9091	TCP	Internal Workbench service
10248-10250, 10255	TCP	Kubernetes components
30000-32767	TCP	Kubernetes internal services range

Make sure that the firewall is permanently set to keep the required ports open, and will save these settings across reboots. Then restart the firewall to load your changed settings.

Tip: There are various tools you can use to configure firewalls and open required ports, including `iptables`, `firewall-cmd`, `susefirewall2`, and more!

You'll also need to update your firewall settings to ensure that the `10.244.0.0/16` pod subnet and `10.100.0.0/16` service subnet are accessible to every node in the cluster, and grant all nodes the ability to communicate via their primary interface.

For example, if you're using `iptables`:

```
# Replace <NODE_IP> with the internal IP address(es) used by all nodes in the␣
↪cluster to connect to the master node
iptables -A INPUT -s 10.244.0.0/16 -j ACCEPT
iptables -A INPUT -s 10.100.0.0/16 -j ACCEPT
iptables -A INPUT -s <NODE_IP> -j ACCEPT
```

If you plan to use online package mirroring, allowlist the following domains in your network's firewall settings:

- repo.anaconda.com
- anaconda.org
- conda.anaconda.org
- binstar-cio-packages-prod.s3.amazonaws.com

To use Workbench in conjucntion with Anaconda Navigator in online mode, allowlist the following sites in your network's firewall settings as well:

- https://repo.anaconda.com (or for older versions of Navigator and conda)
- https://conda.anaconda.org if any users will use conda-forge and other channels on Anaconda.org
- google-public-dns-a.google.com (8.8.8.8:53) to check internet connectivity with Google Public DNS

1.4.10 TLS/SSL certificate requirements

Workbench uses certificates to provide transport layer security for the cluster. Self-signed certificates are generated during the initial installation. Once installation is complete, you can configure the platform to use your organizational TLS/SSL certificates.

You can purchase certificates commercially, or generate them using your organization's internal public key infrastructure (PKI) system. When using an internal PKI-signed setup, the CA certificate is inserted into the Kubernetes secret.

In either case, the configuration will include the following:

- A certificate for the root certificate authority (CA)
- An intermediate certificate chain
- A server certificate
- A certificate private key

For more information about TLS/SSL certificates, see *Updating TLS/SSL certificates*.

1.4.11 DNS requirements

Workbench assigns unique URL addresses to deployments by combining a dynamically generated universally unique identifier (UUID) with your organization's domain name, like this: `https://uuid001.anaconda.yourdomain.com`.

This requires the use of wildcard DNS entries that apply to a set of domain names such as `*.anaconda.yourdomain.com`.

For example, if you are using the domain name `anaconda.yourdomain.com` with a master node IP address of `12.34.56.78`, the DNS entries would be as follows:

```
anaconda.yourdomain.com IN A 12.34.56.78
*.anaconda.yourdomain.com IN A 12.34.56.78
```

Note: The wildcard subdomain's DNS entry points to the Workbench master node.

The master node's hostname and the wildcard domains must be resolvable with DNS from the master nodes, worker nodes, and the end user machines. To ensure the master node can resolve its own hostname, distribute any `/etc/hosts` entries to the gravity environment.

Caution: If `dnsmasq` is installed on the master node or any worker nodes, you'll need to remove it from all nodes *prior to installing Workbench*.

Verify `dnsmasq` is disabled by running the following command:

```
sudo systemctl status dnsmasq
```

If necessary, stop and disable `dnsmasq`, run the following commands:

```
sudo systemctl stop dnsmasq
sudo systemctl disable dnsmasq
```

1.4.12 Browser requirements

Workbench supports the following web browsers:

- Chrome 39+
- Firefox 49+
- Safari 10+

The minimum browser screen size for using the platform is 800 pixels wide and 600 pixels high.

1.4.13 Verifying system requirements

The installer performs pre-installation checks, and only allows installation to continue on nodes that are configured correctly, and include the required kernel modules. If you want to perform the system check yourself prior to installation, you can run the following commands from the installer directory, `~/anaconda-enterprise-<VERSION>`, on your intended master and worker nodes:

To perform system checks on the `master` node, run the following command as sudo or root user:

```
sudo ./gravity check --profile ae-master
```

To perform system checks on a `worker` node, run the following command as sudo or root user:

```
sudo ./gravity check --profile ae-worker
```

If all of the system checks pass and all requirements are met, the output from the above commands will be empty. If the system checks fail and some requirements are not met, the output will indicate which system checks failed.

1.4.14 Pre-installation checklist

Anaconda has created this pre-installation checklist to help you verify that you have properly prepared your environment prior to installation. You can run the system verification checks to automatically verify many of the requirements for you.

> **Caution:** System verficication checks are not comprehensive, so make sure you manually verify the remaining requirements.

Gravity pre-inallation checklist

All nodes in the cluster meet *the minimum or recommended specifications* for CPU, RAM, and disk space.

All nodes in the cluster meet *the minimum IOPS required* for reliable performance.

All cluster nodes are operating the same version of the OS, and that *the OS version is supported* by Workbench.

NTP is being used to *synchronize computer system clocks*, and all nodes are in sync.

The user account performing the installation has `sudo` access on all nodes and is not a root user.

All required kernel modules are loaded.

The sysctl settings are configured correctly.

Any GPUs to be used with Workbench have *a supported NVIDIA CUDA driver installed*.

The system meets *all network port requirements*, whether the specified ports need to be open internally, externally, or during installation only.

The *firewall is configured correctly*, and an rules designed to limit traffic have been *temporarily* disabled until Workbench is installed and verified.

If necessary, the *domains required* for *online* package mirroring have been allowlisted.

The final *TLS/SSL certificates <grav_tls_ssl_reqs>* to be installed with Workbench have been obtained, including the private keys.

The Workbench `A` or `CNAME` domain record is fully operational, and points to the IP address of the master node.

The wildcard DNS entry for Workbench is also fully operational, and points to the IP address of the master node. More information about the wildcard DNS requirements can be found *here*.

The `/etc/resolv.conf` file on all the nodes *does not* include the `rotate` option.

Any existing installations of Docker (and `dockerd`), `dnsmasq`, and `lxd` have been removed from all nodes, as they will conflict with Workbench.

All web browsers to be used to access Workbench are *supported by the platform*.

CHAPTER

TWO

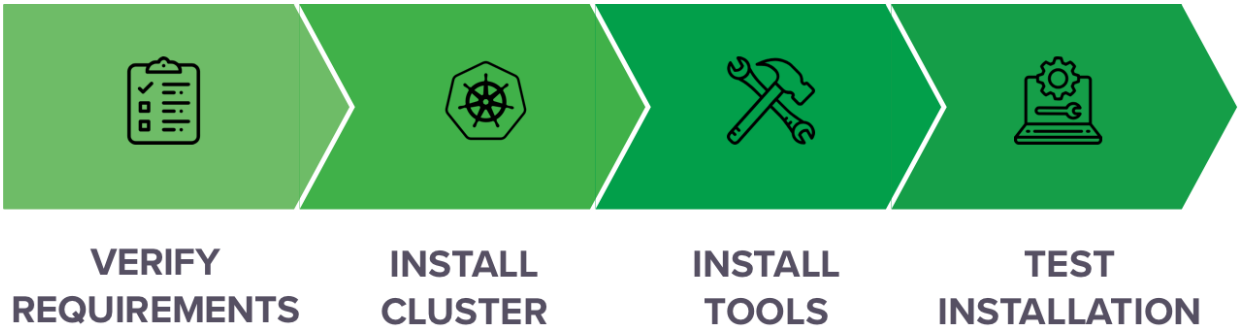
INSTALLING WORKBENCH

Data Science & AI Workbench can be installed on a variety of Kubernetes clusters, in addition to the Gravity Kubernetes environment we have historically provided.

When installing the Gravity environment, you will initially install it onto a single control plane node. After completing this basic installation, you can *add or remove nodes* on the cluster as needed, including GPUs.

When installing into your own Kubernetes environment, these instructions assume that the cluster itself has already been provisioned. Our instructions provide you with the details you need to verify that the cluster meets the basic requirements dictated by Workbench, and to provision the storage and networking resources required to run this application.

When you've determined an initial topology for your cluster, follow this high-level process to install Workbench:



2.1 K3s installation

K3s is a lightweight version of Kubernetes (K8s) that reduces the number of dependencies and requirements needed to install a K8s cluster. Upon request, Anaconda can provide you with the necessary assets to install Data Science & AI Workbench on K3s. After verifying that your environment is prepared for installation using the following pre-installation checklist, you are ready to install the cluster!

2.1.1 Pre-installation

Perform all actions from an administrative account that has `sudo` access on all nodes and a non-zero UID:

1. SSH onto the primary node.
2. Deliver the latest Workbench image tarball and K3s bundle to the primary node.
3. Unpack the K3s bundle and `cd` into the directory that it creates.
4. Remove old installations of conda by running the following command:

   ```
   rm -rf ~/ae5-conda ~/miniconda3
   ```

5. Install and activate the `ae5_conda` environment by running the following commands:

   ```
   bash ae5-conda-latest-Linux-x86_64.sh
   source ~/ae5-conda/bin/activate
   ```

6. Stage the K3s assets by running the following command:

   ```
   ./k3s_preinstall.sh
   ```

   Caution:

   - By default, the pre-install script uses the hostname stored in the `HOSTNAME` environment variable to populate the `k3s_values.yaml` file. To use a different hostname, edit that file or include the `--hostname <HOSTNAME>` argument in your pre-install script command.
   - If you are performing a single-node install, supply the `--single-node` argument in the pre-install script command to skip instructions for adding nodes and use the `anaconda-storage` volume for managed persistence.

   The `k3s_preinstall.sh` script produces two files: `k3s_values.yaml` and `NEXT_STEPS.txt`.

   The pre-installation script is designed to coach you on the necessary actions you need to take to install if your system is not ready. For example, if you do not have your instance backed up, the `k3s_preinstall.sh` script will inform you that the backups are missing and tell you to perform a backup before proceeding. Once the script has completed, it saves the output to the `NEXT_STEPS.txt` file.

   - If you have made an error during the pre-installation process, perform the *pre-installation cleanup commands*. and start over.
   - It is safe to run the `./k3s_preinstall.sh` command as many times as is necessary. No destructive actions are performed on your cluster by running the pre-install script.

7. Verify that both of the files produced by running the pre-installation script were successfully generated. If you cannot find the files, stop here and consult your Workbench support team to diagnose the failures and complete pre-installation successfully.

2.1.2 Installation

The following steps detail the conventional output of what the `k3s_preinstall.sh` script instructs you to do. However, the script makes adjustments to these steps based on your local environment and outputs them to the `NEXT_STEPS.txt` file. *Review the file and, if the output diverges from these instructions, follow the instructions in the file instead.*

1. Log out of the server node, then log back in to pick up the environment changes that were made during the pre-installation process.

2. Navigate to the `anaconda-enterprise-k3s-*` directory and install K3s by running the following command:

   ```
   ./k3s_install.sh
   ```

   Note: This script installs and starts K3s, then uploads the Workbench images. The image upload process can take up to 30 minutes to complete, depending on your setup.

3. *Once the image uploads begin*, you can continue with installation by opening a second terminal and navigating back to the `anaconda-enterprise-k3s-*` directory, or you can wait until the images are fully uploaded to continue.

4. If your cluster has multiple nodes, add them now by running the following command for each node:

   ```
   # Replace <PRIVATE_IP> with the nodes private network IP address
   ./k3s_addnode.sh <PRIVATE_IP>
   ```

5. Verify that the `k3s_values.yaml` contains the expected Workbench configuration values.

   Tip: Take your time and verify *everything* is correct!

6. *Once the Workbench images are fully loaded*, install the Workbench application by running the following command:

   ```
   helm install -f k3s_values.yaml anaconda-enterprise Anaconda-Enterprise/
   ```

7. Monitor your cluster's resources while they stabilize to ensure there are no unexpected issues by running the following command:

   ```
   watch kubectl get pods
   ```

   Allow time for the pods to appear and move to the `Ready` and `Running` states.

8. Open a browser and navigate to your instance of Workbench.

9. Log in to Workbench and explore the platform!

2.2 Bring Your Own Kubernetes (BYOK8s) Installation

Data Science & AI Workbench can be installed on a wide variety of CNCF-compliant Kubernetes cluster. Installation is performed using the industry standard Helm package manager. Successful deployment *requires the expertise of your in-house Kubernetes administrators* to validate our requirements and provision the necessary compute, storage, and networking resources.

After you have verified that your *environment is prepared for installation* by completing the *pre-installation checklist*, you are ready to install the cluster!

Perform the following actions from your established *administration server*.

1. Installation is largely performed in the custom namespace. Modify the default `kubectl` context to point to the new namespace by running the following command:

   ```
   # Replace <NAMESPACE> with the namespace that you reserved for Workbench
   kubectl config set-context --current --namespace=<NAMESPACE>
   ```

   The remainder of these instructions assume this change has been made.

2. Open and unpack the Helm chart archive provided by Anaconda, and `cd` into the root directory of this archive.

   Note: The archive root directory contains the following items of importance:

   - The `Anaconda-Enterprise/` directory. This contains your helm chart.
   - The `values.yaml` override file. Edit this file to include custom configurations for the application.
   - A version of these instructions labeled as `INSTALL.{md,pdf}`.

3. If you need a pull secret to access the Docker registry, create it now, then verify the presence of the pull secret by running the following command:

   ```
   # Replace <PULL_SECRET_NAME> with the name for your pull secret
   kubectl describe secret <PULL_SECRET_NAME>
   ```

4. Using your preferred text editor, open the `values.yaml` override file. Add or modify necessary values to this file. At minimum, you must provide the following:

   ### `values.yaml` override file configurations

   Note: View the `values.yaml` override file *here*.

Configuration	Description
hostname	The fully qualified domain name (FQDN) of the host.
serviceAccountName	The name of the service account with the necessary permissions to install and run the platform.
uid	The UID under which the containers will be run.
storage.pvc	The name of the persistent volume for the `anaconda-storage` function.
persistence.pvc	The name of the persistent volume for the `anaconda-persistence` function.
image.server	The address of the Docker image registry
image.pullSecrets	Information about any pull secrets required to authenticate to the Docker registry: • An empty value indicates that no pull secret is required • A string containing the name of a single secret • A list of strings, with one secret name per entry
dnsServer	(OpenShift Only) The FQDN of the internal cluster DNS server. Uncomment the line provided in the file for this.
ingress.className	The name of the `IngressClass` resource used by your ingress controller. If you are installing the Anaconda-supplied ingress, no modification is necessary for this configuration.
(If necessary) keycloak.truststore	The path to your *LDAPS* truststore (e.g. `/etc/secrets/certs/ldaps.jks`).
(If necessary) keycloak.truststore_password	The LDAPS truststore password
(If necessary) keycloak.truststore_secret	The name of the secret you created containing the truststore

5. Start your installation by running the following command:

```
helm install --values ./values.yaml anaconda-enterprise ./Anaconda-Enterprise/
```

Caution: The current version of Workbench requires the release name `anaconda-enterprise`. Do not change this value.

6. Monitor the progress of your installation by running the following command:

```
watch kubectl get pods
```

7. Wait for all of the pods to get to the `Running` or `Completed` state.

Tip: Installation can take several minutes depending on the performance characteristics of your system. If a particular pod is behaving in an unexpected manner, you can investigate the cause using commands such as:

```
# Replace <POD_NAME> with the name of the pod
kubectl logs <POD_NAME>
kubectl describe pod <POD_NAME>
```

8. If you chose to install the Anaconda-supplied ingress, you must now need to determine its assigned IP address, and create your DNS records for the cluster. To determine this address, run the command:

   ```
   kubectl get svc anaconda-enterprise-nginx.ingress
   ```

   Note: The IP address is provided in the `External IP` column. Create your DNS records for your FQDN and for its wildcard. For example, `anaconda.example.com` and `*.anaconda.example.com`.

   Once these DNS changes have propagated, you can proceed to the next step.

9. Open a web browser and navigate to your instance of Workbench.

   Note: Your browser may initially refuse to connect due to the use of our generated, self-signed SSL certificates. You should temporarily permit your browser to proceed anyway. You will also have to do the same every time you start a new session or deployment, so it is best to comlpete the next step as soon as possible.

10. *Update your SSL cerfiticates*.

   Note: If you are installing the Anaconda-supplied ingress, you can expect it to enter a `CrashLoopBackoff` state until the SSL certificate generation task has completed. This is expected behavior. Once the preliminary certificates are generated, the next automatic restart of the ingress should proceed without incident.

Basic installation of Workbench is now complete! You can now perform any additional *post-installation steps* necessary.

2.3 Gravity Installation

Gravity is an open-source, containerized Kubernetes framework that allows containerized applications like Anaconda Enterprised to be delivered in a self-contained installer that includes a special containerized implementation of Kubernetes. Anaconda has shipped Data Science & AI Workbench in a Gravity package since its first release.

Caution: Due to changes in the business model of Teleport, the original developers of Gravity, Anaconda is limiting the use of Gravity-based installers to existing customers and *plans to end support for Gravity entirely at some point in the future*. Existing Gravity customers are strongly encouraged to migrate their cluster to our new K3s implementation as soon as possible. Anaconda has developed a special process that allows you to migrate from Gravity to K3s without losing any of your existing data!

After you have verified that your *environment is prepared for installation* by completing the *pre-installation checklist*, you're ready to install the cluster!

Note: The Gravity installation process only sets up a single control plane node. Once installation is complete, you can *add additional nodes* as desired, including GPUs.

1. Open a terminal on the master node and log in to a service account with sudo access.
2. Download the installer by running the following command:

```
# Replace <INSTALLER_LOCATION> with the provided location of the installer
curl -O <INSTALLER_LOCATION>
```

Note: If you are in an airgapped environment, you must deliver the installer to the master node in an alternate manner.

3. Decompress the installer and enter the top directory by running the following commands:

   ```
   # Replace <INSTALLER> with the installer file you just downloaded
   tar xzvf <INSTALLER>
   cd <INSTALLER>
   ```

4. Set up and initialize your conda environment by running the following command:

   ```
   ./conda-bootstrap.sh
   ```

5. Enter `yes` to allow the installer to initialize your `ae5-conda` environment by running `conda init` when prompted.

6. Verify your environment successfully created by running the following command:

   ```
   conda env list
   ```

   Note: This command returns a list of existing conda environments. You should see a `base` environment present with an asterisk beside the directory to indicate it is currently active.

7. Perform the Anaconda preflight system check on the master node by running the following command:

   ```
   ae-preflight
   ```

   Note: You will receive an overall `PASS` or `WARN` result from the script. The output is captured in a `results.txt` file for later reference, if necessary. If something goes wrong, you can view the results to determine the issue and correct it.

8. Create a file named `values.yaml` and populate it with the following content:

   ```
   # Replace <HOSTNAME> with the fully qualified domain name of the host server
   # Replace <GID> with the group ID with read-write access to the shared network file␣
   ↪system (NFS) volume
   # Replace <SERVER_FQDN> with the address of the shared NFS volume
   # Replace <SERVER_PATH> with the path to the shared NFS volume
   apiVersion: v1
   kind: Configmap
   metadata:
     name: anaconda-enterprise-install
   data:
     values: |
       hostname: <HOSTNAME>
       persistence:
         groupID: <GID>
   ```

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```
      nfs:
        server: <SERVER_FQDN>
        path: <SERVER_PATH>
```

If you are installing a single-node cluster and you want to use the `/opt/anaconda/storage` volume for managed persistence, the `persistence:` section of the `values.yaml` can be entered as:

```
persistence:
   pvc: anaconda-storage
```

Note: The direct use of `/opt/anaconda/storage` for managed persistence works *only* for single-node clusters. It must be replaced with a network file system (NFS) configuration *before* adding additional nodes to the cluster. Otherwise, sessions and deployments launched on the additional nodes will fail to start. For more information, see *managed persistence*.

---

9. Run the gravity installation command:

```
# Replace <ADVERTISE-ADDR> with the IP address you want to be visible to the other␣
↪nodes. If you have a private network and all nodes can communicate on it, use the␣
↪private IP address for the advertise address
# Replace <CLUSTERNAME> with the name you're giving to your cluster. Alphanumeric␣
↪characters and periods only
# Replace <VALUES_PATH> with the filepath to the values.yaml file you just created
sudo ./gravity install --advertise-addr=<ADVERTISE-ADDR> --cluster=<CLUSTERNAME> --
↪config <VALUES_PATH> --service-uid=$(id -u) --cloud-provider=generic
```

Here is an example of what the installation command looks like for a single-node cluster:

```
sudo ./gravity install --advertise-addr=192.168.1.1 --cluster=MyCluster --config ./
↪values.yaml --service-uid=$(id -u) --cloud-provider=generic
```

If you are using an alternate `TMPDIR`, prepend the command with this new value. For example:

```
sudo TMPDIR=/mytmp ./gravity install --advertise-addr=192.168.1.1 --
↪cluster=MyCluster --config=./values.yaml --service-uid=$(id -u) --cloud-
↪provider=generic
```

Caution: The `--service-uid` is the service account UID and cannot be a root user. If you are performing a reinstallation of Workbench, you must delete the previous `planet` user prior to setting the new `--service-uid`.

10. Monitor the progress from the command line. Your output will look like this:

```
* [0/100] starting installer
* [0/100] preparing for installation... please wait
* [0/100] application: AnacondaEnterprise:5.5.x
* [0/100] starting non-interactive install
* [0/100] initializing the operation
* [20/100] configuring packages
* [50/100] installing software
```

11. Allow time for the process to complete (approximately 20-30 minutes).

12. Create a local user account and password to log in to the Gravity Operations Center. To do so, enter the Gravity environment from any of the nodes by running the following command:

    ```
    sudo gravity enter
    ```

13. Create a local user account and password by running the following command:

    ```
    # Replace <EMAIL> with the email address for the account
    # Replace <PASSWORD> with a password for the account. The password must be six␣
    ↪characters long
    gravity --insecure user create --type=admin --email=<EMAIL> --password=<PASSWORD> --
    ↪ops-url=https://gravity-site.kube-system.svc.cluster.local:3009
    ```

14. Inform gravity that you have completed the installation by running the following command from within the Gravity environment:

    ```
    gravity site complete
    ```

15. Open a web browser and navigate to your instance of Workbench.

    Note: Your browser may initially refuse to connect due to the use of our generated, self-signed SSL certificates. You should temporarily permit your browser to proceed anyway. You will also have to do the same every time you start a new session or deployment, so it is best to complete the next step as soon as possible.

16. *Update your SSL cerfiticates*.

17. Proceed to the *post-install configuration steps*.

2.4 Post-install configuration

Once you have successfully completed installation, there are some additional steps to take before beginning to use Data Science & AI Workbench.

2.4.1 Final configuration steps

1. (Gravity only) To add worker nodes to the cluster, follow the instructions in our *adding and removing nodes* topic.

2. *Wait for the application to fully stabilize.* Workbench can take up to 30 minutes to fully finish loading, depending upon the performance of the cluster network and attached disks. You may be able to log in to the main UI immediately, but sessions and deployments will not be ready to start.

3. Confirm that the cluster has loaded by running the following command from the master node:

    ```
    watch kubectl get pods
    ```

    Wait for every pod to indicate a status of either `Running` or `Completed`. The `app-images` pods will be the last to stabilize. You can exit the `watch` command at any time with `ctrl-C`.

2.4.2 Testing your installation

Once the application has fully loaded, you can do the following to verify that your installation succeeded.

1. Access the Workbench console by entering the URL of your Workbench server in a web browser: `https://anaconda.example.com`, replacing `anaconda.example.com` with the fully-qualified domain name of the host server.
2. Log in using the default username and password `anaconda-enterprise` / `anaconda-enterprise`.
3. Update the passwords for your `anaconda-enterprise` and `admin` users. See *Configuring user access* for information and steps for updating your password.

> **Warning:** Do not alter the `anaconda-enterprise` account username; it is used for certain cluster administration functions.
>
> If you do not update your passwords, anyone with the default credentials will be able to access your admin console. This poses a security risk, so it is important to change these passwords immediately.

You can verify a successful installation by doing any or all of the following:

- *Creating* a new project and starting an editing session
- *Deploying* a project
- *Generating a token* from a deployment

Note: Some of the sample projects can only be deployed after *mirroring the package repository*. To test your installation without doing this first, you can deploy the "Hello Anaconda Enterprise" sample project.

2.5 Updating TLS/SSL certificates

You can replace the self-signed certificates Data Science & AI Workbench generates during installation at any time.

2.5.1 Preparing for the update

Anaconda recommends that you gather the following information and files before you proceed. If you are using the admin console, place your files in a location where you can view them to copy their contents into the applicable fields within the UI. If you are updating your certificates using the command line, you'll need to copy your files to the server.

Most installations will need the following items:

- The fully qualified domain name (FQDN) of the server
- The public SSL certificate for the domain: `tls.crt`
- The private SSL key for the domain: `tls.key`
- If applicable, the intermediate certificate bundle: `intermediate.pem`
- If your certificate was issued by a private root CA, the public certificate for that CA: `rootca.crt`

If you are using LetsEncrypt, your filenames will be different:

- The public SSL certificate for the domain: `cert.pem`

- The private SSL key for the domain: `privkey.pem`
- The intermediate certificate bundle: `chain.pem`
- No root CA file is needed in this case.

If you are using a different domain and/or SSL certificate for the session/deployment subdomains, you also need:

- The wildcard subdomain FQDN
- The public SSL certificate for the wildcard subdomain: `wildcard.crt`
- The private SSL key for the wildcard subdomain: `wildcard.key`

Note:

- Workbench assumes that the intermediate certificate and root CA (if applicable) are identical for both certificates.
- Workbench version 5.6+ automatically applies the updated SSL certificates to all running sessions and deployments.

2.5.2 Updating SSL certificates

You can update your TLS/SSL certificates using the Workbench administrator console.

1. Log in to Workbench as an administrator.
2. Open the **My Account** dropdown menu and select *Admin Console*.
3. Select **Web Certificates** from the left-hand menu.
4. Enter your certificate and key information from the files you gathered during preparation into the appropriate fields. Make sure to paste the *content* of each file into the appropriate box, not the *filenames*.
    - Domain name: The server FQDN
    - SSL Certificate: `tls.crt` / `cert.pem`
    - SSL Private Key: `tls.key` / `privkey.pem`
    - Root Certificate: `rootca.crt` if applicable
    - Intermediate Certificate: `intermediate.pem` / `chain.pem` if applicable
    - Wildcard Domain: The subdomain FQDN if applicable; the server FQDN again if not. *Do not include an asterisk*.
    - Wildcard Certificate: `wildcard.crt` if applicable; `tls.crt` / `cert.pem` if not.
    - Wildcard Private Key: `wildcard.key` if applicable; `tls.key` / `privkey.pem` if not.
5. Click **Save** to update the platform with your changes.
6. If your root CA has changed, restart the Workbench system pods to ensure the pods that use this certificate pick up the new copy by running the following command:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep␣
↪ap-)
```

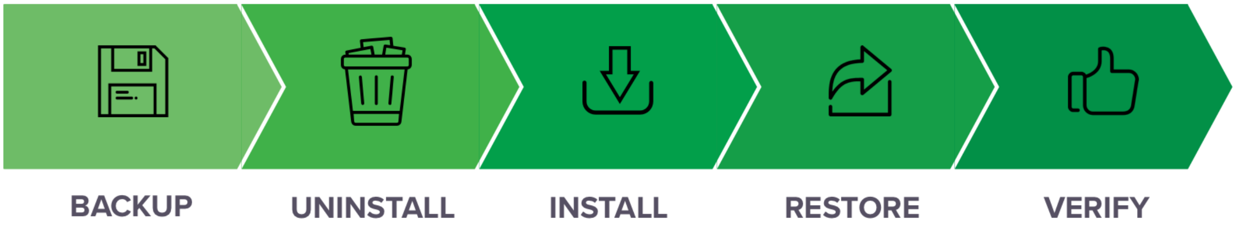
Note: If you use the Workbench CLI, you must *configure the certificates there as well*.

2.6 Upgrading Workbench

The process of moving from one version of Data Science & AI Workbench to another varies slightly, depending on which version you are migrating to and from, so follow the instructions that correspond to your Workbench implementation. If you're moving from an implementation of Anaconda Enterprise 4 to Workbench, we consider that a *migration*. If you're moving between point releases of the same version, we consider that an *upgrade*.

Migrating between major releases of Workbench requires administrators to *migrate the package repository* and project owners to *migrate their notebooks*.

Upgrading Workbench generally involves exporting or backing up your current package repository and all project data, uninstalling the existing version and *installing* the newer version, then importing or restoring this information on the new platform.



2.6.1 Upgrading Workbench on Gravity

Contact the Anaconda implementation team before you begin for assistance upgrading your version of Data Science & AI Workbench. Follow along with these instructions as an Anaconda implementation team member guides you through the upgrade process.

Caution: Current versions of Workbench no longer support Postgres versions 9.6 and older. To align with these changes, you must update your Postgres to a supported version. *Verify your Postgres version is compatible before you begin your upgrade*.

Prerequisites

- You must have `jq` installed.
- You must have a service account with `sudo` access on your Kubernetes (K8s) master node.
- Your K8s master node must be configured with a DNS A record. The A record sets the domain name you use for your Workbench instance.
- If you are upgrading Workbench on a system with multiple nodes, you must verify the clock on each node is in sync with the others. Anaconda recommends using Network Time Protocol (NTP) to synchronize computer system clocks automatically over your network. For more information on installing and using `Chrony` to manage the NTP, see the instructions provided here.

- You must have the `ae-preflight` package installed. For more information, see Workbench pre-flight check.
- Create a backup of your `anaconda-enterprise-anaconda-platform.yml` ConfigMap by running the following command:

  ```
  kubectl get cm anaconda-enterprise-anaconda-platform.yml -o json | jq -r '.
  ↪data["anaconda-platform.yml"]' > configmap-backup.yml
  ```

Upgrading

After you have verified that your system meets all of the installation requirements, you're ready to upgrade the cluster.

There are two basic types of upgrades for Gravity users: in-place upgrades and fresh reinstallation upgrades. Follow along with the instructions here as your Anaconda implementation team member guides you through upgrading your software.

> **Caution:**
>
> - Project sessions are terminated during the upgrade process! Because of this, it is important to stop all sessions prior to upgrading. If you do not, sessions that are terminated as part of the upgrade process must be restarted manually post upgrade.
> - Sessions can be stopped programmatically using `ae5-tools` by running the following command in a terminal that has access your Workbench cluster over the network:
>
>   ```
>   ae5 session list --columns=id --no-header | xargs -n1 ae5 session stop --
>   ↪yes
>   ```

In-place upgrade

> **Warning:** In-place upgrades of Workbench are not supported for versions that are moving from Gravity 6 to Gravity 7. Instead, you must perform a fresh reinstallation to upgrade your software. If you do not, your installation will break. Check the version of Gravity and Workbench before you begin, and choose the upgrade process that best suits your needs.
>
> In-place upgrades are also not supported when upgrading from Workbench 5.6.x to 5.6.2. Please perform a fresh reinstallation to upgrade between these versions.

In-place upgrades are performed while the software is still running. To perform an in-place upgrade:

1. *Create a backup* of your current instance of Workbench.
2. Log in to a service account with `sudo` access on the master node running your Workbench software.
3. Download the installer file by running the following command:

   ```
   # Replace <INSTALLER_LOCATION> with the provided location of the installer␣
   ↪file
   curl -O <INSTALLER_LOCATION>
   ```

4. Decompress the installer file by running the following command:

```
# Replace <INSTALLER> with the installer file you just downloaded
tar xvzf <INSTALLER>
```

5. Enter the installer directory by running the following command:

   ```
   # Replace <INSTALLER> with the version of your installer
   cd <INSTALLER>
   ```

6. Run the following command to verify your environment is properly prepared:

   ```
   ae-preflight
   ```

   If the check returns an overall result of WARN, you can view the results of the check by running the following command:

   ```
   cat results.txt
   ```

   If necessary, make applicable corrections to properly prepare your environment to meet the *installation requirements*. Once you've verified that your environment is properly configured, you can begin the upgrade process.

7. To start the upload and upgrade process, run the following commands:

   ```
   sudo ./upload
   sudo ./gravity upgrade
   ```

   The upgrade process can take up to an hour or more to complete, primarily due to the upload step. You can view the status of the upgrade process at any time by running the following command:

   ```
   sudo watch ./gravity plan
   ```

   Once the upgrade process is complete, the pods begin to initialize on their own, but this process takes some time to finish. Monitor the pods' status by running the following command:

   ```
   sudo watch kubectl get pods
   ```

   If you encounter errors while doing your in-place upgrade, you can view which phase of the upgrade failed by running the following command:

   ```
   sudo ./gravity plan
   ```

   You can return to any phase of the upgrade process by running the rollback command against the name of the phase as it's listed in the **Phase** column of the `./gravity plan` commands' return:

   ```
   # Replace <NAME_OF_PHASE> with the name listed in the Phase column
   sudo ./gravity plan rollback --phase=/<NAME_OF_PHASE>
   ```

   After addressing any errors, resume the upgrade by running the following command:

   ```
   sudo ./gravity upgrade --resume --force
   ```

   Once you have resolved your errors, or if no errors have occurred, it's time to *verify your installation*.

Fresh reinstallation upgrade

A fresh reinstallation upgrade backs up your current Workbench software configurations and settings, then uninstalls and reinstalls the software. After installation is complete, you can apply your saved configurations and settings to the new software version.

To perform a fresh reinstallation upgrade:

- Back up your configuration
- Uninstall
- Reinstall and apply your saved settings

Back up your configurations

1. *Create a backup* of your current instance of Workbench.
2. Log in to a service account with `sudo` access on the master node running your Workbench software.
3. Download the installer file by running the following command:

```
# Replace <INSTALLER_LOCATION> with the provided location of the installer␣
↪file
curl -O <INSTALLER_LOCATION>
```

4. Decompress the installer file by running the following command:

```
# Replace <INSTALLER> with the installer file you just downloaded
tar xvzf <INSTALLER>
```

5. Enter the installer directory by running the following command:

```
# Replace <INSTALLER> with the installer file you just decompressed
cd <INSTALLER>
```

Note: The installer bundle contains the `extract_config.sh` script, which retains the following files when run:

- `anaconda-enterprise-certs.yaml`
- `anaconda-enterprise-keycloak.yaml`
- `helm_values.yaml`
- `gravity_values.yaml`

6. Create a directory to contain the configuration data extracted by the script and name it “reinstall”:

```
mkdir reinstall
```

7. Enter the directory you just created:

```
cd reinstall
```

8. Run the `extract_config.sh` script by running the following command:

```
sudo bash extract_config.sh
```

Once the script has completed, you will need to manually save some additional configurations and secrets to your `reinstall` directory.

9. Export your configmap to a `.yaml` file by running the following command:

   ```
   sudo kubectl get cm -o yaml --export > configmap.yaml
   ```

Uninstall

Uninstall Workbench on all nodes and reboot your instance.

Warning: Do not run the command `sudo rm -rf /opt/anaconda/storage` on the master node as part of your uninstall process. If you do you, will lose your configuration settings and user data.

Reinstall and apply your saved settings

1. Run the following command to verify your environment is properly prepared:

   ```
   ae-preflight
   ```

   If the check returns an overall result of WARN, you can view the results of the check by running the following command:

   ```
   cat results.txt
   ```

   If necessary, make applicable corrections to properly prepare your environment to meet the *installation requirements*. Once you've verified that your environment is properly configured, you can begin the upgrade process.

2. Run the Gravity installation command using the `gravity_values.yaml` file stored in the reinstall directory you created earlier instead of creating a new file during installation:

   ```
   # Replace <ADVERTISE_ADDR> with the IP address you want to be visible to␣
   ↪the other nodes. If you have a private network and all nodes can␣
   ↪communicate on it, use the private IP address for the advertise address
   # Replace <CLUSTER_NAME> with the name you're giving to your cluster.␣
   ↪Alphanumeric characters and periods only
   # Replace <VALUES_PATH> with the filepath to the gravity_values.yaml file␣
   ↪created from running the extract_config.sh script
   sudo ./gravity install --advertise-addr=<ADVERTISE_ADDR> --cluster=<CLUSTER_
   ↪NAME> --config <VALUES_PATH> --service-uid=$(id -u) --cloud-
   ↪provider=generic
   ```

   ### Example command for single-node cluster

   ```
   sudo ./gravity install --advertise-addr=192.168.1.1 --cluster=MyCluster --
   ↪config ./gravity_values.yaml --service-uid=$(id -u) --cloud-
   ↪provider=generic
   ```

3. *Complete the rest of the installation process*.

4. Replace your SSL certificate by running the following commands:

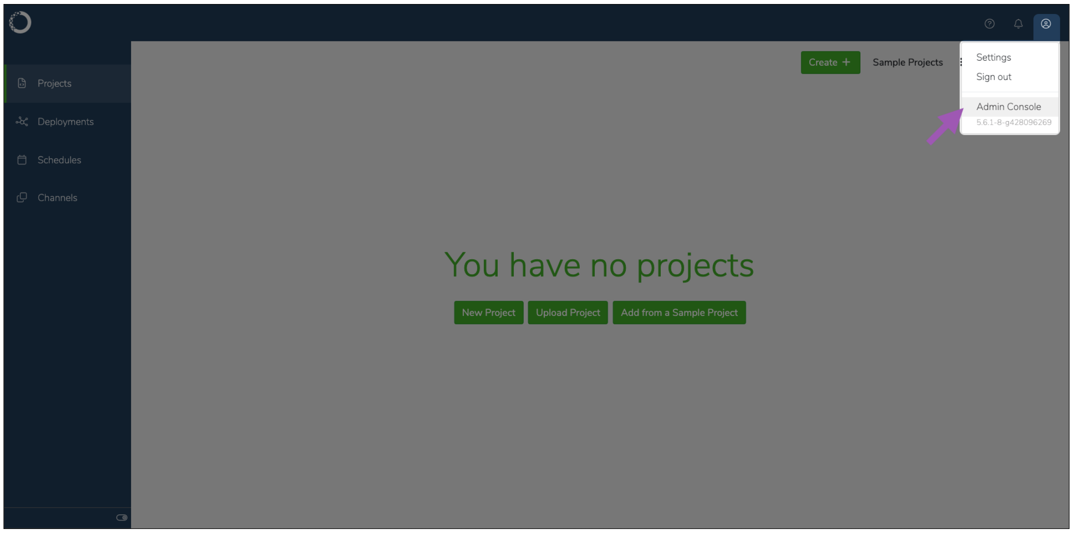
```
sudo kubectl create -f anaconda-enterprise-certs.json
sudo kubectl replace -n kube-system -f cluster-tls.json
```

5. Restore your cluster configurations from the backup you created before you began upgrading by running the following command:

```
# Replace <CONFIG_BACKUP> with the ae5_config_db_YYYYMMDDHHMM.tar.gz file created when you ran the backup script
sudo bash ae_restore.sh <CONFIG_BACKUP> --config-only
```

6. Open a web browser and log in to Workbench as an Administrator.

7. Open the **User** dropdown menu and select **Admin Console**.

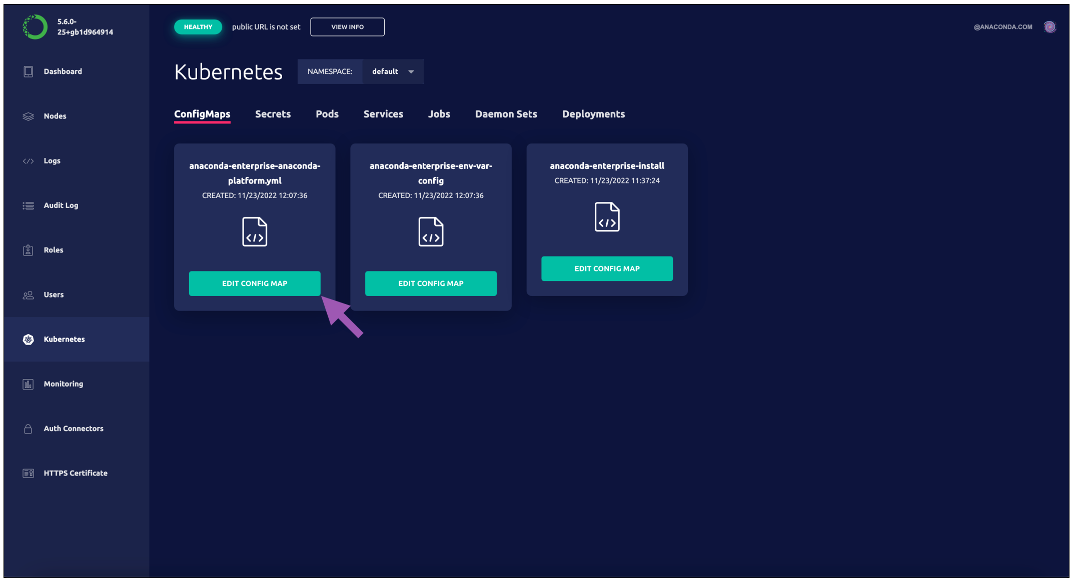


8. Select **Manage Resources** to open your Gravity Ops Center.

9. Log in to your Gravity Ops Center. Contact your Gravity systems administrator if you need access.

10. Select **Kubernetes** from the left-hand navigation menu.

11. Select **Edit config map** under `anaconda-enterprise-anaconda-platform.yml` to open the file. Leave this browser open for now.



anaconda-enterprise-anaconda-platform.yml
CREATED: 11/23/2022 12:07:36

anaconda-enterprise-env-var-config
CREATED: 11/23/2022 12:07:36

anaconda-enterprise-install
CREATED: 11/23/2022 11:37:24

12. Return to your terminal and view the contents of your `configmap.yaml` file by running the following command:

    ```
    cat configmap.yaml
    ```

13. Review the contents of the `anaconda-enterprise-anaconda-platform.yml` file and verify that your configuration values have been properly restored. If necessary, replace the applicable sections of the `anaconda-enterprise-anaconda-platform.yml` file with the configurations saved in your `configmap.yaml` file.

14. Restart the Anaconda platform pods by running the following command:

    ```
    sudo kubectl get pods | grep ap- | cut -d ' ' -f 1 | xargs kubectl delete␣
    ↪pods
    ```

15. *Add the worker nodes to the cluster*.

Once the upgrade process is complete, it’s time to *verify your installation*.

Verifying your upgrade

1. Verify all pods are running by running the following command:

   ```
   sudo kubectl get pods
   ```

2. Open a web browser and navigate to your Authentication Center.

   ```
   # Replace <FQDN> with the fully qualified domain name of your Workbench server
   https://<FQDN>/auth/admin
   ```

3. Select **Users** from the **Manage** menu, then click **View all users** and verify your users’ data is present.

4. Open a web browser and navigate to your Workbench URL. Log in using the same credentials you used for your previous installation.

5. Review the **Projects** list to verify that all project data has been restored.

6. Verify your deployments have returned to a **started** state.

Additional configurations

TLS/SSL certificates

If you did not configure SSL certificates as part of the post-install configuration, do so now. For more information, see *Updating TLS/SSL certificates*.

External version control repository

Workbench uses configurable parameters in the `git:` section of the `anaconda-enterprise-anaconda-platform.yml` configmap to connect to external version control repositories. Verify your parameters are mapped correctly, *as described here*.

Spark/Hadoop

After verifying your installation, run the following command on the *master node* of the Workbench server:

```
# Replace <PATH_TO_SECRETS.yaml> with the path to your anaconda secrets .yaml file
sudo kubectl replace -f <PATH_TO_SECRETS.yaml>
```

To verify that your configuration upgraded correctly:

1. Log in to Workbench.
2. If your configuration uses Kerberos authentication, open a Hadoop terminal and authenticate yourself through Kerberos using the same credentials you used previously. For example, `kinit <USERNAME>`.
3. Open a Jupyter Notebook that uses Sparkmagic and verify that it behaves as expected by running the `sc` command to connect to Sparkmagic and start Spark.

Cleaning up

As part of the upgrade process, the script you run automatically removes the unused packages and images from the previous installation and repopulates the registry to include only those images required by the current installation. This helps prevent the cluster from running out of disk space on the master node.

2.6.2 Bring Your Own Kubernetes (BYOK8s) Upgrade

Contact the Anaconda implementation team before you begin for assistance upgrading your version of Data Science & AI Workbench. It is intended for you to follow along with these instructions as an Anaconda Implementation team member guides you through the upgrade process. They will provide you with a Helm Chart archive that contains all the necessary components needed for upgrading.

Caution:

- Current versions of Workbench no longer support Postgres versions 9.6 and older. To align with these changes, you must update your Postgres to a supported version. *Verify your Postgres version is compatible before you begin your upgrade*.
- It is important to *stop all sessions* prior to upgrading. If you do not, sessions that are terminated as part of the upgrade process must be restarted manually post upgrade.

- Sessions can also be stopped programmatically using `ae5-tools` by running the following command in a terminal that has access to your Workbench cluster over the network:

  ```
  ae5 session list --columns=id --no-header | xargs -n1 ae5 session stop --
  ↪yes
  ```

Prerequisites

- You must have access to the *Administrative Server*.
- You must verify the Service Account used for the upgrade has the *correct permissions*.
- Air-gapped servers must have the Docker images added to their Docker image repository.

Upgrading

Upgrade your BYOK8s cluster by performing the following steps:

1. Log in to the service account on the Administrative Server running your Workbench software.
2. *Create a backup of your cluster configurations*.
3. Unpack the Helm Charts provided by Anaconda onto the Administrative Server:

   ```
   # Replace <HELM_CHARTS> with the Helm Charts you received from Anaconda
   tar xvzf <HELM_CHARTS>
   ```

4. Save your current configurations with the `extract_config.sh` script delivered with your Helm Chart by running the following command:

   ```
   # Replace <NAMESPACE> with the namespace Workbench is installed in
   NAMESPACE=<NAMESPACE> ./extract_config.sh
   ```

   The `extract_config.sh` script creates a file called `helm_values.yaml` and saves it in the directory where the script was run.

5. Verify the information captured in `helm_values.yaml` file is correct and contains all of your current cluster configuration settings.
6. Begin the upgrade by running the following command:

   ```
   helm upgrade --values ./helm_values.yaml anaconda-enterprise ./Anaconda-Enterprise/
   ```

   If the upgrade is successful, your output will look like this:

   ```
   Release "anaconda-enterprise" has been upgraded. Happy Helming!
   NAME: anaconda-enterprise
   LAST DEPLOYED: Wed Dec  7 21:52:34 2022
   NAMESPACE: <YOUR_NAMESPACE>
   STATUS: deployed
   REVISION: 10
   TEST SUITE: None
   ```

   The duration of the upgrade depends on both the cluster node count and the speed of the new docker images loading into each node.

Verifying your upgrade

1. Verify all pods are running by running the following command:

   ```
   sudo kubectl get pods
   ```

2. Open a web browser and navigate to your Authentication Center.

   ```
   # Replace <FQDN> with the fully qualified domain name of your Workbench server
   https://<FQDN>/auth/admin
   ```

3. Select **Users** from the left-hand navigation, then click **View all users** and verify your users' data is present.
4. Open a new tab in your web browser and navigate to your Workbench URL. Log in using the same credentials you used for your previous installation.
5. Review the **Projects** list to verify that all project data has been restored.
6. Verify your deployments have returned to a **started** state.

Caution: If you are upgrading from Workbench version 5.6.2 or earlier *and* have RStudio installed, *you must reinstall RStudio*. This is due to the upgrade of the Workbench base image from UBI8 to UBI9 in version 5.7. UBI9 requires a different binary for RStudio.

2.6.3 Backing up and restoring Workbench

Backing up Data Science & AI Workbench protects your data in case of accidents (deletion of important data) or technical issues (failed hard drive). You can back up at any time, but refer to your company's Disaster Recovery policy for best practices.

Warning: Do not attempt to restore backup files created from a different version of Workbench. To upgrade your version of Workbench, reference Upgrading between versions of Workbench.

Caution: Anaconda recommends the use of managed persistence to ensure open sessions and deployments are captured by the backup process.

If you are not using managed persistence, have all users save their work, stop any open sessions and deployments, and log out of the platform during the backup process.

Note: The backup/restore script supports synchronizing your production cluster to a "hot" backup cluster at periodic intervals. This is commonly used for Disaster Recovery. To learn more about this process, please speak with our Integration Team.

Obtaining backup restore tools

The ae5-conda environment contains all the tools you need to backup and restore Workbench; for more information, see *Administration server*.

1. Download the environment installer file.
2. Install and activate the environment by running the following commands:

   ```
   chmod +x ae5-conda-latest-Linux-x86_64.sh
   bash ae5-conda-latest-Linux-x86_64.sh
   source ~/ae5-conda/bin/activate
   ```

3. Verify your installation by running the following command:

   ```
   ae_backup.sh -h
   ```

   If your terminal returns the usage help text, then your installation of the backup/restore script was successful! You are now ready to run the backup script.

Run the backup script

Run the ae_backup.sh script to create backup files of your cluster in the current directory:

```
bash ae_backup.sh
```

Or specify a destination for your backup files:

```
bash ae_backup.sh /your/file/path/here
```

The backup script creates two tarball files:

```
ae5_config_db_YYYYMMDDHHMM.tar.gz
ae5_data_YYYMMDDHHMM.tar.gz
```

Note:

- YYYYMMDDHHMM is the format for the timestamp of your backup data.
- The ae5_config_db file stores your Kubernetes resources and Postgres data.
- The ae5_data file stores your /opt/anaconda/storage data.
- The backup script does not back up the package repository.

Backup command line options

Option	Description
• `-h` • `--help`	Prints help and exits.
• `-d <DIR>` • `--ae-data <DIR>`	Changes the location of the Workbench storage. The default location is `/opt/anaconda/storage`. **Caution:** Do not update the location of Workbench storage on Gravity clusters!
• `-b <DIR>` • `--backup-dir <DIR>`	Changes the location where the backup files are saved. The default location is the current directory. Use this option when the space in the current directory is insufficient to hold the backup.
• `-s` • `--skip-clean`	Prevents the removal of intermediate files generated during the backup process. This is useful for informational or debugging purposes.
• `-c` • `--config-db`	The script will only create the config/postgres tarball without a data tarball. This is useful if combined with an alternate mechanism for taking snapshots or backups of the data.
• `-r` • `--repository`	Includes the full package repository in the data tarball. By default, this is not included because the repository is typically large and incompressible.

Restore from backup data

Warning: The restore script requires backup files to be created from the same output of the backup script. Do not attempt to load files that were created from different backups.

Run the restore script to restore your cluster from previously-created backup data:

```
bash ae_restore.sh ae5_config_db_YYYYMMDDHHMM.tar.gz ae5_data_YYYYMMDDHHMM.tar.gz
```

Restoration modes

The restore script has three different modes for data restoration that can be used to customize how Workbench is restored.

Restoring to the original host

In this mode, all resources are restored from backup, except for the base ingress specification.

This mode is used when a clean reinstall of an existing cluster has been performed and you wish to perform a full restoration from backup. User workload will be restored (deployments, sessions, jobs), except they will be placed in a paused state. The script provides instructions on how to unpause user workload once the administrator is satisfied that the restoration has completed successfully.

Restoring to a different host without a hostname change

In this mode, only some resources are restored, as described below.

Restored data:

- Kubernetes secrets (non-ssl)
- User/Project Data
- Postgres

Non-restored data:

- Hostname
- SSL certificates
- Configmaps
- Ingress
- Kubernetes resources for user workload

This mode is used if you wish to restore the backup to a separate existing cluster for inspection. By preserving the cluster's native configuration, the operation of the cluster is preserved but disconnected from the source.

Restoring to a different host, but with a hostname change

This mode fully restores all resources, including the deployments and scheduled jobs. *The ingress is also updated in this case to reflect the new hostname.* This is used if you need to replace a faulty master node with a hot backup that was already running *under a different hostname*.

Restoration command line options

Option	Description
• -h • --help	Prints help and exits.
• -d <DIR> • --ae-data <DIR>	Changes the location of the Workbench storage. Default: /opt/anaconda/storage. Should not be changed when used on a Gravity cluster.
• -b <DIR> • --backup-dir <DIR>	Changes the location where backup files are found. Default: current directory. Use when space in the current directory is insufficient.
• -s • --skip-clean	Prevents the removal of intermediate files generated during the backup process. Useful for debugging or informational purposes.
• -u • --update-hostname	Allows the hostname to be modified. Automatically triggers `--restore-certs` and `--restore-configmap` when supplied. If this option is *not supplied*, the existing SSL certificates and configmap are used.
• --restore-certs	Restores SSL certificates from a backup, even if the hostname does not change.
• --restore-configmap	Restores the system's configmap from a backup, even if the hostname does not change.
• -c • --config-only	Only restores configuration data (SSL, secrets, configmaps, etc.) without modifying the Postgres database and data.
• --db-version=	Specifies the PostgreSQL version to use when patching the database StatefulSet during a restore. The version must already exist in the same registry as the current PostgreSQL image. If not, the restore process will fail until the image is available.
• -w • --wait	Waits for system pods to stabilize before exiting the script.
• -p • --pause	Leaves the cluster in a paused state upon completion of the restore process.
• -y • --yes	Skips confirmation prompts during restore. Use with caution.

Bring your own Kubernetes

Customer supplied Kubernetes clusters (non-gravity) can take advantage of this backup/restore script. However the backup/restore process will be slightly different.

When taking a backup, you will need to supply the `-c`, `--config-db` command line argument, as the backup script will only be able to capture your Workbench configuration data. This will not capture user/project data, and you will need to ensure you are taking regular backups of your provided storage solution. This includes the Persistent Volume used for both anaconda-storage and anaconda-persistence that were configured at time of install.

When restoring from a backup, you will need to supply the `-c`, `--config-only` command line option, as the restore script will only be able to restore your Workbench configuration data. This will not restore user/project data, and you will need to ensure you have also restored a backup of your provided storage solution.

2.6.4 Migrating from Gravity to K3s

Due to the suspension of support for Gravity by Teleport, Anaconda highly recommends that Gravity users migrate to a fully supported, up-to-date Kubernetes implementation. To aid you in the process and make it as painless as possible, Anaconda has developed a migration process that allows you to leave your data in place, meaning your cluster will retain its configurations, projects, deployments, and scheduled jobs.

> **Warning:** Do not uninstall Gravity until you are instructed to do so in the process described below.

Prerequisites

Before starting the Gravity to K3s migration process, ensure your system meets the following requirements:

- Verify that you have a functioning Gravity cluster running Workbench.
- Verify that you have 300GB disk space available in `var/lib/rancher`.
- Verify that you have SSH access from the control plane node to all agent nodes.

  > **Tip:** Anaconda recommends generating a dedicated SSH key distributed across the nodes of the cluster—separate from the one you may use to access the cluster itself—to facilitate passwordless node-to-node access.

- Verify that you have the K3s directory bundle and the image tarball for the latest version of Workbench.
- Verify that Docker or Podman is removed from any VMs where K3s will be installed.
- Verify that your cluster's SSL certificates are up to date.
- If you have created an `anaconda-persistence` volume, you need the `.yaml` file you wrote containing the `PersistentVolume` and `PersistentVolumeClaim` values. If you don't have it anymore, *recreate the file before you begin the migration process*.
- Review the K3s installation requirements for your operating system and verify that your virtual machines are prepared to receive K3s:
  - SELinux must be disabled.
  - Anaconda strongly recommends that built-in firewall software is fully disabled during migration. If this is not possible, ensure that you open the ports listed here.
  - On RHEL/CentOS, the `NetworkManager` service must be disabled:

```
systemctl disable nm-cloud-setup.service nm-cloud-setup.timer
```

Note: If Gravity is already successfully running, it is likely that your system already meets these requirements. Even so, Anaconda strongly encourages you to verify the requirements anyway, *especially* on RHEL.

Pre-installation

Perform all actions from an administrative account that has `sudo` access on all nodes and a non-zero UID:

1. SSH onto the primary node.
2. Deliver the latest Workbench image tarball and K3s bundle to the primary node.
3. Unpack the K3s bundle and `cd` into the directory that it creates.
4. Remove old installations of conda by running the following command:

   ```
   rm -rf ~/ae5-conda ~/miniconda3
   ```

5. Install and activate the `ae5_conda` environment by running the following commands:

   ```
   bash ae5-conda-latest-Linux-x86_64.sh
   source ~/ae5-conda/bin/activate
   ```

   This environment contains all the tools you need to manage Workbench; for more information, see *Administration server*.

6. Obtain your current cluster configurations by running the following command:

   ```
   ./extract_config.sh
   ```

   The `extract_config.sh` script produces two files: `helm_values.yaml` and `anaconda-enterprise-certs.json`.

7. Back up your current instance by running the following command:

   ```
   ae_backup.sh
   ```

   The `ae_backup.sh` script produces two timestamped files: `ae5_config_db_<YYYYMMDDHHMM>.tar.gz` and `ae5_data_<YYYYMMDDHHMM>.tar.gz`.

8. Stage the K3s assets by running the following command:

   ```
   ./k3s_preinstall.sh
   ```

   The `k3s_preinstall.sh` script produces two files: `k3s_values.yaml` and `NEXT_STEPS.txt`.

   The preinstallation script is designed to coach you on the necessary actions you need to take to install if your system is not ready. For example, if you do not have your instance backed up, the `k3s_preinstall.sh` script will inform you that the backups are missing and tell you to perform a backup before proceeding. Once the script has completed, it saves the output to the `NEXT_STEPS.txt` file.

   Note:

- If you have made an error during the pre-installation process, perform the *pre-installation cleanup commands*. and start over.
- It is safe to run the `./k3s_preinstall.sh` command as many times as is necessary. No destructive actions are performed on your cluster by running the pre-install script.

9. Verify that all of the files produced by running the pre-installation scripts were successfully generated. If you cannot locate all of the files, stop here and consult your Workbench support team to diagnose the failures and complete pre-installation successfully.

Installation

The following steps detail the conventional output of what the `k3s_preinstall.sh` script will tell you to do. However, the script makes adjustments to these steps based on your local environment and outputs them to the `NEXT_STEPS.txt` file. *Review the file and, if the output diverges from these instructions, follow the instructions in the file instead.*

1. Log out of the server node, then log back in to pick up the environment changes that were made during the pre-installation process.
2. Pause the application by running the following command:

   ```
   ae_pause.sh
   ```

3. Uninstall Gravity and Workbench by running the following commands on each node, starting with the worker nodes and ending with the control plane node:

   ```
   sudo gravity system uninstall
   sudo reboot
   ```

   This removes Gravity and the Workbench application from the cluster, but leaves the Workbench data in place!

   Caution: Reboot each time you uninstall a node!

4. Navigate to the `anaconda-enterprise-k3s-*` directory and install K3s by running the following command:

   ```
   ./k3s_install.sh
   ```

   Note: This script installs and starts K3s, then uploads the Workbench images. The image upload process can take up to 30 minutes to complete, depending on your setup.

5. *Once the image uploads begin*, you can continue with installation by opening a second terminal and navigating back to the `anaconda-enterprise-k3s-*` directory, or you can wait until the images are fully uploaded to continue.
6. If your cluster has multiple nodes, add them now by running the following command for each node:

   ```
   # Replace <PRIVATE_IP> with the nodes private network IP address
   ./k3s_addnode.sh <PRIVATE_IP>
   ```

7. Install the SSL certificates saved by the `extract_config.sh` script by running the following command:

```
kubectl create -f anaconda-enterprise-certs.json
```

8. Verify that the `k3s_values.yaml` contains the expected Workbench configuration values.

   Tip: Take your time and verify *everything* is correct!

9. If necessary, restore your instance's manually-created `anaconda-persistence` volume at this time by running the following command:

   ```
   # Replace <FILE> with the anaconda-persistence volume file name
   kubectl create -f <FILE>.yaml
   ```

   Note: If you have any other volumes, provision them now as well.

10. *Once the Workbench images are fully loaded*, install the Workbench application in paused mode by running the following command:

    ```
    helm install -f k3s_values.yaml --set global.paused=true anaconda-enterprise Anaconda-Enterprise/
    ```

11. Restore the system configurations from the backup you took earlier by running the following command:

    ```
    ae_restore.sh ae5_config_db_<YYYYMMDDHHMM>.tar.gz
    ```

12. Unpause the backed up deployments and scheduled jobs by running the following command:

    ```
    ae_unpause.sh
    ```

13. Monitor your cluster's resources while they stabilize to ensure there are no unexpected issues by running the following command:

    ```
    watch kubectl get pods
    ```

    Allow time to pass for the pods to appear and move to the `Ready` and `Running` states.

14. If you are upgrading from `5.5.x` or older, you must *complete the manual Keycloak upgrade process at this time*.

15. Open a browser and navigate to your instance of Workbench.

16. Log in to Workbench and explore the platform to verify that all of your projects, deployments, and scheduled jobs are present.

2.6.5 Migrating from Gravity to Bring Your Own Kubernetes (BYOK8s)

Contact the Anaconda implementation team before you begin for assistance migrating your version of Data Science & AI Workbench from Gravity to BYOK8s. Follow along with these instructions as an Anaconda implementation team member guides you through the migration process.

Note: If you are using network file storage (NFS) or dynamic storage for both your `anaconda-storage` and `anaconda-persistence` volumes within your Gravity cluster, it is not necessary to perform these steps, as you can unmount these volumes from your Gravity cluster and remount them on your BYOK8s cluster. An Anaconda implementation team member will guide you through this process, if necessary.

Caution: Have all users save their work, stop any open sessions and deployments, and log out of the platform so no data is lost during the migration process.

Prerequisites

The following conditions must be met to complete this task successfully:

- You must have `sudo` access.
- The `jq` conda package must be installed in your base environment.

OR

- Optionally, you can install this ae5-conda environment, which already contains the necessary packages.

Install the backup and restore tool

Migrating your data from Gravity to BYOK8s involves using the Workbench backup and restore tool, which you can obtain using conda.

Note: If you chose to install the `ae5-conda` environment listed in the prerequisites, skip ahead to *verify your installation*.

Standard environment

For a standard environment, you can install the `ae5_backup_restore` package into your base conda environment by opening a terminal and running the following command:

```
conda install -c ae5-admin ae5_backup_restore
```

Once complete, *verify the installation*.

Air-gapped environment

For Airgapped networks, download the latest `ae5_conda` installer file and move it to your master node.

Set the installer file to be executable, then install the `ae5_conda` environment by running the following commands:

```
chmod +x ae5-conda-latest-Linux-x86_64.sh
./ae5-conda-latest-Linux-x86_64.sh
```

Once complete, *verify the installation*.

Verify your installation

Verify you've successfully installed the backup and restore tool by running the following command:

```
ae_backup.sh -h
```

If your terminal returns the usage help text for the backup script, your installation was successful.

Run the backup script

When running the backup script, include the `--config-db` or `-c` command line argument to instruct the backup script to only capture your Workbench configuration data. User and project data is migrated separately later in this process.

To create a backup file of your cluster in your current working directory, run the command:

```
bash ae_backup.sh -c
```

To create a backup file of your cluster and store it in a specific directory, run the command:

```
# Replace <DIRECTORY_PATH> with the path to the directory you want to contain your backup
bash ae_backup.sh -c <DIRECTORY_PATH>
```

The backup script creates a tarball file that stores your Kubernetes resources and Postgres data with the following naming scheme:

```
ae5_config_db_YYYYMMDDHHMM.tar.gz
```

Note: YYYYMMDDHHMM is the format for the date timestamp of your backup data.

Migrate user data

Before you can migrate user data, you must prevent users from making edits to the disk.

1. Open a terminal.
2. SSH into your Workbench master node.
3. Enter Gravity by running the following command:

   ```
   gravity enter
   ```

4. Scale down the Anaconda Platform pods, identified by their `ap-` prefix, by running the following command:

   ```
   kubectl get deploy | grep ap- | cut -d' ' -f1 | xargs kubectl scale deploy --
   ↪replicas=0
   ```

5. Verify that the `ap-` prefixed pods have stopped by running the following command:

   ```
   watch kubectl get pods
   ```

6. Once the `ap-` prefixed pods have stopped, migrate your user data by moving the following directories into the new cluster:

   `/opt/anaconda/storage/git/repositories/anaconda`

`/opt/anaconda/storage/projects`

This can be done by either directly mounting the `/opt/anaconda/storage` volume onto a workstation with access to the BYOK8s cluster, or by compressing the directories separately, then copying them into the storage pod.

> **Caution:** Migrating user data requires that both the Gravity and BYOK8s clusters have identical UID/GID permissions set. If permissions are not correctly aligned, your user data will not migrate.

To directly mount the `/opt/anaconda/storage` volume onto a workstation with access to the BYOK8s cluster, move both directories directly into place on top of the pre-existing directories on the BYOK8s cluster.

If you are unable to directly mount the `/opt/anaconda/storage` volume, you will instead need to copy both tarballs you have taken to the `/tmp` directory by running the following commands:

```
# Replace <PATH_TO_GIT_TARBALL> with the path to your /opt/anaconda/storage/git/
↪repositories/anaconda tarball
# Replace <PATH_TO_PROJECTS_TARBALL> with the path to your /opt/anaconda/storage/
↪projects tarball
# Replace <WORKBENCH_GIT_POD> with the ID of the Workbench git storage pod (the pod␣
↪prefix is "anaconda-enterprise-ap-git-storage-")
# Replace <WORKBENCH_PROJECTS_POD> with the ID of the Workbench project storage pod (the␣
↪pod prefix is "anaconda-enterprise-ap-storage")
kubectl cp <PATH_TO_GIT_TARBALL> <WORKBENCH_GIT_POD>:/tmp
kubectl cp <PATH_TO_PROJECTS_TARBALL> <WORKBENCH_PROJECTS_POD>:/tmp
```

Once you have copied the tarballs to `/tmp`, exec into the pods, then move them into place by running the following commands:

```
# Replace <WORKBENCH_GIT_POD> with the ID of the Workbench git storage pod (the pod␣
↪prefix is "anaconda-enterprise-ap-git-storage-")
kubectl exec -it <WORKBENCH_GIT_POD> /bin/bash
mv /tmp/anaconda /opt/anaconda/storage/git/repositories/anaconda
# Replace <WORKBENCH_PROJECTS_POD> with the ID of the Workbench project storage pod (the␣
↪pod prefix is "anaconda-enterprise-ap-storage")
kubectl exec -it <WORKBENCH_PROJECTS_POD> /bin/bash
mv /tmp/projects /opt/anaconda/storage/projects
```

Run the restore script

Restoring to a different host without a hostname change

Use this method if you are migrating to a cluster with a URL that differs from the URL of your Gravity cluster.

Restored data:

- Kubernetes secrets (non-ssl)
- Postgres
- configmaps
- SSL certs
- Secrets

Non-restored data:

- Hostname
- Ingress

Restore your data by running the following command:

```
bash ae_restore.sh ae5_config_db_YYYYMMDDHHMM
```

Restoring to a different host with a hostname change

Use this method if you are migrating to a new cluster but you want to retain the Gravity cluster's URL.

Restore your data by running the following command:

```
bash ae_restore.sh -u ae5_config_db_YYYYMMDDHHMM
```

After you have moved user data over, and have completed running the Restore script, the migration is complete and you can confirm that your BYOK8s cluster contains all data from the old Gravity cluster.

2.6.6 Uninstalling Workbench

Before using the following instructions to uninstall Data Science & AI Workbench, be sure to follow the steps to *backup your current installation* so you'll be able to restore your data from the backup after installing Workbench 5.2.

To uninstall Workbench on a healthy cluster worker node, run:

```
sudo gravity leave
sudo killall gravity
sudo killall planet
```

To uninstall Workbench on a healthy cluster master node, run:

```
sudo gravity system uninstall
sudo killall gravity
sudo killall planet
sudo rm -rf /var/lib/gravity /opt/anaconda
```

To uninstall a failed or faulty cluster node, run:

```
sudo gravity remove --force
```

To remove an offline node that cannot be reached from the cluster, run:

```
sudo gravity remove <node>
```

Where `<node>` specifies the node to be removed. This value can be the node's assigned hostname, its IP address (the one that was used as an "advertise address" or "peer address" during install), or its Kubernetes name (which you can obtain by running `kubectl get nodes`).

2.6.7 Uninstalling Workbench and K3s

This page provides step-by-step instructions for removing Workbench along with K3s from your cluster cleanly and safely.

Cleaning up after pre-installation

If Workbench is not installed, but you have run `./k3s_preinstall.sh`, the only changes that have been made to your system are the staging of installation asset files, which consume a small amount of space. If you want to remove those files, run the following commands:

```
sudo rm -rf /etc/rancher/k3s /var/lib/rancher/k3s /usr/local/bin/k3s
sudo mv /etc/environment.k3s-orig /etc/environment
```

Uninstalling

To uninstall Workbench and K3s from your cluster:

1. If Workbench is running, you'll need to perform a backup before proceeding. This ensures that no data corruption occurs during the K3s shutdown process. Perform a backup by running the following command:

   ```
   ae_backup.sh
   ```

2. Pause the application by running the following command:

   ```
   ae_pause.sh
   ```

3. If your cluster has worker nodes, uninstall them by running the following command on each node:

   ```
   /usr/local/bin/k3s-agent-uninstall.sh
   ```

4. Uninstall K3s by running the following commands on the server:

   ```
   /usr/local/bin/k3s-uninstall.sh
   sudo mv /etc/environment.k3s-orig /etc/environment
   ```

   This does not remove existing Workbench data (data stored in `/opt/anaconda/storage`). If you would like to remove this data, perform the *pre-installation cleanup commands*.

2.6.8 Uninstalling Workbench on BYOK8s

If you are maintaining your own implementation of Kubernetes (K8s), the removal of Data Science & AI Workbench is fairly straightforward. To uninstall Workbench from your cluster, run the following command:

```
helm uninstall anaconda-enterprise
```

Note: This will remove any of the resources that were installed by the application, but will not remove anything that you had created prior to the `helm install` command, such as persisent volumes.

2.6.9 Keycloak Upgrade

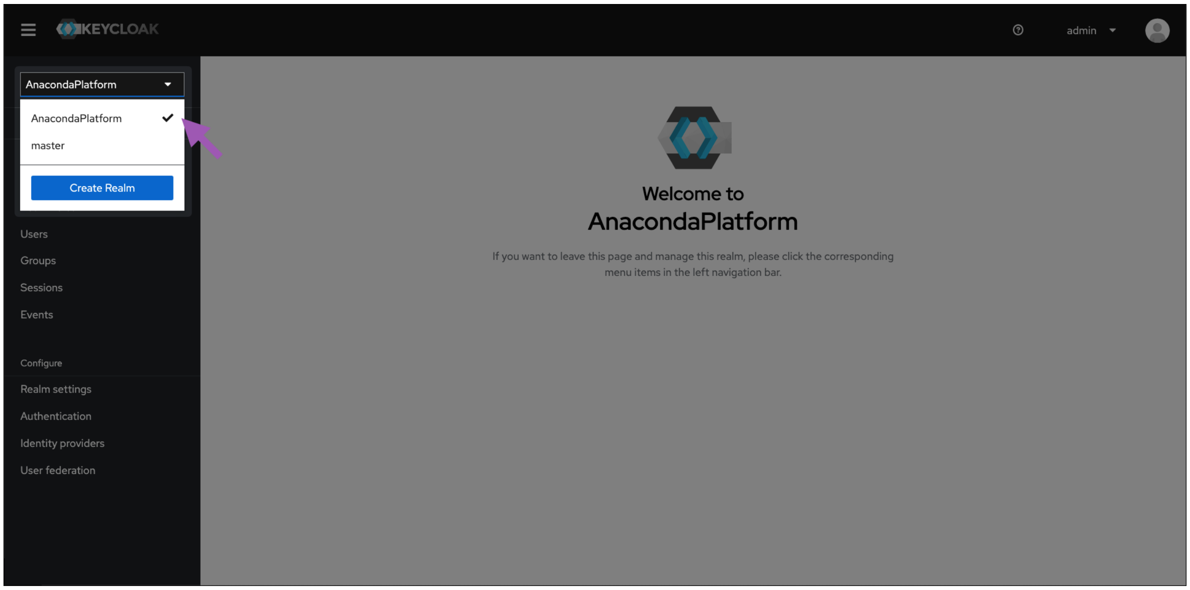
With the release of Data Science & AI Workbench 5.6, significant improvements have been made to our Keycloak implementation. For details, please see the release notes.

Upgrading to Workbench 5.6 requires Keycloak configuration changes to access your instance. You'll need to add a service account with correct permissions to the `anaconda-platform` client, then add a protocol mapper to the `roles` client scope.

Enabling the service account

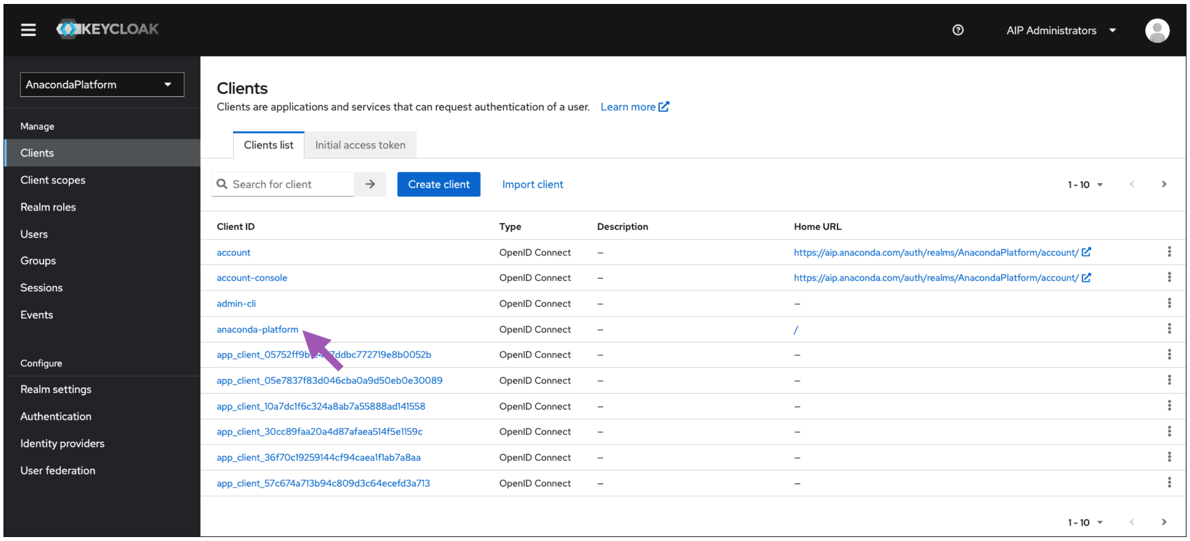
After your upgrade to Workbench 5.6+ completes:

1. Open a browser and log in to your Keycloak admin panel using your existing Keycloak credentials. Your Keycloak admin panel can be found at `https://<FQDN>auth/admin` where `<FQDN>` is your Workbench fully qualified domain name.
2. Verify you are on the **anaconda-platform** realm.



If you want to leave this page and manage this realm, please click the corresponding menu items in the left navigation bar.

3. Select **Clients** from the left-hand navigation, then select **anaconda-platform** from the list of available clients.

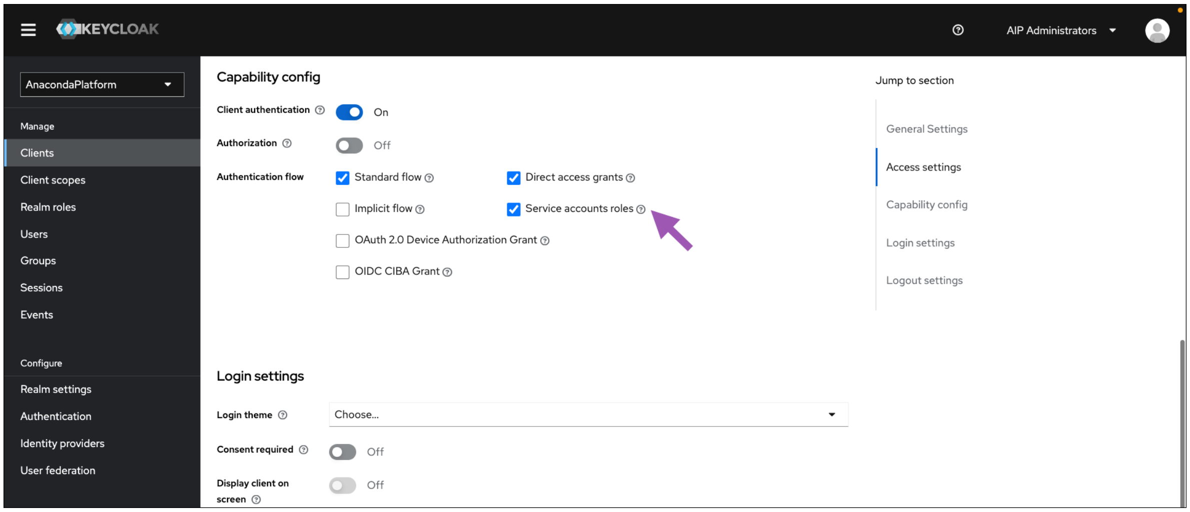


Clients

Clients are applications and services that can request authentication of a user. Learn more

Client ID	Type	Description	Home URL
account	OpenID Connect	–	https://aip.anaconda.com/auth/realms/AnacondaPlatform/account/
account-console	OpenID Connect	–	https://aip.anaconda.com/auth/realms/AnacondaPlatform/account/
admin-cli	OpenID Connect	–	–
anaconda-platform	OpenID Connect	–	/
app_client_05752ff9b[illegible]7ddbc772719e8b0052b	OpenID Connect	–	–
app_client_05e7837f83d046cba0a9d50eb0e30089	OpenID Connect	–	–
app_client_10a7dc1f6c324a8ab7a55888ad141558	OpenID Connect	–	–
app_client_30cc89faa20a4d87afaea514f5e1159c	OpenID Connect	–	–
app_client_36f70c19259144cf94caea1f1ab7a8aa	OpenID Connect	–	–
app_client_57c674a713b94c809d3c64ecefd3a713	OpenID Connect	–	–

4. Select the **Service accounts roles** checkbox under **Capability config**, then save your changes.



Capability config

Client authentication: On

Authorization: Off

Authentication flow:
☑ Standard flow
☑ Direct access grants
□ Implicit flow
☑ Service accounts roles
□ OAuth 2.0 Device Authorization Grant
□ OIDC CIBA Grant

Login settings

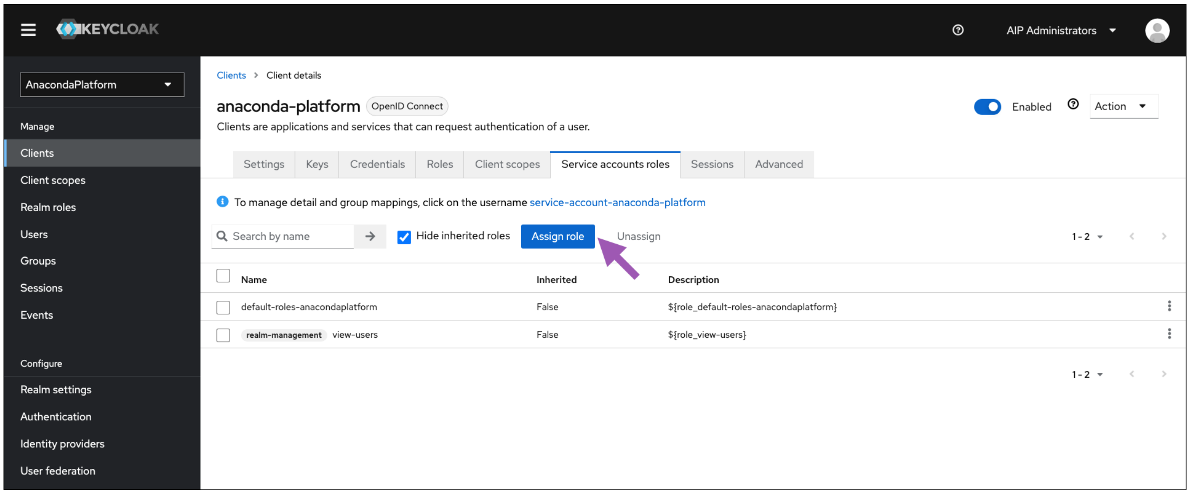
Login theme: Choose...

Consent required: Off

Display client on screen: Off

5. Select the new **Service accounts roles** tab that appears at the top of the page.

6. Click **Assign role**.



anaconda-platform OpenID Connect

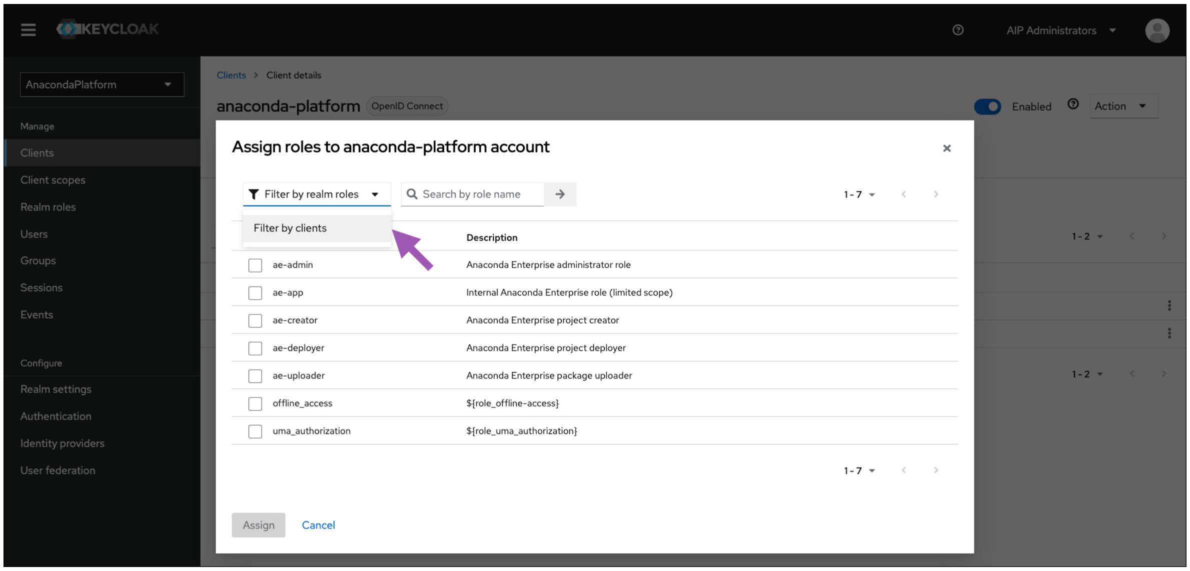
Clients are applications and services that can request authentication of a user.

To manage detail and group mappings, click on the username service-account-anaconda-platform

☑ Hide inherited roles

Name	Inherited	Description
default-roles-anacondaplatform	False	${role_default-roles-anacondaplatform}
realm-management view-users	False	${role_view-users}

7. Open the filter dropdown menu and select **Filter by clients**.



Assign roles to anaconda-platform account

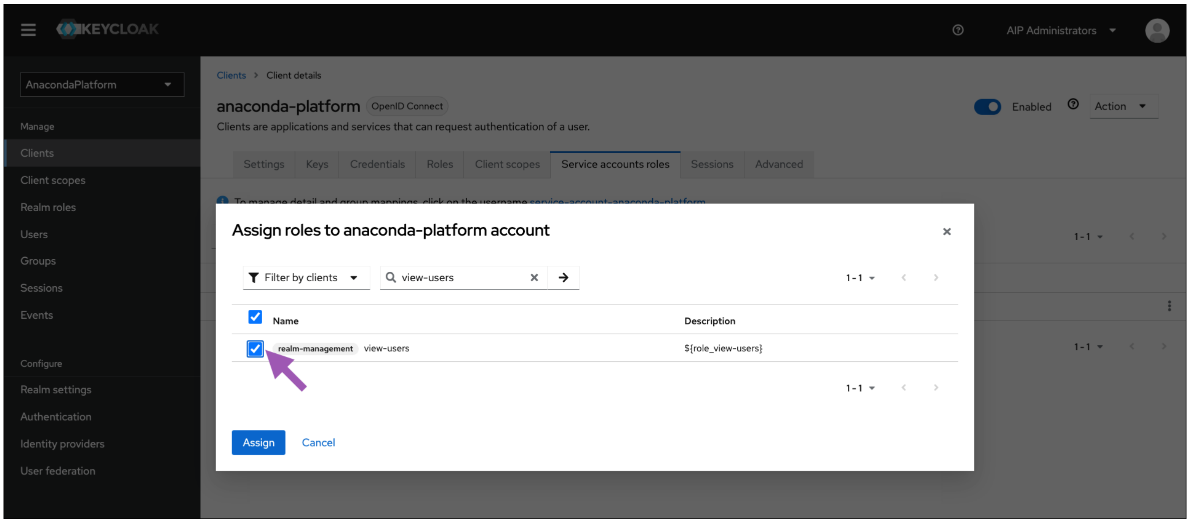
Filter by realm roles | Search by role name | 1 - 7

Filter by clients

	Description
□ ae-admin	Anaconda Enterprise administrator role
□ ae-app	Internal Anaconda Enterprise role (limited scope)
□ ae-creator	Anaconda Enterprise project creator
□ ae-deployer	Anaconda Enterprise project deployer
□ ae-uploader	Anaconda Enterprise package uploader
□ offline_access	${role_offline-access}
□ uma_authorization	${role_uma_authorization}

8. Search for the `view-users` role.

9. Select the role, then click **Assign**.



Clients are applications and services that can request authentication of a user.

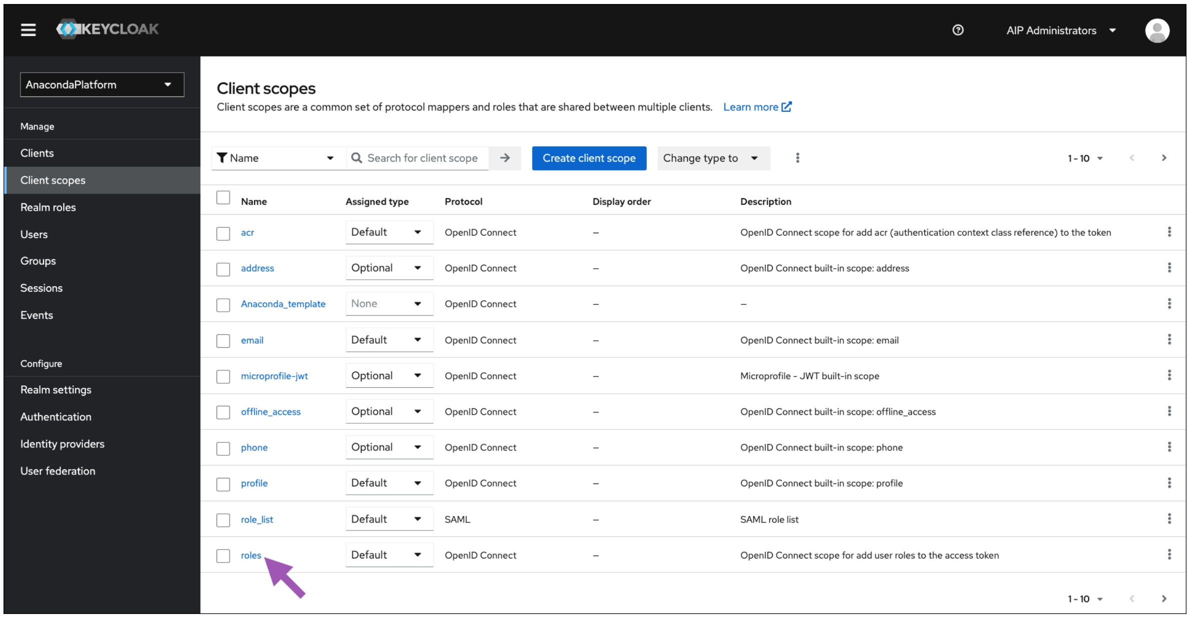
Assign roles to anaconda-platform account

Filter by clients | view-users | 1 - 1

☑ Name	Description
☑ realm-management view-users	${role_view-users}

Adding the protocol mapper

1. Select **Client scopes** from the left-hand navigation, then select **roles** from the list of available client scopes.



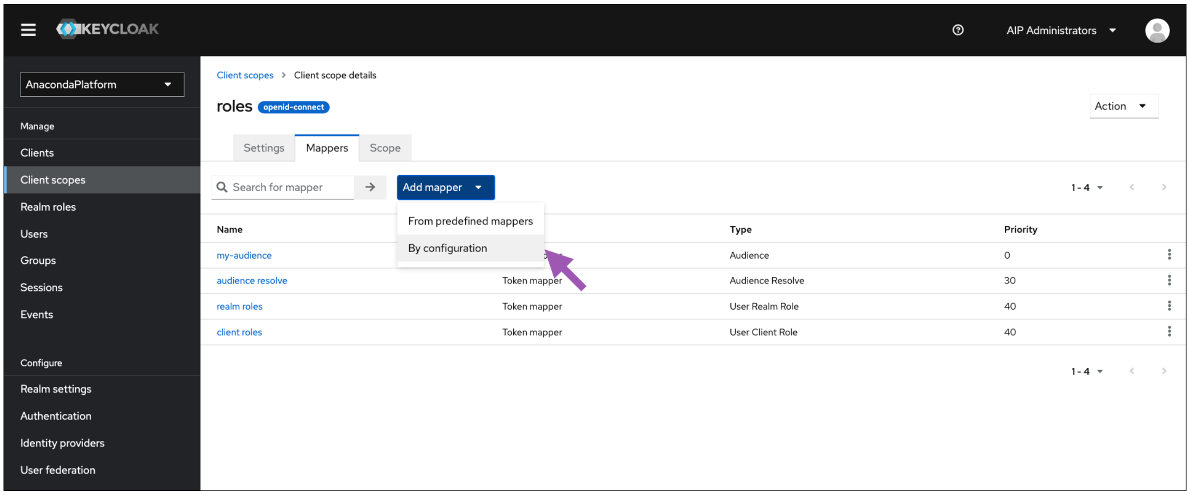
Client scopes

Client scopes are a common set of protocol mappers and roles that are shared between multiple clients. Learn more

Name	Assigned type	Protocol	Display order	Description
acr	Default	OpenID Connect	–	OpenID Connect scope for add acr (authentication context class reference) to the token
address	Optional	OpenID Connect	–	OpenID Connect built-in scope: address
Anaconda_template	None	OpenID Connect	–	–
email	Default	OpenID Connect	–	OpenID Connect built-in scope: email
microprofile-jwt	Optional	OpenID Connect	–	Microprofile - JWT built-in scope
offline_access	Optional	OpenID Connect	–	OpenID Connect built-in scope: offline_access
phone	Optional	OpenID Connect	–	OpenID Connect built-in scope: phone
profile	Default	OpenID Connect	–	OpenID Connect built-in scope: profile
role_list	Default	SAML	–	SAML role list
roles	Default	OpenID Connect	–	OpenID Connect scope for add user roles to the access token

2. Select the **Mappers** tab.

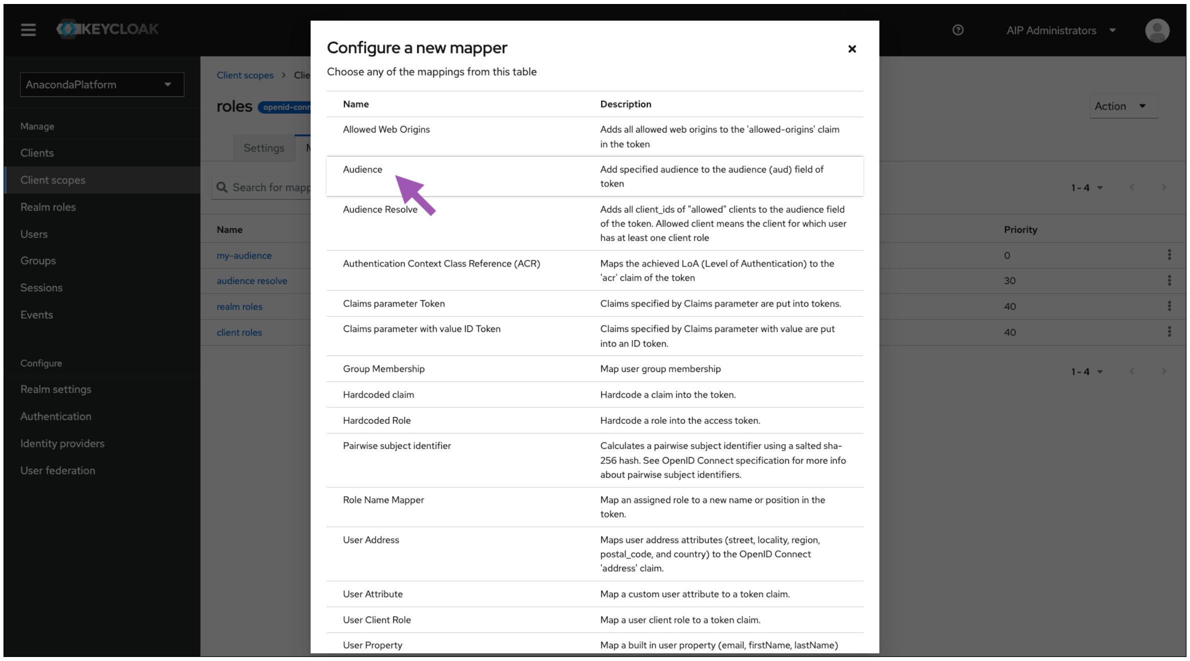
3. Open the **Add mapper** dropdown menu and select **By configuration**.



roles openid-connect

Name		Type	Priority
my-audience		Audience	0
audience resolve	Token mapper	Audience Resolve	30
realm roles	Token mapper	User Realm Role	40
client roles	Token mapper	User Client Role	40

4. Select **Audience**.

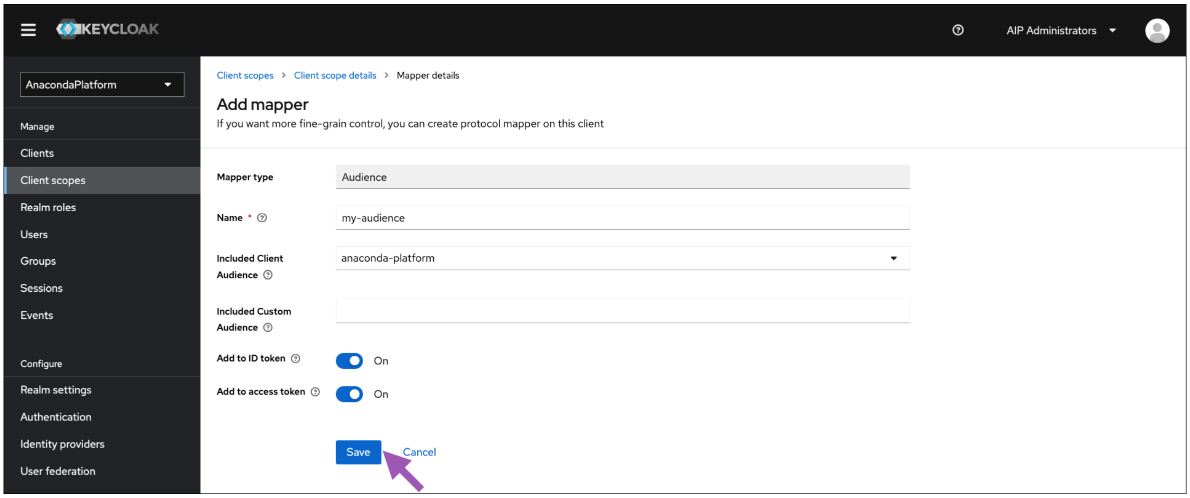


Configure a new mapper

Choose any of the mappings from this table

Name	Description
Allowed Web Origins	Adds all allowed web origins to the 'allowed-origins' claim in the token
Audience	Add specified audience to the audience (aud) field of token
Audience Resolve	Adds all client_ids of "allowed" clients to the audience field of the token. Allowed client means the client for which user has at least one client role
Authentication Context Class Reference (ACR)	Maps the achieved LoA (Level of Authentication) to the 'acr' claim of the token
Claims parameter Token	Claims specified by Claims parameter are put into tokens.
Claims parameter with value ID Token	Claims specified by Claims parameter with value are put into an ID token.
Group Membership	Map user group membership
Hardcoded claim	Hardcode a claim into the token.
Hardcoded Role	Hardcode a role into the access token.
Pairwise subject identifier	Calculates a pairwise subject identifier using a salted sha-256 hash. See OpenID Connect specification for more info about pairwise subject identifiers.
Role Name Mapper	Map an assigned role to a new name or position in the token.
User Address	Maps user address attributes (street, locality, region, postal_code, and country) to the OpenID Connect 'address' claim.
User Attribute	Map a custom user attribute to a token claim.
User Client Role	Map a user client role to a token claim.
User Property	Map a built in user property (email, firstName, lastName)

5. Complete the fields and set the toggle switches as indicated:
   - **Name** - my-audience
   - **Included Client Audience** - anaconda-platform
   - **Add to ID token** - `ON`
   - **Add to access token** - `ON`
6. Click **Save**.



Client scopes > Client scope details > Mapper details

Add mapper

If you want more fine-grain control, you can create protocol mapper on this client

Mapper type: Audience

Name *: my-audience

Included Client Audience: anaconda-platform

Included Custom Audience:

Add to ID token: On

Add to access token: On

Success! You can now log in to your instance from an existing account and use Workbench normally.

CHAPTER

THREE

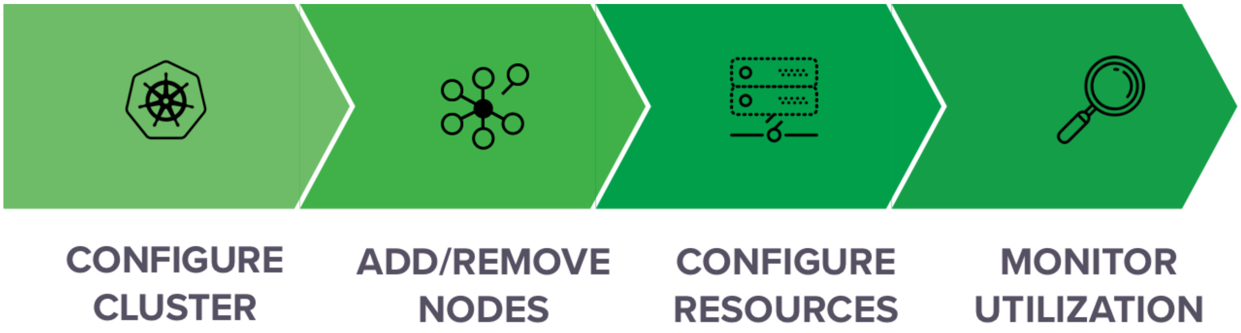
ADMINISTERING WORKBENCH

Administrator users in Workbench are responsible for configuring various aspects of the platform to meet their organization's technical and operational requirements. Key administrative tasks include:

3.1 Managing cluster resources

After you've *installed an Data Science & AI Workbench cluster*, you'll need to continue managing and monitoring the cluster to ensure that it scales with your organization. These on-going tasks include:

- **Adding nodes:** If you outgrow your initial Workbench cluster installation, you can always *add nodes* to your cluster—including GPUs. Once added, make these nodes available to platform users by *configuring resource profiles*.
- **Monitoring and managing resources:** To help you manage your organization's cluster resources more efficiently, Workbench enables you to *monitor which sessions and deployments are running* on specific nodes or by specific users. You can also *monitor cluster resource usage* in terms of CPU, memory, disk space, network, and GPU utilization.
- **Troubleshooting and debugging:** To help you gain insights into user services and troubleshoot issues, Workbench provides *detailed logs* and debugging information related to the Kubernetes services it uses, as well as all *activity performed by users*. See *fault tolerance in Workbench* for information about what to do if a master node fails.



3.1.1 Gravity Monitoring

This section of documentation provides guidance on monitoring your resources using the Gravity Ops center.

Adding and removing nodes

You can view, add, edit and delete server nodes from Data Science & AI Workbench using the Admin Console's Operations Center. If you would prefer to use a command line to join additional nodes to the Workbench master, follow *the instructions provided below*.

NOTES:

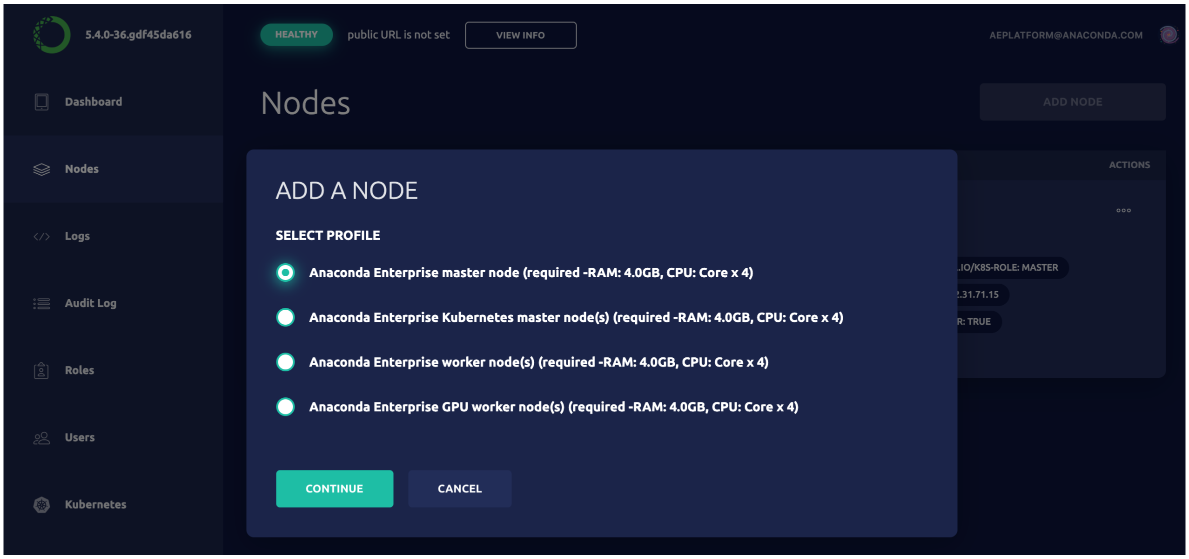
- Workbench does not support running heterogeneous versions in the same cluster. Before adding a new node, *verify that the node is operating the same version of the OS as the rest of the cluster*.
- If you're adding a GPU node, make sure it meets the *GPU requirements*.
- Each installation can only support a single Workbench master node, as this node includes storage for the platform. **DO NOT add an additional Workbench master node to your installation**.

To manage the servers on your system:

1. Log in to Workbench, select the **Menu** icon in the top right corner and click the **Administrative Console** link displayed at the bottom of the slide out window. You must be logged in with a user assigned to the `ae-admin` role.
2. Click **Manage Resources**.
3. Log in to the Operations Center using the Administrator credentials *configured after installation*.
4. Select **Nodes** from the menu on the left to display the configured nodes in your cluster, their IP address, hostname and profile.

To add an existing server to Workbench:

1. Click the **Add Node** button at the top right.



ADD A NODE

SELECT PROFILE

● Anaconda Enterprise master node (required -RAM: 4.0GB, CPU: Core x 4)

○ Anaconda Enterprise Kubernetes master node(s) (required -RAM: 4.0GB, CPU: Core x 4)

○ Anaconda Enterprise worker node(s) (required -RAM: 4.0GB, CPU: Core x 4)

○ Anaconda Enterprise GPU worker node(s) (required -RAM: 4.0GB, CPU: Core x 4)

CONTINUE CANCEL

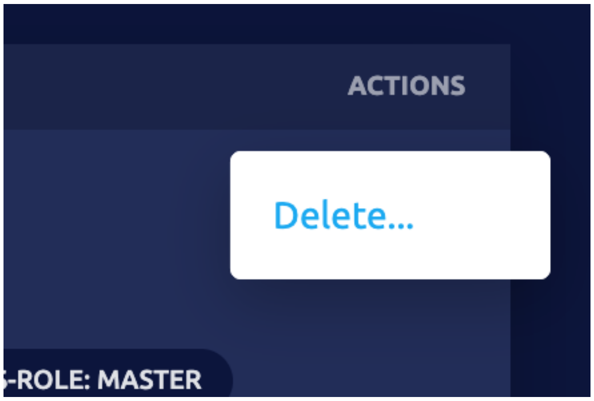
2. Select an appropriate profile for the server and click **Continue**.

3. Copy and paste the command provided into a terminal window to add the server.

   When you refresh the page, your server will appear in the list.

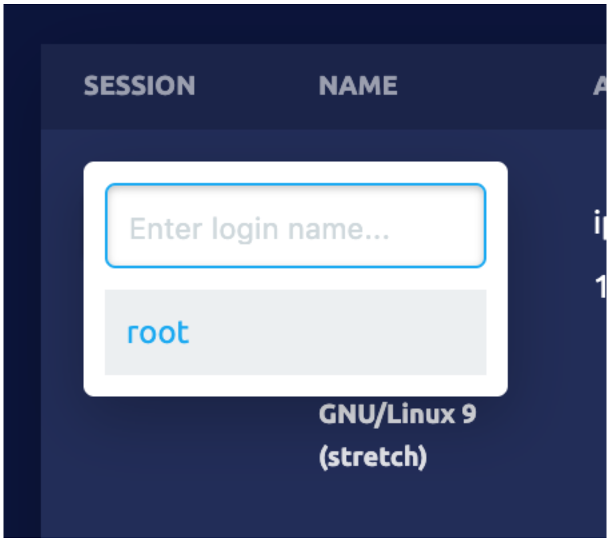
To remove a server node:

Click the Actions menu ··· at the far right of the node you want to remove and select **Delete. . .** .



To log on to a server:

Click on the terminal icon ▭ of the server you want to work with, and select **root** to open a terminal window. It will open a new tab in your browser.



When you are finished, simply close the console window by clicking the ✕ icon.

Using the command line to add nodes

1. Download the gravity binary that corresponds to your version of Workbench from the S3 location provided to you by Anaconda onto the server you're adding to the cluster.

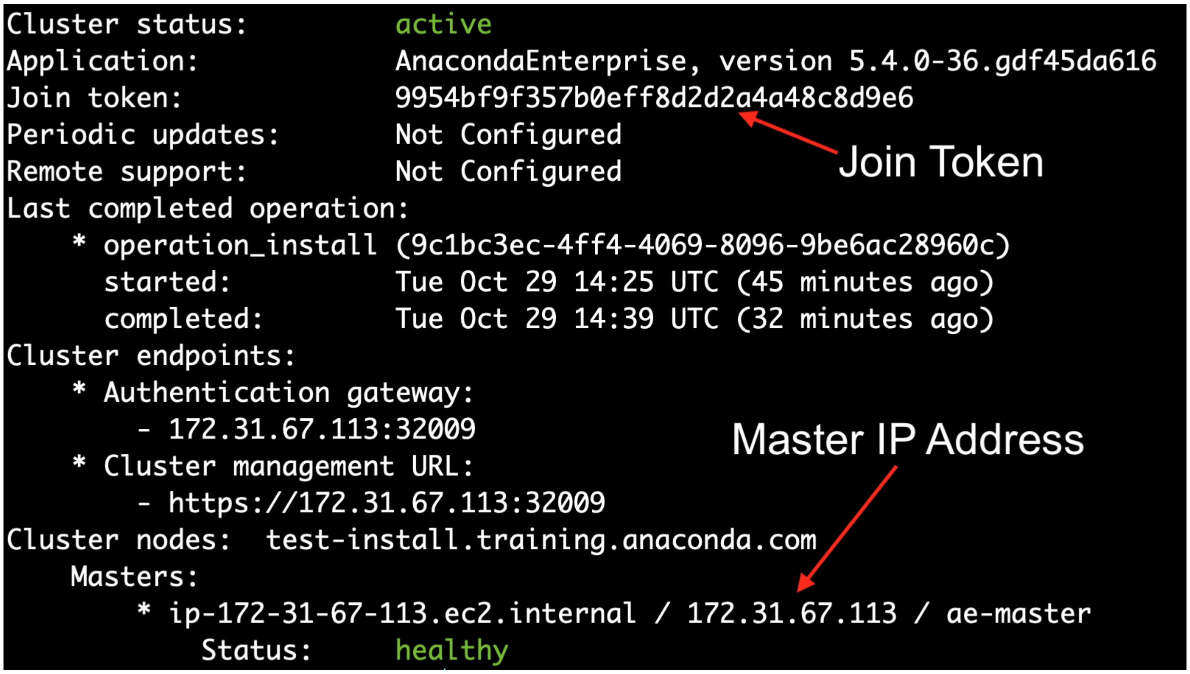
2. Rename the file to something simpler, then make it executable. For example:

```
mv gravity-binary-6.1.9 gravity
chmod +x gravity
```

3. *On the Workbench master*, run the following command to obtain the join token and IP address for the Workbench master node:

```
gravity status
```

   The results should look similar to the following:



```
Cluster status:         active
Application:            AnacondaEnterprise, version 5.4.0-36.gdf45da616
Join token:             9954bf9f357b0eff8d2d2a4a48c8d9e6
Periodic updates:       Not Configured
Remote support:         Not Configured
Last completed operation:
    * operation_install (9c1bc3ec-4ff4-4069-8096-9be6ac28960c)
      started:          Tue Oct 29 14:25 UTC (45 minutes ago)
      completed:        Tue Oct 29 14:39 UTC (32 minutes ago)
Cluster endpoints:
    * Authentication gateway:
        - 172.31.67.113:32009
    * Cluster management URL:
        - https://172.31.67.113:32009
Cluster nodes:  test-install.training.anaconda.com
    Masters:
        * ip-172-31-67-113.ec2.internal / 172.31.67.113 / ae-master
            Status:     healthy
```

4. Copy and paste the join token for the cluster and the IP address for the Workbench master somewhere accessible. You'll need to provide this information when you add a new worker node. You'll also need the IP address of the server node you're adding.

5. *On the worker node*, run the following command to add the node to the cluster:

```
./gravity join --token JOIN-TOKEN --advertise-addr=NODE-IP --role=NODE-ROLE --cloud-
↪provider=CLOUD-PROVIDER MASTER-IP-ADDR
```

   Where:

   `JOIN-TOKEN` = The join token that you obtained in Step 3.

   `NODE-IP` = The IP address of the worker node. This can be a private IP address, as long as the network it's on can access the Workbench master.

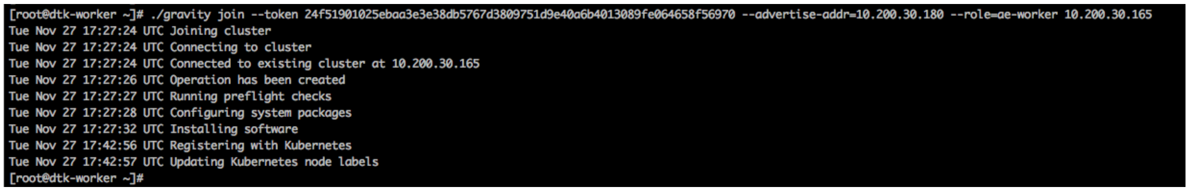
   `NODE-ROLE` = The type of node you're adding: `ae-worker`, `gpu-worker`, or `k8s-master`.

`CLOUD-PROVIDER` = This is auto-detected, and can therefore be excluded unless you don't have Internet access. In this case, use `generic`.

`MASTER-IP-ADDR` = The IP address of the Workbench master that you obtained in Step 3.

> **Warning:** The `--role` flag must be provided and assigned to either `ae-worker`, `gpu-worker`, or `k8s-master`. Without it, the node will be added with the role `ae-master` and may cause your cluster to crash.

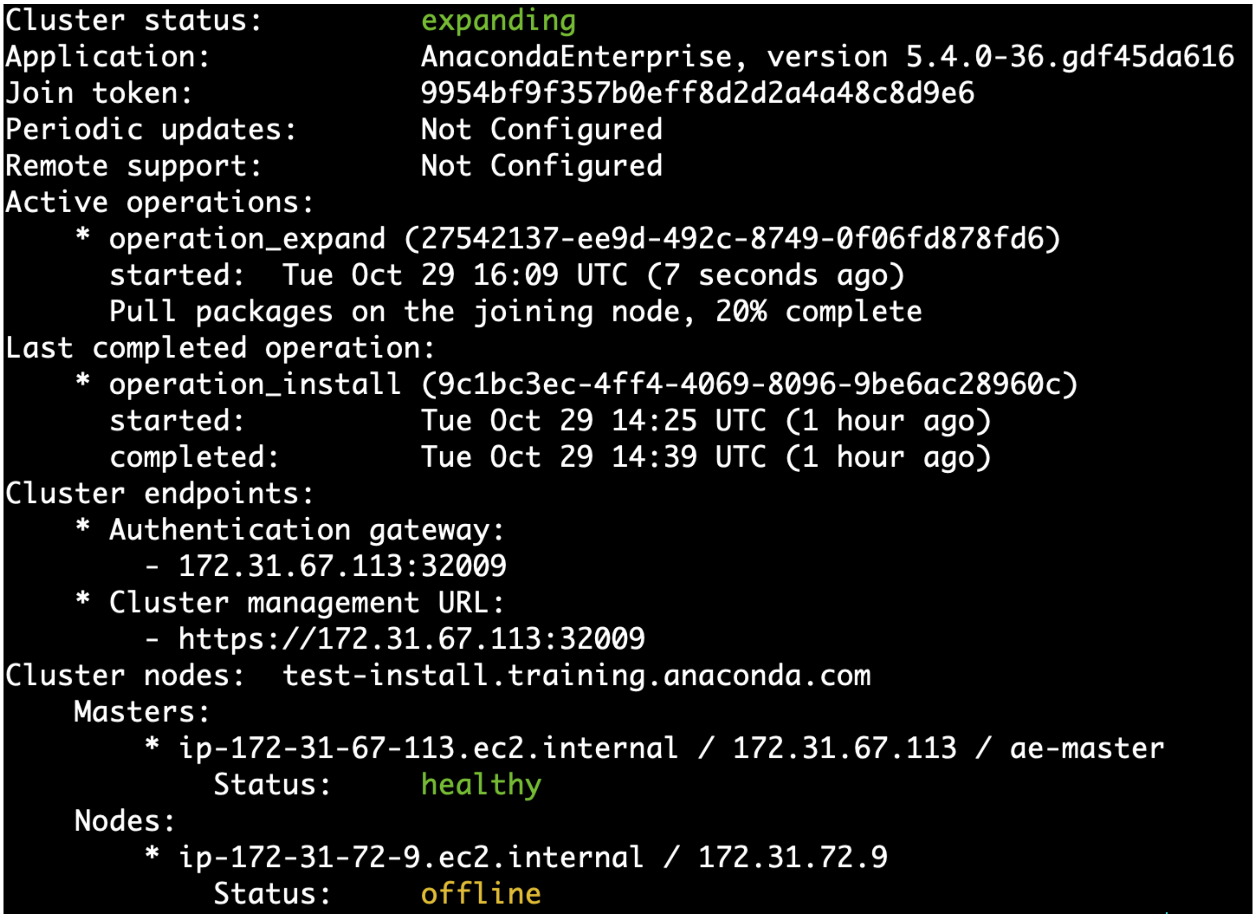
The progress of the join operation is displayed:



```
[root@dtk-worker ~]# ./gravity join --token 24f51901025ebaa3e3e38db5767d3809751d9e40a6b4013089fe064658f56970 --advertise-addr=10.200.30.180 --role=ae-worker 10.200.30.165
Tue Nov 27 17:27:24 UTC Joining cluster
Tue Nov 27 17:27:24 UTC Connecting to cluster
Tue Nov 27 17:27:24 UTC Connected to existing cluster at 10.200.30.165
Tue Nov 27 17:27:26 UTC Operation has been created
Tue Nov 27 17:27:27 UTC Running preflight checks
Tue Nov 27 17:27:28 UTC Configuring system packages
Tue Nov 27 17:27:32 UTC Installing software
Tue Nov 27 17:42:56 UTC Registering with Kubernetes
Tue Nov 27 17:42:57 UTC Updating Kubernetes node labels
[root@dtk-worker ~]#
```

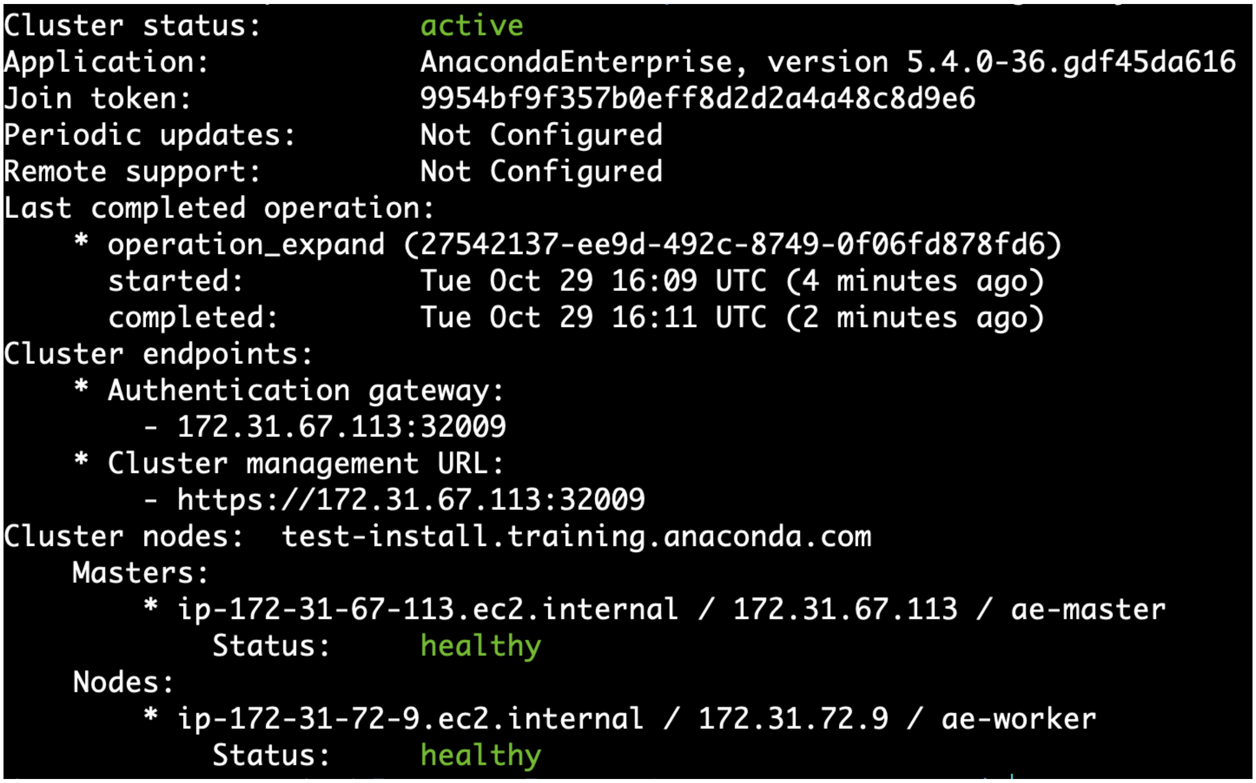
6. To monitor the impact of the join operation on the cluster, run the `gravity status` command *on the Workbench master*.

The output will look similar to the following:



```
Cluster status:         expanding
Application:            AnacondaEnterprise, version 5.4.0-36.gdf45da616
Join token:             9954bf9f357b0eff8d2d2a4a48c8d9e6
Periodic updates:       Not Configured
Remote support:         Not Configured
Active operations:
    * operation_expand (27542137-ee9d-492c-8749-0f06fd878fd6)
      started:  Tue Oct 29 16:09 UTC (7 seconds ago)
      Pull packages on the joining node, 20% complete
Last completed operation:
    * operation_install (9c1bc3ec-4ff4-4069-8096-9be6ac28960c)
      started:          Tue Oct 29 14:25 UTC (1 hour ago)
      completed:        Tue Oct 29 14:39 UTC (1 hour ago)
Cluster endpoints:
    * Authentication gateway:
        - 172.31.67.113:32009
    * Cluster management URL:
        - https://172.31.67.113:32009
Cluster nodes:  test-install.training.anaconda.com
    Masters:
        * ip-172-31-67-113.ec2.internal / 172.31.67.113 / ae-master
            Status:     healthy
    Nodes:
        * ip-172-31-72-9.ec2.internal / 172.31.72.9
            Status:     offline
```

Note that the size of the cluster is `expanding` and the status of the new node being added is `offline`. When the node has successfully joined, the cluster returns to an `active` state, and the status of the new node changes to `healthy`:



```
Cluster status:         active
Application:            AnacondaEnterprise, version 5.4.0-36.gdf45da616
Join token:             9954bf9f357b0eff8d2d2a4a48c8d9e6
Periodic updates:       Not Configured
Remote support:         Not Configured
Last completed operation:
    * operation_expand (27542137-ee9d-492c-8749-0f06fd878fd6)
      started:          Tue Oct 29 16:09 UTC (4 minutes ago)
      completed:        Tue Oct 29 16:11 UTC (2 minutes ago)
Cluster endpoints:
    * Authentication gateway:
        - 172.31.67.113:32009
    * Cluster management URL:
        - https://172.31.67.113:32009
Cluster nodes:  test-install.training.anaconda.com
    Masters:
        * ip-172-31-67-113.ec2.internal / 172.31.67.113 / ae-master
            Status:     healthy
    Nodes:
        * ip-172-31-72-9.ec2.internal / 172.31.72.9 / ae-worker
            Status:     healthy
```

Monitoring cluster utilization

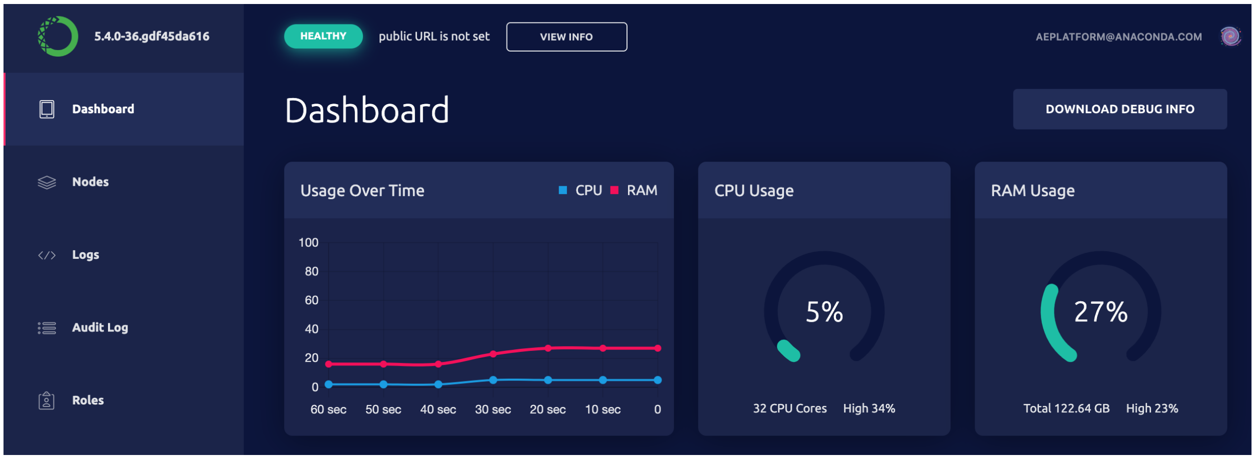
Data Science & AI Workbench enables you to monitor cluster resource usage in terms of CPU, memory, disk space, network and GPU utilization.

To access the Operations Center:

1. Log in to Workbench, select the **Menu** icon in the top right corner and click the **Administrative Console** link displayed at the bottom of the slide out window.
2. Click **Manage Resources**.
3. Login to the Operations Center using the Administrator credentials *configured after installation*

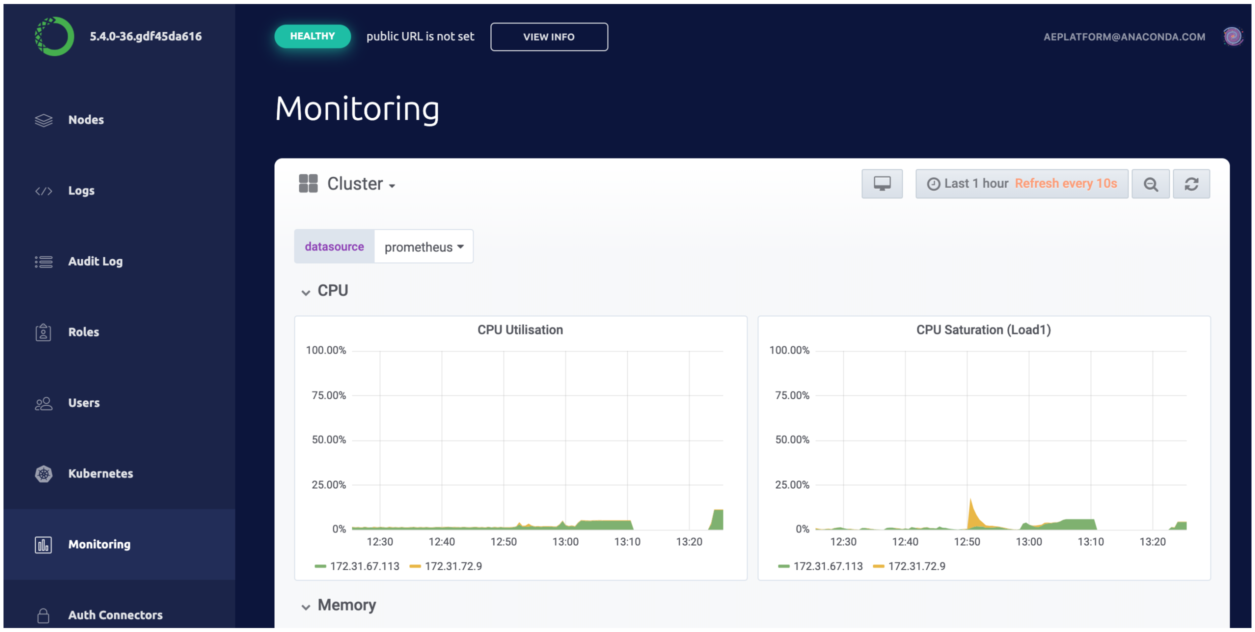
Total cluster resource utilization

The **Dashboard** tab in the Operations Center displays the total CPU and Memory utilize aggregated across all nodes (master and worker) nodes in the Workbench cluster.



Monitoring dashboard

4. Click **Monitoring** in the menu on the left.

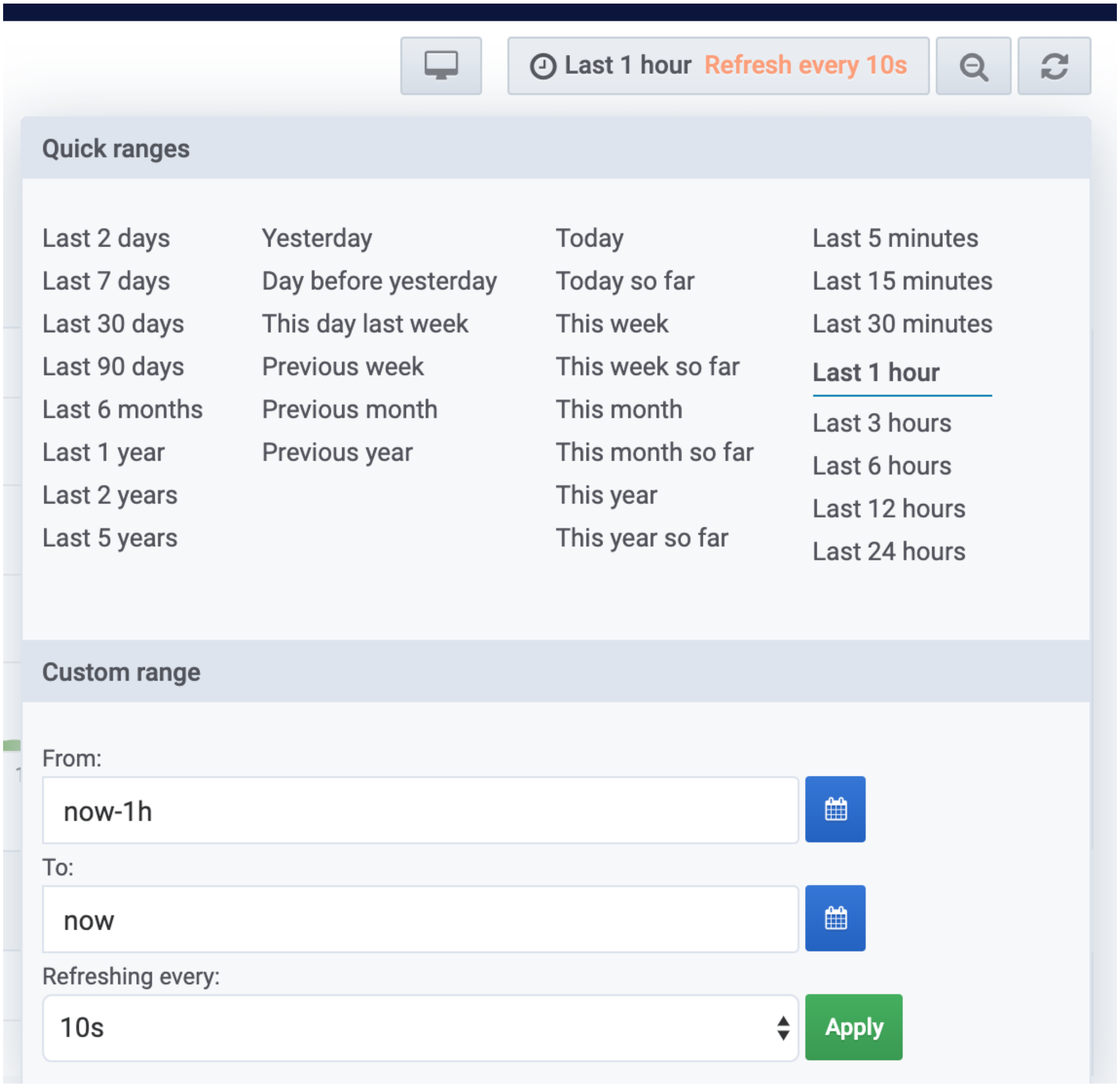


The graphs displayed include the following:

- Overall Cluster CPU Usage
- CPU Usage by Node
- Individual CPU Usage
- Overall Cluster Memory Usage
- Memory Usage by Node

- Individual Node Memory Usage
- Overall Cluster Network Usage
- Network Usage by Node
- Individual Node Network Usage
- Overall Cluster Filesystem Usage
- Filesystem Usage by Node
- Individual Filesystem Usage

Use the control in the upper right corner to specify the range of time for which you want to view usage information, and how often you want to refresh the results.



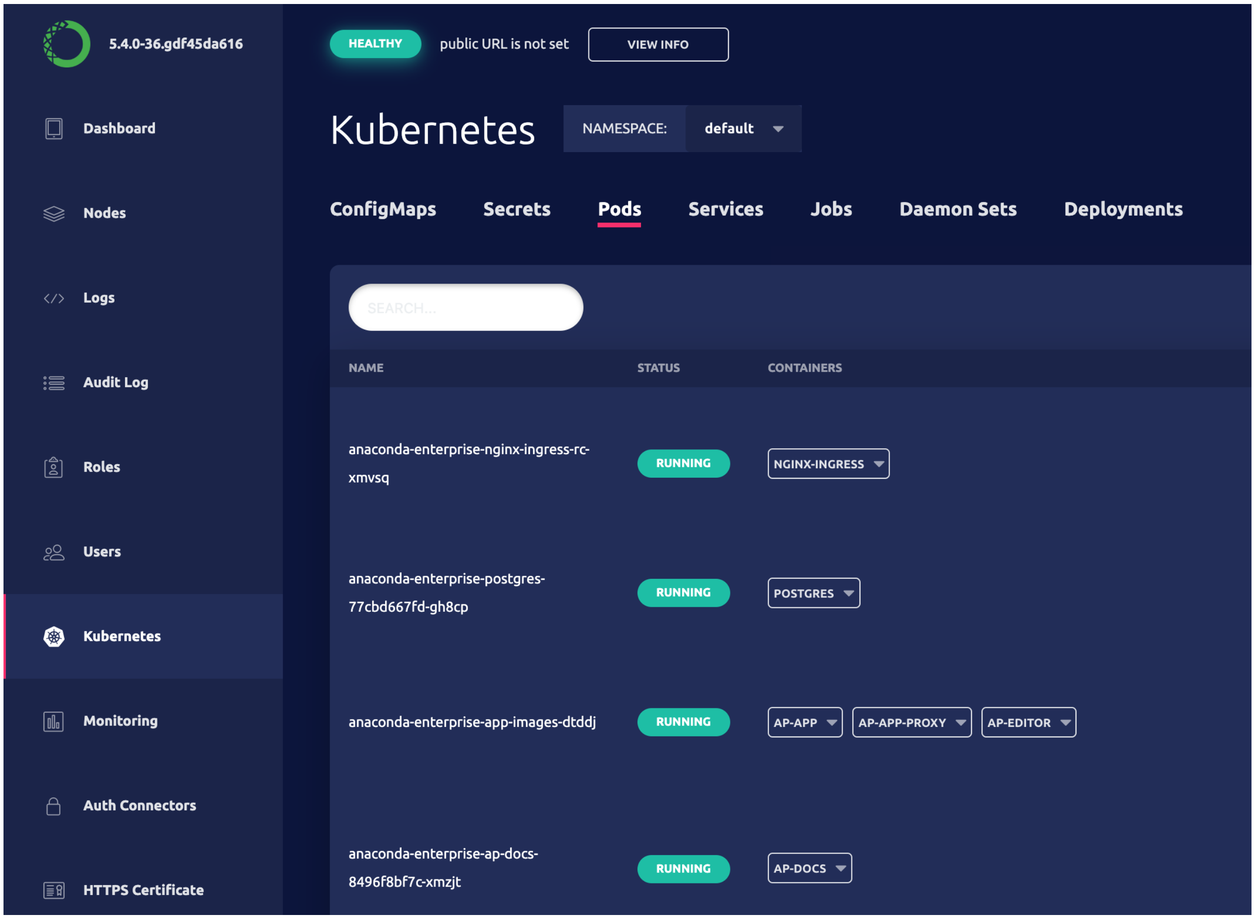
From: now-1h

To: now

Refreshing every: 10s

Monitoring Kubernetes

To view the status of your Kubernetes nodes, pods, services, jobs, daemon sets and deployments from the Operations Center, click **Kubernetes** in the menu on the left and select **Pods**.



NAME	STATUS	CONTAINERS
anaconda-enterprise-nginx-ingress-rc-xmvsq	RUNNING	NGINX-INGRESS
anaconda-enterprise-postgres-77cbd667fd-gh8cp	RUNNING	POSTGRES
anaconda-enterprise-app-images-dtddj	RUNNING	AP-APP AP-APP-PROXY AP-EDITOR
anaconda-enterprise-ap-docs-8496f8bf7c-xmzjt	RUNNING	AP-DOCS

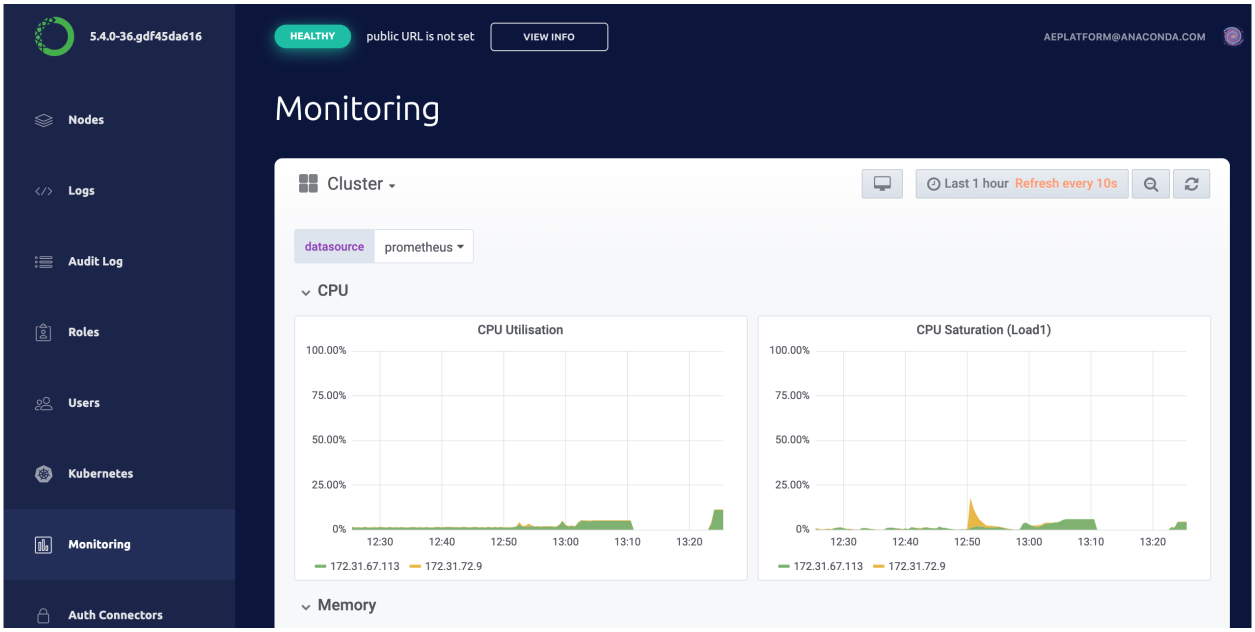
See *Monitoring sessions and deployments* for more information.

To view the status or progress of a cluster installation, click **Operations** in the menu on the left, and select an operation in the list. Clicking on a specific operation switches to the **Logs** view, where you can also view logs based on container or pod.

Monitoring sessions and deployments

Data Science & AI Workbench enables you to see which sessions and deployments are running on specific nodes or by specific users, so you can monitor cluster resource usage. You can also view session details *for a specific user* in the Authorization Center. See *Managing users* for more information.

1. Log in to Workbench, select the **Menu** icon in the top right corner and click the **Administrative Console** link displayed at the bottom of the slide out window.
2. Click **Manage Resources**.
3. Log in to the Operations Center using the Administrator credentials *configured after installation*.
4. Select **Monitoring** from the menu on the left to display the monitoring dashboards.

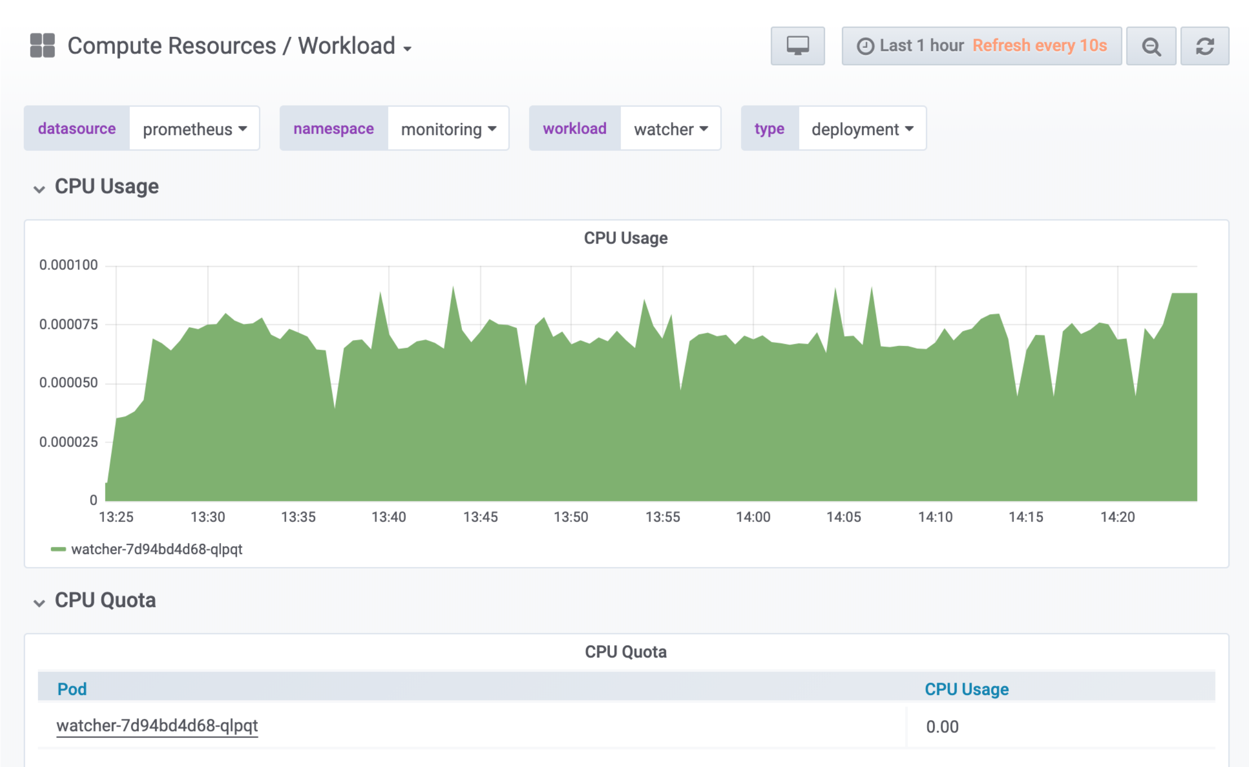


Individual pod

To display the monitoring graph for a user session or deployment you'll need to identify the appropriate Kubernetes pod name.

For an editor session the Kubernetes pod name corresponds to the hostname of the session container. Run `hostname` in a terminal window. For deployments the pod name is available from the logs tab of the deployment under the heading **name**.

1. Click the **Monitoring** tab from the menu on the left
2. Click **Cluster** at the top left of the dashboard
3. Select **Compute Resource / Workload**



datasource: prometheus

namespace: monitoring

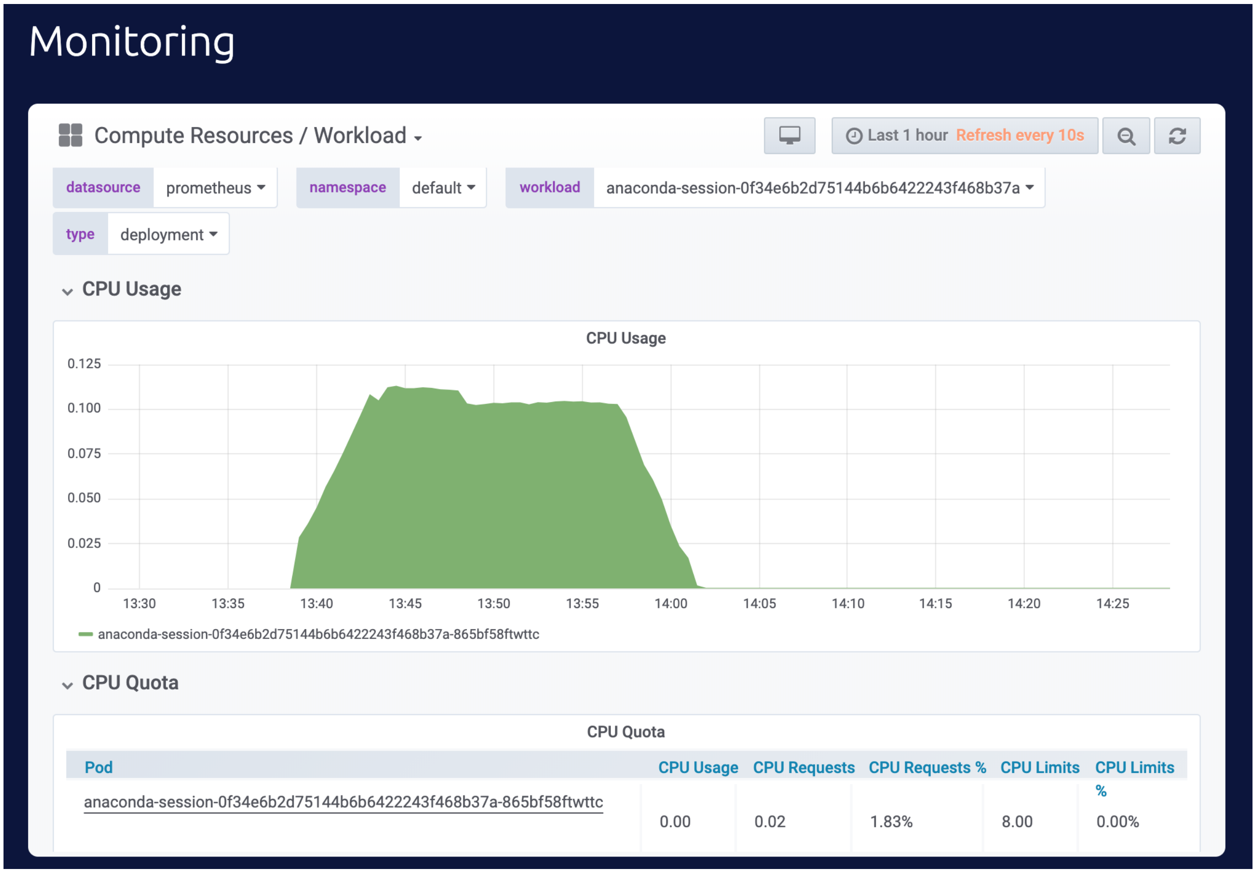
workload: watcher

type: deployment

Pod	CPU Usage
watcher-7d94bd4d68-qlpqt	0.00

To display the monitoring graph for an individual pod

1. Select `default` from the **namespace** menu
2. Select the desired pod from the the **workload** menu



Monitoring

Compute Resources / Workload

Last 1 hour Refresh every 10s

datasource: prometheus

namespace: default

workload: anaconda-session-0f34e6b2d75144b6b6422243f468b37a

type: deployment

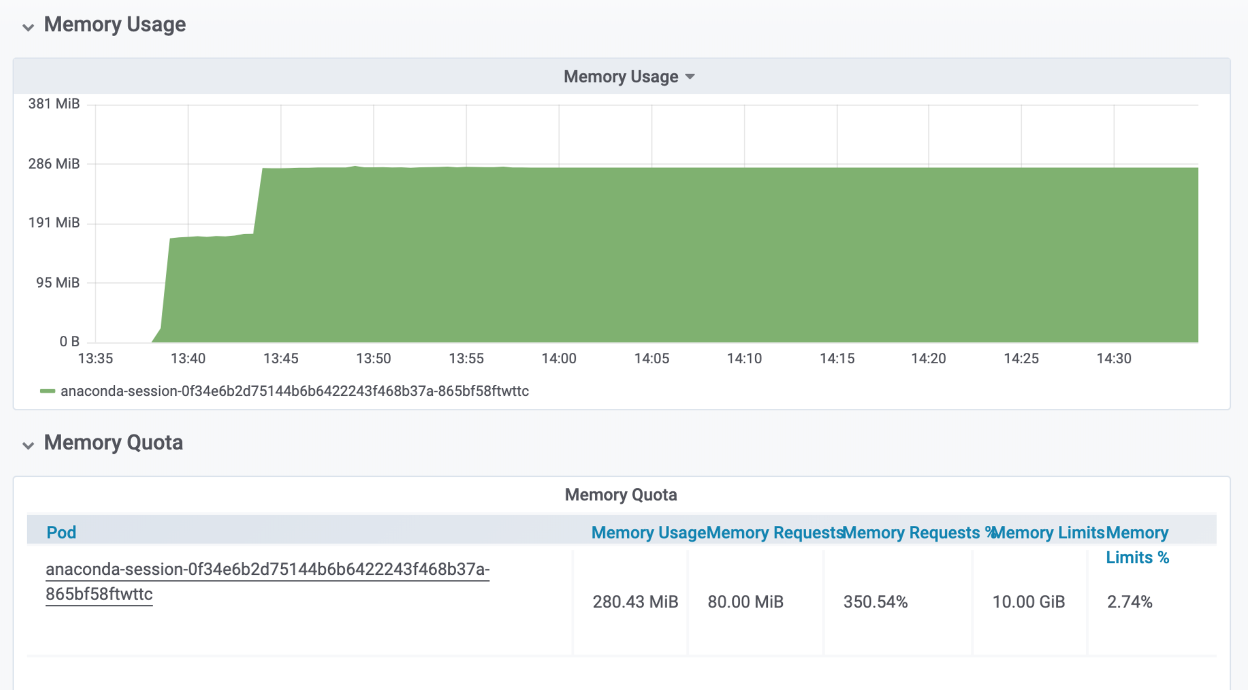
CPU Usage

CPU Quota

CPU Quota

Pod	CPU Usage	CPU Requests	CPU Requests %	CPU Limits	CPU Limits %
anaconda-session-0f34e6b2d75144b6b6422243f468b37a-865bf58ftwttc	0.00	0.02	1.83%	8.00	0.00%

Scroll down further to display the memory usage.



Memory Usage

Memory Quota

Memory Quota

Pod	Memory Usage	Memory Requests	Memory Requests %	Memory Limits	Memory Limits %
anaconda-session-0f34e6b2d75144b6b6422243f468b37a-865bf58ftwttc	280.43 MiB	80.00 MiB	350.54%	10.00 GiB	2.74%

Using the CLI:

Note: For more expanded monitoring, see Workbench Tools.

1. Open an SSH session on the master node in a terminal by logging into the Operations Center and selecting **Servers** from the menu on the left.
2. Click on the IP address for the Workbench master node and select SSH login as **root**.
3. In the terminal window, run `sudo gravity enter`.

To view total node CPU and memory utilization run

```
kubectl top nodes --heapster-namespace=monitoring
```

To view CPU and memory utilization per pod run

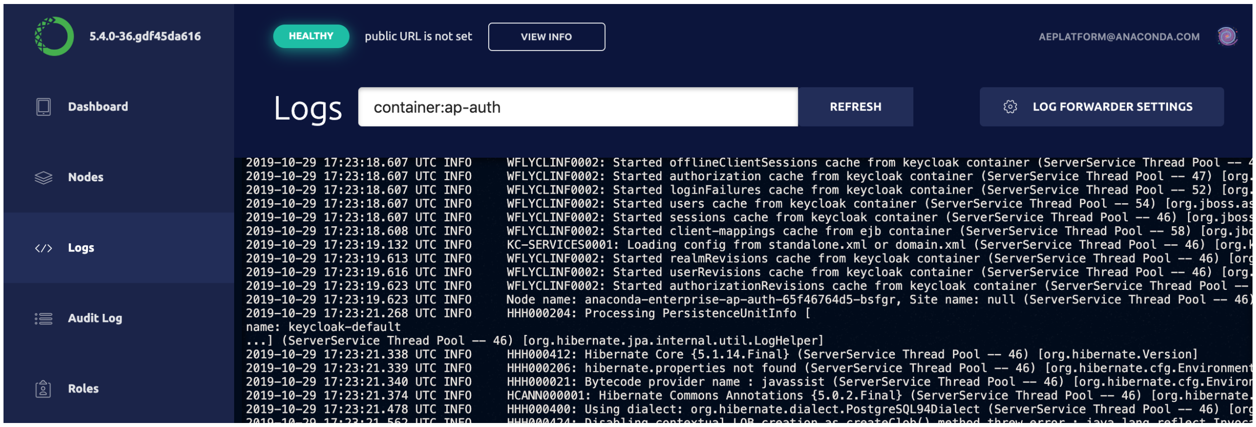
```
kubectl top pods --heapster-namespace=monitoring
```

Viewing system logs

To help you gain insights into user services and troubleshoot issues, Data Science & AI Workbench provides detailed logs and debugging information related to the Kubernetes services and containers it uses.

To access these logs from the Operations Center:

1. Log in to Workbench, select the **Menu** icon in the top right corner, and click the **Administrative Console** link displayed at the bottom of the slide out window.
2. Click **Manage Resources**.
3. Log in to the Operations Center using the Administrator credentials *configured after installation*.
4. Click **Logs** in the left menu to display the complete system log.
5. Use the **Filter** drop-down to view logs based on a container.



container:ap-auth

```
2019-10-29 17:23:18.607 UTC INFO     WFLYCLINF0002: Started offlineClientSessions cache from keycloak container (ServerService Thread Pool -- 4
2019-10-29 17:23:18.607 UTC INFO     WFLYCLINF0002: Started authorization cache from keycloak container (ServerService Thread Pool -- 47) [org.
2019-10-29 17:23:18.607 UTC INFO     WFLYCLINF0002: Started loginFailures cache from keycloak container (ServerService Thread Pool -- 52) [org.
2019-10-29 17:23:18.607 UTC INFO     WFLYCLINF0002: Started users cache from keycloak container (ServerService Thread Pool -- 54) [org.jboss.as
2019-10-29 17:23:18.607 UTC INFO     WFLYCLINF0002: Started sessions cache from keycloak container (ServerService Thread Pool -- 46) [org.jboss
2019-10-29 17:23:18.608 UTC INFO     WFLYCLINF0002: Started client-mappings cache from ejb container (ServerService Thread Pool -- 58) [org.jbo
2019-10-29 17:23:19.132 UTC INFO     KC-SERVICES0001: Loading config from standalone.xml or domain.xml (ServerService Thread Pool -- 46) [org.k
2019-10-29 17:23:19.613 UTC INFO     WFLYCLINF0002: Started realmRevisions cache from keycloak container (ServerService Thread Pool -- 46) [org
2019-10-29 17:23:19.616 UTC INFO     WFLYCLINF0002: Started userRevisions cache from keycloak container (ServerService Thread Pool -- 46) [org.
2019-10-29 17:23:19.623 UTC INFO     WFLYCLINF0002: Started authorizationRevisions cache from keycloak container (ServerService Thread Pool --
2019-10-29 17:23:19.623 UTC INFO     Node name: anaconda-enterprise-ap-auth-65f46764d5-bsfgr, Site name: null (ServerService Thread Pool -- 46)
2019-10-29 17:23:21.268 UTC INFO     HHH000204: Processing PersistenceUnitInfo [
name: keycloak-default
...] (ServerService Thread Pool -- 46) [org.hibernate.jpa.internal.util.LogHelper]
2019-10-29 17:23:21.338 UTC INFO     HHH000412: Hibernate Core {5.1.14.Final} (ServerService Thread Pool -- 46) [org.hibernate.Version]
2019-10-29 17:23:21.339 UTC INFO     HHH000206: hibernate.properties not found (ServerService Thread Pool -- 46) [org.hibernate.cfg.Environment
2019-10-29 17:23:21.340 UTC INFO     HHH000021: Bytecode provider name : javassist (ServerService Thread Pool -- 46) [org.hibernate.cfg.Enviror
2019-10-29 17:23:21.374 UTC INFO     HCANN000001: Hibernate Commons Annotations {5.0.2.Final} (ServerService Thread Pool -- 46) [org.hibernate.
2019-10-29 17:23:21.478 UTC INFO     HHH000400: Using dialect: org.hibernate.dialect.PostgreSQL94Dialect (ServerService Thread Pool -- 46) [org
2019-10-29 17:23:21.562 UTC INFO     HHH000424: Disabling contextual LOB creation as createClob() method threw error : java.lang.reflect.Invoca
```

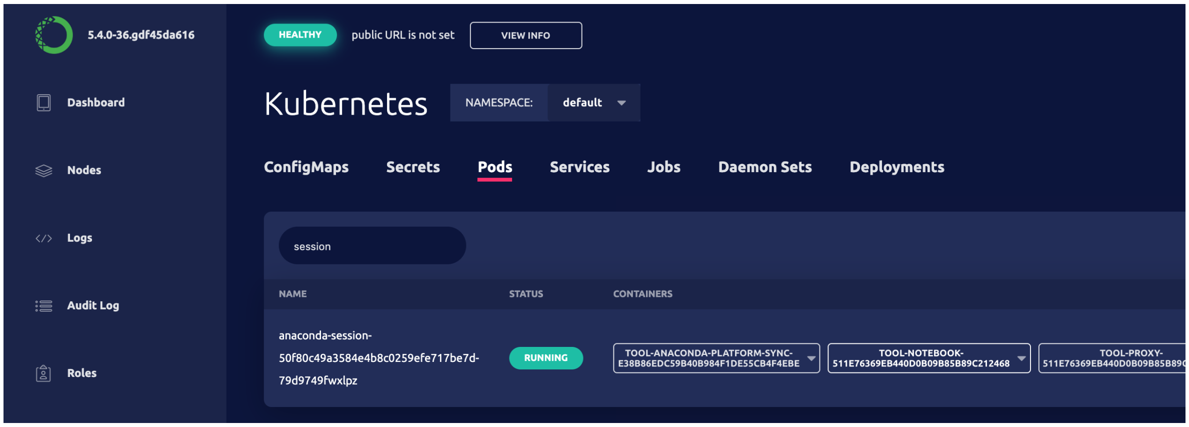
Note: You can also access the logs for a specific pod by clicking **Kubernetes** in the left menu, clicking the **Pods** tab, clicking the name of a pod, and selecting **Logs**.

Individual pods

To display the logs for a user session or deployment you'll need to identify the appropriate Kubernetes pod name.

For an editor session the Kubernetes pod name corresponds to the hostname of the session container. Run `hostname` in a terminal window. For deployments the pod name is available from the logs tab of the deployment under the heading **name**.

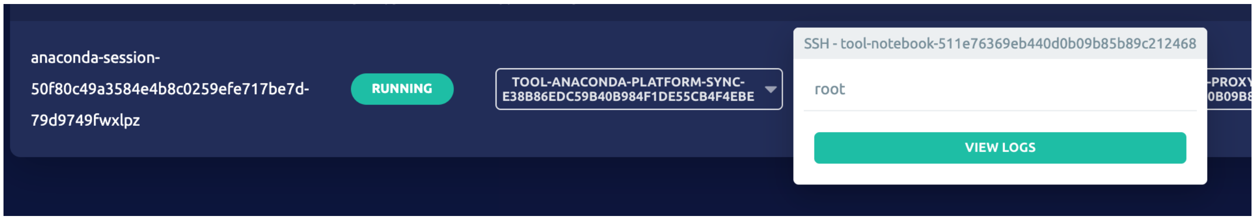
1. Click the **Kubernetes** tab from the menu on the left.
2. Click the **Pods** tab to display a list of all pods and containers. Editor sessions are named `anaconda-session-XXXXX` and deployments are named `anaconda-app-XXXX`.



session

NAME	STATUS	CONTAINERS
anaconda-session-50f80c49a3584e4b8c0259efe717be7d-79d9749fwxlpz	RUNNING	TOOL-ANACONDA-PLATFORM-SYNC-E38B86EDC59B40B984F1DE55CB4F4EBE TOOL-NOTEBOOK-511E76369EB440D0B09B85B89C212468 TOOL-PROXY-511E76369EB440D0B09B85B89C

3. For the chosen pod click the pull-down button on an individual container to view the **Logs** or to gain SSH access.



anaconda-session-
50f80c49a3584e4b8c0259efe717be7d-
79d9749fwxlpz
RUNNING
TOOL-ANACONDA-PLATFORM-SYNC-
E38B86EDC59B40B984F1DE55CB4F4EBE
SSH - tool-notebook-511e76369eb440d0b09b85b89c212468
root
VIEW LOGS
-PROXY
0B09B8

To use the CLI:

1. Open an SSH session on the master node in a terminal by logging into the Operations Center and selecting **Servers** from the menu on the left.
2. Click on the IP address for the Workbench master node and select SSH login as **root**.
3. In the terminal window, run `sudo gravity enter`.
4. Run `kubectl get pods` to view a list of all running session pods.
5. Run `kubectl logs <POD-NAME>` to display the logs for the pod specified.

Viewing activity logs

Data Science & AI Workbench logs all activity performed by users, including the following:

- Each system login.
- All Admin actions.
- Each time a project is created and updated.
- Each time a project is deployed.

In each case, the user who performed the action and when it occurred are tracked, along with any other important details.

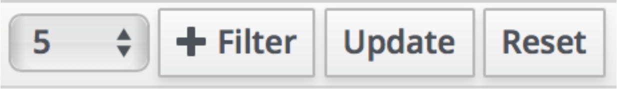
As an Administrator, you can log in to the Administrative Console's Authentication Center to view the log of all login and Admin events:

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Manage Users** to access the Keycloak user interface (UI).
3. Log in using your Keycloak admin account credentials.
4. Click **Events** in the left-hand navigation to display a log of all **Login Events**.
5. Click the **Admin Events** tab to view a summary of all actions performed by Admin users.

To filter events:

Event data can become difficult to manage as it accumulates, so Workbench provides a few options to make it more manageable:

1. Click the **Config** tab to configure the type of events you want Workbench to log, clear events, and schedule if you want to periodically delete event logs from the database.
2. Use the **Filter** options available on both the **Login Events** and **Admin Events** windows to control the results displayed based on variables such as event or operation, user or resource, and a range of dates.



- Click **Update** to refresh the results based on the filter you configured, and **Reset** to return to the original log results.
- Select the maximum number of results you want displayed: 5, 10, 50 or 100.

To view activity at the project level:

1. Switch to the User Console and click **Projects** in the top menu.
2. Select the project you want to view information about to display a list of all actions performed on the project in the **Activity** window.

3.1.2 System metrics

Data Science & AI Workbench uses Prometheus to monitor the operation and performance of the application. Prometheus exposes system metrics such as CPU usage, memory consumption, and network traffic to help you understand and maintain the overall health of your infrastructure. Regularly analyzing your system can help you establish a baseline for your system operations, identify potential issues with your system, and troubleshoot active problems by aiding in determining the root cause.

Prometheus comes with a built-in alert manager that you can configure to inform you when certain conditions are met or when a specified threshold is exceeded. Both Prometheus and the alert manager are installed with their default settings in the *Helm values.yaml file* during the initial installation of Workbench, but can be updated at any time.

Follow the steps for *Setting platform configurations using the Helm chart* to modify the default configurations to enable additional alerts.

Accessing system metrics

You can access the system metrics from the administrative console using the following steps.

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Open your Resource Monitoring consoles by clicking on the resources you want to view.

Configuring alerts

To configure additional custom alerts, you must provide a few key elements in your alert and place the alert in the correct area of the Helm chart (`opsMetrics.prometheus.server.alertingRules`).

Here is an example alert that you might implement in your system:

```
- alert: PodsBlockedInTerminatingState
  expr: count(kube_pod_deletion_timestamp) by (namespace, pod) * count(kube_pod_status_
↪reason{reason="NodeLost"} == 0) by (namespace, pod) > 0
  for: 5m
  labels:
    severity: critical
  annotations:
    # Use outer single quotes '' in annotations if they contain Prometheus labels
    # Use {{"{{}}"}} for Prometheus labels to allow Helm to pass the template to␣
↪Prometheus properly
    summary: 'Pod {{"{{$labels.namespace}}"}}/{{"{{$labels.pod}}"}} blocked in␣
↪Terminating state.'
```

For detailed information about defining alerting rules, see the official Prometheus documentation.

3.1.3 Configuring workload resource profiles

Each project editor session and deployment consumes compute resources within the Workbench cluster. If you need to run applications that require more memory or compute power than Anaconda provides by default, you can create customized resource profiles and configure the number of cores and amount of memory/RAM available for them. You can then allow users to access your customized resource profiles either globally or based on their role, assigned group, or as individual users. For more information about groups and roles in Workbench, see *Roles*.

For example, if your installation includes nodes with GPUs, you can add a GPU resource profile so users can access the GPUs to accelerate computation within their projects, which is essential for AI/ML model training.

Resource profiles that you create are listed for users when they *create* or *deploy* a project. You can create as many resource profiles as needed.

Configuring resource profiles via Helm chart

Workbench includes either a `values.k3s.yaml` or a `values.byok.*.yaml` (depending on your implementation) file that overrides the default values in the top-level Helm chart. If you are performing your initial configurations, use the examples below to add the necessary `resource-profiles:` and `gpu-profile:` sections to the bottom of your file, then continue your environment preparation and installation.

Otherwise, follow the steps for *Setting platform configurations using the Helm chart* to add or update the `resource-profiles:` and `gpu-profile:` configurations to the bottom of your `helm_values.yaml` file as needed for your system setup.

Resource profile examples

```
resource-profiles:
  resource-profile:
    description: Custom resource profile (global)
    user_visible: true
    resources:
      limits:
        cpu: "2"
        memory: 4096Mi

  roles_profile:
    description: Custom resource profile (roles)
    user_visible: true
    resources:
      limits:
        cpu: "3"
        memory: 4096Mi
    acl:
      roles:
        - ae-creator

  groups_profile:
    description: Custom resource profile (groups)
    user_visible: true
    resources:
      limits:
        cpu: "4"
```

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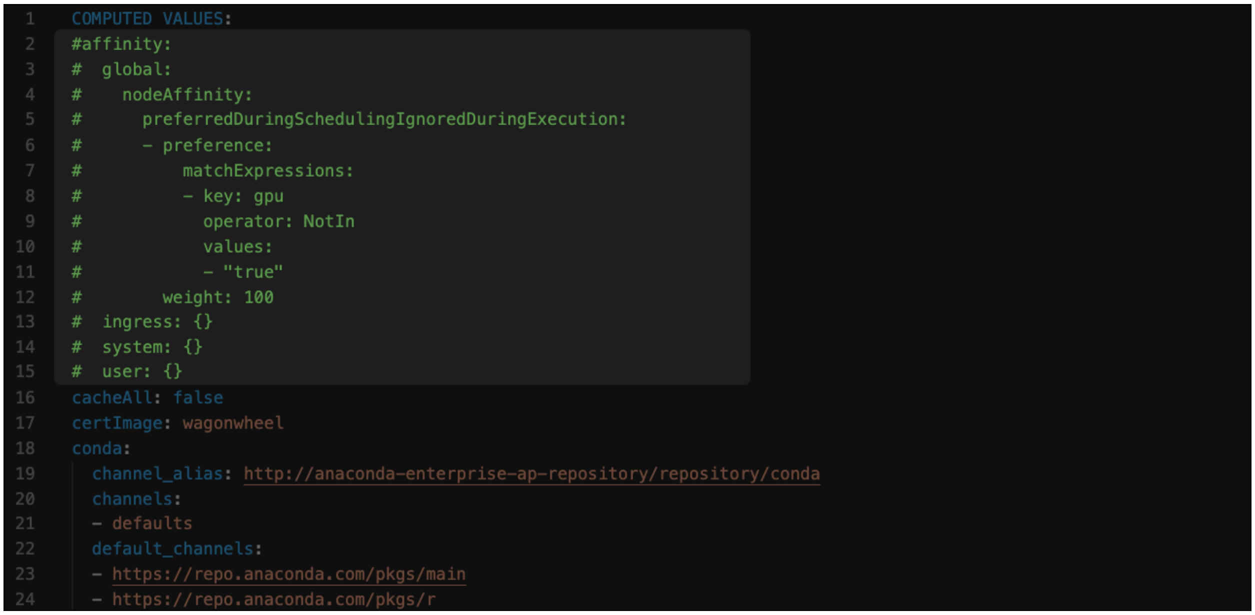
(continued from previous page)

```
        memory: 4096Mi
    acl:
      groups:
        - managers

  users_profile:
    description: Custom resource profile (users)
    user_visible: true
    resources:
      limits:
        cpu: "1"
        memory: 4096Mi
    acl:
      users:
        - user2

  not_visible_to_anyone:
    description: Custom resource profile (not visible)
    resources:
      limits:
        cpu: "3"
        memory: 4096Mi
    user_visible: false

  gpu-profile:
    description: Custom resource profile (GPU resource)
    resources:
      limits:
        cpu: "4"
        memory: 8Gi
        nvidia.com/gpu: 1
      requests:
        cpu: "1"
        memory: 2048Mi
        nvidia.com/gpu: 1
    user_visible: true

  gpu-profile:
    description: Custom resource profile (GPU with limited idle time threshold)
    user_visible: true
    cleanup-threshold: '2 days'
    resources:
        limits:
          cpu: "4"
          memory: 8Gi
          nvidia.com/gpu: 1
        requests:
          cpu: "1"
          memory: 2048Mi
          nvidia.com/gpu: 1
```

Note: Resource profiles display their `description:` as their name. Profiles are listed in alphabetical order, after the default profile.

By default, CPU sessions and deployments are allowed to run on GPU nodes. To reserve your GPU nodes for sessions and deployments that require them, comment out the `affinity:` configuration in the file as shown:



```
COMPUTED VALUES:
#affinity:
#  global:
#    nodeAffinity:
#      preferredDuringSchedulingIgnoredDuringExecution:
#      - preference:
#          matchExpressions:
#          - key: gpu
#            operator: NotIn
#            values:
#            - "true"
#        weight: 100
#  ingress: {}
#  system: {}
#  user: {}
cacheAll: false
certImage: wagonwheel
conda:
  channel_alias: http://anaconda-enterprise-ap-repository/repository/conda
  channels:
  - defaults
  default_channels:
  - https://repo.anaconda.com/pkgs/main
  - https://repo.anaconda.com/pkgs/r
```

If you need to schedule user workloads on a specific node, add a `node_selector` to your resource profile. Use node selectors when running different CPU types, such as Intel and AMD; or different GPU types, such as Tesla v100 and p100. To enable a node selector, add `node_selector` to the bottom of your resource profile, with the `model:` value matching the label you have applied to your worker node.

GPU node selector example

```
gpu-profile:
  description: GPU resource profile
  resources:
    limits:
      cpu: "4"
      memory: 8Gi
      nvidia.com/gpu: 1
    requests:
      cpu: "1"
      memory: 2048Mi
      nvidia.com/gpu: 1
  user_visible: true
  node_selector:
    model: v100
```

Once you have run the Helm upgrade command, verify that the resource profiles you added appear in the **Resource Profile** dropdown under your project's **Settings**.

3.1.4 Fault tolerance in Workbench

Data Science & AI Workbench employs automatic service restarts and health monitoring to remain operational if a process halts or a worker node becomes unavailable. Additional levels of fault tolerance, such as service migration, are provided if there are *at least three nodes* in the deployment. However, the master node cannot currently be configured for automatic failover and does present a single point of failure.

When Workbench is deployed to a cluster with *three or more nodes*, the core services are automatically configured into a fault tolerant mode—whether Workbench is initially configured this way or changed later. As soon as there are three or more nodes available, the service fault tolerance features come into effect.

This means that in the event of any service failure:

- Workbench core services will automatically be restarted or, if possible, migrated.
- User-initiated project deployments will automatically be restarted or, if possible, migrated.

If a *worker node* becomes unresponsive or unavailable, it will be flagged while the core services and backend continue to run without interruption. If additional worker nodes are available the services that had been running on the failed worker node will be migrated or restarted on other still-live worker nodes. This migration may take a few minutes.

The process for adding new worker nodes to the Workbench cluster is described in *Adding and removing nodes*.

Storage and persistency layer

Workbench does not automatically configure storage or persistency layer fault tolerance when using the default storage and persistency services. This includes the database, Git server, and object storage. If you have configured Workbench to use external storage and persistency services then you will need to configure these for fault tolerance.

Recovering after node failure

Other than storage-related services (database, Git server, and object storage), all core Workbench services are resilient to master node failure.

To maintain operation of Workbench in the event of a master node failure, `/opt/anaconda/` on the master node should be located on a redundant disk array or backed up frequently to avoid data loss. See *Backing up and restoring Workbench* for more information.

To restore Workbench operations in the event of a master node failure:

1. Create a new master node. Follow the installation process for adding a new cluster node, described in *command-line installations*.

Note: To create the new master node, select `--role=ae-master` instead of `--role=ae-worker`.

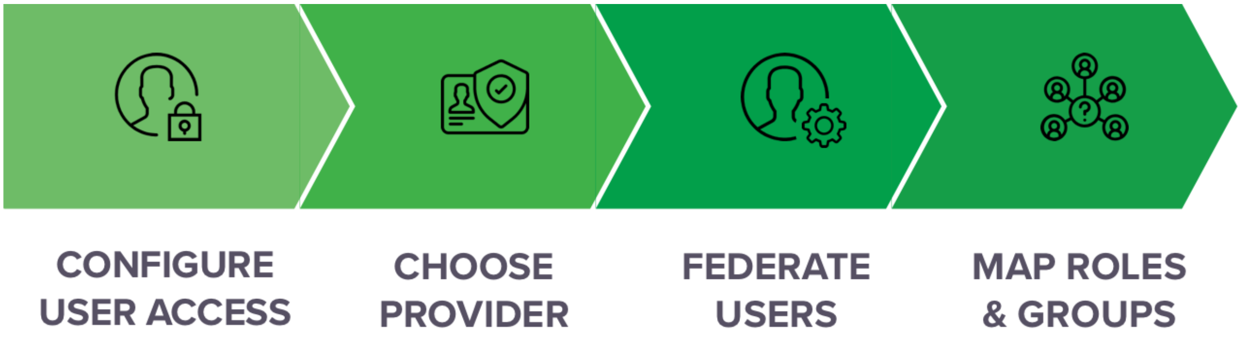
2. Restore data from a backup. After the installation of the new master node is complete, follow the instructions in *Backing up and restoring Workbench*.

3.2 Configuring user access

As an Administrator, you'll need to authorize users so they can use Workbench. This involves *adding users to the system*, setting their credentials, *mapping them to roles*, and optionally *assigning them to one or more groups*.

To help expedite the process of authorizing large groups of users, you can *connect to an external identity provider* such as LDAP or Active Directory and federate those users.

You'll need access to the Administrative Console's Authentication Center to be able to use it to configure identity and access management for Data Science & AI Workbench. Follow *these instructions* to grant Admins permission to manage Workbench users.



3.2.1 Connecting to external identity providers

Data Science & AI Workbench comes with out-of-the-box support for LDAP, Active Directory, SAML and Kerberos. As each enterprise configuration is different, coordinate with your LDAP/AD Administrator to obtain the provider-specific information you need to proceed. We've also provided an *example of an LDAP setup* to help guide you through the process.

Note: You must have pagination turned off before starting.

Adding a provider

You'll use the Administrative Console's Authentication Center to add an identity provider:

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Manage Users** to access the Keycloak user interface (UI).
3. Log in using your Keycloak admin account credentials.
4. Select **User Federation** from the left-hand navigation.
5. Select `ldap` from the Add provider selector to display the initial **Required Settings** screen.

Multiple fields are required. The most important is the **Vendor** drop-down list, which will prefill default settings based on the LDAP provider you select. Make sure you select the correct one:

- `Active Directory`
- `Red Hat Directory Server`
- `Tivoli`
- `Novell eDirectory`

If none of these match your LDAP provider, select `Other` and coordinate with your LDAP Administrator to provide values for the required fields:

Username LDAP attribute

Name of the LDAP attribute that will be mapped to the username. Active Directory installations may use `cn` or `sAMAccountName`. Others often use `uid`.

RDN LDAP attribute

Name of the LDAP attribute that will be used as the RDN for a typical user DN lookup. This is often the same as the above “Username LDAP attribute”, but does not have to be. For example, Active Directory installations may use `cn` for this attribute while using `sAMAccountName` for the “Username LDAP attribute”.

UUID LDAP attribute

Name of an LDAP attribute that will be unique across all users in the tree. For example, Active Directory installations should use `objectGUID`. Other LDAP vendors typically define a UUID attribute, but if your implementation does not have one, any other unique attribute (such as `uid` or `entryDN`) may be used.

User Object Classes

Values of the LDAP `objectClass` attribute for users, separated by a comma. This is used in the search term for looking up existing LDAP users, and if read-write sync is enabled, new users will be added to LDAP with these `objectClass` values as well.

Connection URL

The URL used to connect to your LDAP server. Click **Test connection** to make sure your connection to the LDAP server is configured correctly.

Users DN

The full DN of the LDAP tree–the parent of LDAP users. For example, `'ou=users,dc=example,dc=com'`.

Authentication Type

The LDAP authentication mechanism to use. The default is `simple`, which requires the Bind DN and password of the LDAP Admin.

Bind DN

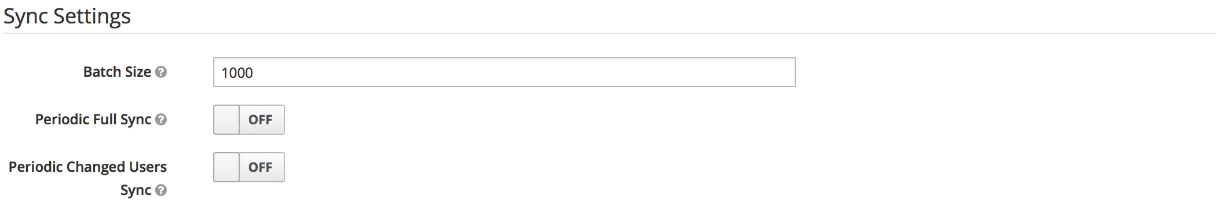
The DN of the LDAP Admin, required to access the LDAP server.

Bind Credential

The password of the LDAP Admin, required to access the LDAP server. After supplying the DN and password, click **Test authentication** to confirm that your connection to the LDAP server can be authenticated.

Configuring sync settings

By default, users will not be synced from the LDAP / Active Directory store until they log in. If you have a large number of users to import, it can be helpful to set up batch syncing and periodic updates.



Sync Settings

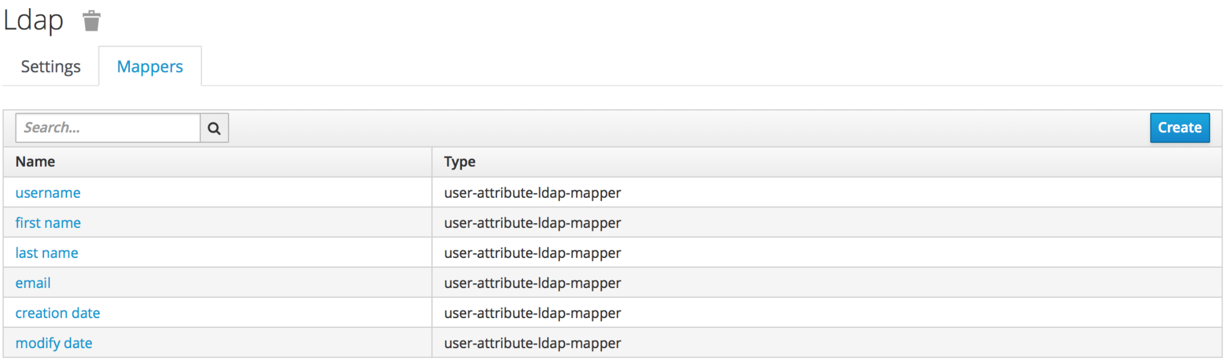
Batch Size: 1000

Periodic Full Sync: OFF

Periodic Changed Users Sync: OFF

Configuring mappers

After you complete the initial setup, the auth system generates a set of "mappers" for your configuration. Each mapper takes a value from LDAP and maps it to a value in the internal auth database.



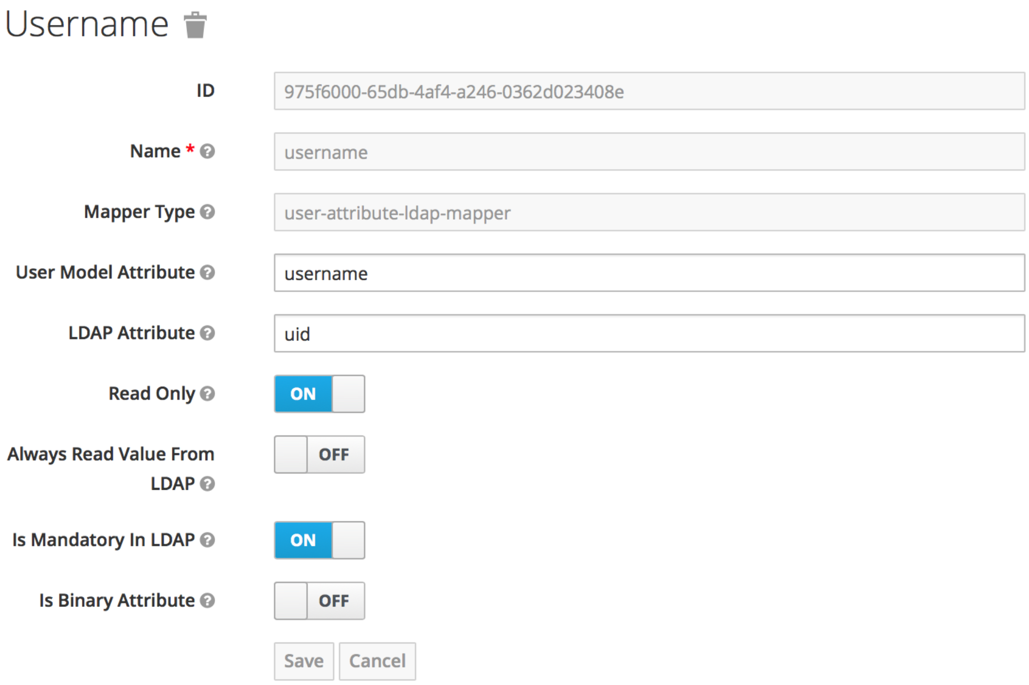
Ldap

Name	Type
username	user-attribute-ldap-mapper
first name	user-attribute-ldap-mapper
last name	user-attribute-ldap-mapper
email	user-attribute-ldap-mapper
creation date	user-attribute-ldap-mapper
modify date	user-attribute-ldap-mapper

Go through each mapper and make sure it is set up appropriately.

- Check that each mapper reads the correct "LDAP attribute" and maps it to the right "User Model Attribute".
- Check that the attribute's "read-only" setting is correct.
- Check whether the attribute should always be read from the LDAP store and not from the internal database.

For example, the `username` mapper sets the Workbench username from the LDAP attribute configured.



Username

ID	975f6000-65db-4af4-a246-0362d023408e
Name *	username
Mapper Type	user-attribute-ldap-mapper
User Model Attribute	username
LDAP Attribute	uid
Read Only	ON
Always Read Value From LDAP	OFF
Is Mandatory In LDAP	ON
Is Binary Attribute	OFF

Configuring advanced mappers

Instead of manually configuring each user, you can automatically import user data from LDAP using additional mappers. The following mappers are available:

User Attribute Mapper (`user-attribute-ldap-mapper`)
Maps LDAP attributes to attributes on the Workbench user. These are the default mappers set up in the initial configuration.

FullName Mapper (`full-name-ldap-mapper`)
Maps the full name of the user from LDAP into the internal database.

Role Mapper (`role-ldap-mapper`)
Sets role mappings from LDAP into realm role mappings. One role mapper can be used to map LDAP roles (usually groups from a particular branch of an LDAP tree) into realm roles with corresponding names.

Multiple role mappers can be configured for the same provider. It's possible to map roles to a particular client (such as the `anaconda-deploy` service), but it's usually best to map in realm-wide roles.

Hardcoded Role Mapper (`hardcoded-ldap-role-mapper`)
Grants a specified role to each user linked with LDAP.

Hardcoded Attribute Mapper (`hardcoded-ldap-attribute-mapper`)
Sets a specified attribute to each user linked with LDAP.

Group Mapper (`group-ldap-mapper`)
Sets group mappings from LDAP. Can map LDAP groups from a branch of an LDAP tree into groups in the Anaconda Platform realm. It will also propagate user-group membership from LDAP. We generally recommend using roles and not groups, so the role mapper may be more useful.

Warning: The group mapper provides a setting `Drop non-existing groups during sync`. If this setting is turned on, existing groups in Workbench Authentication Center will be erased.

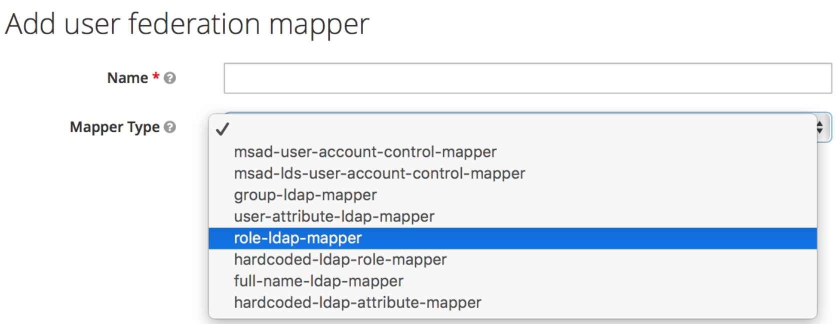
MSAD User Account Mapper (`msad-user-account-control-mapper`)
Microsoft Active Directory (MSAD) specific mapper. Can tightly integrate the MSAD user account state into the platform account state, including whether the account is enabled, whether the password is expired, and so on. Uses the `userAccountControl` and `pwdLastSet` LDAP attributes.

For example if `pwdLastSet` is `0`, the user is required to update their password and there will be an `UPDATE_PASSWORD` required action added to the user. If `userAccountControl` is `514` (disabled account), the platform user is also disabled.

Mapper configuration example

To map LDAP group membership to Anaconda Platform roles, use a role mapper.

Add a mapper of the `role-ldap-mapper` type:



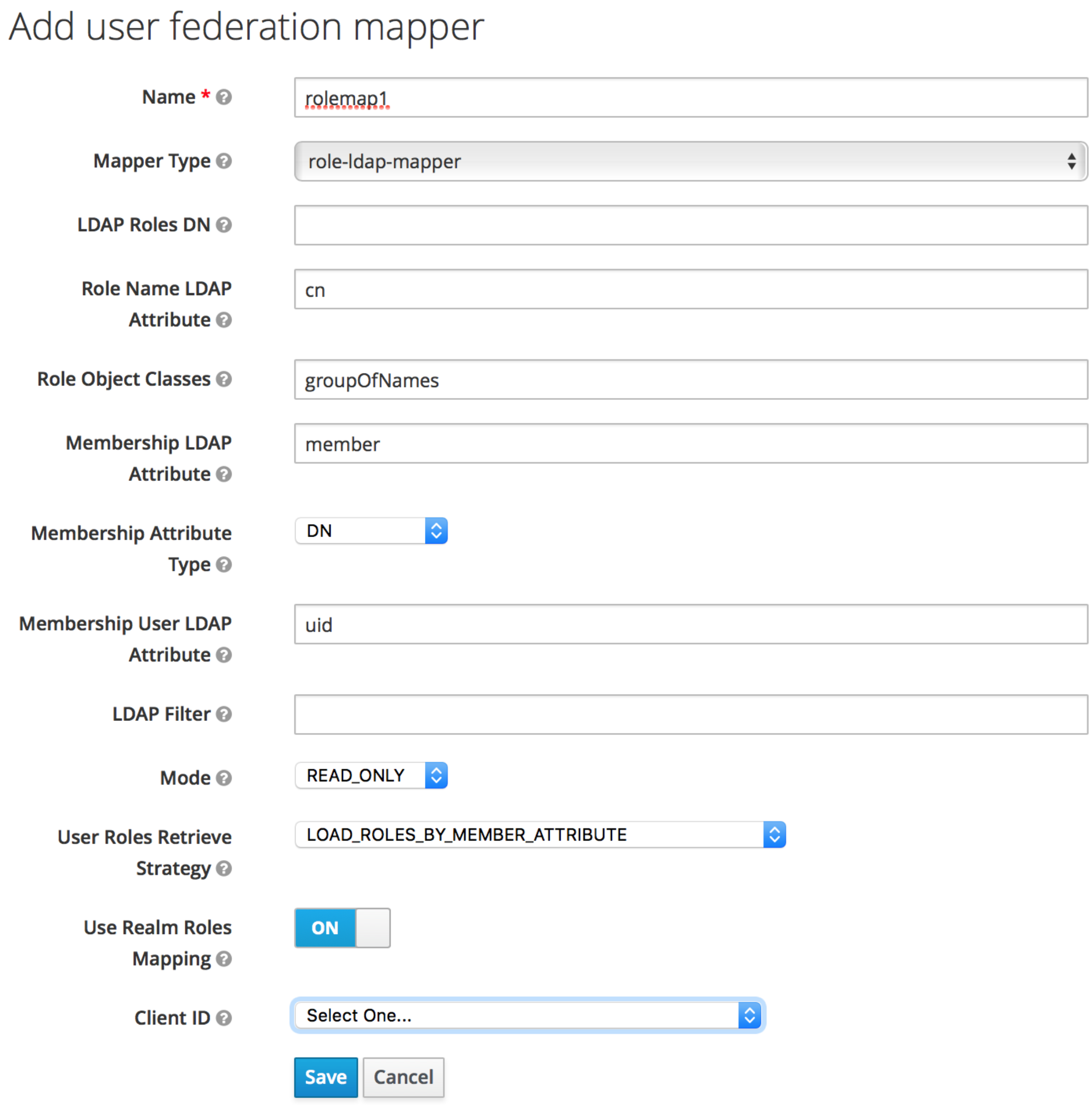
Add user federation mapper

Name *

Mapper Type

✓
msad-user-account-control-mapper
msad-lds-user-account-control-mapper
group-ldap-mapper
user-attribute-ldap-mapper
role-ldap-mapper
hardcoded-ldap-role-mapper
full-name-ldap-mapper
hardcoded-ldap-attribute-mapper

In consultation with your LDAP administrator and internal LDAP documentation, define which LDAP group tree will be mapped into roles in the Anaconda Platform realm. The roles are mapped directly by name, so an LDAP membership of `ae-deployer` will map to the role of the same name in Anaconda Platform.



Add user federation mapper

Name *: rolemap1

Mapper Type: role-ldap-mapper

LDAP Roles DN:

Role Name LDAP Attribute: cn

Role Object Classes: groupOfNames

Membership LDAP Attribute: member

Membership Attribute Type: DN

Membership User LDAP Attribute: uid

LDAP Filter:

Mode: READ_ONLY

User Roles Retrieve Strategy: LOAD_ROLES_BY_MEMBER_ATTRIBUTE

Use Realm Roles Mapping: ON

Client ID: Select One...

Authorizing LDAP groups and roles

To authorize LDAP group members or roles synced from LDAP to perform various functions, add them to the `anaconda-enterprise-anaconda-platform.yml` configmap.

EXAMPLE: To give users in the LDAP group "Workbench", and users with the LDAP-synced role "Publisher", permission to deploy apps, the deploy section would look like this:

```
deploy:
  port: 8081
  prefix: '/deploy'
  url: https://abc.demo.anaconda.com/deploy
  https:
    key: /etc/secrets/certs/privkey.pem
    certificate: /etc/secrets/certs/cert.pem
  hosts:
    - abc.demo.anaconda.com
  db:
    database: anaconda_deploy
  users: '*'
  deployers:
    users: []
    groups:
      - developers
      - Workbench
    roles:
      - Publisher
```

After editing the configmap, restart all pods for your changes to take effect:

```
kubectl get pods | grep ap- | cut -d' ' -f1 | xargs kubectl delete pods
```

Configuring LDAPS (Outbound SSL)

To make correct requests to secure internal resources such as internal enterprise LDAP servers using corporate SSL certificates, you must configure a "trust store". *This is optional*. If your internal servers instead use certificates issued by a public root CA, then the default trust store is sufficient.

To create a trust store, you must have the public certificates you wish to trust available.

Note: These are certificates for your **trusted server** such as Secure LDAP, *not* for Workbench.

Option 1

If the CA certificates are directly available to you, run the following command, replacing `CAFILE.cert` with your CA certificate file:

```
keytool -import -file CAFILE.cert -alias auth -keystore LDAPS.jks
```

Note: If you want to add an intermediate certificate, run this command again **with a unique alias**, to include it in the `LDAPS.jks` file.

Option 2

Alternatively, if you also have the server certificate and key, you can construct a full trust chain in the store.

1. Convert the certificate and key files to PKCS12 format—if they are not already—by running the following command:

   ```
   openssl pkcs12 -export -chain -in CERT.pem -inkey CERT-KEY.pem -out PKCS-CHAIN.p12 -
   ↪name auth -CAfile CA-CHAIN.pem
   ```

   In this example, replace `CERT.pem` with the server's certificate, `CERT-KEY.pem` with the server's key, `PKCS-CHAIN.p12` with a temporary file name, and `CA-CHAIN.pem` with the trust chain file (up to the root certificate of your internal CA).

2. Create a Java keystore to store the trusted certs:

   ```
   keytool -importkeystore -destkeystore LDAPS.jks -srckeystore PKCS-CHAIN.p12 -alias␣
   ↪auth
   ```

3. You will be prompted to set a password. Record the password.

Final steps

For both options, you'll need to follow the steps below to expose the certificates to the Workbench Auth service:

1. Export the existing SSL certificates for your system by running the following commands:

   ```
   sudo gravity enter
   kubectl get secrets anaconda-enterprise-certs --export -o yaml > /opt/anaconda/
   ↪secrets-exported.yml
   ```

2. Exit the gravity environment, and back up the secrets file before you edit it:

   ```
   cp secrets-exported.yml secrets-exported-orig.yml
   ```

3. Run the following command to encode the newly created truststore as `base64`:

   ```
   base64 -i --wrap=0 LDAPS.jks >> OUTPUT.jks
   ```

4. Copy the output of this command, and paste it into the `data` section of the `secrets-exported.yml` file.

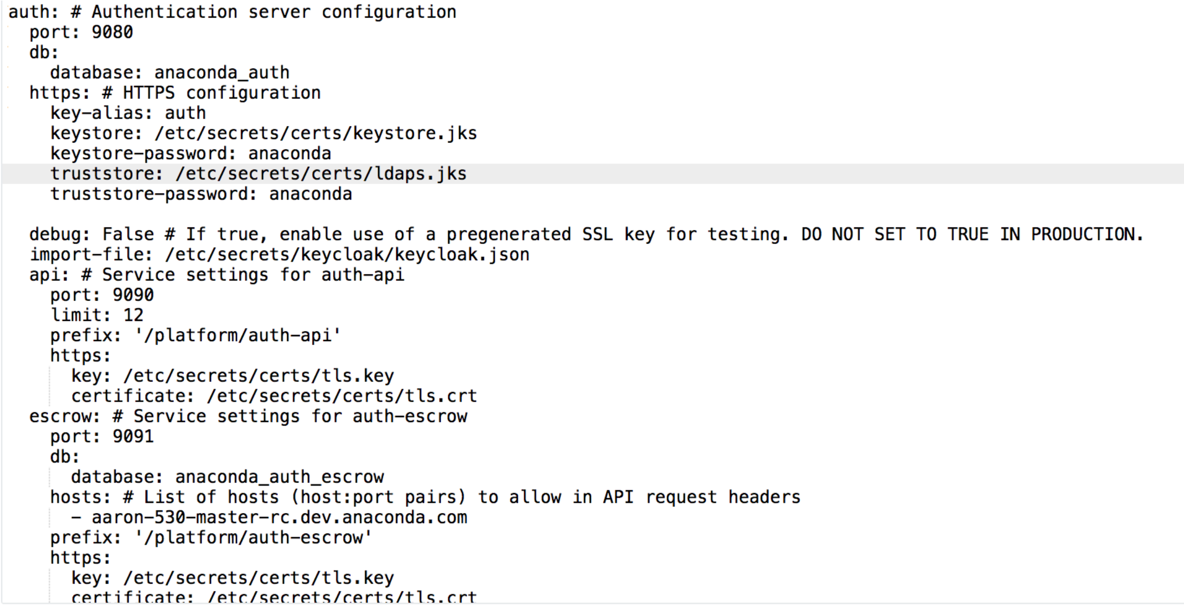
5. Run the following commands to update Workbench with the secrets certificate:

```
sudo gravity enter
kubectl replace -f /opt/anaconda/secrets-exported.yml
```

6. Verify that the `LDAPS.jks` entry has been added to the secret:

```
kubectl describe secret anaconda-enterprise-certs
```

7. *Edit the platform configuration* by setting the `auth.https.truststore` configuration key to `/etc/secrets/certs/ldaps.jks`, and `auth.https.truststore-password` to the matching password. For example, after editing, it should resemble the following:



```
auth: # Authentication server configuration
  port: 9080
  db:
    database: anaconda_auth
  https: # HTTPS configuration
    key-alias: auth
    keystore: /etc/secrets/certs/keystore.jks
    keystore-password: anaconda
    truststore: /etc/secrets/certs/ldaps.jks
    truststore-password: anaconda

  debug: False # If true, enable use of a pregenerated SSL key for testing. DO NOT SET TO TRUE IN PRODUCTION.
  import-file: /etc/secrets/keycloak/keycloak.json
  api: # Service settings for auth-api
    port: 9090
    limit: 12
    prefix: '/platform/auth-api'
    https:
      key: /etc/secrets/certs/tls.key
      certificate: /etc/secrets/certs/tls.crt
  escrow: # Service settings for auth-escrow
    port: 9091
    db:
      database: anaconda_auth_escrow
    hosts: # List of hosts (host:port pairs) to allow in API request headers
      - aaron-530-master-rc.dev.anaconda.com
    prefix: '/platform/auth-escrow'
    https:
      key: /etc/secrets/certs/tls.key
      certificate: /etc/secrets/certs/tls.crt
```

8. Run the following commands to restart the `auth` service:

```
sudo gravity enter
kubectl get pods | grep ap-auth | cut -d' ' -f1 | xargs kubectl delete pods
```

Caution: If you are using Workbench version 5.6.0, you must also complete the following steps to finish your LDAPS configuration. If you do not, your LDAPS configuration will not connect successfully.

9. Create a backup of your current auth configuration:

```
kubectl get deployment anaconda-enterprise-ap-auth -o yaml > auth.yaml
```

10. Edit the auth pod deployment:

```
kubectl edit deployment anaconda-enterprise-ap-auth
```

11. Add the below to the `JAVA_OPTS` key/value:

```
-Djavax.net.ssl.trustStore=/etc/secrets/certs/ldaps.jks
-Djavax.net.ssl.trustStorePassword=anaconda
```

12. Save your changes

3.2.2 Managing users

Managing access to Data Science & AI Workbench involves adding and removing users, setting passwords, *mapping users to roles, and optionally assigning them to groups*. To help expedite the process of authorizing large groups of users at once, you can *connect to an external identity provider* using LDAP, Active Directory, SAML, or Kerberos to federate those users.

Note: To be able to perform these actions, you'll need the appropriate login credentials required to access the Administrative Console's Authentication Center.

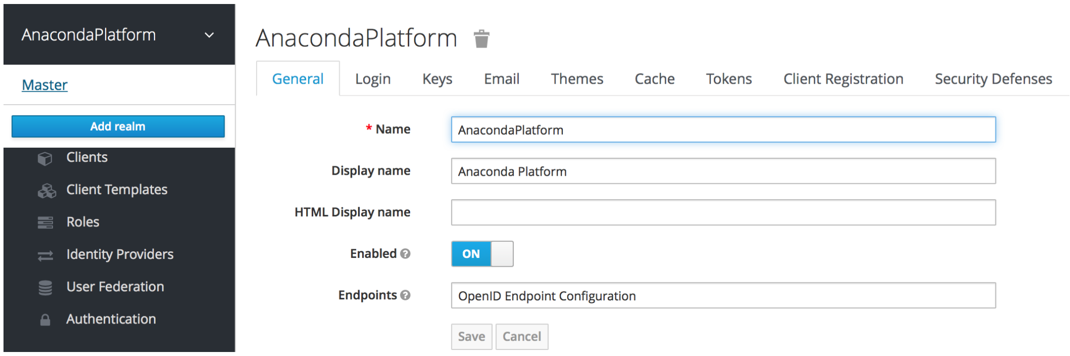
The process of authorizing Operations Center Admins is slightly different. See *Managing System Administrators* for more information.

Creating and configuring users

To access the Authentication Center:

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Manage Users** to access the Keycloak user interface (UI).
3. Log in using your Keycloak admin account credentials.

   Note: To create and manage other Authentication Center Admins, use the realm selector in the upper-left corner to switch to the **Master** realm before proceeding.



* Name: AnacondaPlatform

Display name: Anaconda Platform

HTML Display name:

Enabled: ON

Endpoints: OpenID Endpoint Configuration

4. Select **Users** from the left-hand navigation.
5. On the **Lookup** tab, click **View all users** to list every user in the system, or search the user database for all users that match the criteria you enter, based on their first name, last name, or email address.

   Note: This will search the local user database and not the federated database (such as LDAP) because not all external identity provider systems include a way to page through users. If you want users from a federated database to be synced into the local database, select **User Federation** in the Configure menu on the left, and adjust the **Sync Settings** for your user federation provider.

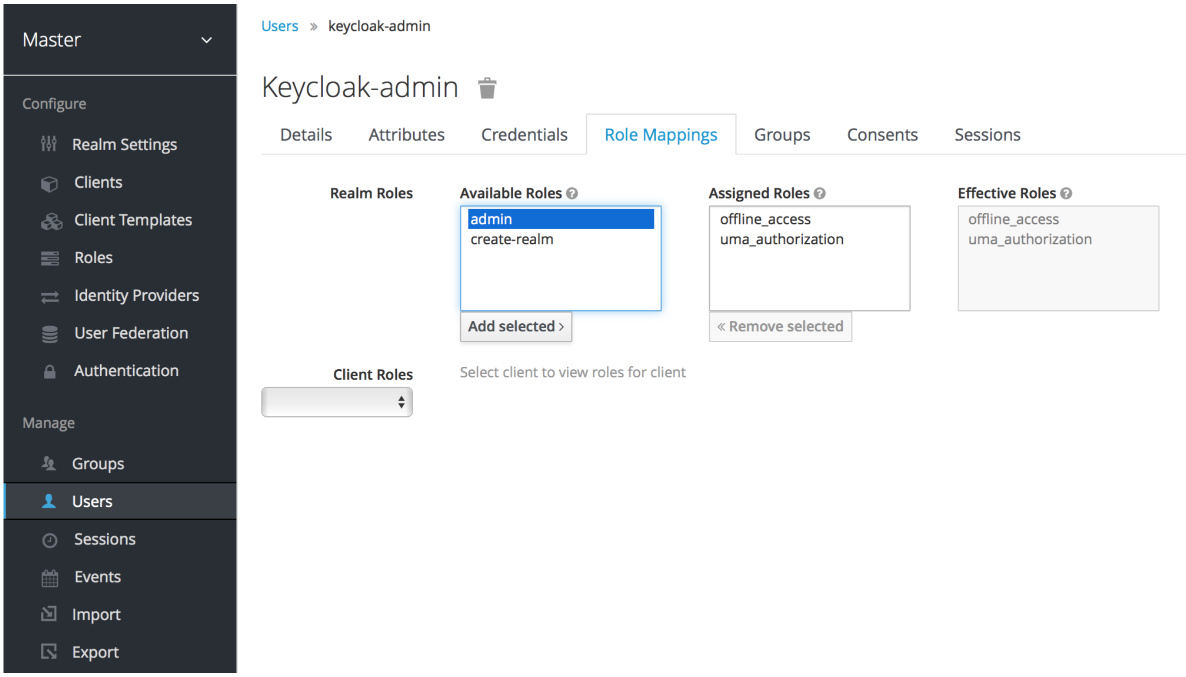
6. **To create a new Workbench user**, click **Add user** and specify a user name—and optionally provide values for the other fields—before clicking **Save**.

Note: Usernames containing unicode characters—special characters, punctuation, symbols, spaces—are not permitted.

7. **To configure a user**, click the user's ID in the list and use the available tabs as follows:

   - Use the **Details** tab to specify information for the user, optionally enable *user registration* and *required actions* and *impersonate the user*. If you include an email address, an invitation to join Workbench will be sent to the email address specified.
   - Use the **Credentials** tab to manage the user's password. If the **Temporary** switch is on, this new password can only be used once—the user will be asked to change their password after they use it to log in to Workbench.
   - Use the **Role Mappings** tab to assign the user one or more roles, and the **Groups** tab to add them to one or more groups. See *managing roles and groups* for more information.

Note: To grant **Authentication Center Administrators** sufficient authority to manage Workbench users, you'll need to assign them the `admin` role.



Realm Roles

Available Roles: admin, create-realm

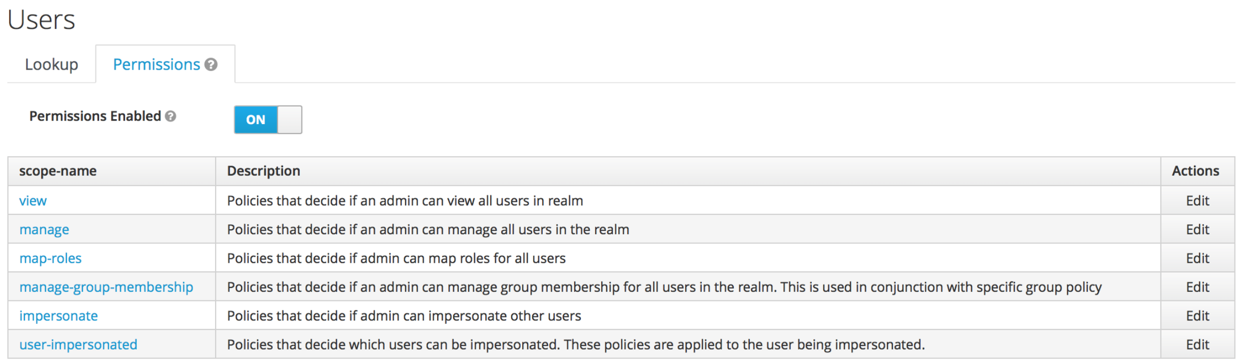
Assigned Roles: offline_access, uma_authorization

Effective Roles: offline_access, uma_authorization

Client Roles

   - Use the **Sessions** tab to view a summary of all sessions the user has started, and log them out of all sessions in a single click. This is handy if a user goes on vacation without logging out of their sessions. You can use the Operations Center to view a summary of all sessions running on specific nodes or by specific users. See *monitoring sessions and deployments* for more information.

To view and edit a set of fine grain permissions that you can enable and use to define policies for allowing other users to manage users in the selected realm, return to the Users list and select the **Permissions** tab:



Users

Permissions Enabled ON

scope-name	Description	Actions
view	Policies that decide if an admin can view all users in realm	Edit
manage	Policies that decide if an admin can manage all users in the realm	Edit
map-roles	Policies that decide if admin can map roles for all users	Edit
manage-group-membership	Policies that decide if an admin can manage group membership for all users in the realm. This is used in conjunction with specific group policy	Edit
impersonate	Policies that decide if admin can impersonate other users	Edit
user-impersonated	Policies that decide which users can be impersonated. These policies are applied to the user being impersonated.	Edit

Add a new master realm admin user/Reset password

Follow these steps from the command line to add a new admin user to the master realm *or* to reset your admin password if you're locked out or have forgotten your password.

1. Exec into the Keycloak container:

```
# Replace <KEYCLOAK_CONTAINER_ID> with your keycloak container ID
docker exec -it <KEYCLOAK_CONTAINER_ID> /bin/bash
```

2. Create a user:

```
# Replace <USERNAME> with your username and <PASSWORD> with your password
/opt/jboss/keycloak/bin/add-user-keycloak.sh -u <USERNAME> -p <PASSWORD> -r master --roles=admin
```

3. Restart the server. Restarting the server will delete the container and any current state:

```
/opt/jboss/keycloak/bin/standalone.sh -Djboss.socket.binding.port-offset=100
```

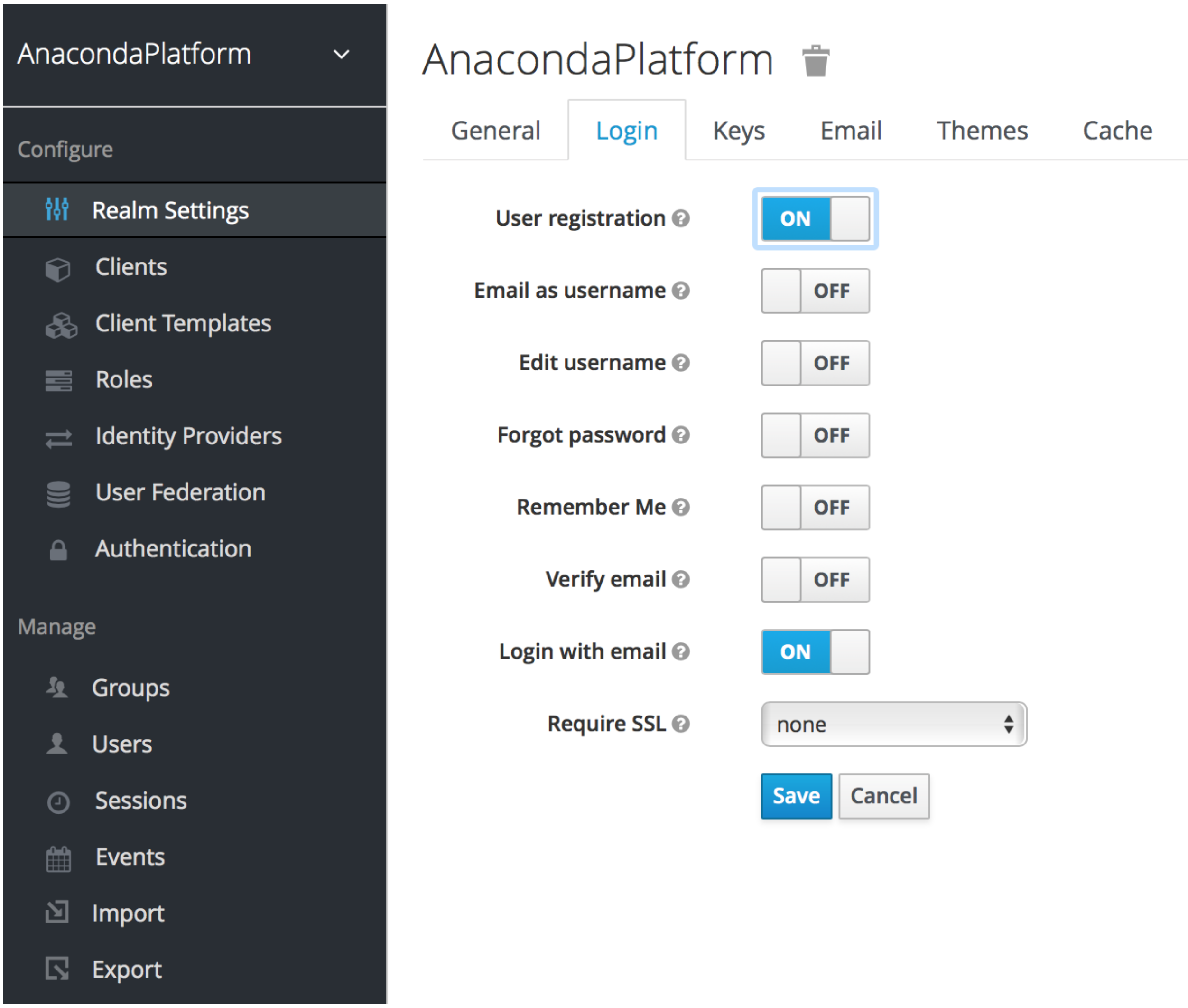
4. Log in to Keycloak from the following URL:

```
# Replace <FQDN> with your fully qualified domain name
<https://<FQDN>/auth/admin/master/console>.
```

Enabling user registration

You can use the Authentication Center to enable users to self register and create their own account. When enabled, the login page will have a **Register** link users can click to open the registration page where they can enter the user profile information and password required to create their new account.

1. Click **Realm Settings** under Configure in the menu on the left menu.
2. Click the **Login** tab, and enable the **User registration** switch.



User registration: ON
Email as username: OFF
Edit username: OFF
Forgot password: OFF
Remember Me: OFF
Verify email: OFF
Login with email: ON
Require SSL: none

You can change the look and feel of the registration form as well as removing or adding additional fields that must be entered. See the Server Developer Guide for more information.

Enabling required actions

You can use the **Required User Actions** drop-down list—on the **Details** tab for each user—to select the tasks that a user must complete (after providing their credentials) before they are allowed to log in to Workbench:

Update Profile
This requires the user to update their profile information, such as their name, address, email, and phone number.

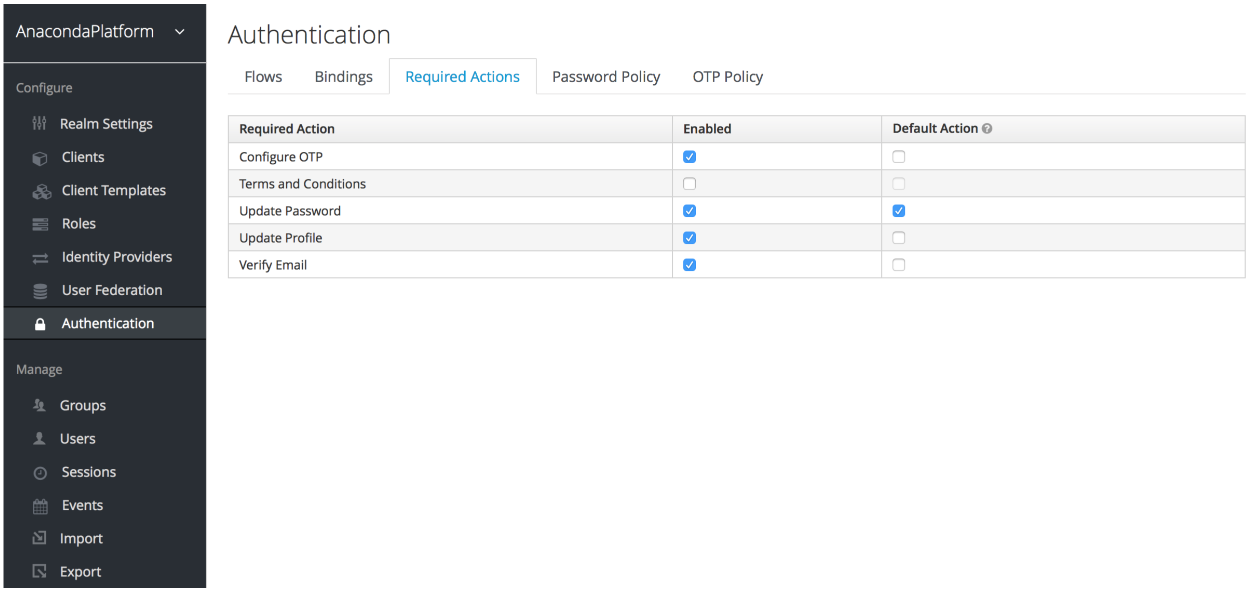
Update Password
When set, a user must change their password.

Configure OTP
When set, a user must configure a one-time password generator on their mobile device using either the Free OTP or Google Authenticator application.

Setting default required actions

You can specify default required actions that will be added to all new user accounts. Select **Authentication** from the Configure menu on the left and use the **Required Actions** tab to specify whether you want each required action to be enabled—available for selection—or also pre-populated as a default for all new users.

Note: A required action must be enabled to be specified as a default.



Required Action	Enabled	Default Action
Configure OTP	☑	□
Terms and Conditions	□	□
Update Password	☑	☑
Update Profile	☑	□
Verify Email	☑	□

Using terms and conditions

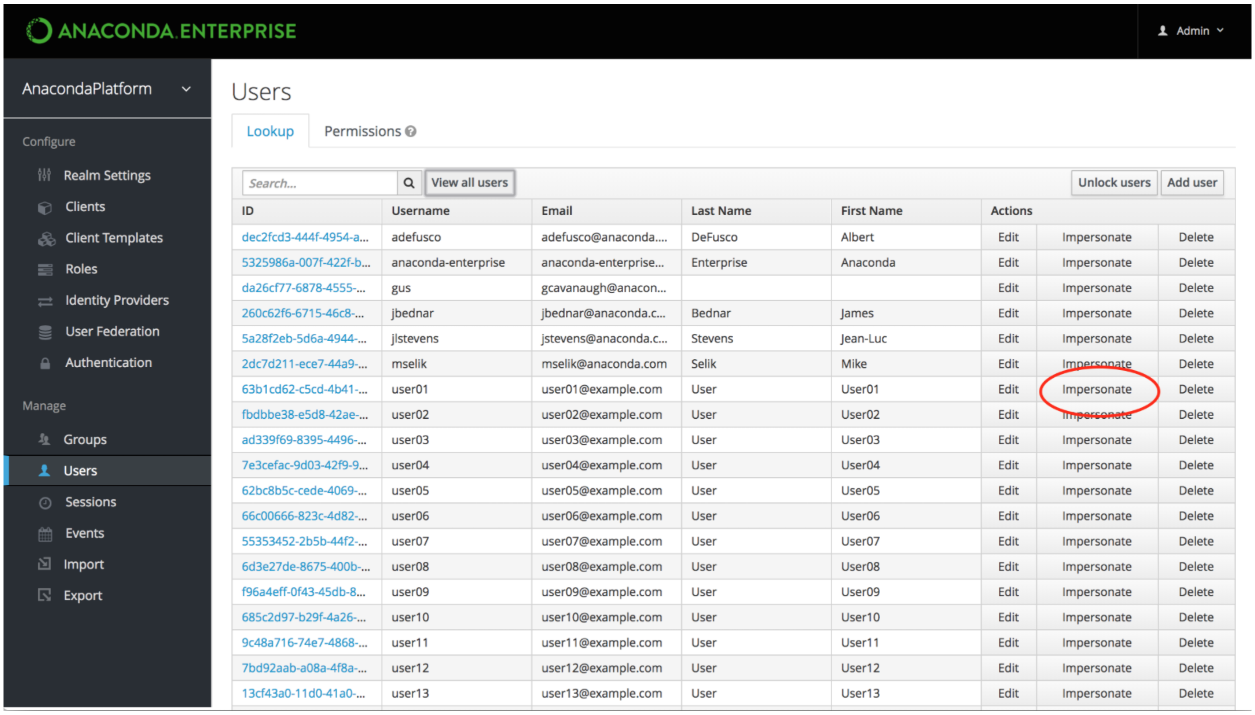
Many organizations have a requirement that when a new user logs in for the first time, they need to agree to the terms and conditions of the website. This functionality can be implemented as a required action, but it requires some configuration. In addition to enabling **Terms and Conditions** as a required action, you must also edit the `terms.ftl` file in the *base* login theme. See the Server Developer Guide for more information on extending and creating themes.

Impersonating users

It is often useful for an Administrator to impersonate a user. For example, a user may be experiencing an issue using an application and an Admin may want to impersonate the user to see if they can duplicate the problem.

Note: Any user with the realm's `impersonation` role can impersonate a user.

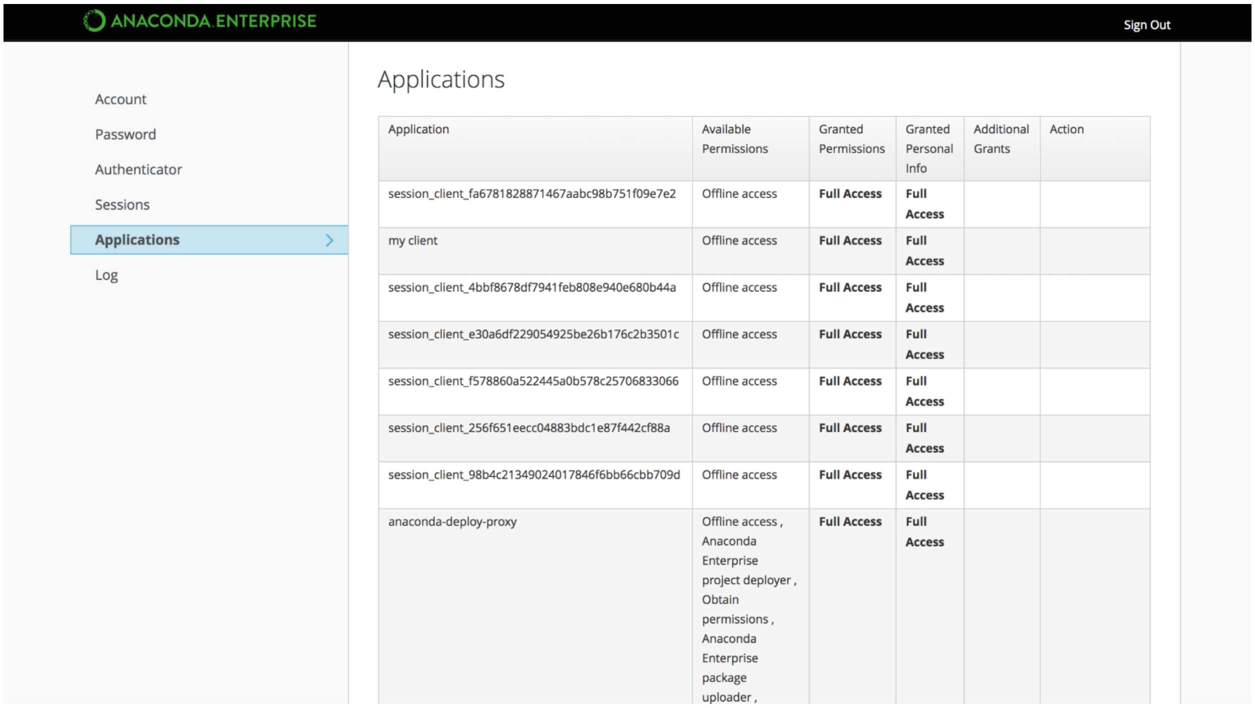
The **Impersonate** command is available from both the Users list and the **Details** tab for a user.



Users

ID	Username	Email	Last Name	First Name	Actions		
dec2fcd3-444f-4954-a...	adefusco	adefusco@anaconda....	DeFusco	Albert	Edit	Impersonate	Delete
5325986a-007f-422f-b...	anaconda-enterprise	anaconda-enterprise...	Enterprise	Anaconda	Edit	Impersonate	Delete
da26cf77-6878-4555-...	gus	gcavanaugh@anacon...			Edit	Impersonate	Delete
260c62f6-6715-46c8-...	jbednar	jbednar@anaconda.c...	Bednar	James	Edit	Impersonate	Delete
5a28f2eb-5d6a-4944-...	jlstevens	jstevens@anaconda.c...	Stevens	Jean-Luc	Edit	Impersonate	Delete
2dc7d211-ece7-44a9-...	mselik	mselik@anaconda.com	Selik	Mike	Edit	Impersonate	Delete
63b1cd62-c5cd-4b41-...	user01	user01@example.com	User	User01	Edit	Impersonate	Delete
fbdbbe38-e5d8-42ae-...	user02	user02@example.com	User	User02	Edit	Impersonate	Delete
ad339f69-8395-4496-...	user03	user03@example.com	User	User03	Edit	Impersonate	Delete
7e3cefac-9d03-42f9-9...	user04	user04@example.com	User	User04	Edit	Impersonate	Delete
62bc8b5c-cede-4069-...	user05	user05@example.com	User	User05	Edit	Impersonate	Delete
66c00666-823c-4d82-...	user06	user06@example.com	User	User06	Edit	Impersonate	Delete
55353452-2b5b-44f2-...	user07	user07@example.com	User	User07	Edit	Impersonate	Delete
6d3e27de-8675-400b-...	user08	user08@example.com	User	User08	Edit	Impersonate	Delete
f96a4eff-0f43-45db-8...	user09	user09@example.com	User	User09	Edit	Impersonate	Delete
685c2d97-b29f-4a26-...	user10	user10@example.com	User	User10	Edit	Impersonate	Delete
9c48a716-74e7-4868-...	user11	user11@example.com	User	User11	Edit	Impersonate	Delete
7bd92aab-a08a-4f8a-...	user12	user12@example.com	User	User12	Edit	Impersonate	Delete
13cf43a0-11d0-41a0-...	user13	user13@example.com	User	User13	Edit	Impersonate	Delete

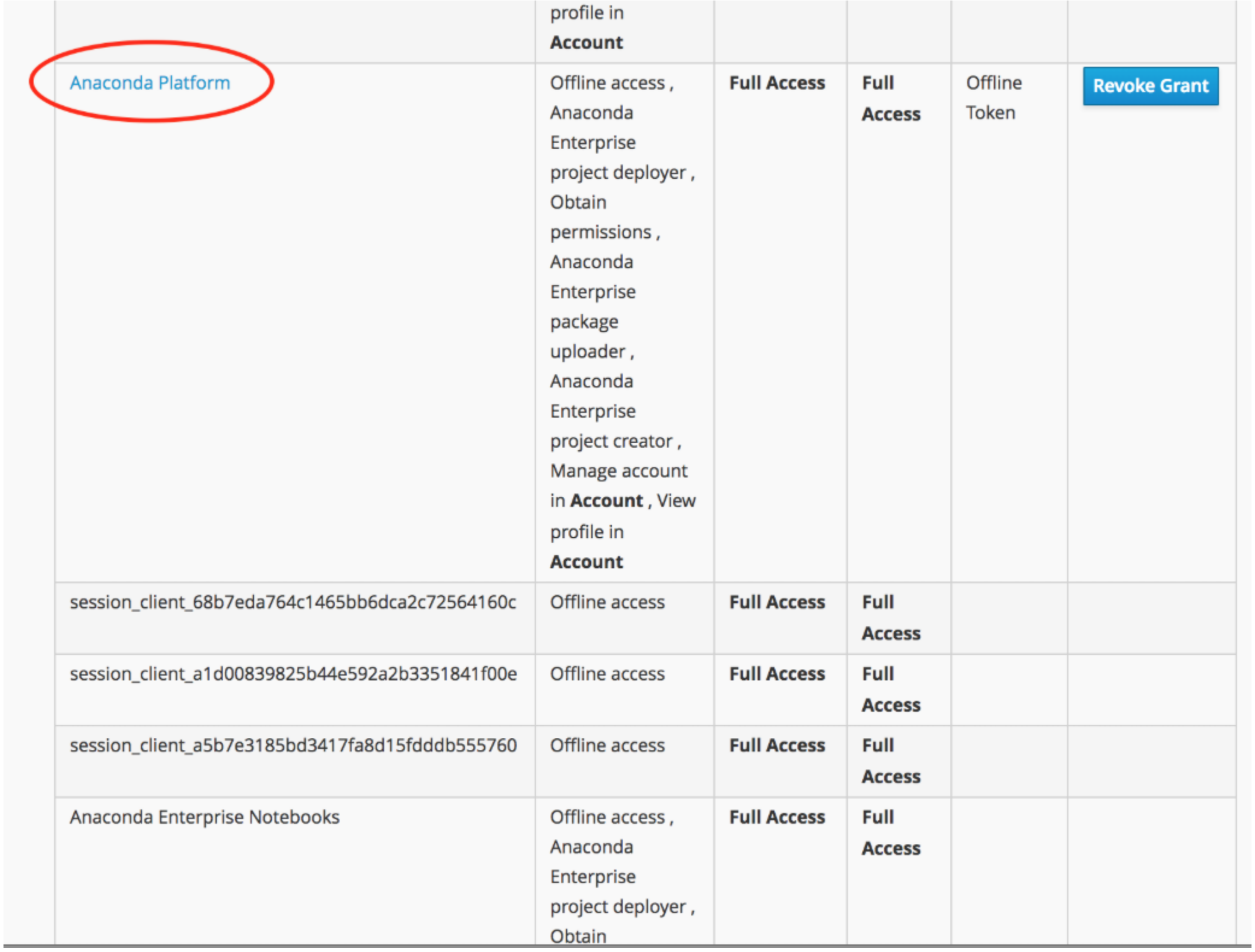
Click **Impersonate** to display a list of applications the user has accessed on the platform, including editor sessions and deployments.



Applications

Application	Available Permissions	Granted Permissions	Granted Personal Info	Additional Grants	Action
session_client_fa6781828871467aabc98b751f09e7e2	Offline access	**Full Access**	**Full Access**		
my client	Offline access	**Full Access**	**Full Access**		
session_client_4bbf8678df7941feb808e940e680b44a	Offline access	**Full Access**	**Full Access**		
session_client_e30a6df229054925be26b176c2b3501c	Offline access	**Full Access**	**Full Access**		
session_client_f578860a522445a0b578c25706833066	Offline access	**Full Access**	**Full Access**		
session_client_256f651eecc04883bdc1e87f442cf88a	Offline access	**Full Access**	**Full Access**		
session_client_98b4c21349024017846f6bb66cbb709d	Offline access	**Full Access**	**Full Access**		
anaconda-deploy-proxy	Offline access , Anaconda Enterprise project deployer , Obtain permissions , Anaconda Enterprise package uploader ,	**Full Access**	**Full Access**		

Click the `Anaconda Platform` link to interact with Workbench as the impersonated user.



		profile in **Account**				
	Anaconda Platform	Offline access , Anaconda Enterprise project deployer , Obtain permissions , Anaconda Enterprise package uploader , Anaconda Enterprise project creator , Manage account in **Account** , View profile in **Account**	**Full Access**	**Full Access**	Offline Token	Revoke Grant
	session_client_68b7eda764c1465bb6dca2c72564160c	Offline access	**Full Access**	**Full Access**		
	session_client_a1d00839825b44e592a2b3351841f00e	Offline access	**Full Access**	**Full Access**		
	session_client_a5b7e3185bd3417fa8d15fdddb555760	Offline access	**Full Access**	**Full Access**		
	Anaconda Enterprise Notebooks	Offline access , Anaconda Enterprise project deployer , Obtain	**Full Access**	**Full Access**		

Note: If the Admin and the user are in the same realm, the Admin will be logged out and automatically logged in as the user being impersonated. If the Admin and user are not in the same realm, the Admin will remain logged in and be logged in as the user in that user's realm.

3.2.3 Roles and groups

Assigning access and permissions for a user is a time consuming process. For an enterprise of hundreds or thousands of users, this would be too time consuming for an IT administrator to realistically perform.

Don't worry! Data Science & AI Workbench lets you utilize roles and groups within Keycloak to take this impossible task and break it down into a manageable workflow. But before you begin creating groups and assigning roles to them, you should understand exactly what each provides you with as an IT administrator.

Roles

Roles determine the level of access a user has within Anaconda. Some custom roles have been embedded into Keycloak to provide users with varying levels of access to the software's available features.

- **ae-admin** - provides the user with full access to the platform and the administrative console
- **ae-creator** - allows the user to create new projects
- **ae-deployer** - allows the user to create new deployments from projects
- **ae-uploader** - allows the user to upload packages

If the default Anaconda roles do not suit your use case, you can *create a custom role* for your users.

Groups

The most important idea to understand about groups is that any permissions that can be granted to an individual by assigning them a role can also be granted to multiple people by assigning the role to a group.

To get you started, Anaconda provides a set of default groups with different roles mapped for each. You can use these defaults as is, or as an example for creating your own groups.

The groups provided by anaconda are structured as follows:

- **admins**
  - **Roles:**
    - ae-admin
- **developers**
  - **Roles:**
    - ae-deployer
    - ae-uploader
    - ae-creator
- **everyone**
  - **Roles:**
    - none
- **managers**
  - **Roles:**
    - none
- **product managers**
  - **Roles:**
    - ae-deployer
    - ae-uploader
    - ae-creator

Managing roles and groups

For Workbench customers, Anaconda has several possible user personas. IT administrators, Business Analysts, Data Scientists, Dev Ops Engineers, and Data Engineers all benefit from using Workbench, but each persona also has different needs based on their work.

You can give every one of your users exactly what they need by using roles and groups!

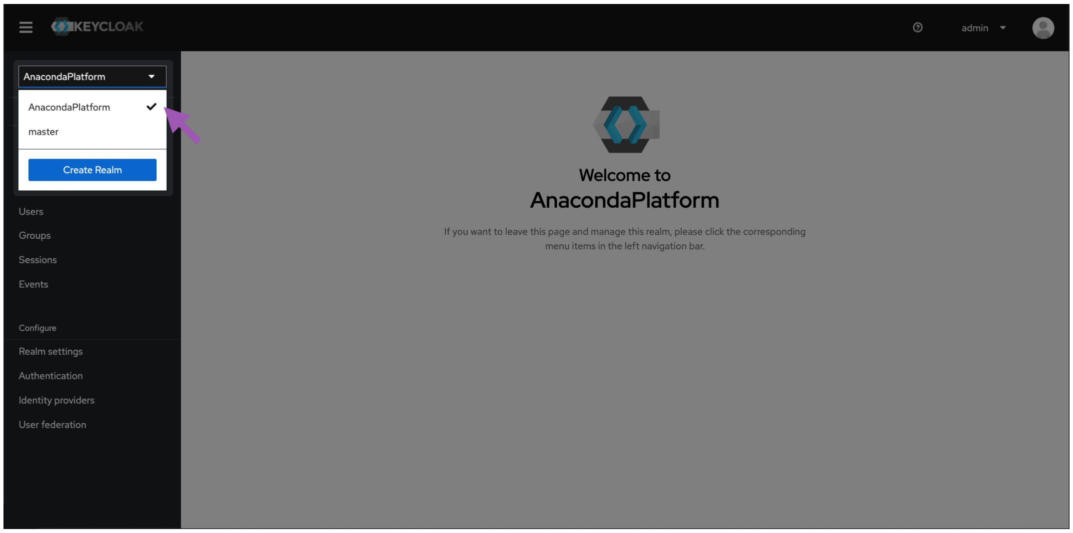
As stated before, Anaconda utilizes Keycloak to manage roles and groups. This includes:

- Viewing available roles and groups
- Creating new roles
- Creating new groups
- Assigning roles to groups
- Configuring the default groups
- Configuring the default roles

To access Keycloak:

1. Log in to Workbench.
2. Open the **My Account** dropdown menu and select *Admin Console*.
3. Select **Manage Users** to access the Keycloak user interface (UI).
4. Log in using your Keycloak admin account credentials.

> **Note:** Verify that you are working on the **AnacondaPlatform** realm when working with roles and groups for Workbench.



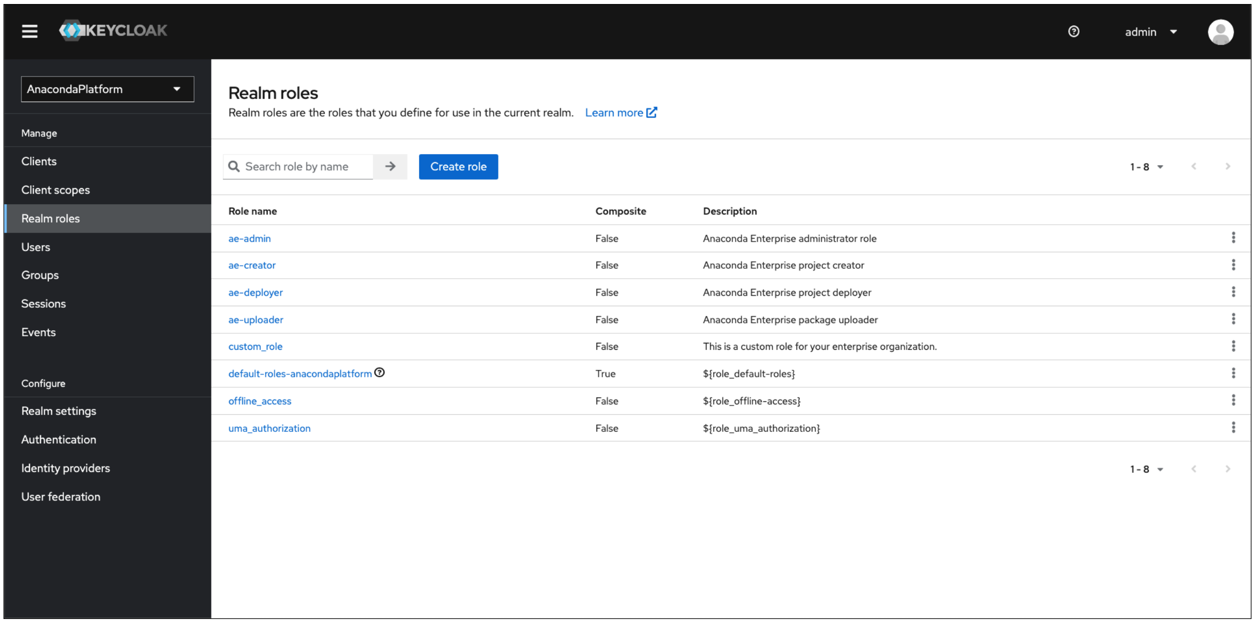
Welcome to
AnacondaPlatform

If you want to leave this page and manage this realm, please click the corresponding menu items in the left navigation bar.

Viewing roles and groups

Roles

Use the left-hand navigation to view **Realm roles** at any time.



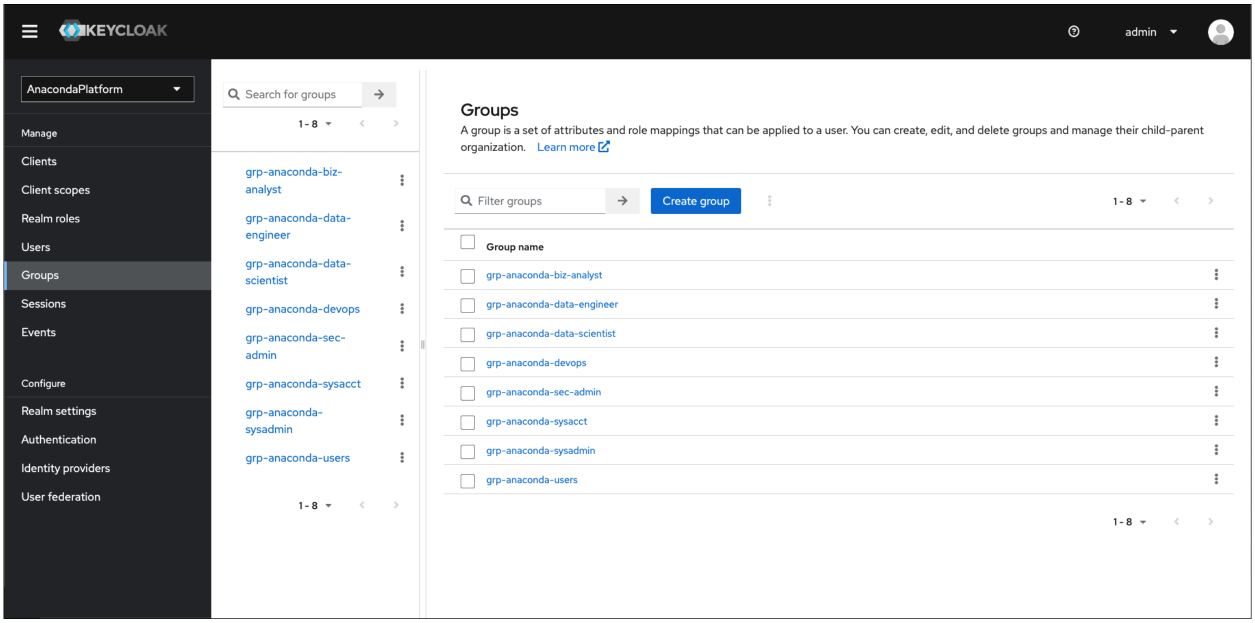
Realm roles

Realm roles are the roles that you define for use in the current realm. Learn more

Role name	Composite	Description
ae-admin	False	Anaconda Enterprise administrator role
ae-creator	False	Anaconda Enterprise project creator
ae-deployer	False	Anaconda Enterprise project deployer
ae-uploader	False	Anaconda Enterprise package uploader
custom_role	False	This is a custom role for your enterprise organization.
default-roles-anacondaplatform	True	${role_default-roles}
offline_access	False	${role_offline-access}
uma_authorization	False	${role_uma_authorization}

Groups

Likewise, use the left-hand navigation to view Groups at any time. If you are importing groups from an external identity server (such as *LDAP* or Active Directory), you will be able to view your imported groups here.



Groups

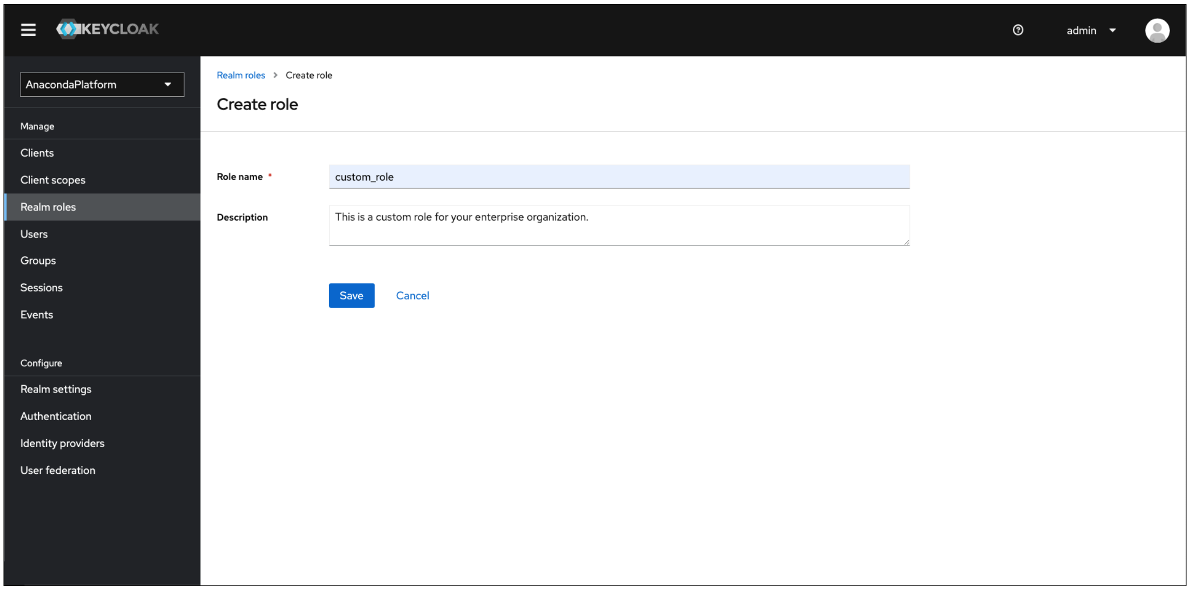
A group is a set of attributes and role mappings that can be applied to a user. You can create, edit, and delete groups and manage their child-parent organization. Learn more

	Group name
□	grp-anaconda-biz-analyst
□	grp-anaconda-data-engineer
□	grp-anaconda-data-scientist
□	grp-anaconda-devops
□	grp-anaconda-sec-admin
□	grp-anaconda-sysacct
□	grp-anaconda-sysadmin
□	grp-anaconda-users

Creating custom roles

To create a custom role for use in Anaconda:

1. From the **Realm roles** page, select **Create role**.
2. Enter a unique name and a brief description for your role.



Role name * custom_role

Description This is a custom role for your enterprise organization.

3. Click **Save**. A notification will appear to inform you that your role has been created successfully.

Assigning permissions for custom roles

Custom roles do not grant permissions upon creation. You must define the permissions for your custom role in your `anaconda-enterprise-anaconda-platform.yml` config map file.

Assign permissions to your custom role by completing the following steps:

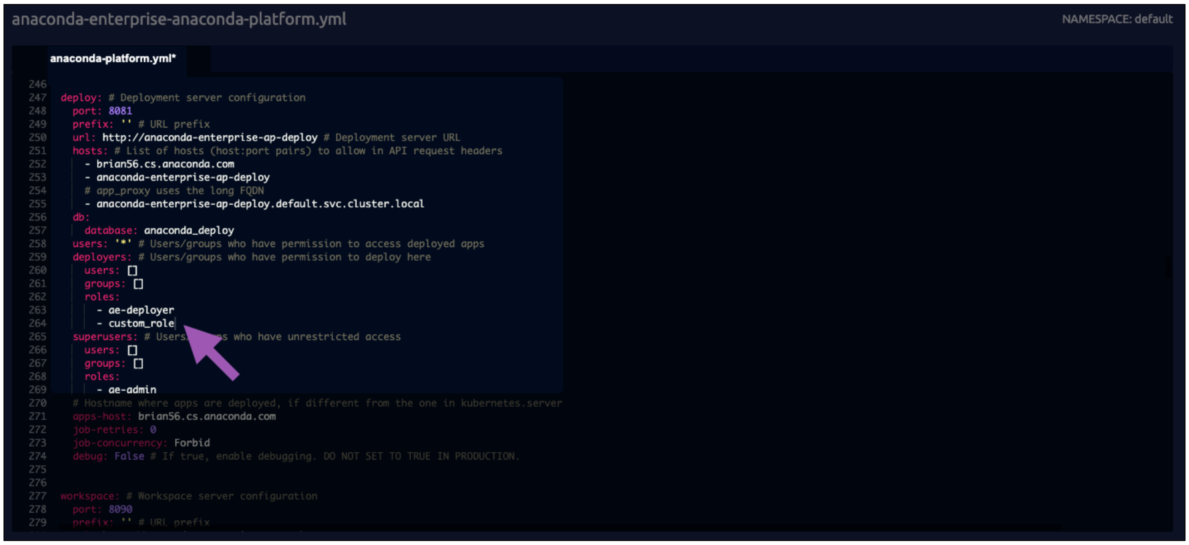
1. Navigate to your Kubernetes cluster admin UI, or access your cluster using `kubectl` commands at the CLI.
2. Find your `anaconda-enterprise-anaconda-platform.yml` config map file.
3. Create and save a copy of this file before you begin assigning permissions for your custom role.

> **Caution:** The changes you're about to make will impact how Workbench functions. The backup you've just created is a failsafe, in case you need to restore the previous configurations.

4. Open your `anaconda-enterprise-anaconda-platform.yml` config map file.
5. Locate the following sections of the file and add your role as needed to assign the correct level of permissions:
   - `admin: users:` - Add your role here to provide it with full access to the platform and the administrative console.
   - `deploy: deployers:` - Add your role here to allow it to create deployments from projects.
   - `workspace: users:` - Add your role here to allow it to open project sessions.
   - `storage: creators:` - Add your role here to allow it to create projects.

- `repository: uploaders:` - Add your role here to allow it to upload packages to the Workbench repository.

Note: Roles listed in the `admin: users:` section of the `anaconda-enterprise-anaconda-platform.yml` file must also be listed in each instance of `superusers:` and in `ui: admin-links: admin: acl:` to grant administrator level permissions.



anaconda-enterprise-anaconda-platform.yml

NAMESPACE: default

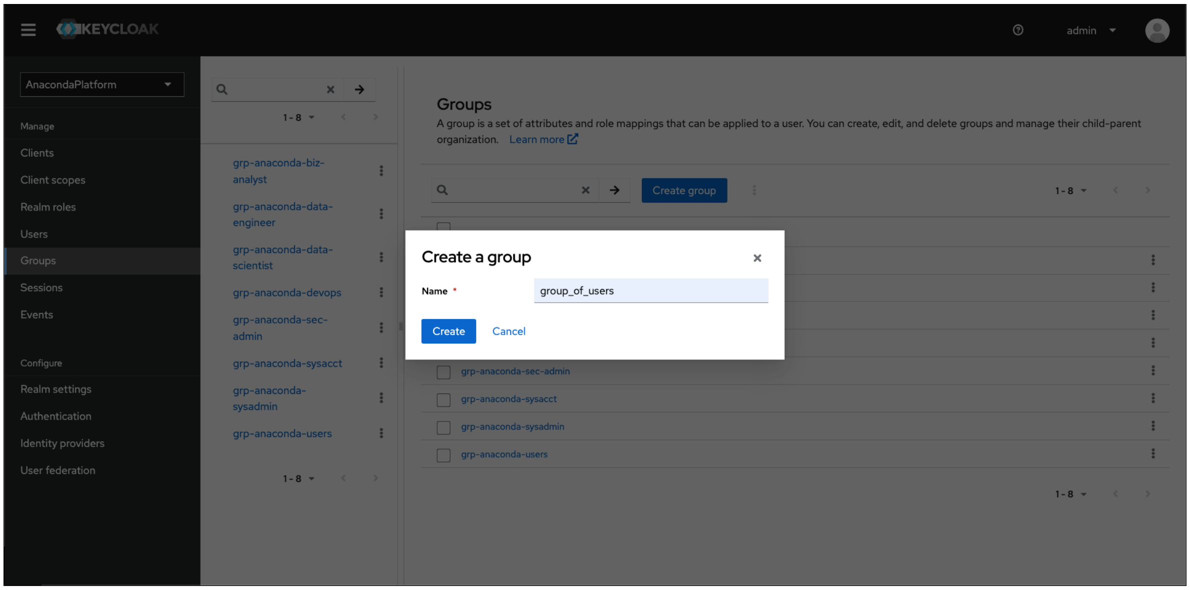
anaconda-platform.yml*

```yaml

deploy: # Deployment server configuration
  port: 8081
  prefix: '' # URL prefix
  url: http://anaconda-enterprise-ap-deploy # Deployment server URL
  hosts: # List of hosts (host:port pairs) to allow in API request headers
    - brian56.cs.anaconda.com
    - anaconda-enterprise-ap-deploy
    # app_proxy uses the long FQDN
    - anaconda-enterprise-ap-deploy.default.svc.cluster.local
  db:
    database: anaconda_deploy
  users: '*' # Users/groups who have permission to access deployed apps
  deployers: # Users/groups who have permission to deploy here
    users: []
    groups: []
    roles:
      - ae-deployer
      - custom_role
  superusers: # Users/groups who have unrestricted access
    users: []
    groups: []
    roles:
      - ae-admin
  # Hostname where apps are deployed, if different from the one in kubernetes.server
  apps-host: brian56.cs.anaconda.com
  job-retries: 0
  job-concurrency: Forbid
  debug: False # If true, enable debugging. DO NOT SET TO TRUE IN PRODUCTION.


workspace: # Workspace server configuration
  port: 8090
  prefix: '' # URL prefix
```

Creating groups

You can create as many groups as your organization needs. To create a new group, complete the following steps:

1. From the **Groups** page, select **Create group**.
2. Enter a unique name for your group.
3. Click **Create**.



A group is a set of attributes and role mappings that can be applied to a user. You can create, edit, and delete groups and manage their child-parent organization. Learn more

Create a group

Name * group_of_users

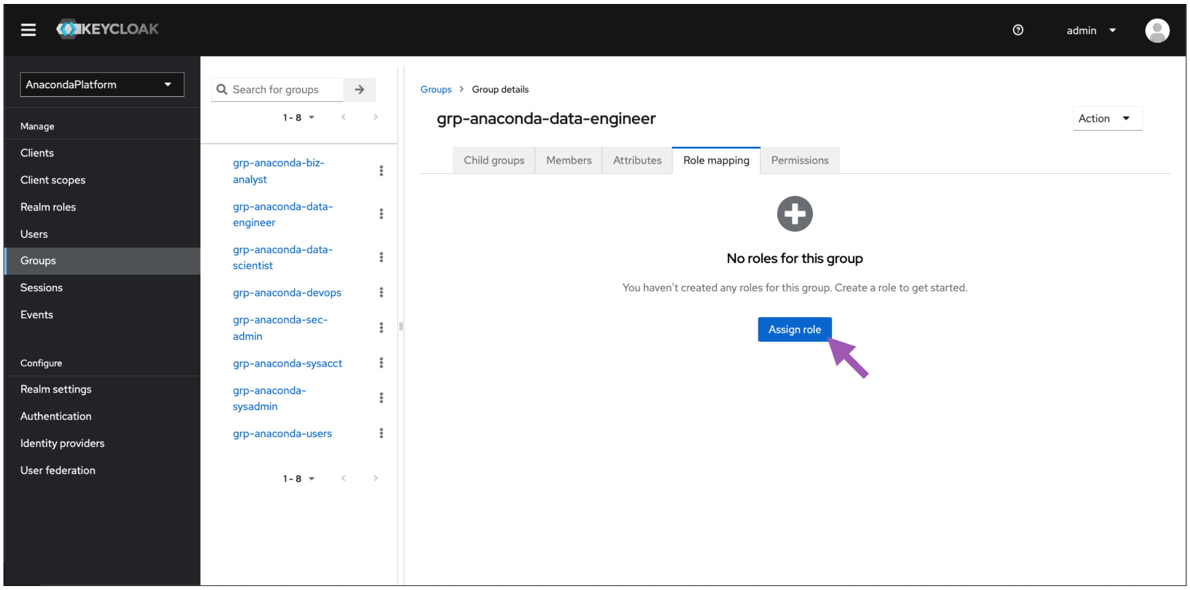
Create Cancel

Note: Creating a group here will not add it to an externally connected server (such as LDAP).

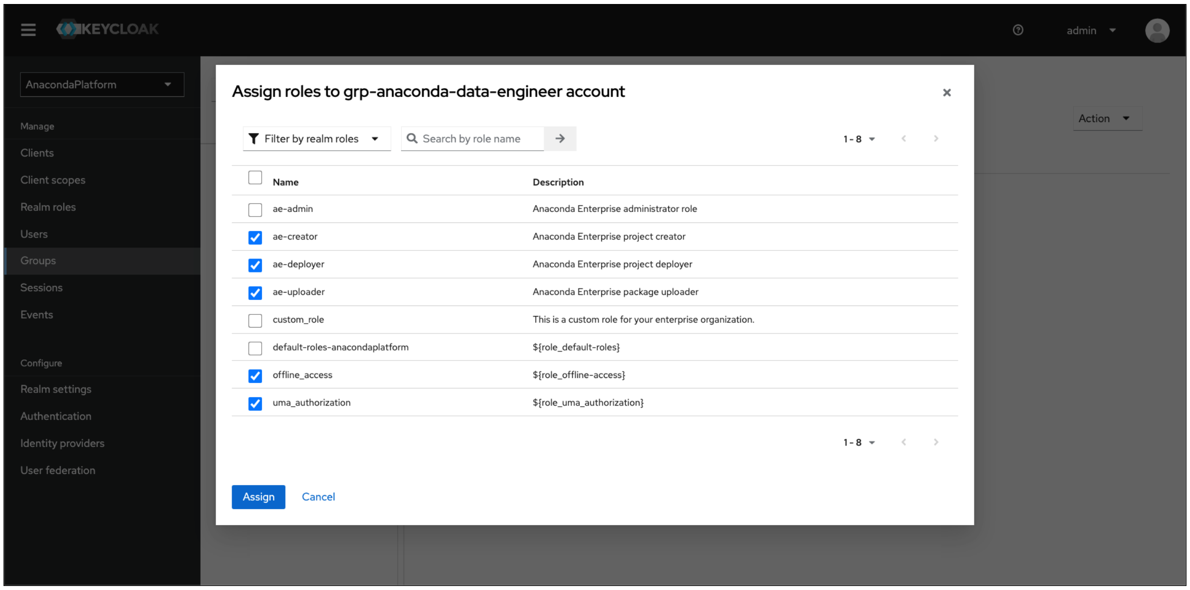
Assigning roles to groups

Assigning a role to a group provides all group members with the permissions granted by the role. To assign a role to a group, complete the following steps:

1. Navigate to the groups page and select a group to assign roles.
2. Select the **Role mapping** tab.
3. Click **Assign role**.

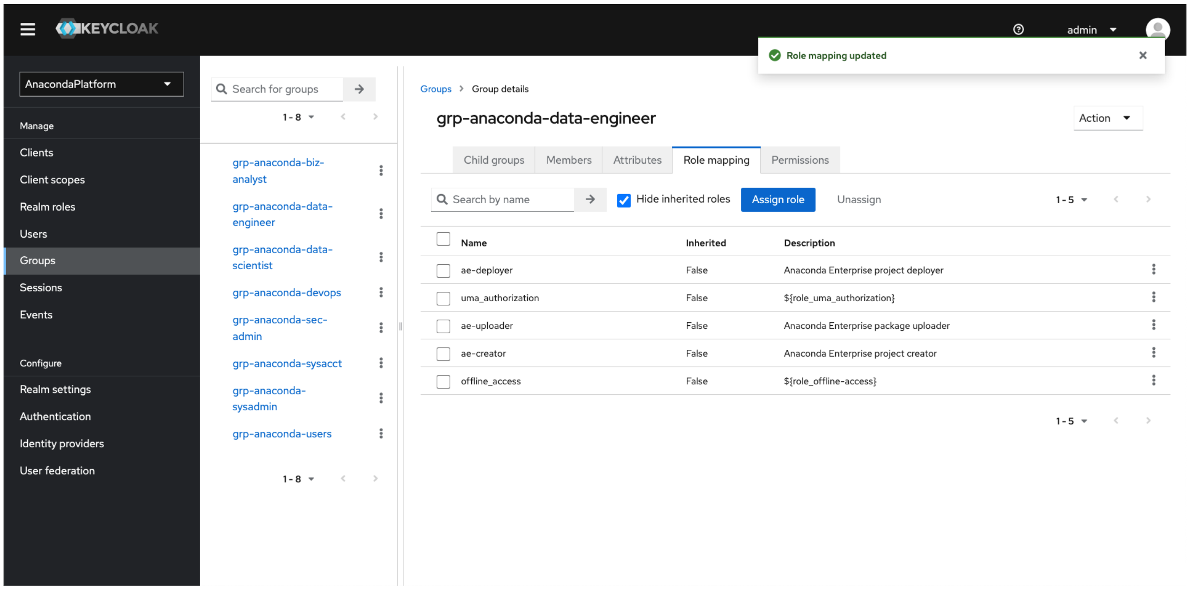


4. Select roles you want to assign to the group, then click **Assign**.



☐	Name	Description
☐	ae-admin	Anaconda Enterprise administrator role
☑	ae-creator	Anaconda Enterprise project creator
☑	ae-deployer	Anaconda Enterprise project deployer
☑	ae-uploader	Anaconda Enterprise package uploader
☐	custom_role	This is a custom role for your enterprise organization.
☐	default-roles-anacondaplatform	${role_default-roles}
☑	offline_access	${role_offline-access}
☑	uma_authorization	${role_uma_authorization}

5. Your newly assigned roles will appear in the **Role mapping** tab.



Role mapping updated

grp-anaconda-data-engineer

☑ Hide inherited roles

	Name	Inherited	Description
□	ae-deployer	False	Anaconda Enterprise project deployer
□	uma_authorization	False	${role_uma_authorization}
□	ae-uploader	False	Anaconda Enterprise package uploader
□	ae-creator	False	Anaconda Enterprise project creator
□	offline_access	False	${role_offline-access}

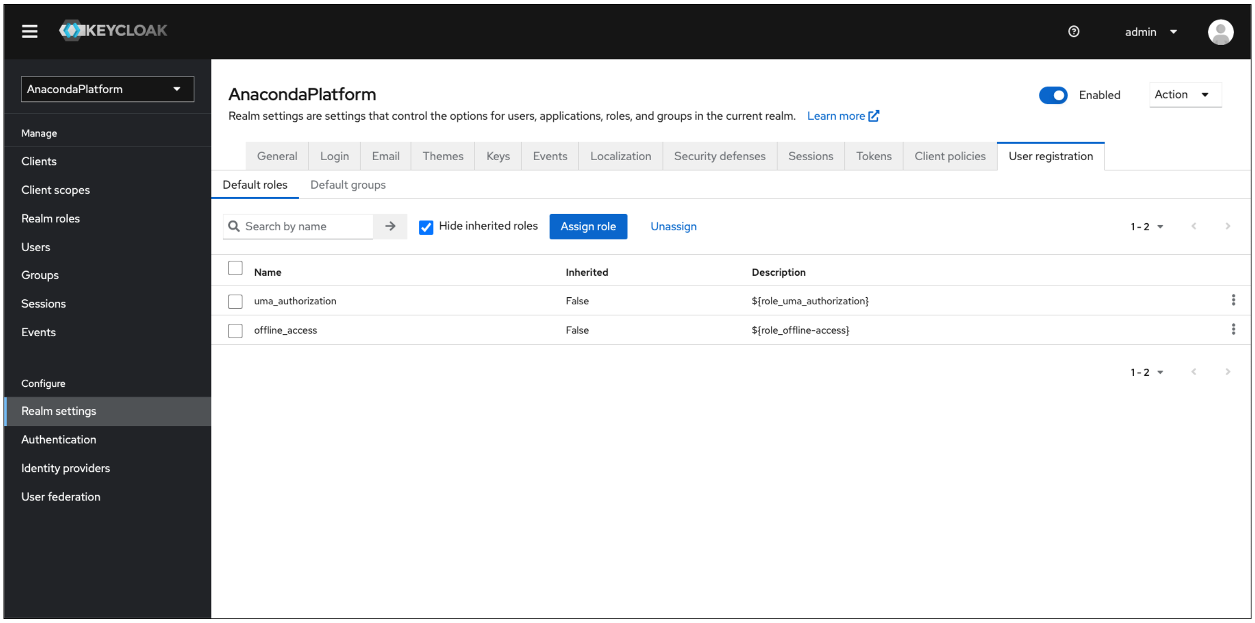
Default roles and groups

Roles

Default roles allow you to automatically assign user role mappings whenever a user is newly created or imported. By default, Workbench assigns the following roles to newly created and imported users:

- ae-deployer
- ae-uploader
- ae-creator
- offline_access
- uma_authorization

You can disable these roles, if necessary, with the exception of the `offline_access` and `uma_authorization` roles. These are system configuration requirements.



AnacondaPlatform

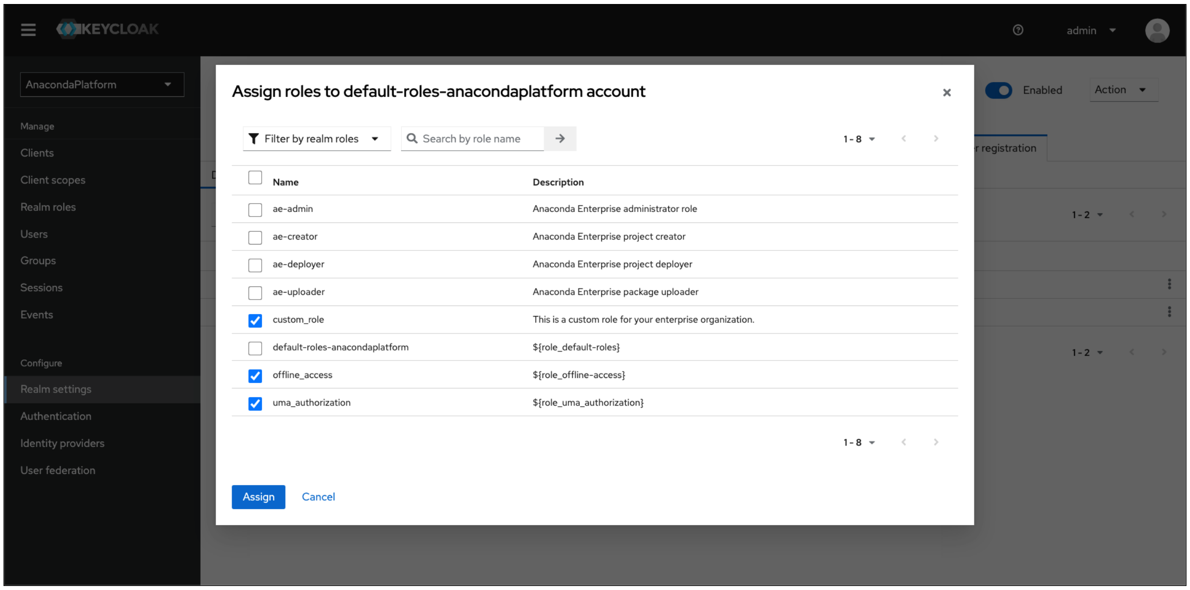
Realm settings are settings that control the options for users, applications, roles, and groups in the current realm. Learn more

☑ Hide inherited roles

Name	Inherited	Description
uma_authorization	False	${role_uma_authorization}
offline_access	False	${role_offline-access}

To assign default roles, complete the following steps:

1. Select **Realm settings** from the left-hand navigation.
2. Select the **User registration** tab.
3. Select the **Default roles** tab.
4. Click **Assign role**.
5. Select the roles you would like to assign users by default, then click **Assign**.

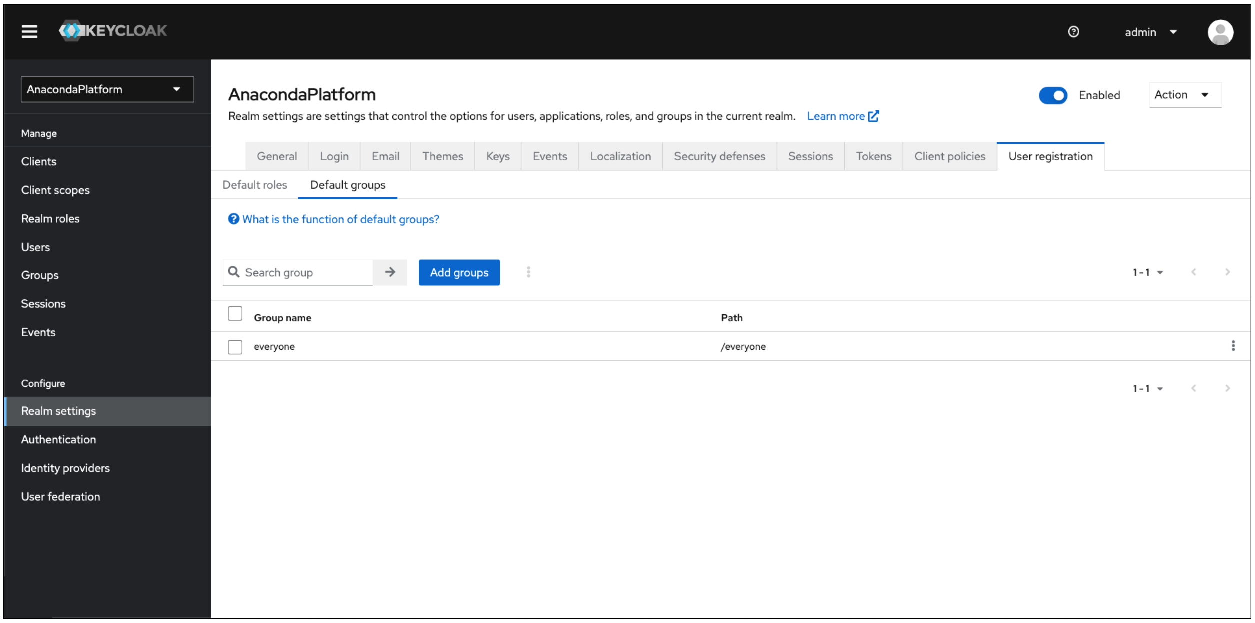


Assign roles to default-roles-anacondaplatform account

	Name	Description
□	ae-admin	Anaconda Enterprise administrator role
□	ae-creator	Anaconda Enterprise project creator
□	ae-deployer	Anaconda Enterprise project deployer
□	ae-uploader	Anaconda Enterprise package uploader
☑	custom_role	This is a custom role for your enterprise organization.
□	default-roles-anacondaplatform	${role_default-roles}
☑	offline_access	${role_offline-access}
☑	uma_authorization	${role_uma_authorization}

Groups

Default groups allow you to automatically assign group membership whenever a new user is created or imported. By default, Anaconda adds all new users to the **everyone** group.



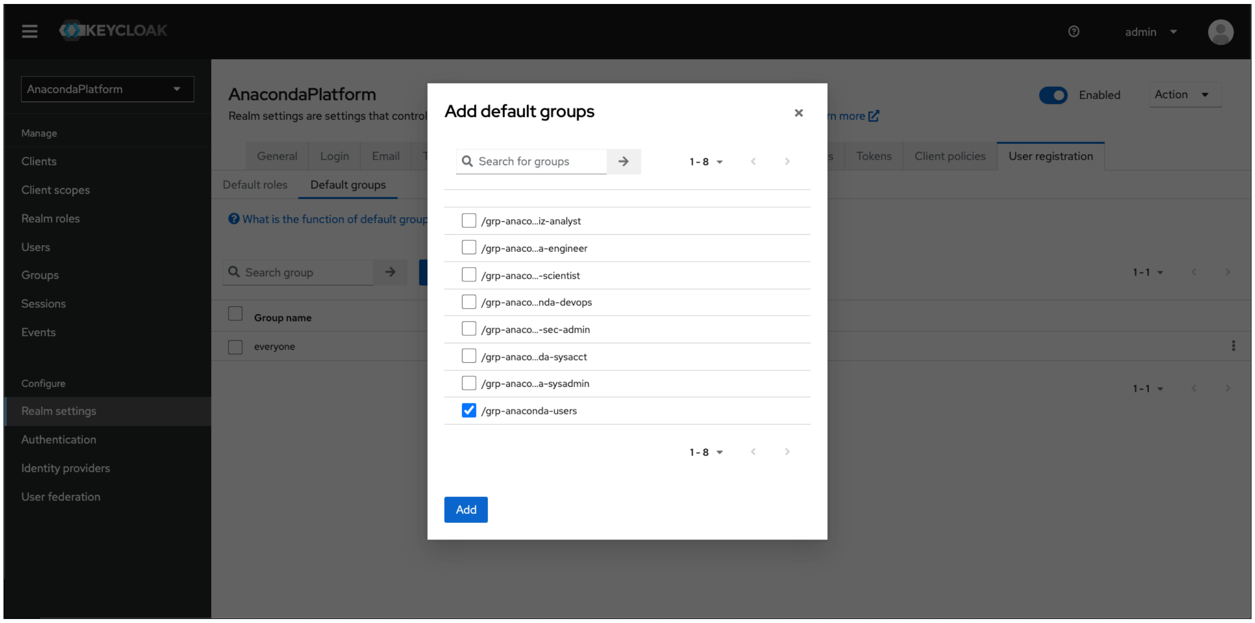
AnacondaPlatform

Realm settings are settings that control the options for users, applications, roles, and groups in the current realm. Learn more

	Group name	Path
□	everyone	/everyone

To assign default groups, complete the following steps:

1. Select **Realm settings** from the left-hand navigation.
2. Select the **User registration** tab.
3. Select the **Default groups** tab.
4. Click **Add groups**.
5. Select the groups you would like to add users to by default, then click **Add**.



Add default groups

□ /grp-anaco...iz-analyst
□ /grp-anaco...a-engineer
□ /grp-anaco...-scientist
□ /grp-anaco...nda-devops
□ /grp-anaco...-sec-admin
□ /grp-anaco...da-sysacct
□ /grp-anaco...a-sysadmin
☑ /grp-anaconda-users

3.2.4 Managing System Administrators

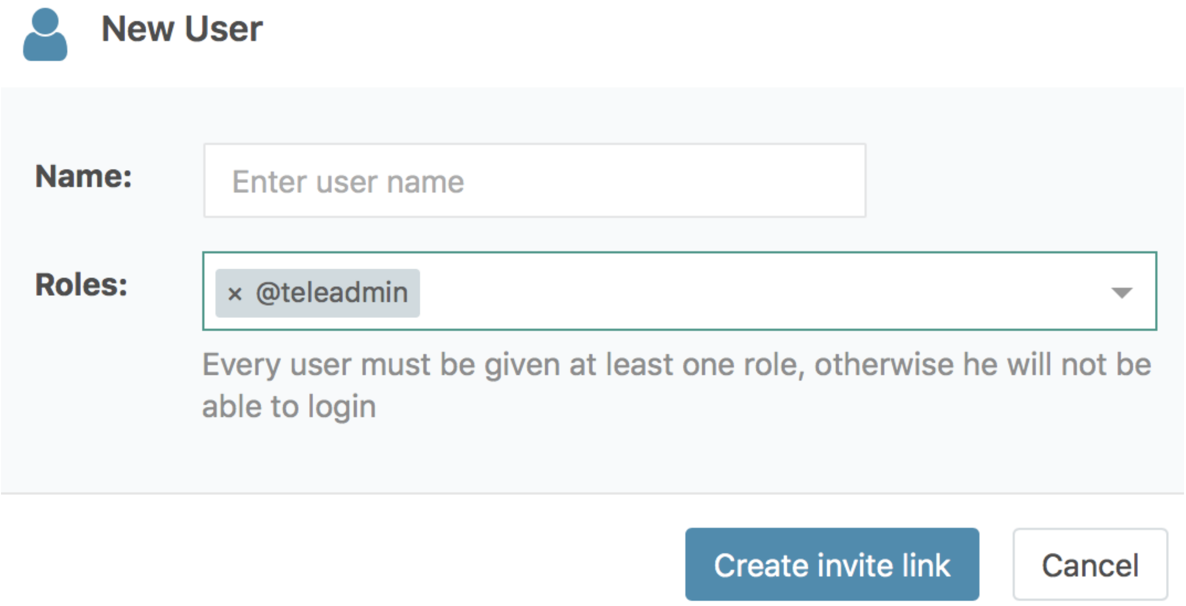
Data Science & AI Workbench distinguishes between System Administrators responsible for authorizing Workbench platform *users*, and System Administrators responsible for managing Workbench *resources*. This enables enterprises to grant the permissions required for configuring each to different individuals, based on their area of responsibility within the organization.

- System Administrators who are granted permission to access the **Authentication Center** can *configure authentication for all platform users*, including platform Admins. See *managing users* for information on how to create and manage Authentication Center Admins.
- System Administrators who are granted permission to access the **Operations Center** can *manage Workbench resources* and *configure advanced platform settings*.

Note: The login credentials for the Operations Center are initially set as part of the *post-install configuration process*. Follow the steps outlined below to authorize additional Admin users to manage cluster resources, *using the Operations Center UI* or *using a command line*. If you prefer to use OpenID Connect (OIDC), see oidc.

Managing Operations Center Admins using the UI

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Manage Users** to access the Keycloak user interface (UI).
3. Log in using your Keycloak admin account credentials.
4. Select **Settings** in the login menu in the upper-right corner.
5. Select **Users** from the left-hand navigation.
6. Click **+ New User** in the upper-right corner.
7. Select `@teleadmin` from the **Roles** drop-down list, and click **Create invite link**.



New User

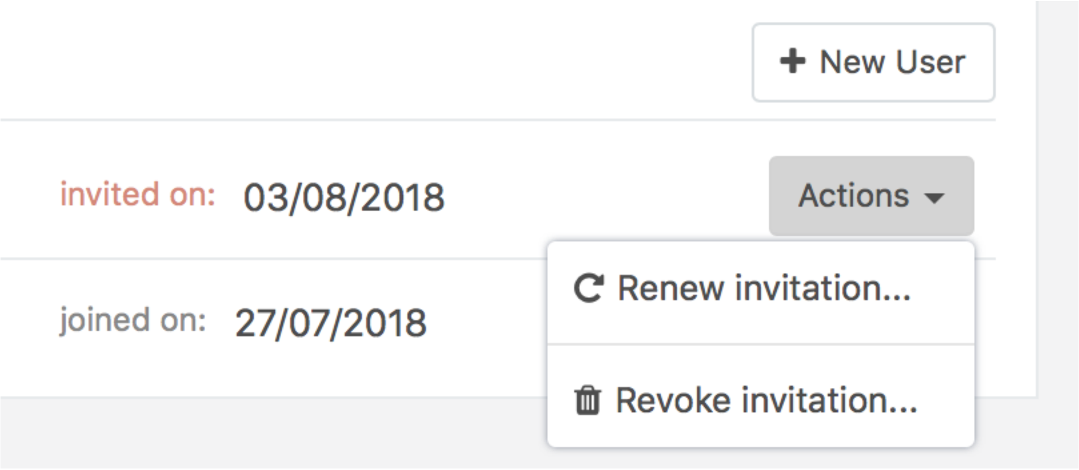
Name: Enter user name

Roles: × @teleadmin

Every user must be given at least one role, otherwise he will not be able to login

8. Copy the invitation URL that is generated, replace the private IP address with the fully-qualified domain name of the host, if necessary, and send it to the individual using your preferred method of secure communication. They'll use it to set their password, and will be automatically logged in to the Operations Center when they click **Continue**.

To generate a new invitation URL, select **Renew invitation** in the **Actions** menu for the user.

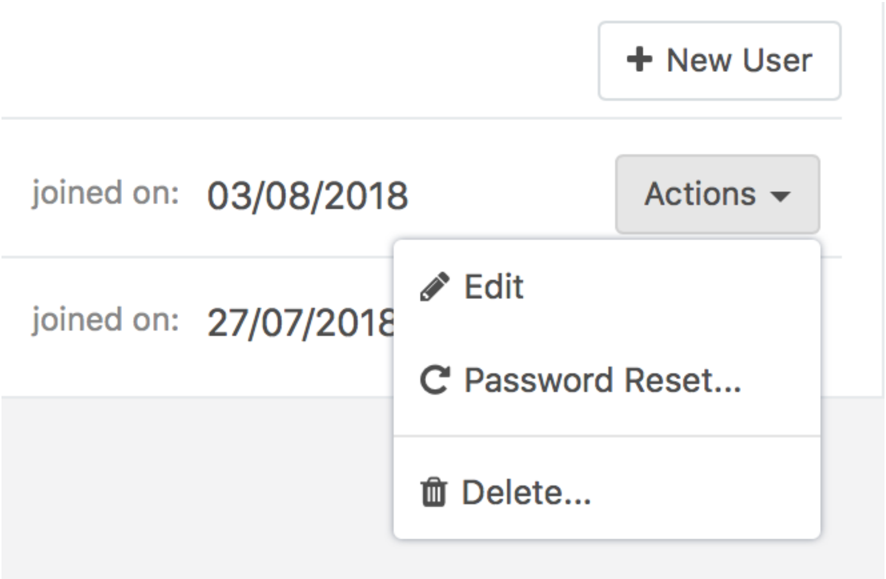


invited on: 03/08/2018

joined on: 27/07/2018

Select **Revoke invitation** to prevent them from being able to use the invitation to create a password and access the Operations Center. This effectively deletes the user before they have a chance to set their credentials.

To delete—or otherwise manage—an Operations Center user after they have set their credentials and completed the authorization process, select the appropriate option from the **Actions** menu.



joined on: 03/08/2018

joined on: 27/07/2018

Managing Operations Center Admins using a command line

To create a new Admin:

Run the following commands *on the Workbench master node*, replacing `<email>` and `<yourpass>` with the email address and password for the user:

```
sudo gravity enter
gravity --insecure user create --type=admin --email=<email> --password=<yourpass> --ops-
↪url=https://gravity-site.kube-system.svc.cluster.local:3009
```

To verify that the user was created, run the following command:

```
sudo gravity resource get users
```

To update an Admin user's password:

To update an Admin user's password, you'll need to delete the user account, then re-create it, replacing `<email>` and `<yourpass>` with the email address and new password:

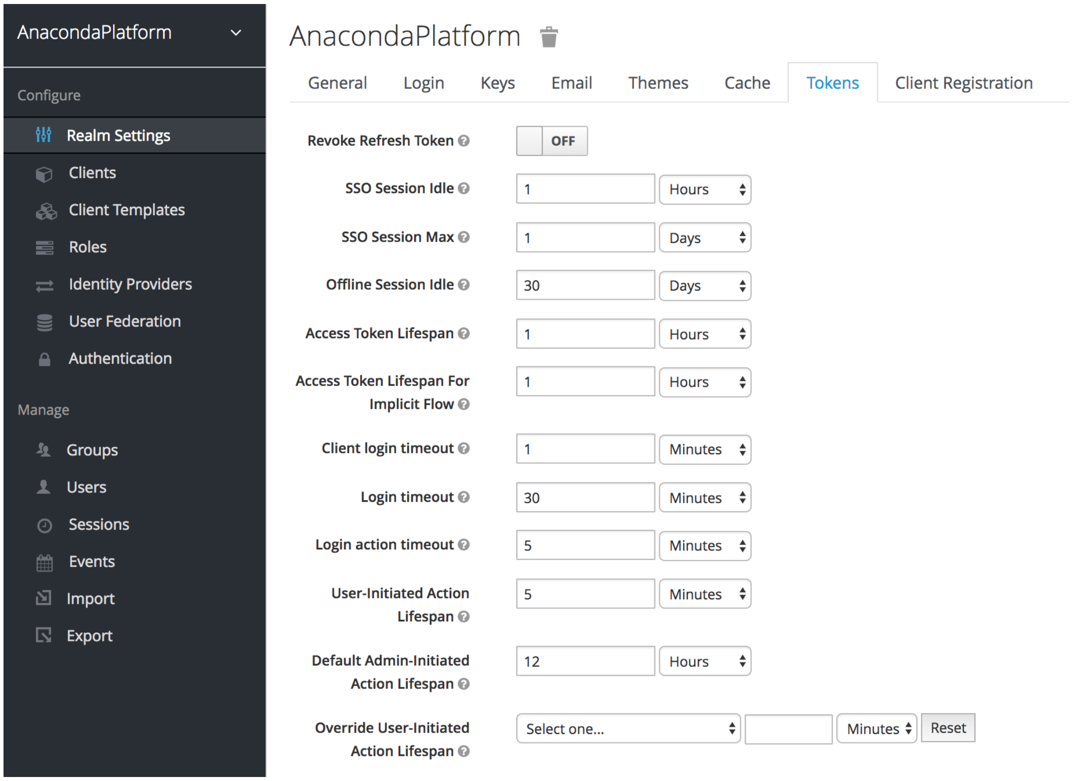
```
sudo gravity enter
gravity --insecure user delete --email=<email> --ops-url=https://gravity-site.kube-
↪system.svc.cluster.local:3009
gravity --insecure user create --type=admin --email=<email> --password=<yourpass> --ops-
↪url=https://gravity-site.kube-system.svc.cluster.local:3009
```

3.2.5 Configuring session timeouts

As an Administrator, you can configure session timeouts for Data Science & AI Workbench platform users, to help you adhere to your organization's security standards or enforce policies.

You'll use the Administrative Console's Authentication Center to set the various parameters related to session timeouts:

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Manage Users** to access the Keycloak user interface (UI).
3. Log in using your Keycloak admin account credentials.
4. Select **Realm Setting** from the left-hand navigation.
5. Click the **Tokens** tab at the top to display the following:



Revoke Refresh Token: OFF

SSO Session Idle: 1 Hours

SSO Session Max: 1 Days

Offline Session Idle: 30 Days

Access Token Lifespan: 1 Hours

Access Token Lifespan For Implicit Flow: 1 Hours

Client login timeout: 1 Minutes

Login timeout: 30 Minutes

Login action timeout: 5 Minutes

User-Initiated Action Lifespan: 5 Minutes

Default Admin-Initiated Action Lifespan: 12 Hours

Override User-Initiated Action Lifespan: Select one... Minutes

6. Use the available configuration options to specify maximum thresholds for each aspect of user sessions, including the following:

   - Time limits for idle browser sessions and single sign on (SSO) tokens
   - Lifespans for OpenID access tokens
   - Time limits for login-related actions, such as resetting a forgotten password

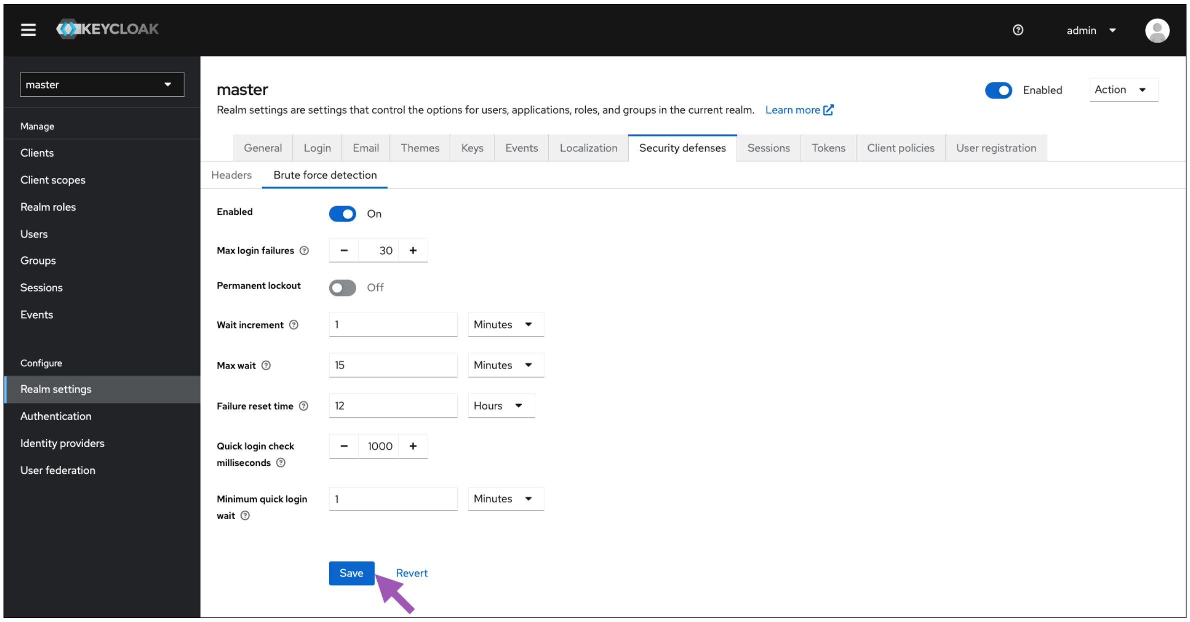
Configuration option	Description
Revoke Refresh Token	If enabled, limits refresh tokens to one-time use
SSO Session Idle	User will be logged out of session if inactive for this length of time
SSO Session Max	Maximum time a user session can remain active, regardless of activity
Offline Session Idle	Amount of time an offline session can be idle before the access token is revoked
Access Token Lifespan	Amount of time an access token will remain valid, before expiring
Access Token Lifespan For Implicit Flow	Timeout for access tokens created with Implicit Flow–no refresh token is provided
Client login timeout	Maximum time a client can take to complete the authorization process
Login timeout	Maximum time a user can take to authenticate before the process restarts
Login action timeout	Maximum time a user can spend on any one page in the authentication process
User-Initiated Action Lifespan	Maximum time before a user-initiated action (e.g., forgot password email) expires
Default Admin-Initiated Action Lifespan	Maximum time before an admin-initiated action (e.g., issue token to user) expires
Override User-Initiated Action Lifespan	Use to optionally configure different timeouts for each user-initiated action

7. Click **Save** to save your changes to the Workbench platform.

3.2.6 Enabling brute force protection

Keycloak provides a number of mechanisms to help secure your Workbench from identity-based attacks. A brute force attack is a method in which an attacker guesses your password by repeated guessing. To protect your installation against such attacks, follow these steps:

1. *Log in to your Keycloak administrative console*.
2. Select **Realm Settings** from the left-hand navigation menu.
3. Select the **Security Defenses** tab.
4. Select the **Brute Force Detection** tab.
5. Toggle **Enabled** to `ON`.
6. Set the parameters for your organization's brute force defenses. Hover your mouse over the question mark icon to see what each parameter manages.
7. Click **Save**.



master

Realm settings are settings that control the options for users, applications, roles, and groups in the current realm.

Enabled: On

Max login failures: 30

Permanent lockout: Off

Wait increment: 1 Minutes

Max wait: 15 Minutes

Failure reset time: 12 Hours

Quick login check milliseconds: 1000

Minimum quick login wait: 1 Minutes

To disable these settings at any time, return to the **Brute Force Detection** tab and toggle **Enabled** to `OFF`.

Other security mitigations

For more information about brute force protection and using Keycloak to mitigate other security threats, please see Keycloak's official documentation.

3.2.7 Establishing an LDAP connection

The Lightweight Directory Access Protocol (LDAP) is a standardized set of rules that governs how information is transmitted and handled between a directory server and other servers on a network. Directory servers are external storage that contains information about users' identities. This could include their first and last name, email address, and employee ID number. Directory servers also often contain sensitive information, such as account passwords. For more information about LDAP, see the official LDAP documentation.

Before you begin

Anaconda highly recommends you have knowledge of your LDAP server and organizational structure to complete this procedure. Configuring identity and access management is complex, and each enterprise has a unique LDAP directory structure.

While your implementation will be based on the specific structure and needs of your organization, the principals and processes described here will enable you to:

- Gather directory information about your LDAP server.
- Establish a connection to your LDAP server in Keycloak.
- Reduce the number of users that need to be mapped into Anaconda through the use of groups and roles.
- Reduce the number of groups that need to be mapped into Anaconda by filtering groups.
- Automate importing new groups for team memberships based on filters.
- Automate the provisioning of permissions to users based on group membership.

Prerequisites

You must have credentials for the "bind user" service account to perform this task. If you do not have the proper credentials, get them from your LDAP Server Administrator.

Gathering directory structure information

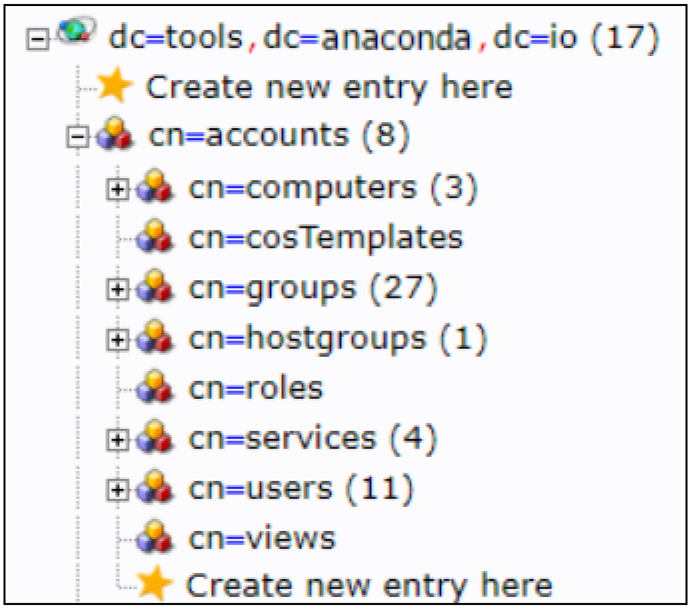
In order to configure Keycloak to validate credentials from your external LDAP server, you need to gather some information about your LDAP directory structure. You'll use this information to link user attributes (object classes, email, user ID, password, etc.) for use in Anaconda.

While you cannot discern a complete picture of your LDAP directory structure from the bind user credentials, you can make some general assumptions about it based on them. For example, if the bind user distinguished name (DN) is:

```
uid=binduser,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
```

We can see the "root" or "base" of the directory tree is `dc=tools,dc=anaconda,dc=io`. From there we can discern the rest of the tree structure. In this example, we can see that the `uid` attribute is stored in the *users* folder, which is stored in the *accounts* folder.

If you prefer, tools are available to aid in the visualization, navigation, and updating of your organization's LDAP directory server, such as phpldapadmin, which was used to generate the following view. This provides additional information about the LDAP structure that you can't discern from just looking at the bind credentials, such as the location of *groups*, which is also stored in the *accounts* folder.



dc=tools,dc=anaconda,dc=io (17)
Create new entry here
cn=accounts (8)
cn=computers (3)
cn=cosTemplates
cn=groups (27)
cn=hostgroups (1)
cn=roles
cn=services (4)
cn=users (11)
cn=views
Create new entry here

Now that you better understand how to discern your LDAP directory structure, you are ready to use the `ldapsearch` tool, along with the bind user credentials, to learn details about an individual user based on their User ID. For more information about the `ldapsearch` tool, see the official documentation.

Gather the information you'll need to configure user federation within Keycloak by running the following command against a known user ID:

```
# Replace <BIND_USER> with your bind user address
# Replace <LDAP_ADDRESS> with the address of your LDAP server
# Replace <DIRECTORY_ROOT> with the root of your LDAP server
# Replace <USER_ID> with the ID of a user on your LDAP sever
ldapsearch -D '<BIND_USER>' -W -H <LDAP_ADDRESS> -b <DIRECTORY_ROOT> "(<USER_ID>)"
```

Following the example for the bind user DN, to find information about user `User1` the command would look like this:

```
ldapsearch -D 'uid=binduser,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io' -W -H ldap://ipa.tools.anaconda.io -b dc=tools,dc=anaconda,dc=io "(uid=User1)"
```

The return from the command will look like this:

```
# User1, users, compat, tools.anaconda.io
dn: uid=User1,cn=users,cn=compat,dc=tools,dc=anaconda,dc=io
objectClass: posixAccount
objectClass: ipaOverrideTarget
objectClass: top
gecos: User1
cn: User1
uidNumber: 1666600031
gidNumber: 1666600031
loginShell: /bin/sh
homeDirectory: /home/User1
ipaAnchorUUID:: OklQQTp0b29scy5jb250aW51dW0uaW86OTEyYTMwNjgtZDhmYy0xMWU4LTgzYTUtMTIyYTE3YWNlMzJh
uid: User1
```

(continues on next page)

(continued from previous page)

```
# User1, users, accounts, tools.anaconda.io
dn: uid=User1,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
displayName: User1
uid: User1
krbCanonicalName: User1@TOOLS.anaconda.IO
objectClass: top
objectClass: person
objectClass: organizationalperson
objectClass: inetorgperson
objectClass: inetuser
objectClass: posixaccount
objectClass: krbprincipalaux
objectClass: krbticketpolicyaux
objectClass: ipaobject
objectClass: ipasshuser
objectClass: ipaSshGroupOfPubKeys
objectClass: mepOriginEntry
loginShell: /bin/sh
initials: U1
gecos: User1
sn: LastName
homeDirectory: /home/User1
mail: User1@tools.anaconda.io
krbPrincipalName: User1@TOOLS.anaconda.IO
givenName: User1
cn: User1
ipaUniqueID: 912a3068-d8fc-11e8-83a5-122a17ace32a
uidNumber: 1666600031
gidNumber: 1666600031
krbPasswordExpiration: 20181026085310Z
krbLastPwdChange: 20181026085310Z
memberOf: cn=ipausers,cn=groups,cn=accounts,dc=tools,dc=anaconda,dc=io
memberOf: cn=grp-anaconda-data-scientist,cn=groups,cn=accounts,dc=tools,dc=anaconda,dc=io
memberOf: cn=grp-anaconda-users,cn=groups,cn=accounts,dc=tools,dc=anaconda,dc=io
memberOf: cn=grp-finance,cn=groups,cn=accounts,dc=tools,dc=anaconda,dc=io

# search result
search: 2
result: 0 Success

# numResponses: 3
# numEntries: 2
```

Remember, the information you need to configure Keycloak to authenticate your users can be found in these results. Save this information and keep it somewhere accessible for reference.

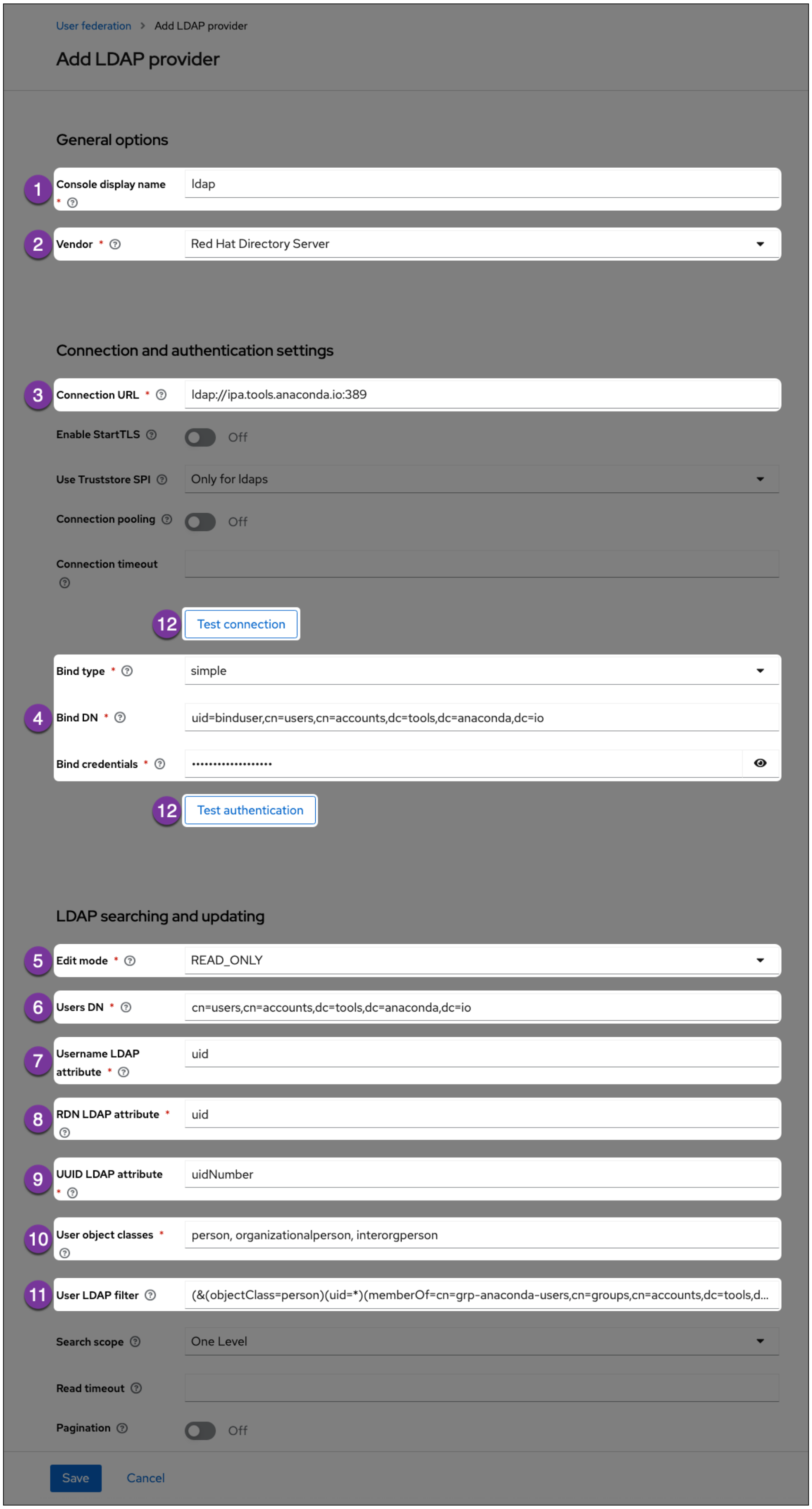
Setting up LDAP user federation

Now that you have gathered information about your directory, you need to tell Keycloak how to interpret that information, so it can use it with Anaconda software.

Note: These attributes can be remapped later, if necessary.

1. Log in to your Keycloak console using an account that has administrator privileges.
2. Select **User federation** from the left-hand navigation menu.
3. Select **ldap** from the **Add provider…** dropdown menu.

Let's take a look at the Add LDAP provider page. Keep in mind that entries shown here are in alignment with the example provided above.



User federation > Add LDAP provider

Add LDAP provider

General options

Console display name *: ldap

Vendor *: Red Hat Directory Server

Connection and authentication settings

Connection URL *: ldap://ipa.tools.anaconda.io:389

Enable StartTLS: Off

Use Truststore SPI: Only for ldaps

Connection pooling: Off

Connection timeout:

Bind type *: simple

Bind DN *: uid=binduser,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io

Bind credentials *: ••••••••••••••••••••

LDAP searching and updating

Edit mode *: READ_ONLY

Users DN *: cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io

Username LDAP attribute *: uid

RDN LDAP attribute *: uid

UUID LDAP attribute *: uidNumber

User object classes *: person, organizationalperson, interorgperson

User LDAP filter: (&(objectClass=person)(uid=*)(memberOf=cn=grp-anaconda-users,cn=groups,cn=accounts,dc=tools,d...

Search scope: One Level

Read timeout:

Pagination: Off

1. **Console Display Name**
   Enter a name for Keycloak to display for the LDAP server.
2. **Vendor**
   Select your LDAP server vendor from the dropdown menu. If you do not know your vendor, ask your LDAP server administrator.
3. **Connection URL**
   Enter the LDAP server's URL here.
4. **Bind User information**
   Enter the bind user information here.
5. **Edit Mode**
   Set the edit mode to `READ_ONLY` so you can view and import user information but don't have to worry about making unwanted changes to your LDAP server.
6. **Users DN**
   Enter the LDAP directory location for your users here.
7. **Username LDAP attribute**
   Get this information from your `ldapsearch` return. This attribute determines what is displayed as your user's name when they sign into Anaconda. In this example, the username attribute is `uid`.

   > **Caution:** Usernames cannot be all numeric values. All numeric usernames are indistinguishable from UUID's, and will break managed persistence if implemented.

8. **RDN LDAP attribute**
   Get this information from your `ldapsearch` return. Usually, the relative distinguished name (RDN) attribute is the same as the username attribute, but this field may default to something else depending on your vendor.
9. **UUID LDAP attribute**
   Get this information from your `ldapsearch` return. Your users' unique identifiers (UUID).
10. **User object classes**
    Get this information from your `ldapsearch` return. Generally, the user object classes field will have more than one entry, separated by a comma.
11. **User LDAP filter**
    The user LDAP filter restricts which users are returned from your LDAP directory. In the example, we only want users with the attribute `objectClass=person` that also have a `uid` and are in the group `cn=grp-anaconda-users`.

    Because users must explicitly be added to the group, unauthorized access is prevented, and license management is simplified.

    Filters also limit the need to synchronize a large number of objects from LDAP, which will help prevent out-of-memory errors in the auth pod.

    > **Caution:** Avoid the temptation to add new groups into the Custom User LDAP Filter! `ldapsearch` utilizes regular expressions and is notorious for its complexity. If implemented incorrectly, a custom filter could cause all users to have their access suspended or be functionally disabled.

12. **Test buttons**
    Use the **Test connection** and **Test authentication** buttons to verify that Anaconda can connect to the provider with the credentials provided. You'll need to resolve any errors before continuing.

> **Tip:** This is a good method for making sure your certifications are in the correct place if you are using LDAPS.

By default, users will not be synced from LDAP until they log in. To test whether the custom user LDAP Filter is working correctly, add or remove users in LDAP, then enable the sync settings to see if your changes are picked up and user authentication works as expected.

After you save your configurations, your LDAP server can be viewed on the **User Federation** page.

> **Caution:** If you are using LDAPS, you must also complete the steps provided here.

Once you've saved your changes, you can navigate to **Users** in the left-hand navigation, then select **View all users** to verify that your users' information was imported correctly.

Configuring Group Mappers

Once user federation is established, you can set up a *group mapper* for Keycloak to import your LDAP server's groups automatically for you. Once again, use the `ldapsearch` tool to gather information about your LDAP directory, only this time, look for information pertaining to your organizations groups.

To gather information about groups in your LDAP directory, run the following command against a known group DN:

```
# Replace <BIND_USER> with your bind user address
# Replace <LDAP_ADDRESS> with the address of your LDAP server
# Replace <DIRECTORY_ROOT> with the root of your LDAP server
# Replace <GROUP_DN> with the group's distinguished name
ldapsearch -D '<BIND_USER>' -W -H <LDAP_ADDRESS> -b <DIRECTORY_ROOT> "(<GROUP_DN>)"
```

Following with the earlier example, the command looks like this:

```
ldapsearch -D 'uid=binduser,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io' -W -H ldap:/
↪/ipa.tools.anaconda.io -b dc=tools,dc=anaconda,dc=io "(cn=grp-anaconda-users)"
```

The return from the command will look like this:

```
# grp-anaconda-users, groups, compat, tools.anaconda.io
dn: cn=grp-anaconda-users,cn=groups,cn=compat,dc=tools,dc=anaconda,dc=io
objectClass: posixGroup
objectClass: ipaOverrideTarget
objectClass: ipaexternalgroup
objectClass: top
gidNumber: 1666600026
memberUid: User1
memberUid: User2
memberUid: User3
memberUid: User4
memberUid: User5
memberUid: User6
memberUid: User7
memberUid: User8
memberUid: User9
```

(continues on next page)

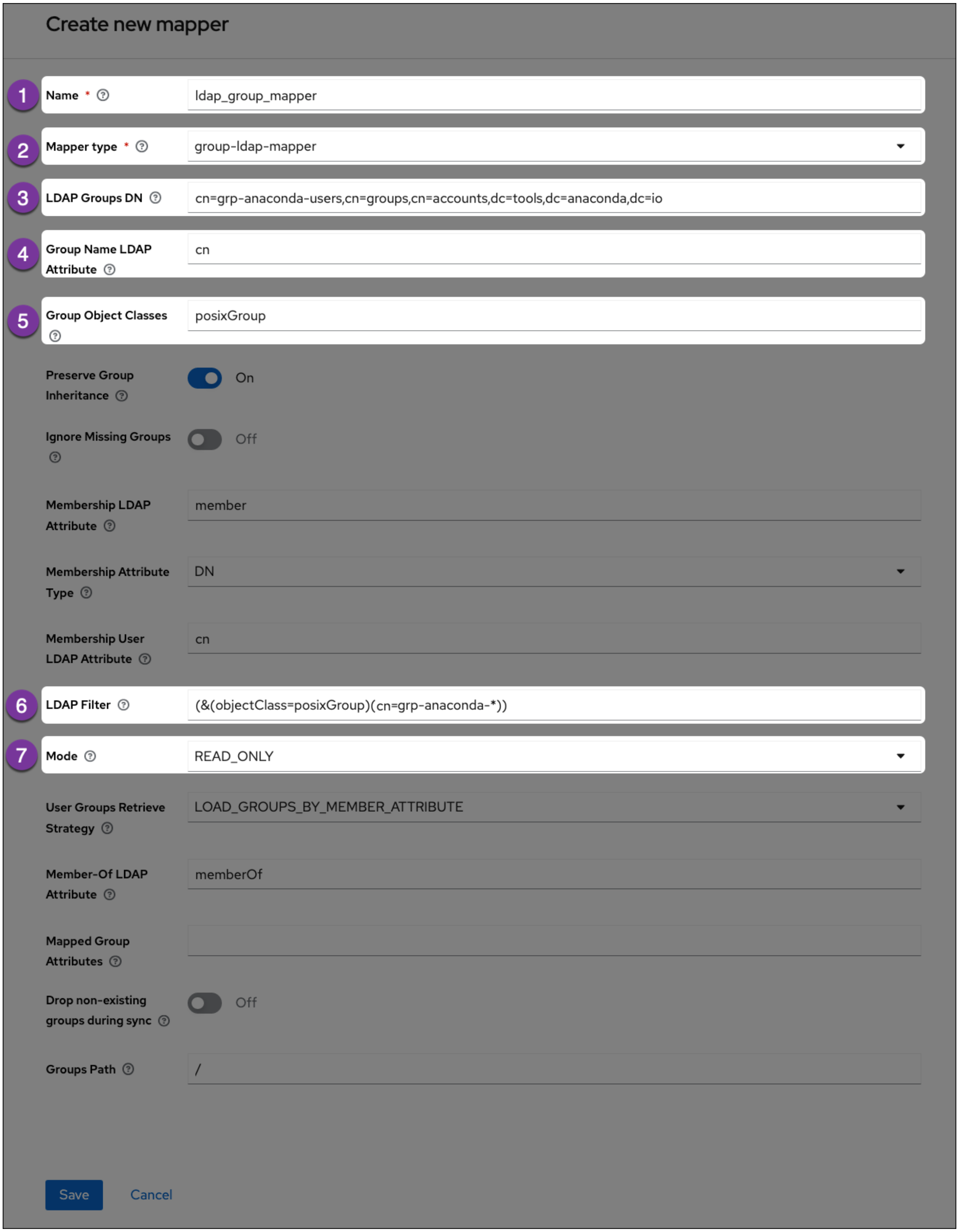
(continued from previous page)

```
ipaAnchorUUID:: OklQQTp0b29scy5jb250aW51dW0uaW86NGFhOTQ4NzYtZDg4YS0xMWU4LWE2ZD
ctMTIyYTE3YWNlMzJh
cn: grp-anaconda-users

# grp-anaconda-users, groups, accounts, tools.anaconda.io
dn: cn=grp-anaconda-users,cn=groups,cn=accounts,dc=tools,dc=anaconda,dc=io
objectClass: top
objectClass: groupofnames
objectClass: nestedgroup
objectClass: ipausergroup
objectClass: ipaobject
objectClass: posixgroup
cn: grp-anaconda-users
ipaUniqueID: 4aa94876-d88a-11e8-a6d7-122a17ace32a
gidNumber: 1666600026
member: uid=User1,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
member: uid=User2,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
member: uid=User3,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
member: uid=User4,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
member: uid=User5,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
member: uid=User6,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
member: uid=User7,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
member: uid=User8,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io
member: uid=User9,cn=users,cn=accounts,dc=tools,dc=anaconda,dc=io

# search result
search: 2
result: 0 Success

# numResponses: 3
# numEntries: 2
```

Remember, the information you need to create a group mapper can be found in these results. Save this information and keep it somewhere accessible for reference. Return to Keycloak and complete the following steps:

1. Select **User Federation** from the left-hand navigation.
2. Select your LDAP server.
3. Select the **Mappers** tab.
4. Select **Add mapper**.
5. Enter a name for your group mapper, such as *ldap_group_mapper*.
6. Select **group-ldap-mapper** from the **Mapper Type** dropdown menu. More options will appear based on your dropdown selection.

Let's take a look at the Create new mapper page. Keep in mind that entries shown here are in alignment with the example provided above.



Create new mapper

Name *	ldap_group_mapper
Mapper type *	group-ldap-mapper
LDAP Groups DN	cn=grp-anaconda-users,cn=groups,cn=accounts,dc=tools,dc=anaconda,dc=io
Group Name LDAP Attribute	cn
Group Object Classes	posixGroup
Preserve Group Inheritance	On
Ignore Missing Groups	Off
Membership LDAP Attribute	member
Membership Attribute Type	DN
Membership User LDAP Attribute	cn
LDAP Filter	(&(objectClass=posixGroup)(cn=grp-anaconda-*))
Mode	READ_ONLY
User Groups Retrieve Strategy	LOAD_GROUPS_BY_MEMBER_ATTRIBUTE
Member-Of LDAP Attribute	memberOf
Mapped Group Attributes	
Drop non-existing groups during sync	Off
Groups Path	/

1. **Name**

   Enter a name for Keycloak to display for the LDAP group mapper.

2. **Mapper Type**
   Select **group-ldap-mapper** from the dropdown menu.
3. **LDAP Groups DN**
   Get this information from your `ldapsearch` return. Provide the distinguished name of the group you would like to map.
4. **Group Name LDAP Attribute**
   Get this information from your `ldapsearch` return. Enter the attribute that is associated with groups. In this example, the attribute is `cn`.
5. **Group Object Classes**
   Get this information from your `ldapsearch` return. This field will often have multiple entries, separated by a comma.
6. **LDAP Filter**
   If you have established groups of users in your LDAP server that you plan to provide with access to Anaconda, you can import those specific groups by providing search filter criteria here. However, depending on how your LDAP server is structured, filtering to the correct groups can be complicated.

   The search filter utilizes regular expressions (i.e. supports the use of wildcard characters). This example shows the search filter as `cn=grp-anaconda-*`, which will reach out to the LDAP server and import all groups that begin with `grp-anaconda-`.
7. **Mode**
   Open the **Mode** dropdown menu and select *READ_ONLY*.

> **Caution:** If implemented incorrectly, a custom filter could cause all users to have their access suspended or be functionally disabled.

Click **Save** to create your LDAP server mapper. An ID field appears at the top of the Mapper details page once it's established.

Mapping group roles

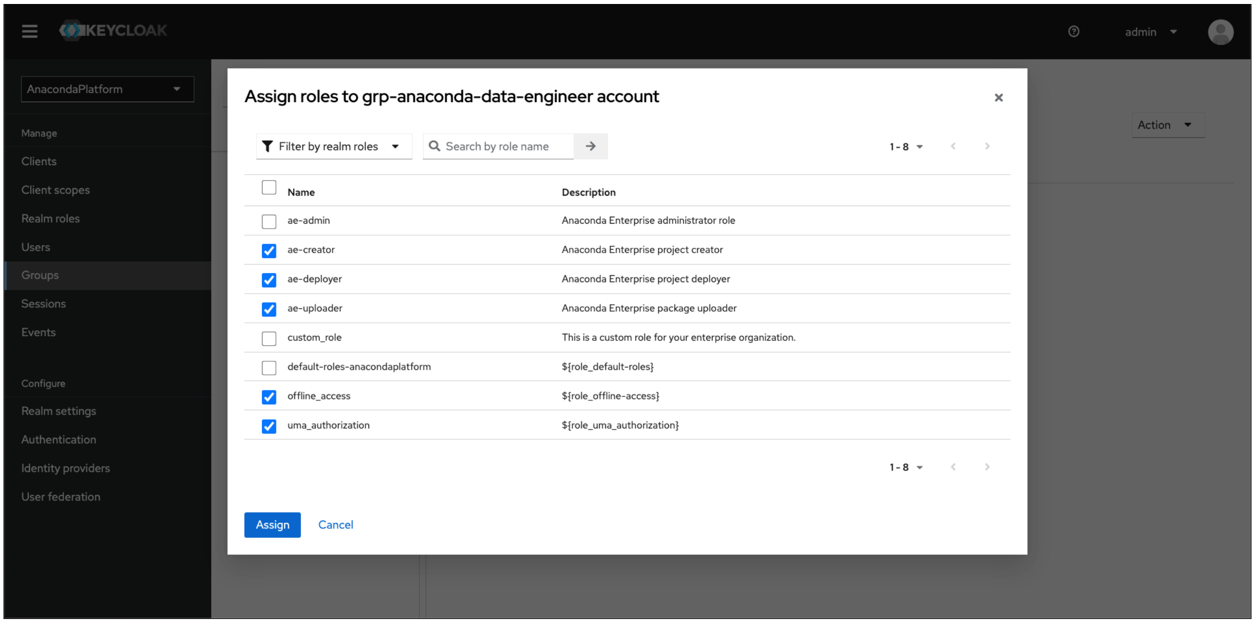
If you have groups of users that you plan to provide with access to Anaconda, you can import them using the LDAP filter as described above. Once complete, you need to provide your groups of users with permissions to work within Anaconda.

Roles determine a user's permissions within Anaconda, and a set of "realm" roles are established for you by default when you install. As a final step in establishing a connection to your LDAP server, you can map these provided roles to groups within your LDAP server to provide your team members with everything they need to work within Anaconda. Once the group roles are established, if a new team member arrives, adding them to the correct LDAP group provides them with all the correct permissions they need to use Anaconda right away. For more information about roles, see *Roles and groups*.

In the example below, groups have been established within the LDAP Server specifically for Anaconda users. Roles have been assigned to these groups to provide their members with the "proper" level of functionality within Anaconda for them to perform their jobs. A brief explanation on what their set role permissions will allow them to do has been provided in the right-hand column.

LDAP Group	ae-admi	ae-creat	ae-deplo	ae-uploa	of-fline_	uma_a	Description
grp-anacond biz-analyst					X		Business Analysts can access the system. They cannot create projects or grant others access to the system.
grp-anacond data-scientist		X	X	X	X	X	Data Scientists can create and share projects, but cannot deploy them.
grp-anacond data-engineer		X		X	X	X	Data Engineers can additionally deploy projects, as well as grant access to others.
grp-anacond devops			X	X	X		DevOps can deploy projects and upload packages, but cannot create projects.
grp-anacond sec-admin							This group should be used to administer user access within the system. Therefore, no roles should be defined in the `AnacondaPlatform` realm. If required, roles can be defined and access granted in the Auth Center `Master` realm.
grp-anacond sysadmir	X						By default, the `ae-admin` role is a superuser for all other roles.
grp-anacond sysacct							The roles for system accounts are yet to be defined. These could be used for automated CI/CD tasks.
grp-anacond users							This is used as a coarse-grained control for access to Workbench, so no roles are defined.

Use the **Role Mappings** tab to assign the appropriate role(s) to each group imported from your LDAP server.



Assign roles to grp-anaconda-data-engineer account

	Name	Description
□	ae-admin	Anaconda Enterprise administrator role
☑	ae-creator	Anaconda Enterprise project creator
☑	ae-deployer	Anaconda Enterprise project deployer
☑	ae-uploader	Anaconda Enterprise package uploader
□	custom_role	This is a custom role for your enterprise organization.
□	default-roles-anacondaplatform	${role_default-roles}
☑	offline_access	${role_offline-access}
☑	uma_authorization	${role_uma_authorization}

Configuring LDAPS

LDAP over SSL, or LDAPS, allows you to encrypt your LDAP server data while it travels during communications, in order to protect it from attacks like certificate theft. For more information, see the official Keycloak documentation on LDAPS.

Prerequisites

You must have the Java `jre` package installed to complete this procedure. You must have SSL/TLS certificates for your LDAP server.

Establishing LDAPS

Gravity

If you are using a custom certificate authority (CA), you must create a truststore on your host. If you are using a public CA, you can skip the truststore installation and go straight to exporting your existing SSL certificates to the Data Science & AI Workbench auth service.

1. If the CA certificates are directly available to you, generate your truststore by running the following command:

   ```
   # Replace <CA_CERT> with your with your CA .pem file
   keytool -import -file <CA_CERT> -alias auth -keystore LDAPS.jks
   ```

   Note: If you need to add an intermediate certificate, run this command again *with a unique alias*, to include it in the `LDAPS.jks` file.

2. Export the existing SSL certificates for your system by running the following commands:

   ```
   # Replace <PATH_TO> with the filepath for your secrets-exported.yml file
   kubectl get secrets anaconda-enterprise-certs --export -o yaml > /<PATH_TO>/
   ↪secrets-exported.yml
   ```

3. As a precautionary measure, create a backup of the `secrets-exported.yml` file prior to encoding it by running the following command:

   ```
   cp secrets-exported.yml secrets-exported-orig.yml
   ```

4. Run the following command to encode the newly created truststore as `base64`:

   ```
   base64 -i --wrap=0 LDAPS.jks >> OUTPUT.jks
   ```

5. Copy the output of this command, and paste it into the `data` section of the `secrets-exported.yml` file.

6. Run the following command to update Workbench with the secrets certificate:

   ```
   # Replace <PATH_TO> with the filepath for your secrets-exported.yml file
   kubectl replace -f /<PATH_TO>/secrets-exported.yml
   ```

7. Verify that the `LDAPS.jks` entry has been added to the secret:

```
kubectl describe secret anaconda-enterprise-certs
```

8. Run the following command to restart the `auth` service:

   ```
   kubectl get pods | grep ap-auth | cut -d' ' -f1 | xargs kubectl delete pods
   ```

   > **Caution:** If you are using Workbench version 5.6.0 or later, you must also complete the following steps to finish your LDAPS configuration. If you do not, your LDAPS configuration will not connect successfully.

9. Create a backup of your current auth configuration:

   ```
   kubectl get deployment anaconda-enterprise-ap-auth -o yaml > auth.yaml
   ```

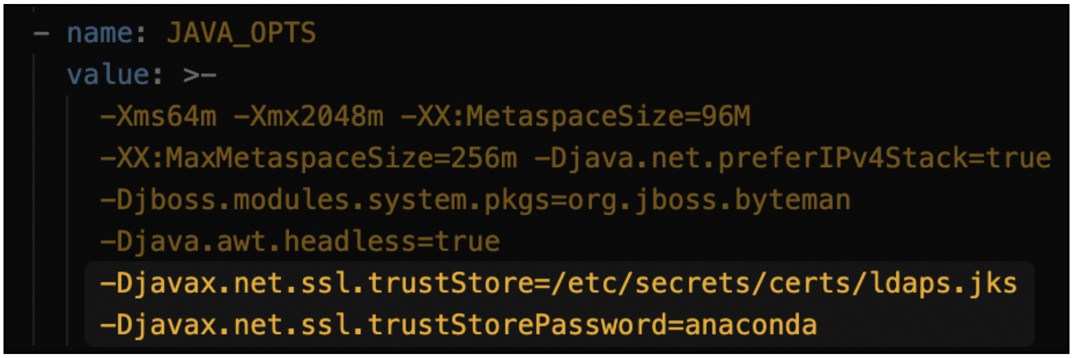
10. Edit the auth pod deployment:

    ```
    kubectl edit deployment anaconda-enterprise-ap-auth
    ```

11. Add the below to the `JAVA_OPTS` key/value:

    ```
    -Djavax.net.ssl.trustStore=/etc/secrets/certs/ldaps.jks
    -Djavax.net.ssl.trustStorePassword=anaconda
    ```

    Here is an example of what your `auth.yaml` file's `JAVA_OPTS` might look like when complete.



```
- name: JAVA_OPTS
  value: >-
    -Xms64m -Xmx2048m -XX:MetaspaceSize=96M
    -XX:MaxMetaspaceSize=256m -Djava.net.preferIPv4Stack=true
    -Djboss.modules.system.pkgs=org.jboss.byteman
    -Djava.awt.headless=true
    -Djavax.net.ssl.trustStore=/etc/secrets/certs/ldaps.jks
    -Djavax.net.ssl.trustStorePassword=anaconda
```

12. Save your changes.

BYOK8s

1. If the CA certificates are directly available to you, generate your truststore by running the following command:

   ```
   # Replace <CA_CERT> with your with your CA .pem file
   keytool -import -file <CA_CERT> -alias auth -keystore LDAPS.jks
   ```

   > **Note:** If you need to add an intermediate certificate, run this command again *with a unique alias*, to include it in the `LDAPS.jks` file.

2. Encode the newly created truststore as `base64` by running the following command:

```
base64 -i --wrap=0 LDAPS.jks >> <OUTPUT.jks>
```

3. Create the secret template for `<OUTPUT.jks>`

   ```
   # Replace <OUTPUT.jks> with the encoded truststore file you just created
   # Replace <TRUSTSTORE_SECRET> with the name of your LDAPS truststore secret
   # Replace <NAMESPACE> with your Anaconda Enerprise namespace
   kind: Secret
   apiVersion: v1
   metadata:
       name: <TRUSTSTORE_SECRET>
       namespace: <NAMESPACE>
   data:
       <OUTPUT.jks>
   type: kubernetes.io/tls
   ```

4. Create the new kubernetes secret by running the following command:

   ```
   # Replace <SECRET_NAME> with a name for your truststore secret file
   kubectl create -f <SECRET_NAME>
   ```

5. Save your configuration changes using the `extract_config.sh` script by running the following command:

   ```
   # Replace <NAMESPACE> with your Workbench namespace
   NAMESPACE=<NAMESPACE> ./extract_config.sh
   ```

   The `extract_config.sh` script creates a file called `helm_values.yaml` and saves it in the directory the script was run from.

6. Verify the information captured in the `helm_values.yaml` file is correct and contains all of your current cluster configuration settings.

7. Open the `helm_values.yaml` file and include the following lines:

   ```
   # Replace <OUTPUT.jks> with your encoded truststore file
   # Replace <TRUSTSTORE_PASS> with the password of thevtruststore
   # Replace <TRUSTSTORE_SECRET> with the name of your truststore secret
   keycloak:
       truststore: /etc/secrets/certs/<OUTPUT.jks>
       truststore_password: "<TRUSTSTORE_PASS>"
       truststore_secret: <TRUSTSTORE_SECRET>
   ```

   ### Example config variables

   ```
   keycloak:
       truststore: /etc/secrets/certs/ldaps.jks
       truststore_password: anaconda
       truststore_secret: ldaps_secret
   ```

8. Update your Helm Chart by running the following command:

   ```
   helm upgrade --values ./helm_values.yaml anaconda-enterprise ./Anaconda-
   ↪Enterprise/
   ```

3.2.8 Google IAM setup example

In addition to providing out-of-the-box support for LDAP, Active Directory, SAML and Kerberos, Data Science & AI Workbench also enables you to configure the platform to use other external identity providers to authenticate users. If your enterprise uses Google's Cloud IAM (Identity and Access Management) to manage access to Google Cloud Platform (GCP) resources, for example, you can use the following process to configure the platform to use Cloud IAM as your identity provider. This will allow users to log in to the platform using their Google (or G-Suite) credentials.

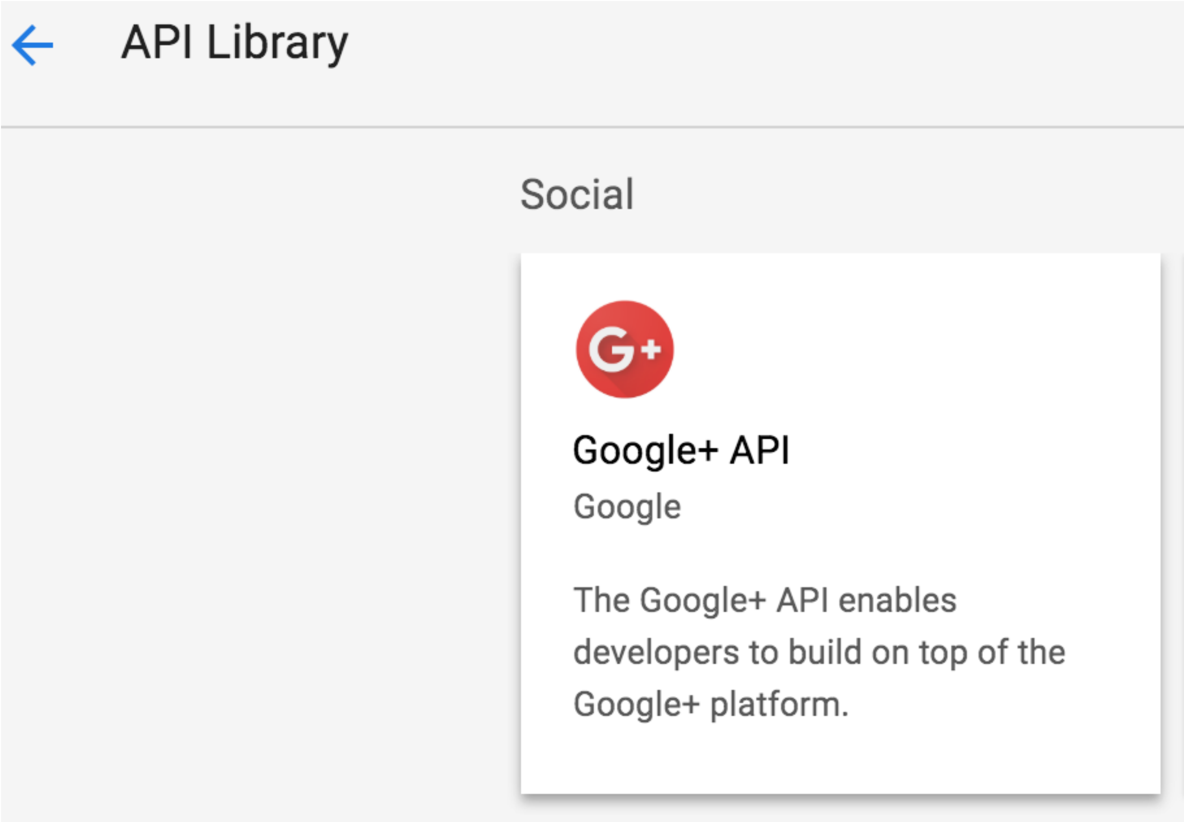
Before you begin:

- You'll need to configure a Google Cloud project on GCP.
- You'll need to *enable the Google+ API* for the project.
- You'll need to *create the credentials* to use to authorize the platform to connect to Google IAM.

Enabling the Google+ API

With your project selected *in Google Cloud Platform*:

1. Select **APIs & Services** from the menu on the left.
2. Select **ENABLE APIs AND SERVICES**, then locate and select the Google+ API card in the API library.



API Library

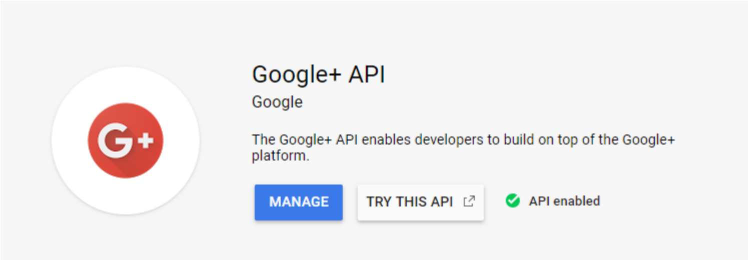
Social

Google+ API

Google

The Google+ API enables developers to build on top of the Google+ platform.

3. Click **ENABLE**.



Google+ API

Google

The Google+ API enables developers to build on top of the Google+ platform.

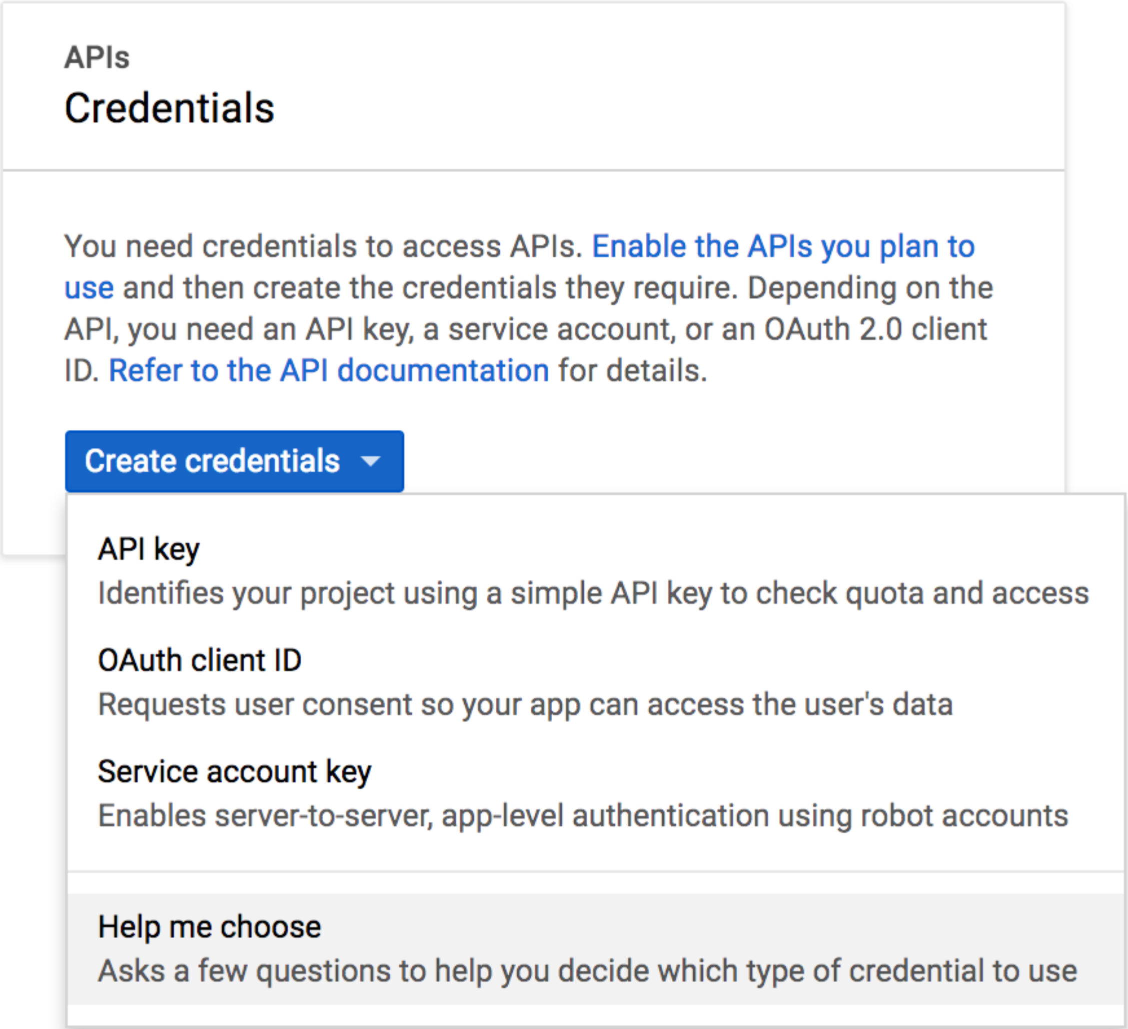
Now you can create credentials for the platform to access your Google Cloud project.

Creating Google+ credentials

With your project selected *in Google Cloud Platform*:

1. Select **APIs & Services > Credentials** from the menu on the left.
2. Click **Create credentials** and select **Help me choose** from the drop-down menu.

> **Note:** If you haven't already, be sure to *enable the Google+ API* before proceeding.



APIs

Credentials

You need credentials to access APIs. Enable the APIs you plan to use and then create the credentials they require. Depending on the API, you need an API key, a service account, or an OAuth 2.0 client ID. Refer to the API documentation for details.

API key

Identifies your project using a simple API key to check quota and access

OAuth client ID

Requests user consent so your app can access the user's data

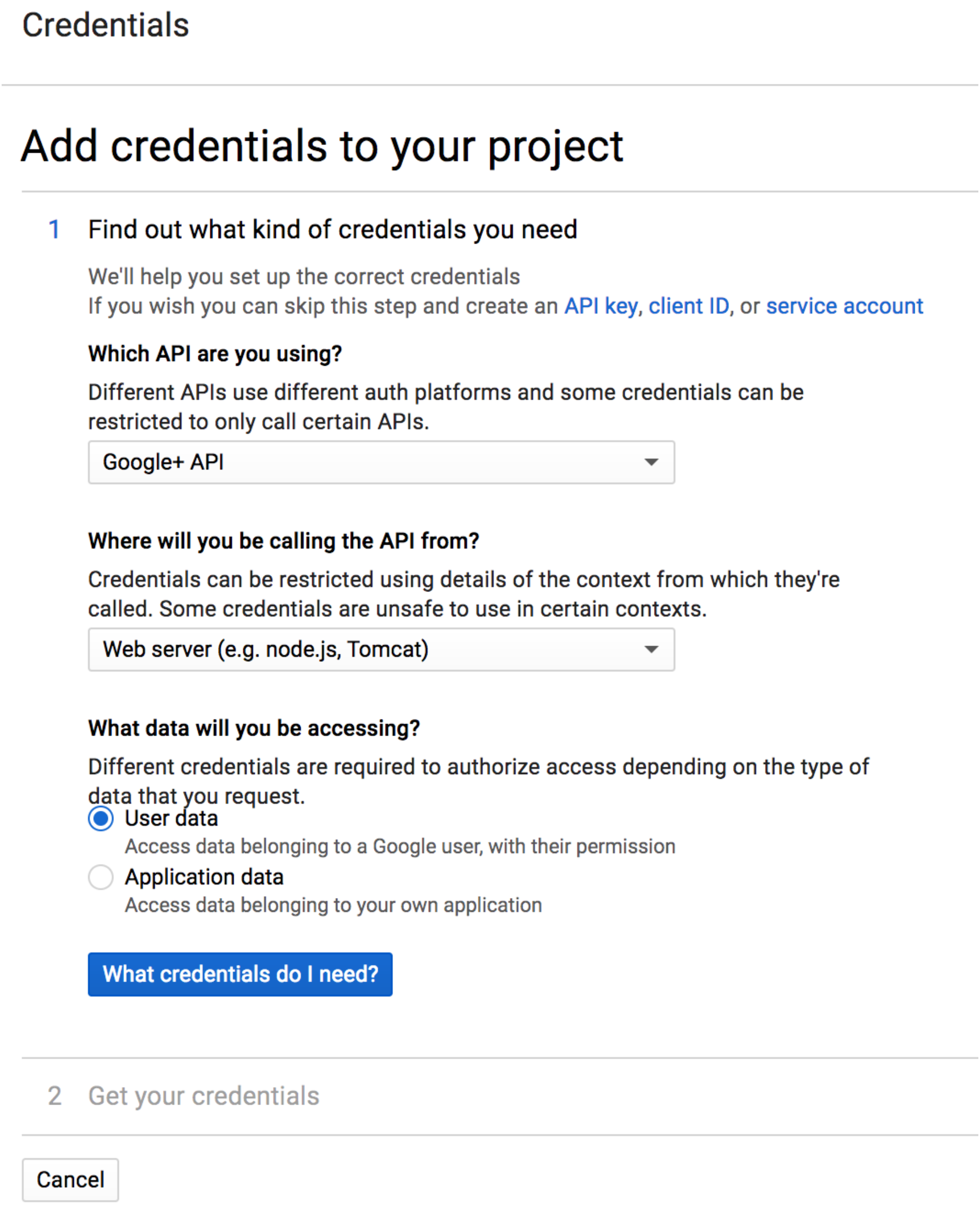
Service account key

Enables server-to-server, app-level authentication using robot accounts

Help me choose

Asks a few questions to help you decide which type of credential to use

3. Select **Google+ API** from the API drop-down list, **Web server** from the next drop-down, and **User data** for the last question.



Credentials

Add credentials to your project

1 Find out what kind of credentials you need

We'll help you set up the correct credentials
If you wish you can skip this step and create an API key, client ID, or service account

Which API are you using?

Different APIs use different auth platforms and some credentials can be restricted to only call certain APIs.

Google+ API ▾

Where will you be calling the API from?

Credentials can be restricted using details of the context from which they're called. Some credentials are unsafe to use in certain contexts.

Web server (e.g. node.js, Tomcat) ▾

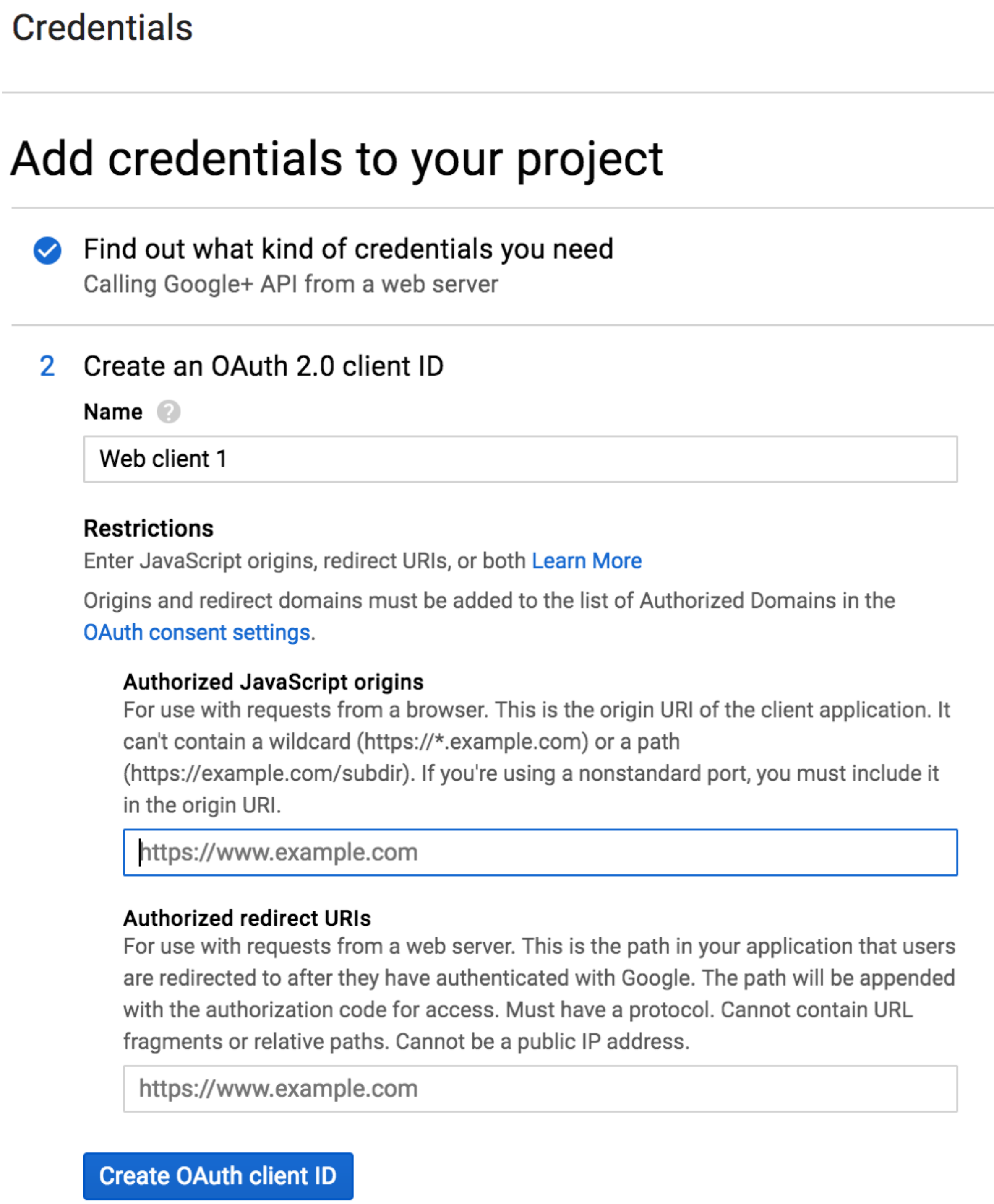
What data will you be accessing?

Different credentials are required to authorize access depending on the type of data that you request.

● User data
Access data belonging to a Google user, with their permission

○ Application data
Access data belonging to your own application

4. Click **What credentials do I need?** to create the appropriate credentials for the platform.



Credentials

Add credentials to your project

✓ Find out what kind of credentials you need
Calling Google+ API from a web server

2 Create an OAuth 2.0 client ID

Name

Web client 1

Restrictions

Enter JavaScript origins, redirect URIs, or both Learn More

Origins and redirect domains must be added to the list of Authorized Domains in the OAuth consent settings.

Authorized JavaScript origins

For use with requests from a browser. This is the origin URI of the client application. It can't contain a wildcard (https://*.example.com) or a path (https://example.com/subdir). If you're using a nonstandard port, you must include it in the origin URI.

https://www.example.com

Authorized redirect URIs

For use with requests from a web server. This is the path in your application that users are redirected to after they have authenticated with Google. The path will be appended with the authorization code for access. Must have a protocol. Cannot contain URL fragments or relative paths. Cannot be a public IP address.

https://www.example.com

5. Enter a meaningful name, such as `Data Science & AI Workbench`, to identify the platform (and help differentiate it from any other web applications you may have configured to use Google IAM).
6. In the **Authorized JavaScript origins** field, provide the FQDN of the Workbench server instance.
7. *Open the Workbench Auth Center* (*see instructions below*), and copy and paste the value from the **Redirect URI** field into the **Authorized redirect URIs** field here.

Note: If the domain is not an authorized domain, you'll see an `Invalid Redirect` error, and be prompted to add it to the authorized domains list before proceeding.

8. Click **Create OAuth client ID**.
9. On the **OAuth consent screen** tab:
   - Set the **Application type** to **Public**.
   - Set the **Application name** to `Data Science & AI Workbench` (or something else meaningful to platform users).
   - Optionally, upload a logo to help users recognize Workbench.
   - Provide a **Support email** address for users to reach out for help.
   - Provide the full path to the authorized homepage where users will access Anaconda Enteprise.
   - Optionally provide authorized links to a your organization's privacy policy and terms of service.
10. Click **Create** to display the OAuth client credentials that you'll need to copy and paste into Workbench, to enable the platform to authenticate with Google. (See Step 5 below.)

Configuring Google to be your identity provider

Now that you've configured your GCP project to work with Workbench, you need to use the Workbench Administrative Console's Authentication Center to configure Google as your external identity provider:

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Manage Users** to access the Keycloak user interface (UI).
3. Log in using your Keycloak admin account credentials.
4. Select **Identity Providers** from the left-hand navigation, then select `Google` from the **Add provider** dropdown.
5. The **Settings** tab displays the **Redirect URI** you need to copy to the Google Cloud project's configuration. The Redirect URI will looking similar to this: `https://<full-qualified-domain-name>/auth/realms/AnacondaPlatform/broker/google/endpoint`.
6. Copy and paste the credentials from GCP (Step 9 above) into the **Client ID** and **Client Secret** fields, and click **Save**.

Now that you've completed the configuration, the login screen will include a Google login option.

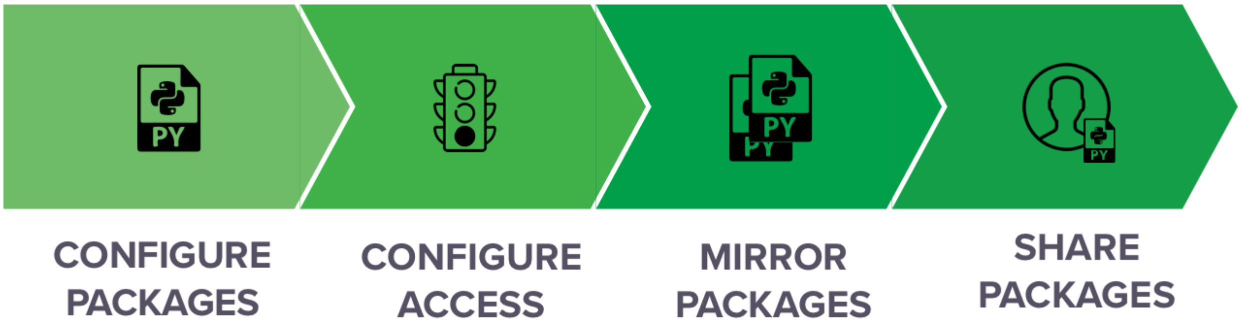
Note: When users choose this option and log in to the platform, they'll be automatically added as new Workbench users. As an Administrator, you can then configure their group assignments and role mappings. For more information, see *Roles and groups*.

3.3 Configuring channels and mirrors

Data Science & AI Workbench facilitates software distribution through the strategic use of channels and mirrors. Channels represent locations in repositories where Workbench uses conda to look for packages. As an administrator, you can populate a channel with packages from an external repository location by creating a mirror.

Note: Workbench supports the use of both conda and pip packages in its internal repository.

For instructions on configuring conda in Workbench, see *Configuring conda in Workbench*. For instructions on managing Workbench channels, see *Channels*. For instructions on mirroring repository channels into Workbench, see *Mirroring*.



3.3.1 Configuring conda in Workbench

As an administrator, it is your responsibility to maintain conda within Data Science & AI Workbench. Similar to how a user must configure conda to understand which channels to attempt to pull packages from when creating environments, Workbench requires configurations in the form of a *system-level* `.condarc` file to understand which channels Workbench *users* have access to when creating environments or installing packages in projects. Configuring conda at the system level overrides any user-level conda configurations.

The system-level `.condarc` file is populated from the `conda:` section of the `anaconda-enterprise-anaconda-platform.yml` configmap file or the `values.yml` helm chart override file. If no modifications are made during installation, the default Workbench `.condarc` file looks like this:

Default .condarc configuration

```
conda:
    channels:
    - defaults
    # List of channels that should be used for channel 'defaults'
    default_channels:
    - https://repo.anaconda.com/pkgs/main
    - https://repo.anaconda.com/pkgs/r
    # URL prefix to add to short channel names
    channel_alias: http://anaconda-enterprise-ap-repository/repository/conda
    # configuration for proxies with SSL inspection
```

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```
    ssl_verify: /var/run/secrets/anaconda/ca-chain.pem
    # Additional configuration values not included above
    other_variables: {}
```

The default Workbench setup allows all users to have access to all packages from Anaconda's `main` and `r` channels. However, with the `channel_alias:` set to the internal Workbench repository, conda is still able to access channels created within Workbench (whether via the UI or CLI) when the channel name is invoked in a conda command with the `-c` tag, or listed in a project's `anaconda-project.yml` configuration file, even if they are not listed in the `.condarc`.

Note: Anaconda recommends removing the `r` channel if you are not using R language packages.

To configure conda for workbench, *follow these instructions* to edit the configmap's `conda:` section to include the channels you need to provide to all Workbench users.

Note: Anaconda recommends listing only `defaults` in the `channels:` list, and listing only necessary channels in the `default_channels:` list. Place the channels you want available to all users in the `default_channels:` list.

Here are some example `.condarc` configuration variations that you can use as a template for your own `.condarc` settings.

Using internal Workbench repository channels only

If you want to centralize all of your channels to the internal Workbench repository, *mirror* the external channels and packages you want into internal Workbench channels. Make your internal channels available to all users by entering them in the `default_channels:` list by name, and leave the `channel_alias:` alone.

```
# Replace <CHANNEL_NAME> with the name of an internal Workbench repository channel
conda:
    channels:
    - defaults
    default_channels:
    - <CHANNEL_NAME>
    - <CHANNEL_NAME>
    ssl_verify: /var/run/secrets/anaconda/ca-chain.pem
    channel_alias: http://anaconda-enterprise-ap-repository/repository/conda
```

Using the internal Workbench repository with external channels

Similar to the default configurations, if you would like to be able to access the internal Workbench repository channels and still provide access to specific external repository channels, enter the full URL of the external channel location(s) in the `default_channels:` list and leave the `channel_alias:` alone.

```
# Replace <CHANNEL_URL> with the full URL of an external repository channel
conda:
    channels:
```

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```
    - defaults
    default_channels:
    - <CHANNEL_URL>
    - <CHANNEL_URL>
    ssl_verify: /var/run/secrets/anaconda/ca-chain.pem
    channel_alias: http://anaconda-enterprise-ap-repository/repository/conda
```

External repository channels only

If you have a repository of channels and packages that are hosted on an external site, you can set the `channel_alias:` to the repository's fully qualified domain name (FQDN). This setup enables you to invoke channel names in conda commands using the `-c` tag. In this example, we use anaconda.org as an external repository site:

```
# Replace <ORG_NAME> with your anaconda.org organization name
# Replace <ORG_CHANNEL> with the name of an anaconda.org channel
conda:
    channels:
    - defaults
    default_channels:
    - <ORG_CHANNEL>
    - <ORG_CHANNEL>
    ssl_verify: /var/run/secrets/anaconda/ca-chain.pem
    channel_alias: https://conda.anaconda.org/<ORG_NAME>/
```

The channels you specify can be *public* or *private*. Private channels require users to authenticate via `anaconda-enterprise-cli` before they can access packages from them. For more information about channel sharing, see *sharing channels*.

Configuring a proxy for conda

You can configure Workbench to use a proxy server for conda if your organization's network security policy requires it.

Obtain your proxy values

You must know the address of your proxy server and what port you need to communicate over to proceed. Gather this information, and keep it somewhere you can reference quickly.

Verify proxy values

Test your proxy values by setting them as environment variables from within a Workbench project:

1. Log in to Workbench.
2. Open a session in the project you want to use to test the proxy.

> **Note:** If the project already has a session open, you'll need to stop the current session and open a new one.

3. Open a terminal window within JupyterLab.
4. Set and export your proxy variables by running the following commands:

```
# Replace <PROXY_URL> with the full URL of your proxy server
# Replace <PORT> with the port number you are using to communicate
# Replace <PROXY_DOMAIN> with the FQDN of your proxy server
export http_proxy=<PROXY_URL>:<PORT>
export https_proxy=<PROXY_URL>:<PORT>
export no_proxy=*<PROXY_DOMAIN>
export HTTP_PROXY=<PROXY_URL>:<PORT>
export HTTPS_PROXY=<PROXY_URL>:<PORT>
export NO_PROXY=*<PROXY_DOMAIN>
```

5. Verify the proxy works by running the following command:

```
conda create -n testenv python
```

Configure global system variables

Once you've confirmed your proxy works, follow instructions for *setting global config variables* to apply those variables to all future sessions, deployments, and scheduled jobs.

The lines you add to the global config should look something like the following, with your specific proxy address and port number substituted in:

```
http_proxy: http://proxy.example.com:1245/
https_proxy: https://proxy.example.com:1245/
no_proxy: *.example.com
HTTP_PROXY: http://proxy.example.com:1245/
HTTPS_PROXY: https://proxy.example.com:1245/
NO_PROXY: *.example.com
```

3.3.2 Managing channels and packages

Data Science & AI Workbench allows all users to create channels in the internal Workbench repository and allows users with the `ae-uploader` role to upload packages to channels that they have read-write permissions for.

Note:

- For more information about assigning user permissions, see *roles*.
- For more information about channel permissions, see *sharing channels*.
- For more information about how Workbench manages channels, see *configuring conda in Workbench*.

As an administrator, it is your responsibility to monitor and maintain the channels and packages that are available in the internal Workbench repository for your users.

Warning: Do not modify the `anaconda-enterprise` channel. Modifications to this channel can cause serious problems for the platform!

Viewing all channels

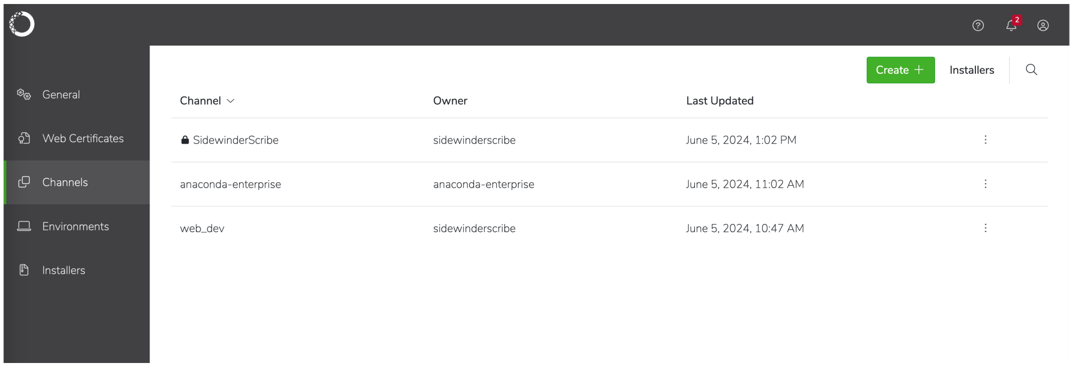
As an administrator, you are able to view and manage all channels.

1. Log in to Workbench as a user with administrator permissions.

   Tip: The `anaconda-enterprise` user has the correct permissions.

2. Open the **My Account** dropdown menu and select *Admin Console*.
3. Select **Channels** from the left-hand menu.

   The channels page displays a complete list of channels that exist within the internal Workbench repository. Each channel's owner and when the channel was last updated is displayed for all channels.



Channel	Owner	Last Updated
🔒 SidewinderScribe	sidewinderscribe	June 5, 2024, 1:02 PM
anaconda-enterprise	anaconda-enterprise	June 5, 2024, 11:02 AM
web_dev	sidewinderscribe	June 5, 2024, 10:47 AM

Note: Channels that display a lock beside their name are private. For more information about private channels, see *sharing channels*.

Creating a channel

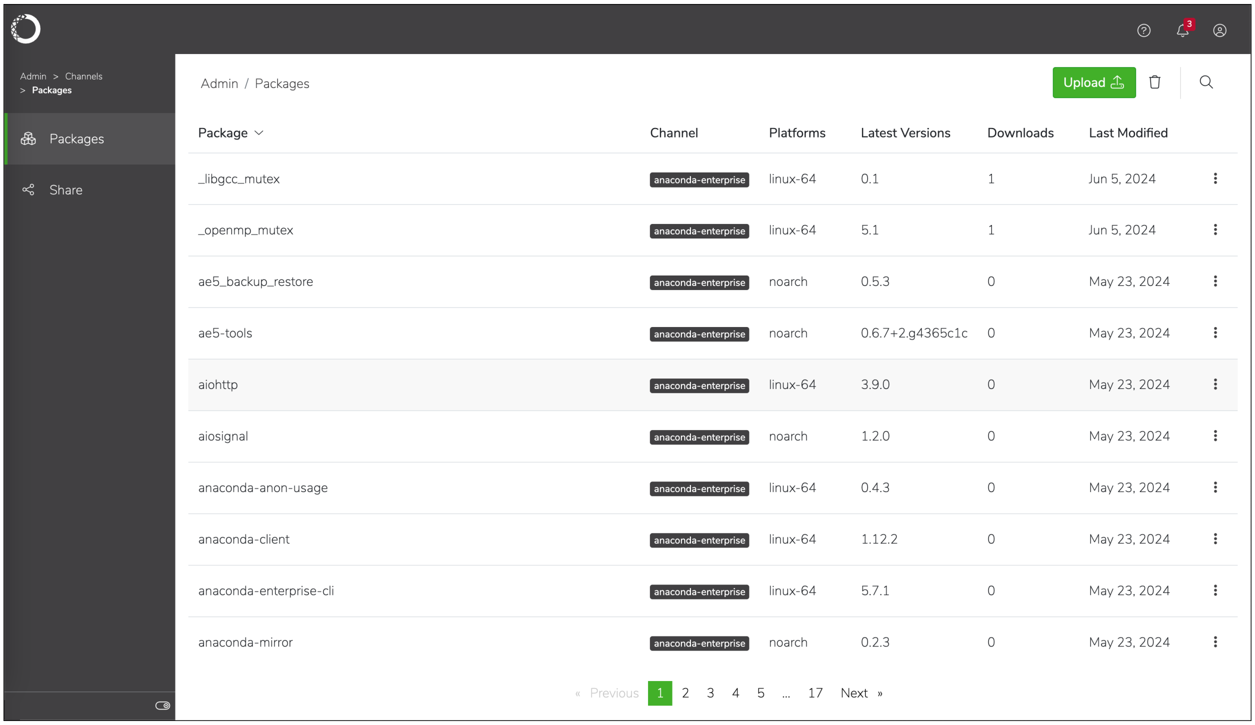
To create a channel in the internal Workbench repository:

1. Log in to Workbench.
2. Select **Channels** from the left-hand menu.
3. Click **Create** in the upper right corner.
4. Set the channel to public or private access.
5. Enter a name for the channel, then click **Create**.

Viewing channel packages

From the channels page, click on a channel name to view its packages.

You can see the supported platforms, latest versions, when each package in the channel was last modified, and the number of times each package has been downloaded.



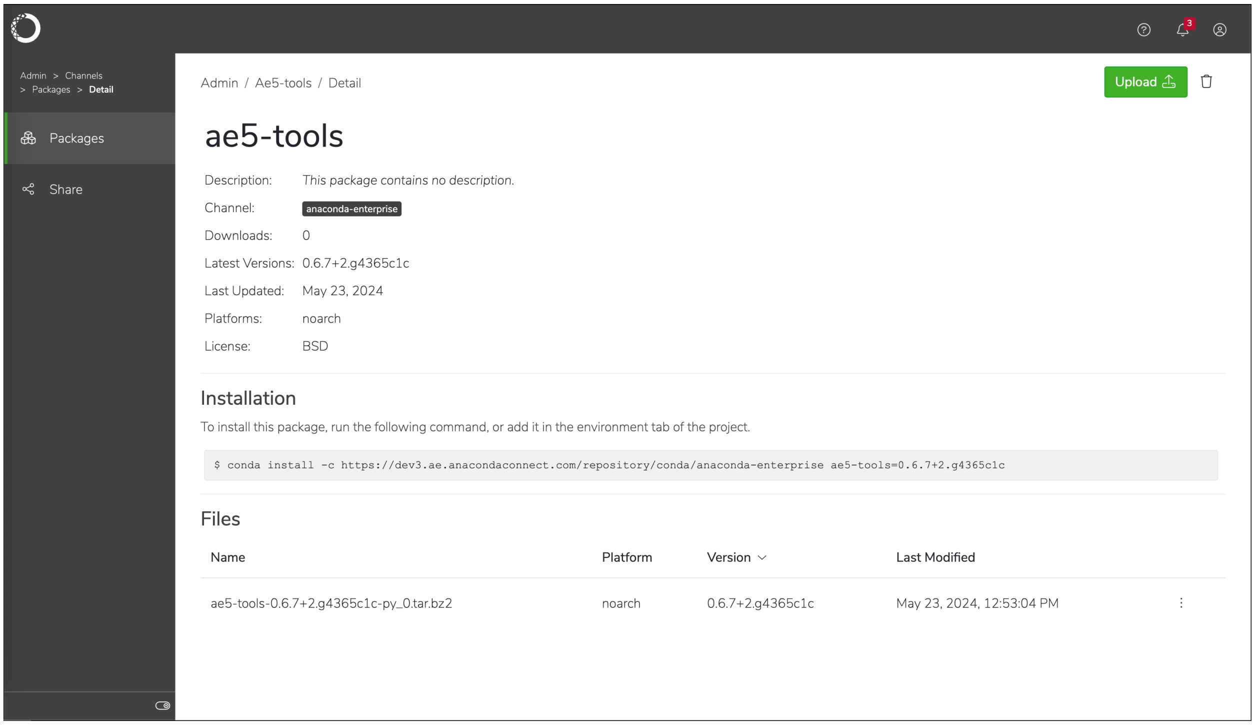
Package	Channel	Platforms	Latest Versions	Downloads	Last Modified
_libgcc_mutex	anaconda-enterprise	linux-64	0.1	1	Jun 5, 2024
_openmp_mutex	anaconda-enterprise	linux-64	5.1	1	Jun 5, 2024
ae5_backup_restore	anaconda-enterprise	noarch	0.5.3	0	May 23, 2024
ae5-tools	anaconda-enterprise	noarch	0.6.7+2.g4365c1c	0	May 23, 2024
aiohttp	anaconda-enterprise	linux-64	3.9.0	0	May 23, 2024
aiosignal	anaconda-enterprise	noarch	1.2.0	0	May 23, 2024
anaconda-anon-usage	anaconda-enterprise	linux-64	0.4.3	0	May 23, 2024
anaconda-client	anaconda-enterprise	linux-64	1.12.2	0	May 23, 2024
anaconda-enterprise-cli	anaconda-enterprise	linux-64	5.7.1	0	May 23, 2024
anaconda-mirror	anaconda-enterprise	noarch	0.2.3	0	May 23, 2024

Viewing package details

Each package in Workbench presents valuable information pertaining to the package, such as its platform architecture, version, license, number of downloads, and the last time the package was updated. You can also find a command on this page to assist you with installing the package in your environment.

From the channel packages page, select any package to view the package details page.

Tip: You can search for packages by name to locate them more efficiently.


Admin > Channels > Packages > Detail
Packages
Share
Admin / Ae5-tools / Detail
Upload

ae5-tools

Description:	*This package contains no description.*
Channel:	anaconda-enterprise
Downloads:	0
Latest Versions:	0.6.7+2.g4365c1c
Last Updated:	May 23, 2024
Platforms:	noarch
License:	BSD

Installation

To install this package, run the following command, or add it in the environment tab of the project.

```
$ conda install -c https://dev3.ae.anacondaconnect.com/repository/conda/anaconda-enterprise ae5-tools=0.6.7+2.g4365c1c
```

Files

Name	Platform	Version	Last Modified
ae5-tools-0.6.7+2.g4365c1c-py_0.tar.bz2	noarch	0.6.7+2.g4365c1c	May 23, 2024, 12:53:04 PM

Uploading a package to a channel

To add a package to an existing channel:

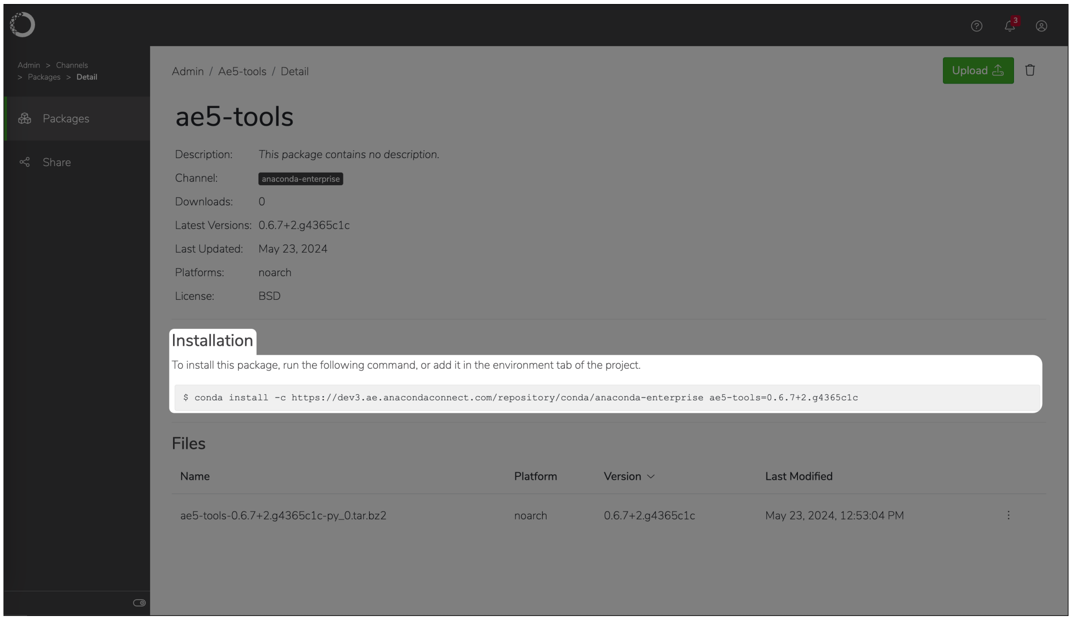
1. From the channels page, click on a channel name to view its packages.
2. Click **Upload** .
3. Click **Browse** and locate the package in your file system.
4. Click **Upload**.

Note: There is a 1GB file size limit for package file uploads.

Installing a package from a channel

To install a package from an internal Workbench channel:

1. From the channels page, click on a channel name to view its packages.
2. Select any package to view the package details page.
3. Copy the installation command provided.
4. Run the copied command in the environment you want to install the package in.



Admin / Ae5-tools / Detail

ae5-tools

Description:	*This package contains no description.*
Channel:	anaconda-enterprise
Downloads:	0
Latest Versions:	0.6.7+2.g4365c1c
Last Updated:	May 23, 2024
Platforms:	noarch
License:	BSD

Installation

To install this package, run the following command, or add it in the environment tab of the project.

```
$ conda install -c https://dev3.ae.anacondaconnect.com/repository/conda/anaconda-enterprise ae5-tools=0.6.7+2.g4365c1c
```

Files

Name	Platform	Version	Last Modified
ae5-tools-0.6.7+2.g4365c1c-py_0.tar.bz2	noarch	0.6.7+2.g4365c1c	May 23, 2024, 12:53:04 PM

Removing a package from a channel

To remove a package from an internal Workbench channel:

1. From the channels page, click on a channel name to view its packages.
2. Open the package's actions dropdown menu, then select *Delete*.
3. Click **Delete**.

Sharing channels

There are two types of channels within the internal Workbench repository, public and private. Channels are set to public access by default.

Sharing public channels

Public channels are accessible by non-authenticated users. In other words, people that do not have access to Workbench can still access packages in the internal Workbench repository channels.

To share a public channel:

1. From the channels page, click on a channel name to view its details.
2. Select **Share** from the left-hand navigation.
3. Copy the channel address and distribute it to individuals who need access to the channel.

Sharing private channels

Private channels are accessible only to other Workbench users that you have added as collaborators to the channel.

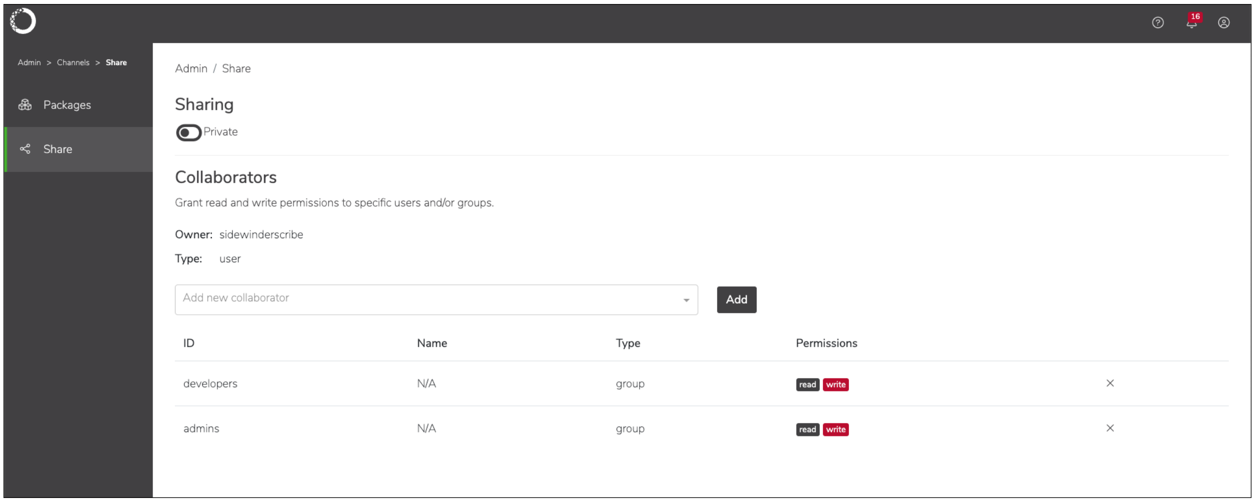
To mark a channel as private:

1. From the channels page, click on a channel name to view its details.
2. Select **Share** from the left-hand navigation.
3. Set the **Sharing** toggle to **Private**.

To share a private channel with other Workbench users:

1. From the channels page, click on a channel name to view its details.
2. Select **Share** from the left-hand navigation.
3. Begin typing a user or group name in the **Add New Collaborator** dropdown to search for matches. Select the correct entry, then click **Add**.

Note: By default, collaborators are granted read-write access to your shared channel. If you want to prevent collaborators from adding or removing packages in your channel, you'll need to *restrict them to read-only access using the CLI*.



Sharing

Private

Collaborators

Grant read and write permissions to specific users and/or groups.

Owner: sidewinderscribe

Type: user

Add new collaborator

ID	Name	Type	Permissions	
developers	N/A	group	read write	×
admins	N/A	group	read write	×

Managing channels using the CLI

Log in to the CLI before you begin attempting to manage channels.

Creating a channel

Create a new channel in the internal Workbench repository by running the following command:

```
# Replace <CHANNEL_NAME> with the name of the channel you want to create
anaconda-enterprise-cli channels create <CHANNEL_NAME>
```

Uploading a package to a channel

Upload a conda package to a channel by running the following command:

```
anaconda-enterprise-cli upload --channel <path/to/package>
```

Listing all channels

Get a list of all the channels on the platform with the `channels list` command:

```
anaconda-enterprise-cli channels list
```

Sharing channels

Share and manage permissions for channels with the `share` command:

Share with user

```
# Replace <CHANNEL_NAME> with the name of the channel you want to share
# Replace <USERNAME> with the username of the user you want to share the channel with
anaconda-enterprise-cli channels share --user <USERNAME> <CHANNEL_NAME>
```

Share with group

```
# Replace <CHANNEL_NAME> with the name of the channel you want to share
# Replace <GROUP_NAME> with the name of group you want to share with
anaconda-enterprise-cli channels share --group <GROUP_NAME> <CHANNEL_NAME>
```

Note: By default, sharing a channel with a user or group provides them with read-write access to the channel. Restrict access to the channel to read-only by including `--level r` before the <CHANNEL_NAME>.

For example:

```
anaconda-enterprise-cli channels share --group <GROUP_NAME> --level r <CHANNEL_NAME>
```

Revoking channel access

Revoke a user's or a group's access to a channel by running one of the following commands:

Revoke user access

```
# Replace <CHANNEL_NAME> with the name of the channel you want to revoke access to
# Replace <USERNAME> with the username of the user whose access you want to revoke
anaconda-enterprise-cli channels share --user <USERNAME> --remove <CHANNEL_NAME>
```

Revoke group access

```
# Replace <CHANNEL_NAME> with the name of the channel you want to revoke access to
# Replace <GROUP_NAME> with the name of the group whose access you want to revoke
anaconda-enterprise-cli channels share --group <GROUP_NAME> --remove <CHANNEL_NAME>
```

Setting a default channel

The `default_channel` value is not set when `anaconda-enterprise-cli` is installed. This means every time you run an `upload` command, you need to supply a specific channel name.

If you don't want to include the `--channel` option with each command, set a default channel by running the following command:

```
# Replace <CHANNEL_NAME> with the name of the channel you want to upload to by␣
↪default
anaconda-enterprise-cli config set default_channel <CHANNEL_NAME>
```

View your current default channel by running the following command:

```
# Replace <CHANNEL_NAME> with the name of the channel you want to upload to by␣
↪default
anaconda-enterprise-cli config get default_channel '<CHANNEL_NAME>'
```

Note: For more information about actions you can take with channels in the CLI, run the following command:

```
anaconda-enterprise-cli channels --help
```

3.3.3 Mirroring channels and packages

Data Science & AI Workbench enables you to create local copies of a repositories so users can access packages from a centralized, on-premise location. This process is called mirroring. You can mirror the full content of a repository, or include only specific packages or types of packages from the repository in your mirror. You can also create mirrors in an air-gapped network improve performance and security.

You can mirror an online repository, or you can use a tarball containing package data to populate a channel in Workbench.

Prerequisites:

- Follow the steps for *administration server setup* on your current machine to install the necessary tools for mirroring.
- *Configure the Workbench CLI*.

Note: It can take several hours to mirror an entire repository, depending on its size.

Creating a conda mirror

The basic steps for creating a conda mirror are:

1. *Prepare your mirror configuration file*.
2. *Log in to the Workbench CLI*.
3. *If necessary, create a channel in the internal Workbench repository*.
4. Initiate the mirror by running the following command:

   ```
   anaconda-mirror-ae5 --file /path/to/<mirror.yaml>
   ```

   Note: Append `--dry-run` to the command to see what actions *would* be taken by the mirror, without performing actual modifications.

Preparing your mirror configuration file

Create a `<mirror>.yaml` file that details the configurations for the mirror.

Tip: You can name this file whatever you'd like. Anaconda recommends naming it the same as the channel you are mirroring to.

Basic configurations:

Define source channel locations, package platforms, and destination/storage location details. Manage package formats, clean up outdated packages, and test configurations without applying changes by including these configurations.

Parameter	Description
channels	List of URLs for channels you want to mirror from. If a short channel name is supplied, Workbench uses its system-level .condarc file's channel_alias: value to complete the channel URL.
platforms	List of platforms you want to mirror packages for. For example, win-64 or linux-64. If no value is supplied, the mirror will include packages for all platforms available on the source channel.
dest_channel	The short name for the internal Workbench repository channel you are mirroring to. The rest of the channel URL is automatically completed by anaconda-enterprise-cli for you.
dest_site	The web address or path where you want to store your mirrored packages. The specific formatting and necessity of this value depends on the type of destination repository. For more information, see *repository-specific configurations*.
format_policy	Determines how the mirror manages .conda and .tar.bz2 files: • prefer-conda or prefer-tarbz2 - Mirror one package format over the other if both are available for a package. If the preferred type is unavailable, the other file type is still downloaded. • only-conda or only-tarbz2 - Mirror packages that are available in the preferred file format only. • transmute-conda or transmute-tarbz2 - Convert packages to the preferred format as necessary. *Requires the* conda-package-handling *package to function*. • keep-both - Mirror both file types for all available packages. Defaults to prefer-conda for repositories that support .conda formatting and only-tarbz2 for those that do not. If your repository does not support .conda formatting, Anaconda recommends installing the conda-package-handling package and using the transmute-tarbz2 option.
clean	true / false - If true, removes packages from the destination channel that are not on the source channel when updating. Default: false (to ensure packages are not inadvertently removed)
dry_run	true / false - If true, outputs what actions *would* be taken by the mirror, without performing actual modifications. Default: false

Filtering configurations:

Fine-tune which packages are included in the mirror. Specify versions of Python or R packages that your packages should be compatible with, include only specific packages, or exclude packages by name and license family type.

Parameter	Description
python_versions	A comma-separated list of Python versions. Restricts all Python packages and packages that depend on Python to these versions.
r_versions	A comma-separated list of R versions. Restricts all R packages and packages that depend on R to these versions.
pkg_list	List of package names or valid MatchSpec strings. If supplied, only the specified packages will be mirrored, not their dependencies. Cannot be paired with license_exclude, exclude, or include.
license_exclude	List of license families to exclude from the mirror. To see a list of valid license families, use the anaconda-mirror-ae5 --help command. Cannot be paired with pkg_list.
exclude	List of package names or valid MatchSpec strings to exclude. Cannot be paired with pkg_list.
include	List of package names or valid MatchSpec strings to override the mirror's other filters and include these packages even if they would otherwise be filtered out. Cannot be paired with pkg_list.

Note: For more information about MatchSpec, see package match specifications.

Advanced configurations:

Configure repository authentication, enforce platform restrictions, and manage SSL verification for secure connections.

Parameter	Description
username / password	Supplies credentials for repository authentication. For more information, see *repository-specific configurations*.
strict_platforms	true / false - If true, excludes noarch from the mirror. Default: false (all platforms use noarch)
max_attempts	Number of retry attempts for failed connections. Default: 5
max_failures	Number of failed transactions before stopping. Default: 100
verify_ssl	true / false - Enables or disables SSL verification. Default: true

Note: If Workbench is installed in a proxied environment, see *Configuring conda in Workbench* for information on setting the NO_PROXY variable.

Repository-specific configurations

JFrog Artifactory

For Artifactory destinations, the dest_site can be a repository hostname, or a full URL.

Hostname

If you supply the hostname only, anaconda-mirror interprets the channel path as:

```
https://<dest_site>/artifactory/<dest_channel>
```

URL

If you supply a URL, anaconda-mirror appends /artifactory/dest_channel to it to complete the channel path. For example, if you set the dest_site to https://example.site.com, the full path is interpreted as this:

```
https://example.site.com/artifactory/<dest_channel>
```

If your mirror is not at this location, further pathing can be included in the URL to reach the correct location. For example, if you set dest_site as https://example.site.com/artifactory/repo/subpath/, it will interpret the path literally and append the dest_channel value to the end:

```
https://example.site.com/artifactory/repo/subpath/<dest_channel>
```

To authenticate to a JFrog Artifactory repository:

- Configure the `username` and `password` values in your `.yaml` file to contain your credentials. If both values are supplied, they are delivered using basic HTTP authentication. You can substitute an access token for your password if necessary.
- Configure just the `password` value in your `.yaml` file. This is delivered as a bearer token using the `Authorization: Bearer` header. This *must* be an access token.
- Configure your `.netrc` file to store your `username` and `password` for the repository. These values are delivered using basic HTTP authentication.

S3 bucket

For Simple Storage Service (S3) buckets, the channel path is a concatenation of the `dest_site` and `dest_channel` values.

For example, if you were mirroring to an S3 bucket, your `dest_site` would be set to `<bucket_name>/full/path/to/` and the full channel path is interpreted as:

```
<bucket_name>/full/path/to/<dest_channel>
```

Authentication to an S3 source is currently controlled entirely by the environment. For example, you can use the `aws` CLI tool to configure the target region and authenticate. You may wish to use the `AWS_PROFILE` environment variable to select among multiple configurations.

Local

Much like the S3 bucket, the local repository channel path consists of a concatenation of the `dest_site` and `dest_channel` values.

No authentication is necessary for local repositories.

anaconda-enterprise-cli

The `dest_site` value defaults to the `<SITE_NAME>` value established when you *configure the workbench CLI*. If you have only configured the CLI to be able to access one site (i.e. your Workbench instance), there is no need to specify this value.

Authentication is handled when you log in to the CLI.

Example conda and R mirrors

Here are some example mirror `.yaml` files you can use to mirror some common repositories:

Anaconda's main channel (full)

```
dest_channel: main
channels:
  - https://repo.anaconda.com/pkgs/main
platforms:
  - linux-64
```

Anaconda's R channel (full)

```
dest_channel: r
channels:
  - https://repo.anaconda.com/pkgs/r
platforms:
  - linux-64
```

Air-gapped network mirror

```
dest_channel: anaconda
channels:
  - /file/path/to/unpacked/repository/packages
platforms:
  - linux-64
```

Mirroring a PyPI repository

The full PyPI mirror size is currently close to 10TB, so ensure that your file storage location has sufficient disk space before proceeding.

Because `anaconda-mirror` does not handle `.pip` package formatting, mirrors for PyPI repositories containing such packages are managed by the `anaconda-enterprise-cli` tool.

The steps are identical to creating a conda mirror:

1. *Prepare your mirror configuration file*.
2. *Log in to the Workbench CLI*.
3. *If necessary, create a channel in the internal Workbench repository*.
4. Initiate the mirror by running the following command:

   ```
   anaconda-enterprise-cli mirror pypi --config pypi-mirror.yaml
   ```

This command loads the packages on `https://pypi.org` into the user's account.

Mirrored packages can be viewed at `https://<FQDN>/repository/pypi/pypi/simple/`, replacing `<FQDN>` with the fully qualified domain name of your installation of Workbench. (The second `pypi` in the url should match the `user` configuration value described below.)

PyPI configurations:
PyPI mirror `.yaml` configuration values consist of the following:

Parameter	Description
user	The local user under which the PyPI packages are imported. Default: pypi
pkg_list	List of package names to mirror. If supplied, only the specified packages will be mirrored, not their dependencies. Cannot be paired with blocklist or allowlist.
allowlist	List of package names to mirror. If supplied, only the specified packages will be mirrored, not their dependencies. Cannot be paired with pkg_list.
blocklist	List of package names to skip. Packages listed here are not mirrored. Cannot be paired with pkg_list.
latest_only	If supplied, only the latest package versions are mirrored. Default: false
remote_url	The URL of the PyPI mirror. /pypi is appended to build the XML RPC API URL, /simple for the simple index and /pypi/{package}/{version}/json for the JSON API. Default: https://pypi.python.org/
xml_rpc_api_url	A custom value for XML RPC URL. If this value is present, it takes precedence over the URL built using remote_url. Default: null.
simple_index_url	A custom value for the simple index URL. If this value is present, it takes precedence over the URL built using remote_url. Default: null.
use_xml_rpc	Whether to use the XML RPC API as specified by PEP381. If this is set to true, the XML RPC API is used to determine which packages to check. Otherwise, the script falls back to the simple index. If the XML RPC fails, the simple index is used. Default: true
use_serial	If set to true, uses the serial number provided by the XML RPC API. Only packages updated since the last serial saved are checked. If this is set to false, all PyPI packages are checked for updates. Default: true
create_org	Creates the mirror user as an organization instead of a regular user account. All superusers are added to the **Owners** group of the organization. Default: false

Note: All mirrored PyPI-like channels are publicly available to pull packages from both inside and outside Workbench (no authentication is required).

Example PyPI mirror (partial)

```
allowlist:
  - requests
  - six
  - numpy
  - simplejson
latest_only: true
remote_url: https://pypi.org/
use_xml_rpc: true
```

Configuring pip

To configure pip to use this new mirror, create `pip.conf` as follows:

```
# Replace <WORKBENCH_URL> with the actual URL to your Workbench instance
[global]
index-url=<WORKBENCH_URL>/repository/pypi/pypi/simple/
```

To configure Workbench sessions and deployments to automatically use the `pip.conf`, run the following command.

```
anaconda-enterprise-cli spark-config --config /etc/pip.conf pip.conf
```

For more specific information on configuring pip, see the official pip documentation.

3.4 Configuring persistent environments and sample projects

When you create a new project in Data Science & AI Workbench, you must select a template environment for the project. Anaconda provides several template Anaconda environments, along with Python, R, or Hadoop-Spark environments for you to choose from.

If these environments do not suit your needs, you can create new environments and provide them for your users in one of two locations. These "persistent" environments can be placed in the list of template environments that are available upon project creation or in the sample projects gallery for users to clone.

Creating and managing your environments using the process outlined here ensures they are pre-solved and fixed, which not only guarantees consistent operation across different projects and deployments, but also shields the environments from the variability introduced by updates to software dependencies and changes to the conda resolver itself.

This results in stable, reliable bases for your team. For more information and best practices for managing environments, see *Managing environments for reproducibility*.

3.4.1 Creating your environment

1. Log in to Workbench as a user with administrator permissions.

   Tip: The `anaconda-enterprise` user has the proper permissions.

2. Click **Create** and select *New Project*.
3. Select any **Environment** and **Resource Profile**, then click **Create**.
4. Open a session for the project.
5. Open a terminal in the project session.
6. Configure conda to create new environments in the environments directory by running the following command:

   ```
   export CONDA_ENVS_DIRS=/opt/continuum/envs
   export CONDA_PKGS_DIRS=/opt/continuum/envs/.pkgs
   ```

7. Use conda to create or clone your environment.

Create an environment

Here is an example command for creating a conda environment:

```
# Replace <ENV_NAME> with a name for your new environment
conda create -y -n <ENV_NAME> python=3.8 ipykernel
```

Clone an environment

Here is an example command for cloning a conda environment:

```
# Replace <CLONE_ENV> with the name of the environment you want to clone
# Replace <ENV_NAME> with a name for your new environment
conda create -y --clone <CLONE_ENV> --name <ENV_NAME>
```

Caution: `python` and `ipykernel` *must* be included in every environment you create for Workbench.

3.4.2 Providing your environment to users

There are two methods for providing your environment to your users:

- Place the environment in the sample projects gallery and allow other users to clone the environment as a project.
- Include the environment as an available option in the **Environment** dropdown when creating a new project.

Both of these methods are accomplished by creating a project template archive (`.tar.bz2`) file that uses the environment you just created, and then placing the file in the correct directory.

The project template archive file must contain, at a minimum, the `anaconda-project.yml` file. For more information and help building projects, see the official Anaconda Project documentation.

1. In your terminal, navigate to the project directory by running the following command:

   ```
   cd /opt/continuum/project
   ```

2. Create a directory to store an `anaconda-project.yml` file for your custom environment by running the following command:

   ```
   # Replace <PROJECT> with the name of your project
   mkdir <PROJECT>
   ```

3. Create a copy of your current project's `anaconda-project.yml` file in the directory you just created by running the following command:

   ```
   # Replace <PROJECT> with the name of your project
   cp anaconda-project.yml <PROJECT>
   ```

4. Enter the project directory you just created by running the following command:

   ```
   # Replace <PROJECT> with the name of your project
   cd /opt/continuum/project/<PROJECT>
   ```

5. Using your preferred file editor, edit the `anaconda-project.yml` file in your project directory to represent your custom environment. This involves updating the `name:`, `description:`, `packages:`, and `env_specs:` sections of the file.

   Tip: Delete the commented section below `env_specs:` showing available packages. It is likely that these do not align with your custom environment.

   Note: Your project's `name:` will display on the **Sample Projects** grid *or* the **Environments** drop-down list after the project is created.

Example anaconda-project.yml

```
# Replace <PROJECT> with your projects name
# Replace <A_BRIEF_DESCRIPTION> with a description of your environment
# Replace <ENV_NAME> with the name of the environment you created or cloned

name: <PROJECT>

description: <A_BRIEF_DESCRIPTION>

packages:
    - python=3.8
    - ipykernel

platforms:
    - linux-64

env_specs:
    <ENV_NAME>: {}
```

6. Create an archive file for the project, then set permissions for it by running the following commands:

```
# Replace <PROJECT> with your project name
cd /opt/continuum/project
tar cfj <PROJECT>.tar.bz2 <PROJECT>
chmod 644 <PROJECT>.tar.bz2
```

   Note: This archive file is the template that other projects will use as a starting point for their own projects.

7. Move your project archive file to the sample project gallery by running the following command:

```
# Replace <PROJECT> with your project name
mv /opt/continuum/project/<PROJECT>.tar.bz2 /gallery
```

8. Enter the sample gallery directory by running the following command:

```
cd /gallery
```

9. (Optional) If you want to include the environment as an available option in the **Environment** dropdown when creating a new project, add the project archive file name (`<PROJECT>.tar.bz2`) to the `TEMPLATES` file. Save and close the file when complete. Otherwise, skip this step.

10. Update the sample projects gallery to include your project by running the following command:

    ```
    python reindex.py
    ```

11. Verify that you can either find and select your sample project on the **Sample Projects** page, or select your environment from the **Environment** dropdown when creating a new project.

3.5 Generating custom Anaconda installers

As an Data Science & AI Workbench Administrator, you can *create custom environments*. These environments include specific packages and their dependencies. You can then *create a custom installer* for the environment, that can be shipped to HDFS and used in Spark jobs.

Custom installers enable IT and Hadoop administrators to maintain close control of a Hadoop cluster while also making these tools available to data scientists who need Python and R libraries. They provide an easy way to ship multiple custom Anaconda distributions to multiple Hadoop clusters.

3.5.1 Creating an environment

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Environments** from the left-hand navigation.
3. Click **Create**, give the environment a unique name, and then click **Save**.

    Note: Environment names can contain alphanumeric characters and underscores only.

4. Select the channel you want to choose packages from, then select the specific packages—and version of each—you want to include in the installer.
5. Click **Save** to create the environment. Workbench resolves all the package dependencies and displays the environment in the list.

    Note: If there is an issue resolving the dependencies, you'll be notified and prompted to edit the environment.

You can now use the environment as a basis for creating additional versions of the environment or other environments.

Editing an existing environment

1. Click on an environment name to view details about the packages included in the environment, then click **Edit**.
2. Change the channels and/or packages included in the environment, and enter a version number for the updated package before clicking **Save**. The new version is displayed in the list of environments.

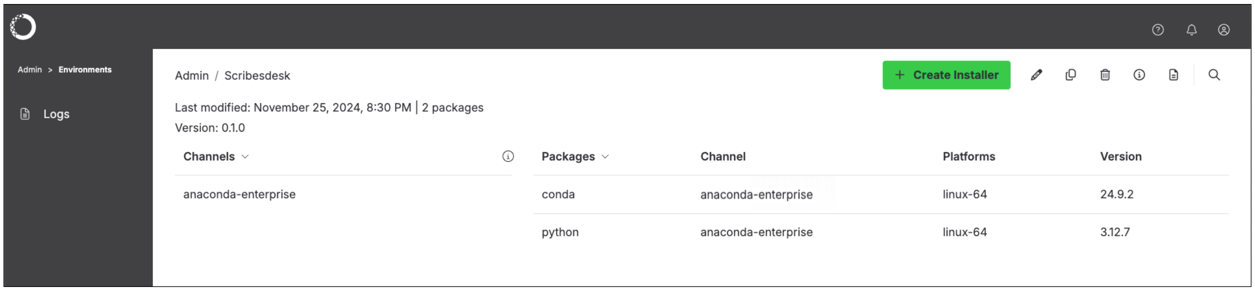
3.5.2 Creating a custom installer for an environment

Select the environment in the list, click **Create installer**, and then select the type of installer you want to create. Workbench creates the installer and displays it in the **Installers** list.

Note:

- *If you created a management pack*: Install it on your Hortonworks HDP cluster and add it to your local Ambari server to make it available to users. For more information, see this blog post about generating custom management packs.
- *If you created a parcel*: Install it on your CDP cluster to make it available to users, or directly download the parcel onto your CDP cluster as described here.

Use the icons at the top of the page to manage your environment. You can edit, duplicate, delete, and view logs and resolved packages for the selected environment.



Admin / Scribesdesk

Last modified: November 25, 2024, 8:30 PM | 2 packages
Version: 0.1.0

Channels
anaconda-enterprise

Packages	Channel	Platforms	Version
conda	anaconda-enterprise	linux-64	24.9.2
python	anaconda-enterprise	linux-64	3.12.7

3.6 Project session management

Effective project session management is essential for optimizing resource utilization and ensuring fair access to compute resources in Workbench. As an administrator, you can set thresholds on the number of active sessions a user is allowed to have open simultaneously, preventing any single user from monopolizing resources. Additionally, you can define thresholds for how long sessions are allowed to remain idle—in days and hours—before being automatically terminated by the system. You can also terminate active sessions manually, if necessary.

3.6.1 Viewing project session settings

To view a list of currently open sessions:

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Sessions** from the left-hand navigation.
3. Select the **Settings** tab.

Note: Project session settings cannot be configured from the application UI.

3.6.2 Configuring project session thresholds

Workbench includes either a `values.k3s.yaml` or a `values.byok.*.yaml` (depending on your implementation) file that overrides the default values in the top-level Helm chart. If you are performing your initial configurations, use the example below to add the `idleSessionControl:` and `activeSessionLimit:` sections to the bottom of your file, then continue your environment preparation and installation.

Otherwise, follow the steps for *Setting platform configurations using the Helm chart* to add or update the `idleSessionControl:` and `activeSessionLimit:` configurations to the bottom of the `helm_values.yaml` file, as needed for your system setup:

Session threshold example

```
# Idle session termination control
idleSessionControl:
  # -- The granularity of the idle time (measured in integer hours).
  # @section -- Idle Session Control
  # -- Idle session expiration threshold (measured in days).
  # @section -- Idle Session Control
  cleanupThreshold: '5 days'

# -- The maximum number of sessions a user may run concurrently.
# @section -- Active Session Control
activeSessionLimit: 15
```

Note: By default, the system is globally configured to limit users to *20 active sessions*, which are allowed to idle for up to *seven days* before being terminated.

Session management can also be customized per *workload resource profile*, meaning that you can apply different thresholds to each resource profile if necessary. For example, because GPU resources generally cost more than CPU resources, applying a shorter idle time threshold to the GPU-associated resource profiles can lead to significant cost savings while also ensuring that these resources are available for the users who require them. For more information, see the `GPU with limited idle time threshold example` provided in the resource profile examples.

3.6.3 Viewing active sessions

To view a list of currently open sessions:

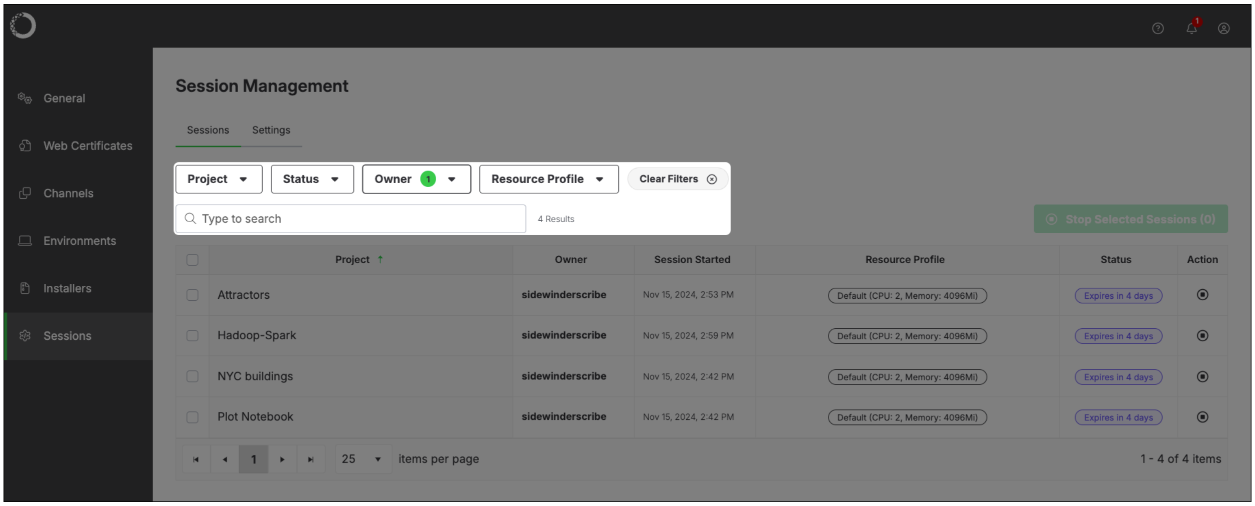
1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Sessions** from the left-hand navigation.

3.6.4 Filtering active sessions

Search for projects by name, or use the filter categories efficiently locate project sessions.

Note:

- Click on the table headers to sort the displayed sessions.
- Reselect any filter or click **Clear Filters** to remove them and reset the table.



Session Management

4 Results

□	Project ↑	Owner	Session Started	Resource Profile	Status	Action
□	Attractors	sidewinderscribe	Nov 15, 2024, 2:53 PM	Default (CPU: 2, Memory: 4096Mi)	Expires in 4 days	⦿
□	Hadoop-Spark	sidewinderscribe	Nov 15, 2024, 2:59 PM	Default (CPU: 2, Memory: 4096Mi)	Expires in 4 days	⦿
□	NYC buildings	sidewinderscribe	Nov 15, 2024, 2:42 PM	Default (CPU: 2, Memory: 4096Mi)	Expires in 4 days	⦿
□	Plot Notebook	sidewinderscribe	Nov 15, 2024, 2:42 PM	Default (CPU: 2, Memory: 4096Mi)	Expires in 4 days	⦿

3.6.5 Stopping sessions

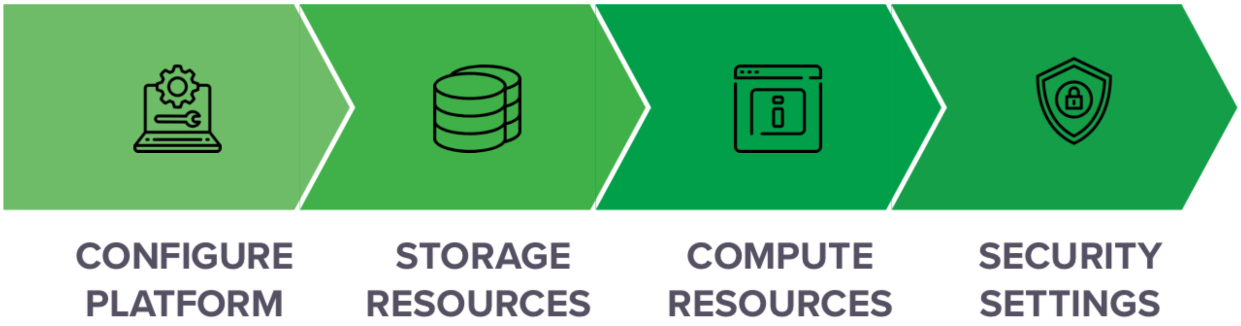
Stopping a project session terminates the pod running that session, releasing its compute resources back to the cluster. Select the sessions you would like to terminate, then click **Stop Selected Sessions**.

> **Warning:** If you stop an active project session, anyone using that project will receive a `Directory not found` error and lose all in-progress work.

3.7 Advanced platform settings

After installing Data Science & AI Workbench, there are default settings that you may want to update with information specific to your installation, including the *password for the database* and the *redirect URLs* for the Workbench platform.

- If you've *installed Livy server*, you'll need to *configure it to work with the platform* so users can access your Hadoop Spark cluster.
- If your organization already uses a repository such as GitHub, Bitbucket, or GitLab for version control, you can *configure Workbench to use that repository* instead of the internal Git server.
- You can also *add one or more NFS shares* to your organization's configuration for platform users to store data and source code. They can then access these resources within their sessions and deployments.
- You may want to *replace the self-signed certificates generated during installation* with your organization's own certificates—or change other default security settings—after initial installation.



3.7.1 Configuring platform settings

Global configurations:

- The Authentication Center client URL
- The internal database
- Optional NFS server volume mounts
- HTTPS certificate settings
- Resource profiles
- The Kubernetes cluster
- Any users, groups, or roles with Admin authorization
- The git commit file size limit (Anaconda recommends keeping files under 50MB)

Per-Service configurations:

- The authentication server used to secure access
- The deployment server used to deploy apps
- The workspace server used to run sessions
- The storage server used to store and version projects

- The local repository server used for channels and packages
- The S3 endpoint and Git server used to store object and data
- The local documentation server URL and platform UI configuration
- System metrics from Prometheus
- Alert management
- Grafana dashboard visualizations

Setting platform configurations using the Helm chart

This is the preferred and recommended method for updating platform configurations.

Anaconda's Kubernetes Helm chart encapsulates application definitions, dependencies, and configurations into a single `values.yaml` file. This file contains both global and per-service settings for the platform. For more information about how Workbench uses Helm and to view the default Helm chart template, see *Helm chart*.

To make configuration changes to the platform:

1. Connect to your instance of Workbench.
2. Save your current configurations using the `extract_config.sh` script by running the following command:

   ```
   # Replace <NAMESPACE> with the namespace Workbench is installed in
   NAMESPACE=<NAMESPACE> ./extract_config.sh
   ```

   Note: The `extract_config.sh` script creates multiple files and saves them in the directory where the script was run. You need the `helm_values.yaml` file.

3. Verify that the information captured in `helm_values.yaml` file contains your current cluster configuration settings.
4. Update the `helm_values.yaml` file to include or alter your cluster configurations, then save your changes.
5. Perform a Helm upgrade by running the following command:

   ```
   helm upgrade --values ./helm_values.yaml anaconda-enterprise ./Anaconda-
   ↪Enterprise/
   ```

Setting platform configurations using the config map

Workbench platform settings can also be managed by the `anaconda-enterprise-anaconda-platform.yml` config map, though this is *no longer the recommended method for platform configuration updates*.

1. Connect to your instance of Workbench.
2. Create a backup of your current configmap file, then edit your configurations by running the following commands:

BYOK8s

Run the commands from anywhere you have `kubectl` access to the cluster:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl get cm -n <NAMESPACE> anaconda-enterprise-anaconda-platform.yml -
↪o=jsonpath={.data."anaconda-platform\.yml"} > anaconda-platform.yml
kubectl delete cm -n <NAMESPACE> anaconda-enterprise-anaconda-platform.yml
kubectl create cm -n <NAMESPACE> anaconda-enterprise-anaconda-platform.yml -
↪-from-file anaconda-platform.yml
```

Gravity

Run the following commands in an interactive shell *on the master node*:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
sudo gravity enter
kubectl get cm -n <NAMESPACE> anaconda-enterprise-anaconda-platform.yml -
↪o=jsonpath={.data."anaconda-platform\.yml"} > anaconda-platform.yml
kubectl delete cm -n <NAMESPACE> anaconda-enterprise-anaconda-platform.yml
kubectl create cm -n <NAMESPACE> anaconda-enterprise-anaconda-platform.yml -
↪-from-file anaconda-platform.yml
```

3. Make your changes to the file, then save it.

4. Restart all pods using the following command:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep␣
↪ap-)
```

Tip: If something goes wrong with your configuration updates, you can restore your previous configurations by re-running the following commands:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete cm -n <NAMESPACE> anaconda-enterprise-anaconda-platform.yml
kubectl create cm -n <NAMESPACE> anaconda-enterprise-anaconda-platform.yml --
↪from-file anaconda-platform.yml
```

3.7.2 Setting global config variables

Data Science & AI Workbench provides a secondary config map (`anaconda-enterprise-env-var-config`) that you can use to configure the platform. Any environment variables added to this config map will be available to all sessions, deployments, and scheduled jobs. This is a convenient alternative to using the Workbench CLI, as you can add any variable supported by conda configuration.

To make global configuration changes to the platform:

1. Create a backup of your current configmap file, then edit your configurations by running the following commands:

BYOK8s

Run the following commands from anywhere you have `kubectl` access to the cluster:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl get cm -n <NAMESPACE> anaconda-enterprise-env-var-config -
↪o=jsonpath={.data."container-env-vars\.yml"} > container-env-vars.yaml
kubectl edit cm -n <NAMESPACE> anaconda-enterprise-env-var-config
```

Gravity

Run the following commands in an interactive shell *on the master node*:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
sudo gravity enter
kubectl get cm anaconda-enterprise-env-var-config -o yaml > anaconda-env-
↪var-config.yaml
kubectl edit cm -n <NAMESPACE> anaconda-enterprise-env-var-config
```

2. Make your changes to the file, then save it.
3. Restart all pods using the following command:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep␣
↪ap-)
```

Tip: If something goes wrong with your configuration updates, you can restore your previous configurations by re-running the following commands:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete cm -n <NAMESPACE> anaconda-enterprise-env-var-config
kubectl create cm -n <NAMESPACE> anaconda-enterprise-env-var-config --from-
↪file anaconda-env-var-config.yml
```

3.7.3 Changing the database password

You can change the password for the Data Science & AI Workbench database as needed, to adhere to your organization's policies. To do so, you'll need to connect to the associated pod, make the change, and update the platform with the new password.

1. Run the following command to determine the id of the postgres pod:

```
kubectl get pod | grep postgres
```

2. Run the following command to connect to the postgres pod, where `<id>` represents the id of the pod:

```
kubectl exec -it anaconda-enterprise-postgres-<id> /bin/sh
```

3. Run this `psql` command to connect to the database:

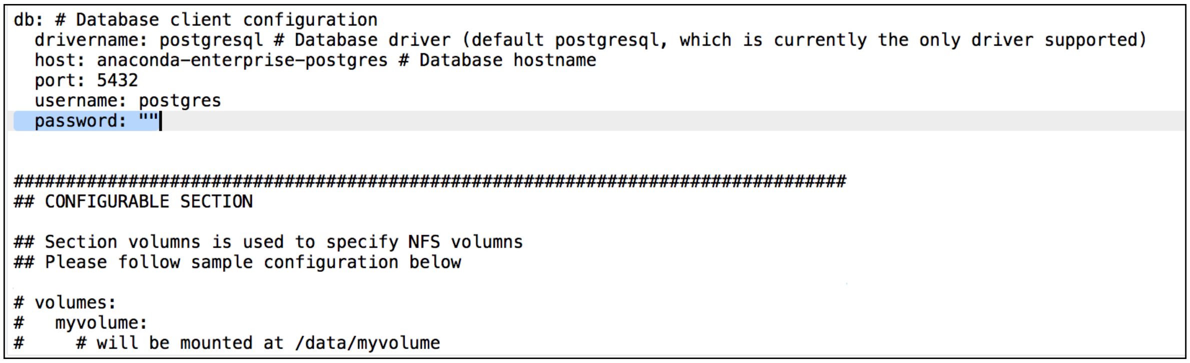
```
psql -h localhost -U postgres
```

4. Set the password by running the following command:

```
ALTER USER postgres WITH PASSWORD 'new_password';
```

To update the platform settings with the database password of the host server:

1. Access the Workbench Operations Center by entering this URL in your browser: `https://anaconda.example.com:32009`, replacing `anaconda.example.com` with the FQDN of the host server.
2. Login with the default username and password: `aeplatform@yourcompany.com` / `aeplatform`. You'll be asked to change the default password when you log in.
3. Click **Configuration** in the left menu to display the Workbench Config map.
4. In the GLOBAL CONFIGURATION section of the configuration file, locate the `db` section and enter the password you just set:



```
db: # Database client configuration
  drivername: postgresql # Database driver (default postgresql, which is currently the only driver supported)
  host: anaconda-enterprise-postgres # Database hostname
  port: 5432
  username: postgres
  password: ""


################################################################################
## CONFIGURABLE SECTION

## Section volumns is used to specify NFS volumns
## Please follow sample configuration below

# volumes:
#   myvolume:
#     # will be mounted at /data/myvolume
```

5. Click **Apply** to update the platform with your changes.
6. Restart all the service pods using the following command:

```
kubectl get pods | grep ap- | cut -d' ' -f1 | xargs kubectl delete pods
```

3.7.4 Workbench CLI

The Data Science & AI Workbench has a collection of tools that you can use to interact with your instance of Workbench at the operating system (OS) level. Workbench uses the `anaconda-enterprise-cli` package to manage its system via the command line. Everything you need to use the CLI tools is contained in the `ae5-conda-latest-Linux-x86_64.sh` script that is run during environment preparation.

Follow the steps for *administration server setup* on your current machine to install `anaconda-enterprise-cli`.

Configuring the CLI

Before you can log in to your instance of Workbench, you'll need to tell the CLI which sites it has access to and which one of the available sites to reach out to and interact with. To configure your CLI, complete the following steps:

1. Add your Workbench repository URL to the list of sites `anaconda-enterprise-cli` can access by running the following command:

```
# Replace <FQDN> with the fully qualified domain name of your Workbench instance
# Replace <SITE_NAME> with a short name you want to use to refer to your Workbench␣
↪site
anaconda-enterprise-cli config set sites.<SITE_NAME>.url https://<FQDN>/repository/
↪api
```

2. Configure your instance of Workbench as the default site for `anaconda-enterprise-cli` to interact with by running the following command:

```
# Replace <SITE_NAME> with the short name you provided in the previous command
anaconda-enterprise-cli config set default_site <SITE_NAME>
```

3. Verify your configuration was successful by running the following command:

```
anaconda-enterprise-cli config view
```

Logging in to the CLI

1. Access the CLI by running the following command:

```
anaconda-enterprise-cli login
```

2. Use your Workbench username and password to log in when prompted:

```
Username: <YOUR_USERNAME>
Password: <YOUR_PASSWORD>
```

Configuring SSL certificates using the CLI

If you *updated the platform's TLS/SSL certificate*, you must update the Workbench CLI configurations to use the new repository certificates using the following commands:

Generic Linux

```
anaconda-enterprise-cli config set ssl_verify true
```

Ubuntu

```
anaconda-enterprise-cli config set sites.master.ssl_verify /etc/ssl/certs/ca-
↪certificates.crt
```

RHEL/CentOS

```
anaconda-enterprise-cli config set sites.master.ssl_verify /etc/pki/tls/certs/ca-bundle.
↪crt
```

Next Steps:

You can now configure *channels* and *mirrors* for your Workbench users.

CLI Configuration files

The Workbench CLI reads configuration information from the following places:

System-level configuration: `/etc/anaconda-platform/cli.yml`

User-level configuration: `$INSTALL_PREFIX/anaconda-platform/cli.yml` and `$HOME/.anaconda/anaconda-platform/cli.yml`

To change how the CLI is configured, modify the appropriate `cli.yml` files based on your needs.

Note: Changing configuration settings at the user level overrides any system-level CLI configurations.

Included CLI tools

The Workbench CLI uses multiple tools to interact with your instance and your repositories, and these tools are provided via the `ae5-conda-latest-Linux-x86_64.sh` script.

The script contains the following tools:

Package	Version	Build	Channel	Documentation
ae5-tools	0.4.1	pypi_0	ae5-admin	ae5-tools github
ae5_backup_restore	0.3.2	0	ae5-admin	ae5_backup_restore github
ae_preflight	0.1.9	py_0	ae5-admin	ae_preflight github
anaconda-enterprise-cli	5.5.2	pypi_0	ae5-admin	
anaconda-mirror	5.4.0	pypi_0	defaults	*Mirroring channels and packages*
python	3.11.2	h7a1cb2a_0		

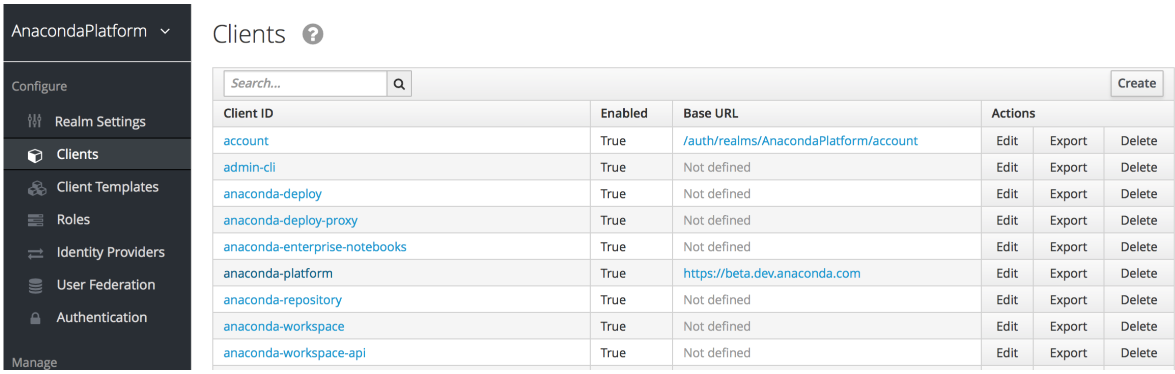
3.7.5 Changing the platform redirect URLs

Use the Data Science & AI Workbench Authentication Center to update the redirect URLs for the platform.

1. Enter the following URL in your browser, `https://<server-name.domain.com>/auth/`, replacing `server-name.domain.com` with the fully-qualified domain name of the host server.

2. Login with username and password configured to authorize access to the platform. See *Managing System Administrators* for instructions on setting these credentials, if you haven't already done so.

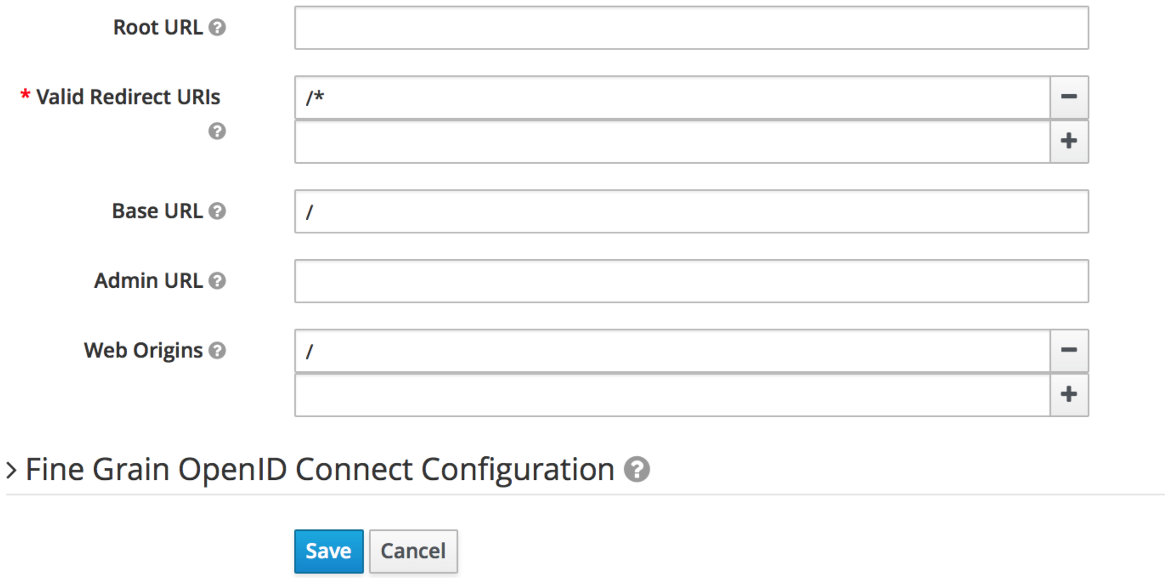
3. Verify that `AnacondaPlatform` is displayed as the current realm, then select **Clients** from the **Configure** menu on the left.



Client ID	Enabled	Base URL	Actions		
account	True	/auth/realms/AnacondaPlatform/account	Edit	Export	Delete
admin-cli	True	Not defined	Edit	Export	Delete
anaconda-deploy	True	Not defined	Edit	Export	Delete
anaconda-deploy-proxy	True	Not defined	Edit	Export	Delete
anaconda-enterprise-notebooks	True	Not defined	Edit	Export	Delete
anaconda-platform	True	https://beta.dev.anaconda.com	Edit	Export	Delete
anaconda-repository	True	Not defined	Edit	Export	Delete
anaconda-workspace	True	Not defined	Edit	Export	Delete
anaconda-workspace-api	True	Not defined	Edit	Export	Delete

4. In the **Clients** list, click `anaconda-platform` to display the platform settings.

5. On the **Settings** tab, update all URLS in the following fields with the FQDN of the Workbench server, or the following symbols:



Root URL

* Valid Redirect URIs: /*

Base URL: /

Admin URL

Web Origins: /

Note: If you choose to provide the FQDN of your Workbench server, be sure each field also ends with the symbols shown. For example, the **Valid Redirect URIs** would look something like this: `https://server-name.domain.com/*`.

6. Click **Save** to update the server with your changes.

3.7.6 Apache Livy and Workbench

To support your organization's data analysis operations, Data Science & AI Workbench enables platform users to connect to remote Apache Hadoop or Spark clusters. Workbench uses Apache Livy to handle session management and communication to Spark clusters, including different versions of Spark, independent clusters, and even different types of Hadoop distributions, such as those installed by different Cloudera Data Platform (CDP) Parcel versions.

Livy provides all the authentication layers that Hadoop administrators are familiar with, including Kerberos. Workbench can also authenticate to a Hadoop Distributed File System (HDFS) using Kerberos when Kerberos Impersonation is enabled.

Selecting a Spark template when creating a project will connect users to the remote Spark cluster where Livy is installed. They can use the Python libraries available through the platform or package a specific environment for the job. For more information, see ../../data-science-workflows/spark-hadoop.

Tested Versions:

Workbench has been verified against the following versions.

Software	Version
Hadoop (Includes YARN and HDFS)	3.1.1
Spark	2.4.7
Hive	3.1.3000
Impala	3.4.0
Livy	0.7.1-incubating

Note: Workbench has also been verified against Cloudera Data Platform 7.1.7.

3.7.7 Configuring Livy server for Hadoop Spark access

Review the *Apache Livy requirements* before you begin the configuration process. There are three main configuration settings you must update on your Apache Livy server to allow Data Science & AI Workbench users access to Hadoop/Spark clusters:

- *Livy impersonation*
- *Cluster access*
- *Project access*

If the Hadoop cluster is configured to use Kerberos authentication, you'll need to *allow Livy to access the services*. Additionally, you can configure Livy as a secure endpoint. For more information, see *Configuring Livy to use HTTPS* below.

Configuring Livy impersonation

To enable users to run Spark sessions within Workbench, they need to be able to log in to each machine in the Spark cluster. The easiest way to accomplish this is to configure Livy impersonation as follows:

1. Add `Hadoop.proxyuser.livy` to your authenticated hosts, users, or groups.
2. Check the option to `Allow Livy to impersonate users` and set the value to all (`*`), or a list of specific users or groups.

If impersonation is *not* enabled, the user executing the livy-server (`livy`) must exist on every machine. You can add this user to each machine by running the following command on each node:

```
sudo useradd -m livy
```

Note: If you have any problems configuring Livy, try setting the log level to `DEBUG` in the `conf/log4j.properties` file.

Configuring cluster access

Livy server enables users to submit jobs from any remote machine or analytics cluster—even where a Spark client is not available—without requiring you to install Jupyter and Anaconda directly on an edge node in the Spark cluster.

To configure Livy server, put the following environment variables into a user's `.bashrc file`, or the `conf/livy-env.sh` file that's used to configure the Livy server.

These values are accurate for a Cloudera install of Spark with Java version 1.8:

```
SPARK_HOME=/opt/cloudera/parcels/CDH-7.1.7-1.cdh7.1.7.p0.15945976/lib/spark
LIVY_LOG_DIR=/var/log/livy2
LIVY_PID_DIR=/var/run/livy2
JAVA_HOME=/usr/java/jdk1.8.0_232-cloudera/
```

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```
SPARK_CONF_DIR=/etc/spark/conf
HADOOP_HOME=/opt/cloudera/parcels/CDH-7.1.7-1.cdh7.1.7.p0.15945976/lib/hadoop
HADOOP_CONF_DIR=/etc/hadoop/conf
```

Note that the port parameter that's defined as `livy.server.port` in `conf/livy-env.sh` is the same port that will generally appear in the Sparkmagic user configuration.

The minimum required parameter is `livy.spark.master`. Other possible values include the following:

- `local[*]`—for testing purposes
- `yarn-cluster`—for using with the YARN resource allocation system
- a full spark URI like `spark://masterhost:7077`—if the spark scheduler is on a different host.

Example with YARN:

```
livy.spark.master = yarn-cluster
```

The YARN deployment mode is set to `cluster` for Livy. The `livy.conf` file, typically located in `$LIVY_HOME/conf/livy.conf`, may include settings similar to the following:

```
# What host address to start the server on. By default, Livy will bind to all network␣
↪interfaces.
livy.server.host = 0.0.0.0

# What port to start the server on.
livy.server.port = 8998

# What spark master Livy sessions should use.
livy.spark.master = yarn

# What spark deploy mode Livy sessions should use.
livy.spark.deploy-mode = cluster
```

Restart Livy server once configuration is complete.

Anaconda recommends using a process control mechanism to restart your Livy server to ensure that it's reliably restarted in the event of a failure.

Note: The above example is to be used as a template only. Anaconda cannot assist with configuring Apache Livy for your organization.

Using Livy with Kerberos authentication

If the Hadoop cluster is configured to use Kerberos authentication, you'll need to do the following to allow Livy to access the services:

1. Generate two keytabs for Apache Livy using `kadmin.local`.

   Caution: The keytab principals for Livy must match the hostname that the Livy server is deployed on, or you'll see the following exception: `GSSException: No valid credentials provided (Mechanism level: Failed to find any Kerberos credentials)`.

These are hostname and domain dependent, so edit the following example according to your Kerberos settings:

```
$ sudo kadmin.local

kadmin.local:  addprinc livy/<HOSTNAME>

kadmin.local:  xst -k livy-<HOSTNAME>.keytab livy/<HOSTNAME>@<REALM>
...

kadmin.local:  addprinc HTTP/<HOSTNAME>

kadmin.local:  xst -k HTTP-<HOSTNAME>.keytab HTTP/<HOSTNAME>@<REALM>
...
```

This will generate two files: `livy-<HOSTNAME>.keytab` and `HTTP-<HOSTNAME>.keytab`.

2. Change the permissions of these two files so they can be read by `livy-server`.
3. Enable Kerberos authentication and reference these two keytab files in the `conf/livy.conf` configuration file, as shown:

```
# Kerberos settings

# Authentication support for Livy server
# Livy has a built-in SPnego authentication support for HTTP requests with below␣
↪configurations.
livy.server.auth.type = kerberos
livy.server.auth.kerberos.principal = HTTP/<HOSTNAME>@<REALM>
livy.server.auth.kerberos.keytab = <FILEPATH>/<KEYTAB>
livy.server.auth.kerberos.name-rules = DEFAULT
livy.server.launch.kerberos.principal = livy/<HOSTNAME>@<REALM>
livy.server.launch.kerberos.keytab = <FILEPATH>/<KEYTAB>
```

Note: The hostname and domain are not the same—verify that they match your Kerberos configuration.

Note: The above example is to be used as a template only. Anaconda cannot assist with configuring Kerberos for your organization.

Configuring Livy to use HTTPS

If you want to use Sparkmagic to communicate with Livy via HTTPS, you need to do the following to configure Livy as a secure endpoint:

- Generate a keystore file, certificate, and truststore file for the Livy server—or use a third-party SSL certificate.
- Update Livy with the keystore details.
- Update your Sparkmagic configuration.
- Restart the Livy server.

If you’re using a self-signed certificate

1. Generate a keystore file for Livy server using the following command:

```
keytool -genkey -alias <host> -keyalg RSA -keysize 1024 -dname CN=<host>,OU=hw,O=hw,
↪L=paloalto,ST=ca,C=us -keypass <keyPassword> -keystore <keystore_file> -storepass
↪<storePassword>
```

2. Create a certificate:

```
keytool -export -alias <host> -keystore <keystore_file> -rfc -file <cert_file> -
↪storepass <StorePassword>
```

3. Create a truststore file:

```
keytool -import -noprompt -alias <host> -file <cert_file> -keystore <truststore_
↪file> -storepass <truststorePassword>
```

4. Update `livy.conf` with the keystore details. For example:

```
livy.keystore = <FILEPATH>/keystore.jks
livy.keystore.password = anaconda
livy.key-password = anaconda
```

5. Update `~/.sparkmagic/config.json`. For example:

```
 "kernel_python_credentials" : {
   "username": "",
   "password": "",
   "url": "https://<IP>:8998",
   "auth": "None"
  },
"ignore_ssl_errors": true,
```

> **Note:** In this example, `ignore_ssl_errors` is set to `true` because this configuration uses self-signed certificates. Your production cluster setup may be different.

> **Caution:** If you misconfigure a `.json` file, all Sparkmagic kernels will fail to launch. You can test your Sparkmagic configuration by running the following Python command in an interactive shell: `python -m json.tool config.json`.
>
> If you have formatted the JSON correctly, this command will run without error. Additional edits may be required, depending on your Livy settings.

6. Restart the Livy server.

The Livy server should now be accessible over https. For example, `https://<livy host>:<livy port>`.

To test your SSL-enabled Livy server, run the following Python code in an interactive shell to create a session:

```
livy_url = "https://<livy host>:<livy port>/sessions"
data = {'kind': 'spark', 'numExecutors': 1}
```

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```
headers = {'Content-Type': 'application/json'}
r = requests.post(livy_url, data=json.dumps(data), headers=headers, auth=HTTPKerberosAuth(mutual_authentication=REQUIRED,     sanitize_mutual_error_response=False), verify=False)
r.json()
```

Run the following Python code to verify the status of the session:

```
session_url = "https://<livy host>:<livy port>/sessions/0"
headers = {'Content-Type': 'application/json'}
r = requests.get(session_url, headers=headers, auth=HTTPKerberosAuth(mutual_authentication=REQUIRED,  sanitize_mutual_error_response=False), verify=False)
r.json()
```

Then submit the following statement:

```
session_url = "https://<livy host>:<livy port>/sessions/0/statements"
data ={"code": "sc.parallelize(1 to 10).count()"}
headers = {'Content-Type': 'application/json'}
r = requests.get(session_url, headers=headers, auth=HTTPKerberosAuth(mutual_authentication=REQUIRED, sanitize_mutual_error_response=False), verify=False)
r.json()
```

If you're using a third-party certificate

Note: Ensure that Java JDK is installed on the Livy server.

1. Create the `keystore.p12` file using the following command:

```
openssl pkcs12 -export -in [path to certificate] -inkey [path to private key] -certfile [path to certificate ] -out keystore.p12
```

2. Use the following command to create the `keystore.jks` file:

```
keytool -importkeystore -srckeystore keystore.p12 -srcstoretype pkcs12 -destkeystore keystore.jks -deststoretype JKS
```

3. If you don't already have the `rootca.crt`, you can run the following command to extract it from your Workbench installation:

```
kubectl get secrets anaconda-enterprise-certs -o jsonpath="{.data[`rootca\.crt`]}" | base64 -d > /ext/share/rootca.crt
```

4. Add the `rootca.crt` to the `keystore.jks` file:

```
keytool -importcert -keystore keystore.jks -storepass <password> -alias rootCA -file rootca.crt
```

5. Add the `keystore.jks` file to the `livy.conf` file. For example:

```
livy.keystore = <FILEPATH>/keystore.jks
livy.keystore.password = anaconda
livy.key-password = anaconda
```

6. Restart the Livy server.
7. Run the following command to verify that you can connect to the Livy server (using your actual host and port):

   ```
   openssl s_client -connect anaconda.example.com:8998 -CAfile rootca.crt
   ```

   If running this command returns 0, you've successfully configured Livy to use HTTPS.

To add the trusted root certificate to the Workbench server

1. Install the `ca-certificates` package:

   ```
   yum install ca-certificates
   ```

2. Enable dynamic CA configuration:

   ```
   update-ca-trust force-enable
   ```

3. Add your `rootca.crt` as a new file:

   ```
   cp rootca.crt /etc/pki/ca-trust/source/anchors
   ```

4. Update the certificate authority trust:

   ```
   update-ca-trust extract
   ```

To connect to Livy within a session

Open the project and run the following command in an interactive shell:

```
import os
os.environ['REQUESTS_CA_BUNDLE'] = /path/to/root.ca
```

You can also edit the `anaconda-project.yml` file for the project and set the environment variable there. See ../../data-science-workflows/spark-hadoop for more information.

Configuring project access

After you've installed Livy and configured cluster access, some additional configuration is required before you, as a Workbench user, can connect to a remote Hadoop Spark cluster from within your projects. For more information, see Connecting to the Hadoop Spark ecosystem.

- If the Hadoop installation used Kerberos authentication, add the `krb5.conf` to the global configuration using the following command:

  ```
  anaconda-enterprise-cli spark-config --config /etc/krb5.conf krb5.conf
  ```

- To use Sparkmagic, pass two flags to the previous command to configure a Sparkmagic configuration file:

```
anaconda-enterprise-cli spark-config --config /etc/krb5.conf krb5.conf --config /
↪opt/continuum/.sparkmagic/config.json config.json
```

This creates a yaml file—`anaconda-config-files-secret.yaml`—with the data converted for Workbench.

Use the following command to upload the yaml file to the server:

```
sudo kubectl replace -f anaconda-config-files-secret.yaml
```

To update the Workbench server with your changes, run the following command to identify the pod associated with the workspace services:

```
kubectl get pods
```

Restart the workspace services by running:

```
kubectl delete pod anaconda-enterprise-ap-workspace-<unique ID>
```

Now, whenever a new project is created, `/etc/krb5.conf` will be populated with the appropriate data.

3.7.8 Adding Anaconda Assistant to Workbench

Anaconda Assistant is the AI pair programmer developed by Anaconda to assist you with coding in your Jupyter Notebooks. You can install the Anaconda Assistant as an optional component of the Data Science & AI Workbench.

Installing Anaconda Assistant

1. Open a browser and log in to Workbench as the `anaconda-enterprise` user.
2. Open any existing project and view its settings.
3. If necessary, change the **Default Editor** to *JupyterLab*.
4. Open a project session.
5. Open a terminal window in your project session.
6. Download the Anaconda Assistant tarball and its checksum by running the following commands:

   ```
   curl -O https://airgap-svc.s3.amazonaws.com/misc/jupyter_anaconda_toolbox.
   ↪tgz
   curl -O https://airgap-svc.s3.amazonaws.com/misc/jupyter_anaconda_toolbox.
   ↪tgz.sha256
   ```

7. Verify the checksum of the files you downloaded by running the following command:

   ```
   sha256sum --check jupyter_anaconda_toolbox.tgz.sha256
   ```

   Tip: If the checksum is valid, you will receive `jupyter_anaconda_toolbox.tgz: OK` in the return.

8. Unpack the tarball you just downloaded into the tools directory by running the following command:

```
tar xvzf  jupyter_anaconda_toolbox.tgz -C /tools
```

9. Create a symbolic link to this new Jupyter environment.

   ```
   ln -s /tools/jlab_anaconda_toolbox /tools/jupyter
   ```

10. Start a new session in a different project to verify the newly built environment launches Jupyterlab successfully and the asssistant is present.

Note:

- Keep this session open while you enable and test the Anaconda Assistant.
- If for any reason the new Jupyterlab environment does not launch successfully, you can remove the symbolic link to revert Jupyterlab projects to opening with the default `lab_launch` environment by navigating to the `tools/` directory and running the following command:

  ```
  rm jupyter
  ```

Enabling the Anaconda Assistant

Obtaining an anaconda.cloud token

To enable the Anaconda Assistant, you must have an Anaconda Cloud account. If you do not have an Anaconda Cloud account, create one now.

Note: You must obtain your token from a machine that has connectivity to `https://anaconda.cloud/`.

Anaconda Assistant utilizes a token that must be generated using the `anaconda-cloud-cli` package, which is available in Anaconda's default channel. This token provides your Workbench instance with access to the Anaconda Assistant API.

1. Open a terminal application *outside* of Workbench on your machine.
2. Create a conda environment with the packages you need by running the following command:

   ```
   conda create -n anaconda-cloud -y anaconda-cloud-auth anaconda-cloud-cli
   ```

3. Activate your new environment by running the following command:

   ```
   conda activate anaconda-cloud
   ```

4. Log in to anaconda.cloud by running the following command:

   ```
   anaconda login
   ```

5. Select `anaconda.cloud` and press Enter/return.
6. Use the browser window that appears to log in to Anaconda Cloud using your account credentials.

   Tip: You can close the window once you are logged in.

7. Return to your terminal application (outside of Workbench) and enter a python command prompt by running the following command:

```
python
```

8. View your token by running the following commands:

```
from anaconda_cloud_auth.token import TokenInfo
TokenInfo.load('id.anaconda.cloud').api_key
```

Note: Store this token in a secure location for now.

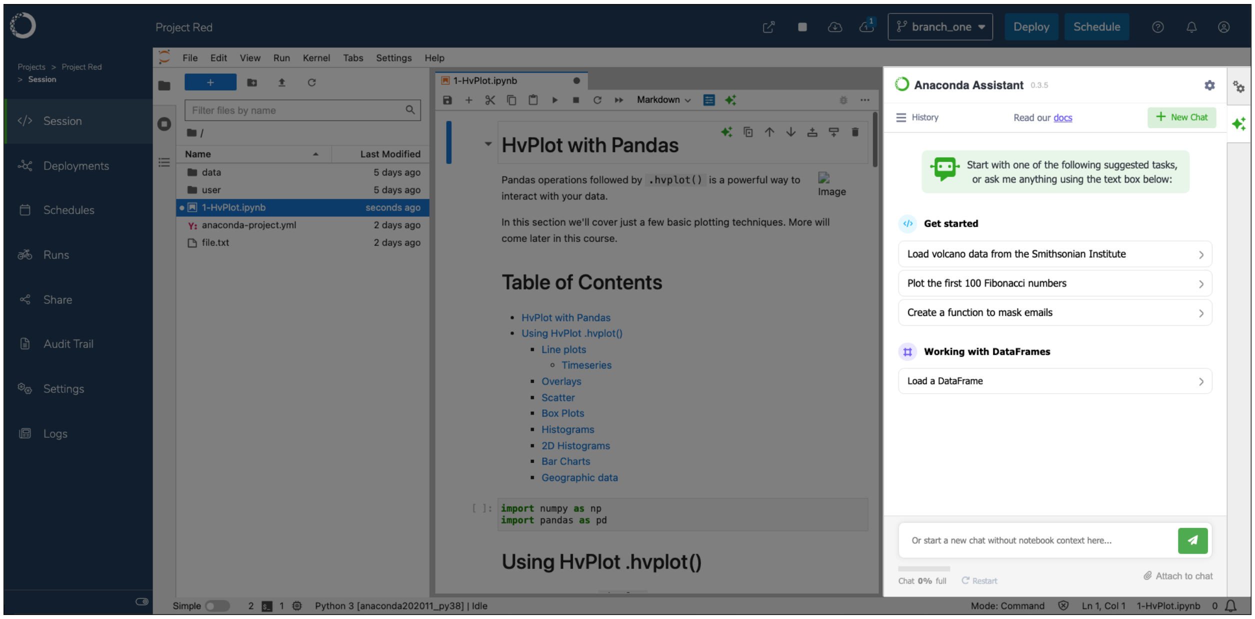
Setting environment variables

1. Connect to your instance of Workbench.
2. Edit the anaconda-enterprise-env-var-config configmap by following the process for *setting global config variables*.
3. Include the following lines:

```
# Replace <CLOUD_API_TOKEN> with the your cloud API token (do not include␣
↪single quotes from token output)
ANACONDA_AE5_CLOUD_TOKEN: <CLOUD_API_TOKEN>
ANACONDA_ASSISTANT_ENVIRONMENT_TYPE: enterprise-notebooks-prod
```

Verifying installation

With the tarball extracted into the /tools volume and your anaconda.cloud API key stored as a system variable, return to Workbench and create a new project with JupyterLab as its default editor. You will see the Anaconda Assistant on the right hand side of the screen when you open a notebook (.ipynb) file.



Name	Last Modified
data	5 days ago
user	5 days ago
1-HvPlot.ipynb	seconds ago
anaconda-project.yml	2 days ago
file.txt	2 days ago

HvPlot with Pandas

Pandas operations followed by .hvplot() is a powerful way to interact with your data.

In this section we'll cover just a few basic plotting techniques. More will come later in this course.

Table of Contents

- HvPlot with Pandas
- Using HvPlot .hvplot()
  - Line plots
    - Timeseries
  - Overlays
  - Scatter
  - Box Plots
  - Histograms
  - 2D Histograms
  - Bar Charts
  - Geographic data

```
[ ]: import numpy as np
     import pandas as pd
```

Using HvPlot .hvplot()

Start with one of the following suggested tasks, or ask me anything using the text box below:

Get started

- Load volcano data from the Smithsonian Institute
- Plot the first 100 Fibonacci numbers
- Create a function to mask emails

Working with DataFrames

- Load a DataFrame

Or start a new chat without notebook context here...

Chat 0% full Restart Attach to chat

For more information about how to use the Assistant, see the Anaconda Assistant quickstart guide.

3.7.9 Adding VSCode to Workbench

You can install VSCode as an optional component of Data Science & AI Workbench. Technically, the stock Microsoft version of VSCode will not run in a browser-based environment, so Anaconda relies on `code-server`, a patched version of VSCode that allows it to be run in the browser.

> **Caution:** For security reasons, browsers block certain operations (such as opening and viewing `.ipynb` files) when using an untrusted or self-signed SSL certificate. To ensure full functionality of VSCode in Workbench, use a trusted SSL certificate. For more information, see *Updating TLS/SSL certificates*.

Installing VSCode

> **Note:** Anaconda recommends installing VSCode during a scheduled maintenance interval to prevent users from creating new sessions during installation. Existing sessions or deployments do not need to be halted.

1. Download the VSCode tarball file.
2. Open a browser and log in to Workbench as the `anaconda-enterprise` user.
3. Open any existing project and view its settings.
4. If necessary, change the **Default Editor** to *JupyterLab*.
5. Open a project session.
6. Upload the VSCode tarball you just downloaded into the project.
7. Open a terminal for your session.
8. Unpack the tarball you just downloaded into the tools directory by running the following command:

   ```
   tar xzvf vscode.tar.gz -C /tools
   ```

Enabling VSCode as an editor option

Once you have unpacked the tarball, you must enable VSCode as an editor option for project sessions.

1. Access your Kubernetes cluster resource management console.
2. Open the `anaconda-enterprise-anaconda-platform.yml` file.
3. Find the `tools:` section of the file.
4. Add the following line, nested under `tools:`:

   ```
   vscode: VSCode
   ```

5. Save your work and close the file.
6. Open a terminal window and restart the `workspace` and `ui` pods by running the following command:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep -E
↪'workspace|ui')
```

Removing VSCode as an editor option

1. Access your Kubernetes cluster resource management console.
2. Open the `anaconda-enterprise-anaconda-platform.yml` file.
3. Search for the `tools:` section of this file and remove the following line:

```
vscode: VSCode
```

4. Save your work and close the file.
5. Open a terminal and restart the `workspace` and `ui` pods by running the following command:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep -E
↪'workspace|ui')
```

Verifying your installation

1. Return to Workbench in your browser and navigate to the projects grid.
2. Create a new project.
3. Open your project and view its settings.
4. Open the **Default Editor** dropdown menu and select *Visual Studio Code*.
5. Click **Save**.
6. Open a session for your project.

Uninstalling VSCode

To completely remove VSCode from your instance of Workbench:

1. Stop any existing project session that is currently using VSCode. These sessions must also choose a different default editor, such as JupyterLab.

> **Caution:** If you do not choose a different default editor, sessions will fail to start for these projects.

2. Access your Kubernetes cluster resource management console.
3. Open the `anaconda-enterprise-anaconda-platform.yml` file.
4. Search for the `tools:` section of this file and remove the following line:

```
vscode: VSCode
```

5. Save your work and close the file.
6. Open a terminal and restart the `workspace` and `ui` pods by running the following command:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep -E
↪'workspace|ui')
```

7. Once the cluster is stable, you can remove VSCode from the `/tools` volume by running the following command:

   ```
   rm -r /tools/vscode
   ```

Upgrading to a new version of Workbench

Upgrading Workbench will not affect the VSCode installation. However, the upgrade process will re-hide VSCode as an editor option. For more information, see *Enabling VSCode as an editor option*.

Updating the VSCode installation

Anaconda recommends performing a fresh installation if you need to upgrade VSCode, as this minimizes the risk of unexpected issues.

1. Stop any existing project session that is currently using VSCode.
2. Download the latest VSCode installation project and save it locally.
3. Open a browser and log in to Workbench as an administrator with managed persistence permissions.

   Tip: The anaconda-enterprise user account has these permissions.

4. Open a session for your VSCode installation project.
5. Open a terminal in your session.
6. Move the existing VSCode installation aside in case you need it by running the following command:

   ```
   mv /tools/vscode /tools/vscode.old
   ```

   Tip: If an error occurs, you can restore this file to avoid downtime.

7. Remove the directory by running the following command:

   ```
   rm -r /tools/vscode
   ```

8. Upload your new VSCode tarball file to the project.
9. Install VSCode by running the following command:

   ```
   bash install_vscode.sh
   ```

10. Verify your installation by running the following command:

    ```
    bash /tools/vscode/start_vscode.sh
    ```

    If your command returns an “address already in use” error, your installation was successful.

11. Remove the /tools/vscode.old directory once the update is complete.

```
rm -rf /tools/vscode.old
```

Installing VSCode extensions

Anaconda relies on the Open VSX Registry as a source for VSCode extensions.

Installing an extension into a project

1. Open a session in your project using the VSCode editor.
2. Click the extensions icon in the left-hand navigation.
3. Enter an extension's name in the search field.
4. Click **Install** beside the extension you want.

If you do not have a connection to the registry, you will need to obtain the extension's `.vsix` file manually, then upload it to the project you want to use it in.

Installing an extension manually

1. Open a browser and log in to Workbench as an administrator with managed persistence permissions.

   Tip: The anaconda-enterprise user account has these permissions.

2. Open a project session using the VSCode editor.
3. Upload your `.vsix` file to the project.
4. Click the extensions icon in the left-hand navigation.
5. Click the more actions icon, then select **Install from VSIX…**.
6. Navigate to `/opt/continuum/project/` and select your extension from the list.

3.7.10 Adding RStudio to Workbench

This topic covers how to install RStudio and use it within Data Science & AI Workbench.

Note: Anaconda recommends installing RStudio during a scheduled maintenance interval to prevent users from creating new sessions during installation. Existing sessions or deployments do not need to be halted.

Prerequisites

These instructions are written for Workbench version 5.5.2 or later, and require the `/tools` volume from managed persistence to be enabled. For more information, see Mounting an external file share.

Installing RStudio

Launching the RStudio installer project

1. Download the RStudio installer project and save it to your machine.
2. Log in to Workbench as a user with read/write access to the `/tools` volume.

   Tip: The `anaconda-enterprise` user has the correct permissions.

3. Use the **Create+ / Upload Project** dialog to upload the RStudio installer project you just downloaded. Anaconda recommends using the JupyterLab editor for this task.
4. Open a session for the RStudio installer project.

Obtaining the RStudio Server binaries

Now that your project is created, you need to obtain and install the Red hat Package Manager (RPM) files and pull them into the project session. There are multiple methods for accomplishing this.

Downloading RStudio directly from Workbench

Anaconda recommends users with clusters that have internet access download RStudio directly through Workbench.

1. From your RStudio project session, open a new terminal window.
2. If you need to set proxy variables manually to access the internet, do so now.
3. Run the command:

   ```
   bash download_rstudio.sh
   ```

Here is an example output from the download script:

```
+-------------------------+
| AE5 RStudio Downloader |
+-------------------------+
- Target version: 2023.12.0-369
- Downloading into the data directory
- Downloading RHEL9 version only
- Downloading RHEL9/CentOS9 RPM file to data/rs-centos9.rpm
- URL: https://download2.rstudio.org/server/rhel9/x86_64/rstudio-server-
↪rhel-2023.12.0-369-x86_64.rpm
% Total    % Received % Xferd  Average Speed   Time    Time     Time ␣
↪Current
```

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```
                                Dload  Upload   Total   Spent    Left  Speed
100  108M  100  108M    0     0  18.4M      0  0:00:05  0:00:05 --:--:-- 23.
↪2M
- Verifying data/rs-centos9.rpm
+------------------------+
The RStudio binaries have been downloaded.
You may now proceed with the installation step.
See the README.md file for more details.
+------------------------+
```

Using the download script on another Unix server

If you need to download the binaries on a separate machine first, use the download_rstudio.sh script.

1. Download the script file download_rstudio.sh from the project to your desktop.
2. Move the script file to a machine that can run bash and curl and has connectivity to download2.rstudio.org.
3. Run the command:

   ```
   bash download_rstudio.sh
   ```

4. If necessary, transfer the binaries rs-centos7.rpm and rs-centos8.rpm to the machine from which you access Workbench.
5. Use the JuptyerLab **upload** button to upload both binaries into the RStudio installer project.

Running the installation script

Now that you have obtained the RStudio binaries and uploaded the rs-centos7.rpm and rs-centos8.rpm files to your RStudio installer project:

1. Open a terminal window.
2. If you have previously installed content into /tools/rstudio, remove it now by running the following command:

   ```
   rm -r /tools/rstudio
   ```

3. Install RStudio by running the following command:

   ```
   bash install_rstudio.sh
   ```

Note: The script will verify that all prerequisites are met before performing any file modifications.

Here is an example output from the RStudio installer:

```
+-----------------------+
| AE5 RStudio Installer |
+-----------------------+
- Install prefix: /tools/rstudio
- Verifying data/rs-centos9.rpm
- Creating directory /tools/rstudio
- Unpacking RHEL9/CentOS9 package
1177155 blocks
- Moving files into final position
- Installing support files
+-----------------------+
RStudio installation is complete.
Once you have verified the installation, feel free to
shut down this session and delete the project.
+-----------------------+
WARNING: Many R packages make use of Java, and it seems
not to be present on this installation of AE5. To make
Java available to all AE5 users, run install_java.sh, or
manually download a JDK Linux x64 archive and unpack its
contents into the directory /tools/java.
+-----------------------+
```

Enabling RStudio as an editor

With installation complete, the next step is to add RStudio to the editor selection list within Workbench's User Interface (UI).

1. Access your Kubernetes cluster resource management console.
2. Open the `anaconda-enterprise-anaconda-platform.yml` configmap and search for the `tools:` section of the file.
3. Add the following line, nested under `tools:`:

```
rstudio: Rstudio
```

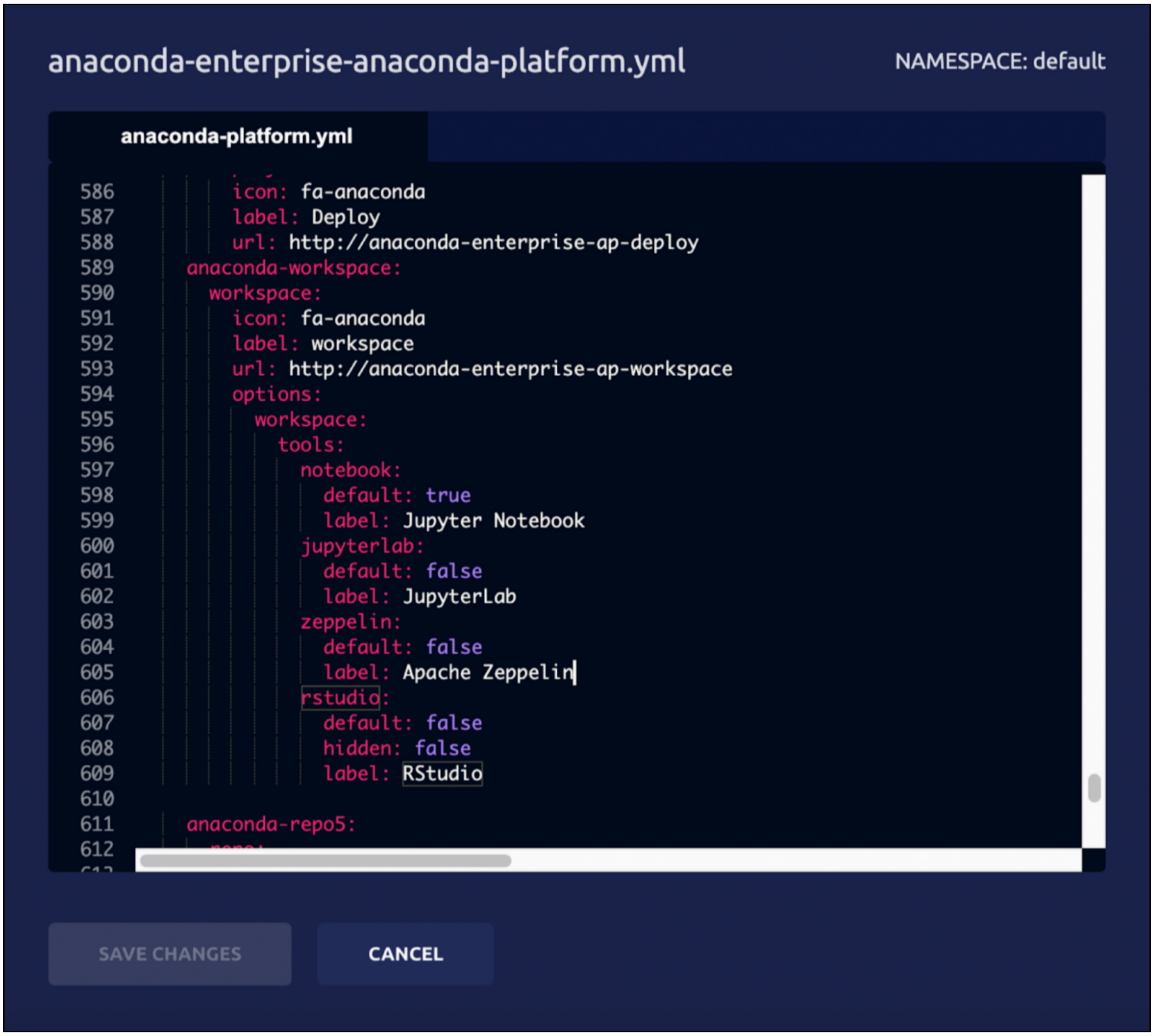
4. Save your work and close the file.
5. Open a terminal and restart the `workspace` and `ui` pods by running the following command:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep -
↪E 'workspace|ui')
```

Note: Minor disruptions in UI responsiveness may occur while the pods are stabilizing. If you have allowed users to continue working during this installation, they may need to refresh their browsers.

Once the cluster pods stabilize, the RStudio editor will be present in the **Default Editor** dropdown on any project's **Settings** page.

With RStudio enabled as an editor, your Op-Center will typically look like this:



```
      icon: fa-anaconda
      label: Deploy
      url: http://anaconda-enterprise-ap-deploy
  anaconda-workspace:
    workspace:
      icon: fa-anaconda
      label: workspace
      url: http://anaconda-enterprise-ap-workspace
      options:
        workspace:
          tools:
            notebook:
              default: true
              label: Jupyter Notebook
            jupyterlab:
              default: false
              label: JupyterLab
            zeppelin:
              default: false
              label: Apache Zeppelin
            rstudio:
              default: false
              hidden: false
              label: RStudio

  anaconda-repo5:
```

Verifying your installation

1. If necessary, stop the session for your RStudio installer project.
2. Go to the RStudio installer project's **Settings** page.
3. Open the **Default Editor** dropdown, select *RStudio*, and then click **Save**.
4. Start a new session and wait for the editor to launch.

If your installation is unsuccessful:

1. Click on the **Logs** tab.
2. Search the editor logs for a section titled Workbench R Session Manager and look for errors there and below.
3. Copy the full content of this log so it can be shared with Anaconda.
4. Stop the session completely.
5. Go to the project's **Settings** page, and change the **Default Editor** back to JupyterLab.

6. If your errors are obvious to you and understand what corrective action is needed, open a new session to make those changes.

Please reach out to Anaconda support if this occurs. Make sure to include a copy of the editor logs you obtained above.

Disabling RStudio

To remove RStudio as an editor option for new projects:

1. Log in to your Kubernetes administrative console.
2. Open the `anaconda-enterprise-anaconda-platform.yml` configmap file.
3. Search for the `tools:` section of this file and remove the following line:

   ```
   rstudio: Rstudio
   ```

4. Save your work and close the file.
5. Open a terminal and restart the `workspace` and `ui` pods by running the following command:

   ```
   # Replace <NAMESPACE> with your Workbench cluster namespace
   kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep -
   ↪E 'workspace|ui')
   ```

   Note: Existing projects that are using RStudio will still have access to the editor.

Uninstalling RStudio

Caution: If you need to permanently remove `/tools/rstudio`, instruct all users to stop all sessions currently using RStudio and choose a different editor, such as JupyterLab, before continuing. If they do not, sessions will fail to fully start.

To permanently uninstall RStudio, you need to remove the `/tools/rstudio` directory. Anaconda recommends removing the directory from outside Workbench, if possible. If necessary, instructions are provided to remove RStudio using Workbench.

Uninstalling RStudio using Workbench

1. Log in to Workbench as a user with read/write access to the `/tools` volume.

   Tip: The `anaconda-enterprise` user has the correct permissions.

2. Remove `/tools/rstudio` from within a Workbench session by running the following command:

```
rm -r /tools/rstudio
```

Upgrading to a new version of Workbench

Upgrading to a new version of Workbench will not affect your RStudio installation; however, the upgrade process will cause the editor to be hidden. Once the upgrade is complete, you'll need to *enable RStudio as an editor* again.

Upgrading RStudio

Anaconda recommends performing a fresh installation when upgrading RStudio.

1. *Launch the RStudio installation project*.
2. *Obtain the RStudio server binaries*.
3. (Optional) Rename your existing RStudio directory. If your installation is unsuccessful for any reason, you can rename the existing RStudio directory back to its original state to avoid downtime. Run the command:

   ```
   mv /tools/rstudio /tools/rstudio.old
   ```

4. Instruct all users to stop all sessions currently using RStudio.
5. *Run the installation script*.
6. *Enable RStudio as an editor*.
7. *Verify your installation*.
8. If necessary, remove the old installation `/tools/rstudio.old`. Run the command:

   ```
   rm -r /tools/rstudio.old
   ```

9. Log out of Workbench.

Installing RStudio on additional Workbench instances

Once you have successfully installed RStudio on one instance, you can copy and move the `/tools/rstudio` directory to another instance, reducing the amount of work involved for a second install.

Create an archive of an existing installation

1. Log in to an instance of Workbench with a running RStudio installation.
2. Open a session using the JupyterLab editor.
3. Open a terminal window.
4. Create the archive. Run the command:

   ```
   tar cfz rstudio.tar.gz -C /tools rstudio
   ```

5. Download this file to your desktop. Once you have done so, you can remove the file from your Workbench session.

Move the archive to a new instance

1. Open any session using the JupterLab editor.
2. Upload the archive `rstudio.tar.gz` into the project.
3. Open a terminal window.
4. (Optional) Rename your existing RStudio directory. If your installation is unsuccessful for any reason, you can rename the existing RStudio directory back to its original state to avoid downtime. Run the command:

   ```
   mv /tools/rstudio /tools/rstudio.old
   ```

5. Install the archive. Run the command:

   ```
   tar xfz rstudio.tar.gz -C /tools
   ```

6. *Verify your installation*.
7. If necessary, remove the old installation `/tools/rstudio.old`. Run the command:

   ```
   rm -r /tools/rstudio.old
   ```

8. *Enable RStudio as an editor*.
9. Log out of Workbench.

3.7.11 Adding MLflow to Workbench

You can install MLflow as an optional component of Data Science & AI Workbench.

Prerequisites

You must have managed persistence enabled.

Set environment variables

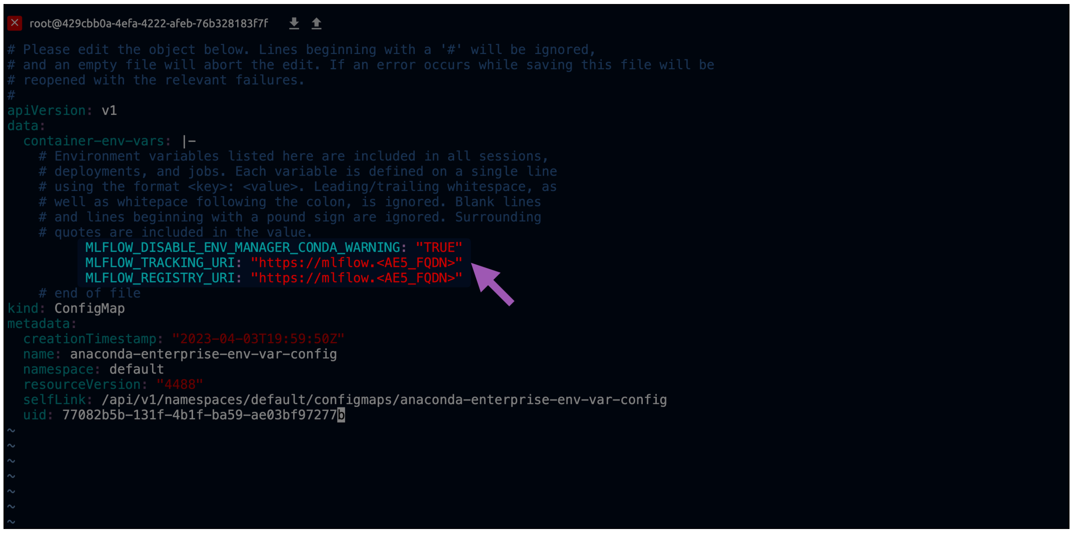
Setting environment variables allows MLflow to be accessible from all sessions, deployments, and schedules. This also sets the deployment-wide values for the MLflow tracking server endpoint.

1. Connect to your instance of Workbench.
2. Edit the `anaconda-enterprise-env-var-config` config map by following the process for *setting global config variables*.
3. Include the following lines:

   ```
   # Replace <WORKBENCH_FQDN> with your Workbench fully qualified domain name
   MLFLOW_DISABLE_ENV_MANAGER_CONDA_WARNING: TRUE
   MLFLOW_TRACKING_URI: https://mlflow.<WORKBENCH_FQDN>
   MLFLOW_REGISTRY_URI: https://mlflow.<WORKBENCH_FQDN>
   ```

   Note: If your `ENV_VAR_PLACEHOLDER: foo` entry still exists, replace it now.

   Here is an example of what your file might look like when complete:



```
# Please edit the object below. Lines beginning with a '#' will be ignored,
# and an empty file will abort the edit. If an error occurs while saving this file will be
# reopened with the relevant failures.
#
apiVersion: v1
data:
  container-env-vars: |-
    # Environment variables listed here are included in all sessions,
    # deployments, and jobs. Each variable is defined on a single line
    # using the format <key>: <value>. Leading/trailing whitespace, as
    # well as whitepace following the colon, is ignored. Blank lines
    # and lines beginning with a pound sign are ignored. Surrounding
    # quotes are included in the value.
          MLFLOW_DISABLE_ENV_MANAGER_CONDA_WARNING: "TRUE"
          MLFLOW_TRACKING_URI: "https://mlflow.<AE5_FQDN>"
          MLFLOW_REGISTRY_URI: "https://mlflow.<AE5_FQDN>"
    # end of file
kind: ConfigMap
metadata:
  creationTimestamp: "2023-04-03T19:59:50Z"
  name: anaconda-enterprise-env-var-config
  namespace: default
  resourceVersion: "4488"
  selfLink: /api/v1/namespaces/default/configmaps/anaconda-enterprise-env-var-config
  uid: 77082b5b-131f-4b1f-ba59-ae03bf97277b
~
~
~
~
~
~
~
```

Download MLflow

1. Download the latest MLflow release.
2. Extract all files from the tarball you just downloaded.

Tip: Keep these somewhere that is easy for you to locate.

Install MLflow

1. Open a browser and navigate to Workbench.
2. Log in as an administrator account with managed persistence permissions.
3. Click **Create +**, then select **Upload Project** from the dropdown menu.
4. Click **Browse**.
5. Locate the extracted files from your download and select the `MLflowTracking ServerProject-<VERSION>.tar.gz` file.
6. Provide a name for your MLflow Server project.
7. Click **Upload**.
8. Open a session for your new MLflow Server project.
9. Upload the `migrate-<VERSION>.py` and `anaconda-platform-mlflow-runtime-<VERSION>.tar.gz` files to the root of the project.

   Caution: Do not commit changes to the project until instructed. If you attempt to commit too early, you will receive an error due to the size of the runtime file.

10. Open a terminal in your session, and run the following command:

```
# Replace <VERSION> with your release version
python migrate-<VERSION>.py
```

11. Activate your new environment by running the following command:

    ```
    conda activate /tools/mlflow/mlflow_env/
    ```

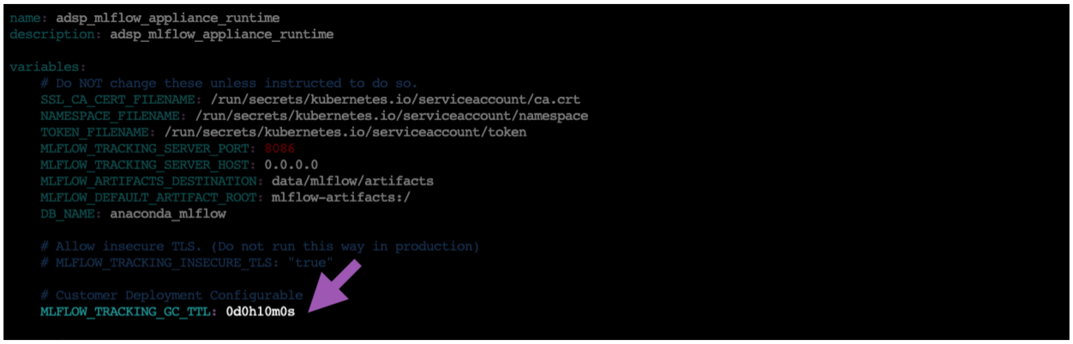
12. Verify your installation was successful by running the following command:

    ```
    mlflow
    ```

    Tip: If your install was successful, your command returns a list of available MLflow arguments.

13. Open the `anaconda-project.yml` file in the project with your preferred file editor.

14. Update the `MLFLOW_TRACKING_GC_TTL` value to something that makes sense for your use case.

    ```
    name: adsp_mlflow_appliance_runtime
    description: adsp_mlflow_appliance_runtime

    variables:
        # Do NOT change these unless instructed to do so.
        SSL_CA_CERT_FILENAME: /run/secrets/kubernetes.io/serviceaccount/ca.crt
        NAMESPACE_FILENAME: /run/secrets/kubernetes.io/serviceaccount/namespace
        TOKEN_FILENAME: /run/secrets/kubernetes.io/serviceaccount/token
        MLFLOW_TRACKING_SERVER_PORT: 8086
        MLFLOW_TRACKING_SERVER_HOST: 0.0.0.0
        MLFLOW_ARTIFACTS_DESTINATION: data/mlflow/artifacts
        MLFLOW_DEFAULT_ARTIFACT_ROOT: mlflow-artifacts:/
        DB_NAME: anaconda_mlflow

        # Allow insecure TLS. (Do not run this way in production)
        # MLFLOW_TRACKING_INSECURE_TLS: "true"

        # Customer Deployment Configurable
        MLFLOW_TRACKING_GC_TTL: 0d0h10m0s
    ```

    Note: The `MLFLOW_TRACKING_GC_TTL` variable instructs MLflow to perform garbage collection on deleted artifacts that have reached a specified age.

15. Commit the changes you've made to the project.

    Note: It is not necessary to commit the `migrate-<VERSION>.py` file to the project. Once installation is complete, you can safely delete this file.

16. Stop the project session.

Deploy MLflow

1. Select **Deployments** from the left-hand navigation.
2. Click **Deploy**.
3. Enter a name for the deployment, set the static url to the same value used in your `anaconda-enterprise-env-var-config` file (`https://mlflow.<AE5_FQDN>`), and then click **Deploy**.

Provide Access

1. Select the deployment you just created.
2. Select **Share** from the left-hand navigation menu.
3. Enter the names of users or groups to provide with permissions to access MLflow, then click **Add**.

   Note: This list populates from Keycloak.

4. Select **Settings** from the left-hand menu.
5. Click **Generate** to create a token for this deployment.

   Note: Every user who needs API access to MLflow also requires this token. You must share this token manually.

   The administrator of the MLFlow Tracking Server *must* generate and provide the access token *each time* the server is restarted.

Set up garbage collection

When a client deletes a resource, MLflow transitions the resource into a `deleted` lifecycle state and hides it in the UI, but does not purge it from the system. Deleted resources will block creation of new resources with the same name until the garbage collection process has purged it.

The garbage collection process works in tandem with the `MLFLOW_TRACKING_GC_TTL` variable that is set in the `anaconda-platform.yml` project file. When a resource reaches the age specified by the `MLFLOW_TRACKING_GC_TTL` variable AND the garbage collection process runs, it will be purged.

1. Create a schedule within the MLflow Server project.
2. Name the schedule MLflow Garbage Collection.
3. Open the **Deployment Command** dropdown menu and select **gc**.
4. Schedule an interval to run the garbage collection. Custom schedules utilize cron expressions.
5. Click **Schedule**.

Upgrading MLflow

1. Download the latest MLflow release.
2. Open a browser and navigate to Workbench.
3. Log in as an administrator account with managed persistence permissions.
4. Open your MLflow Server project.
5. Select **Deployments** from the left-hand navigation.
6. Terminate your current deployment.
7. Select **Schedules** from the left-hand navigation.
8. Pause all scheduled runs.
9. Start a new session in your MLflow Server project.

10. Upload your newly obtained `migrate-<VERSION>.py` and `anaconda-platform-mlflow-runtime-<VERSION>.tar.gz` files to the root of the project.

11. Open a terminal in your project and run the following command:

    ```
    # Replace <VERSION> with your release version
    python migrate-<VERSION>.py
    ```

12. Redeploy your MLflow Server project.

13. Generate a new token to share your deployment.

    Note: Remember, you *must* generate an access token and provide it to users *each time* the server is restarted!

14. Restart all scheduled runs.

3.7.12 Connecting to an external version control repository

Data Science & AI Workbench supports the use of an external version control repository for user-created projects. Anaconda recommends connecting to this external version control repository *at time of installation*, however you are also able to migrate from one version control repository to another after installation is complete.

- To provide permission granularity and maintain parity with your external version control repository, Workbench grants individual platform users access to individual repositories. *To prevent default permissions being applied to all users within a group, users cannot belong to the given organization or group.*
- Platform users are prompted for their access token *before they create their first project* in Workbench. Anaconda recommends you *advise users to create an ever-lasting token*, to retain permanent access to their files from within Workbench. For more information about auth token permissions, see *Configuring user access to external version control*.

Tip: Anaconda recommends that you collect the following information before you begin:

- If necessary, the fully qualified domain name (FQDN) of your version control server.
- The organization, team, or group name associated with your service account.
- The username of the administrator for the organization, team, or group.
- The personal access token or password required to connect to your version control repository.

Supported external git versions

Workbench supports integration with the following external repositories:

External repository	Supported versions
GitHub Enterprise Server	2.15 through 3.14.1
GitHub Enterprise Cloud	github.com
Bitbucket Server/Data Center	5.9.1 through 8.9.0
Bitbucket Cloud	bitbucket.org
GitLab Self-Managed	10.4.2 through 17.4
GitLab Cloud	gitlab.com

GitHub

GitHub Enterprise Server

1. Create a backup copy of the `anaconda-enterprise-anaconda-platform.yml` configmap.
2. Open the `anaconda-enterprise-anaconda-platform.yml` configmap for editing.
3. Locate the `git:` section of the file.
4. *Uncomment* (remove the # from the start of lines in) the `Example external repo configuration` section.
5. *Comment out* (add a # to the start of) the remaining lines in the `git:` section.
6. Configure the `Example external repo configuration` values as follows:

Attribute	Description
`name`	A descriptive name for the GitHub service your organization uses.
`type`	Specifies the API version for accessing GitHub repositories. GitHub uses `github-v3-api`
`url`	The URL of the version control server API. For example: `https://your-domain.com/api/v3/`
`credential-url`	The hostname of the GitHub server used to manage user credentials. For example: `https://your-domain.com/api/path/`
`organization`	The name of your GitHub organization.
`username`	Specifies a username for a GitHub account. This account *must have Owner permissions for your GitHub organization*.
`auth-token`	The personal access token associated with the `username` GitHub account.

> **Caution:** The `url` and `credential-url` attributes *must* contain all lowercase characters.

Example Github Enterprise Server configuration

```
git:
   ## Example external repo configuration
   name: github-server
   type: github-v3-api
   url: https://<FQDN>/api/v3/
   http-timeout: 60
   credential-url: https://<FQDN>/api/v3/
   disable-tls-verification: false
   repository: '{owner}-{id}'
   organization: <GitHub_organization>
   username: <admin_username>
   auth-token: <username_token>
   # type: internal
   # http-timeout: 60
   # repository: '{owner}-{id}'
   # The maximum size of a commit in the git repository max-commit-file-size:␣
↪50000000
```

7. Save your changes.

8. Delete and restart system pods by running the following command:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep ap-)
```

Once all pods have returned to a running state, users are prompted to add their personal access token after logging into the platform.

GitHub Enterprise Cloud

1. Create a backup copy of the `anaconda-enterprise-anaconda-platform.yml` configmap.
2. Open the `anaconda-enterprise-anaconda-platform.yml` configmap for editing.
3. Locate the `git:` section of the file.
4. *Uncomment* (remove the # from the start of lines in) the `Example external repo configuration` section.
5. *Comment out* (add a # to the start of) the remaining lines in the `git:` section.
6. Configure the `Example external repo configuration` values as follows:

Attribute	Description
`name`	A descriptive name for the GitHub service your organization uses.
`type`	Specifies the API version for accessing GitHub repositories. GitHub uses `github-v3-api`
`url`	The URL of the version control server API. GitHub Enterprise Cloud uses `https://api.github.com`
`credential-url`	The hostname of the GitHub server used to manage user credentials. GitHub Enterprise Cloud uses `github.com`
`organization`	The name of your GitHub organization.
`username`	Specifies a username for a GitHub account. This account *must have Owner permissions for your GitHub organization*.
`auth-token`	The personal access token associated with the `username` GitHub account.

Caution: The `url` and `credential-url` attributes *must* contain all lowercase characters.

Example Github Enterprise Cloud configuration

```
git:
   ## Example external repo configuration
   name: github-cloud
   type: github-v3-api
   url: https://api.github.com/
   http-timeout: 60
   credential-url: https://github.com/<github-organization>
   repository: '{owner}-{id}'
   organization: <GitHub_organization>
   username: <admin_username>
   auth-token: <username_token>
   # type: internal
```

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```
  # http-timeout: 60
  # repository: '{owner}-{id}'
  # The maximum size of a commit in the git repository max-commit-file-size:␣
↪50000000
```

7. Save your changes.
8. Restart system pods with the following command for changes to take effect:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep ap-)
```

Once all pods have returned to a running state, users should now be prompted to add their personal access token after logging into the platform.

GitLab

GitLab Enterprise (Self-Managed)

1. Create a backup copy of the `anaconda-enterprise-anaconda-platform.yml` configmap.
2. Open the `anaconda-enterprise-anaconda-platform.yml` configmap for editing.
3. Locate the `git:` section of the file.
4. *Uncomment* (remove the # from the start of lines in) the `Example external repo configuration` section.
5. *Comment out* (add a # to the start of) the remaining lines in the `git:` section.
6. Configure the `Example external repo configuration` values as follows:

Attribute	Description
`name`	A descriptive name for the GitLab service your organization uses.
`type`	Specifies the API version for accessing GitLab repositories. GitLab Enterprise (Self-Managed) uses `gitlab-v4-api`
`url`	The URL of the version control server API. For example: `https://your-gitlab-domain.com`
`credential-url`	The hostname of the Bitbucket server used to manage user credentials. For example: `https://your-gitlab-domain.com`
`organization`	The name of your GitLab group.
`username`	Specifies a username for a GitLab account. This account *must have Administrator permissions for your GitLab Server*.
`auth-token`	The personal access token associated with the `username` GitLab Administrator account.

Caution: The `url` and `credential-url` attributes *must* contain all lowercase characters.

Example GitLab Enterprise (Self-Managed) configuration

```
git:
   ## Example external repo configuration
   name: gitlab-server
   type: gitlab-v4-api
   url: https://<FQDN>.com
   http-timeout: 60
   credential-url: https://<FQDN>.com
   repository: '{owner}-{id}'
   organization: <GitLab_group>
   username: <admin_username>
   auth-token: <username_token>
   # type: internal
   # http-timeout: 60
   # repository: '{owner}-{id}'
   # The maximum size of a commit in the git repository max-commit-file-size:␣
↪50000000
```

7. Save your changes.
8. Restart system pods with the following command for changes to take effect:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep ap-)
```

Once all pods have returned to a running state, users should now be prompted to add their personal access token after logging into the platform.

GitLab Enterprise (Cloud)

Note: Gitlab.com does not support versioning of archive downloads and app deployments. In other words, the latest revision will always be downloaded or deployed.

1. Create a backup copy of the `anaconda-enterprise-anaconda-platform.yml` configmap.
2. Open the `anaconda-enterprise-anaconda-platform.yml` configmap for editing.
3. Locate the `git:` section of the file.
4. *Uncomment* (remove the # from the start of lines in) the `Example external repo configuration` section.
5. *Comment out* (add a # to the start of) the remaining lines in the `git:` section.
6. Configure the `Example external repo configuration` values as follows:

Attribute	Description
`name`	A descriptive name for the GitLab service your organization uses.
`type`	Specifies the API version for accessing GitLab repositories. GitLab Enterprise (Cloud) uses `gitlab-v4-api`
`url`	The URL of the version control server API. GitLab (Cloud) uses `https://gitlab.com`
`credential-url`	The hostname of the GitLab server used to manage user credentials. GitLab (Cloud) uses `https://gitlab.com`
`organization`	The name of your GitLab group.
`username`	Specifies a username for a GitLab account. This account *must have Administrator permissions for your GitLab instance*.
`auth-token`	The personal access token associated with the `username` GitLab Administrator account.

Caution: The `url` and `credential-url` attributes *must* contain all lowercase characters.

Example GitLab Enterprise Cloud configuration

```
git:
   ## Example external repo configuration
   name: gitlab-cloud
   type: gitlab-v4-api
   url: https://gitlab.com
   http-timeout: 60
   credential-url: https://gitlab.com
   repository: '{owner}-{id}'
   organization: <GitLab_group>
   username: <admin_username>
   auth-token: <username_token>
   # type: internal
   # http-timeout: 60
   # repository: '{owner}-{id}'
   # The maximum size of a commit in the git repository max-commit-file-size: 50000000
```

7. Save your changes.
8. Restart system pods with the following command for changes to take effect:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep ap-)
```

Once all pods have returned to a running state, users should now be prompted to add their personal access token after logging into the platform.

Bitbucket

Caution: By default, Bitbucket uses `master` as its default Git branch. Workbench uses `main` as its default Git branch. You must update the system-wide default branch name in Bitbucket to target `main`. If you do not, your deployments will fail.

Bitbucket Server/Data Center

1. Create a backup copy of the `anaconda-enterprise-anaconda-platform.yml` configmap.
2. Open the `anaconda-enterprise-anaconda-platform.yml` configmap for editing.
3. Locate the `git:` section of the file.
4. *Uncomment* (remove the # from the start of lines in) the `Example external repo configuration` section.
5. *Comment out* (add a # to the start of) the remaining lines in the `git:` section.
6. Configure the `Example external repo configuration` values as follows:

Attribute	Description
`name`	A descriptive name for the Bitbucket Server/Data Center service your organization uses.
`type`	Specifies the API version for accessing Bitbucket repositories. Bitbucket Server/Data Center uses `bitbutcket-v1-api`
`url`	The URL of the version control server API. For example: `https://your-bitbucket-server-domain:7990`
`credential-url`	The hostname of the Bitbucket server used to manage user credentials. For example: `https://your-bitbucket-server-domain:7990`
`organization`	The name of your Bitbucket team.
`username`	Specifies a username for a Bitbucket account. This account *must have Admin level permissions for your Bitbucket Server*.
`auth-token`	The password associated with the `username` Bitbucket account.

Caution: The `url` and `credential-url` attributes *must* contain all lowercase characters.

Example Bitbucket Server/Data Center configuration

```
git:
   ## Example external repo configuration
   name: bitbucket-server
   type: bitbucket-v1-api
   url: https://<FQDN>:7990
   http-timeout: 60
   credential-url: https://<FQDN>:7990
   repository: '{owner}-{id}'
   organization: <Bitbucket_team>
   username: <Bitbucket_admin>
   auth-token: <admin_password>
   # type: internal
   # http-timeout: 60
```

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```
  # repository: '{owner}-{id}'
  # The maximum size of a commit in the git repository max-commit-file-size:␣
↪50000000
```

7. Save your changes.
8. Restart system pods with the following command for changes to take effect:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep ap-)
```

Once all pods have returned to a running state, users should now be prompted to add their personal access token after logging into the platform.

Bitbucket Cloud

Note: Bitbucket.com does not support versioning of archive downloads and app deployments. In other words, the latest revision will always be downloaded or deployed.

1. Create a backup copy of the `anaconda-enterprise-anaconda-platform.yml` configmap.
2. Open the `anaconda-enterprise-anaconda-platform.yml` configmap for editing.
3. Locate the `git:` section of the file.
4. *Uncomment* (remove the # from the start of lines in) the `Example external repo configuration` section.
5. *Comment out* (add a # to the start of) the remaining lines in the `git:` section.
6. Configure the `Example external repo configuration` values as follows:

Attribute	Description
`name`	A descriptive name for the Bitbucket Server/Data Center service your organization uses.
`type`	Specifies the API version for accessing Bitbucket repositories. Bitbucket cloud uses `bitbutcket-v2-api`
`url`	The URL of the version control server API. Bitbucket cloud uses `https://api.bitbucket.org`
`credential-url`	The hostname of the Bitbucket server used to manage user credentials. Bitbucket cloud uses `https://bitbucket.org`
`organization`	The name of your Bitbucket team.
`username`	Specifies a username for a Bitbucket account. *This account must have Admin-level permissions for your Bitbucket Server.*
`auth-token`	The password associated with the `username` Bitbucket account.

Caution: The `url` and `credential-url` attributes *must* contain all lowercase characters.

Example Bitbucket Cloud configuration

```
git:
   ## Example external repo configuration
   name: bitbucket-cloud
   type: bitbucket-v2-api
   url: https://api.bitbucket.org
   http-timeout: 60
   credential-url: https://bitbucket.org/
   repository: '{owner}-{id}'
   organization: <Bitbucket_team>
   username: <Bitbucket_admin>
   auth-token: <admin_password>
   # type: internal
   # http-timeout: 60
   # repository: '{owner}-{id}'
   # The maximum size of a commit in the git repository max-commit-file-size:␣
↪50000000
```

7. Save your changes.

8. Restart system pods with the following command for changes to take effect:

```
# Replace <NAMESPACE> with your Workbench cluster namespace
kubectl delete -n <NAMESPACE> --wait=false $(kubectl get pods -o name|grep ap-)
```

Once all pods have returned to a running state, users should now be prompted to add their personal access token after logging into the platform.

3.7.13 Migrating projects between version control repositories

If your organization has changed Git hosting services, and you therefore need to migrate projects from one *supported* version control repository to another, Anaconda recommends you follow this high-level process:

1. *Perform pre-migration setup*.
2. *Run the project migration script*.
3. *Perform post migration cleanup*.
4. *Adding collaborators*.

Prerequisites:

- *Update the Data Science & AI Workbench config map* with the information required to connect to the external version control repository.
- To run the project migration script, you'll need Administrator access to a command line tool that can run bash or Python scripts *on the master node of the Workbench cluster*.
- Ensure a recent version of `git` is installed on the master node
- You'll also need the origin Git host token/password, and destination Git host token/password.

Pre-migration setup

1. If you haven't already done so, *on the master node*, change to the directory of the unpacked Workbench installer and install the bootstrap conda environment:

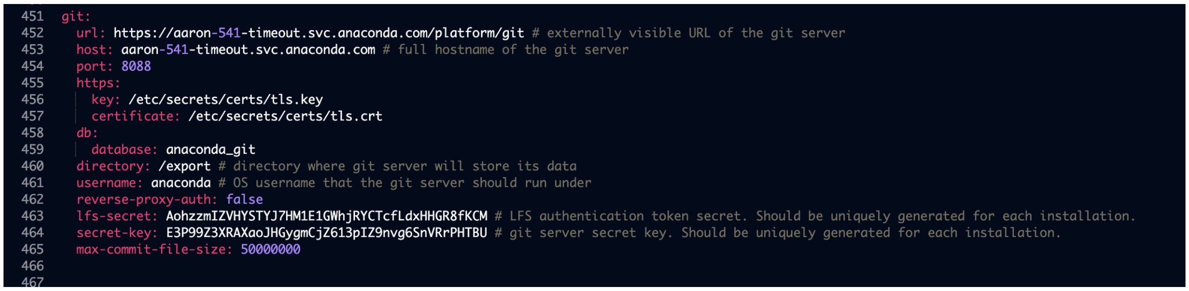
   ```
   bash conda-bootstrap.sh
   ```

2. After the environment is finished installing, you may need to log out and log back in to activate the conda environment.

3. Temporarily disable reverse proxy authentication by adding the following key-value pair to the `git` section (outside of the `storage` section in the config map) of the `anaconda-enterprise-anaconda-platform.yml` file used to *configure the platform to use an external version control repository*:

   ```
   reverse-proxy-auth: false
   ```

   This should look similar to the following:

   ```
   git:
     url: https://aaron-541-timeout.svc.anaconda.com/platform/git # externally visible URL of the git server
     host: aaron-541-timeout.svc.anaconda.com # full hostname of the git server
     port: 8088
     https:
       key: /etc/secrets/certs/tls.key
       certificate: /etc/secrets/certs/tls.crt
     db:
       database: anaconda_git
     directory: /export # directory where git server will store its data
     username: anaconda # OS username that the git server should run under
     reverse-proxy-auth: false
     lfs-secret: AohzzmIZVHYSTYJ7HM1E1GWhjRYCTcfLdxHHGR8fKCM # LFS authentication token secret. Should be uniquely generated for each installation.
     secret-key: E3P99Z3XRAXaoJHGygmCjZ613pIZ9nvg6SnVRrPHTBU # git server secret key. Should be uniquely generated for each installation.
     max-commit-file-size: 50000000
   ```

4. Run the following command to restart the associated pod on the master node:

   ```
   kubectl delete pod -l 'app=ap-git-storage'
   ```

5. Create a user mappings file that maps Workbench user IDs to Git user IDs. This is a colon-separated text file where the first field is the Workbench user name, and the second field is the corresponding Git user name. For example:

   ```
   ae-admin:git-admin
   ae-user1:git-user1
   ae-user2:git-user2
   ```

   Note: If you intend on migrating to or from a Bitbucket repository, you must use your `Bitbucket account ID` instead of your `Bitbucket username` in the `user mappings file`.

Using the migration tool

Caution: Using the migration tool with `https` instead of `http` for the internal storage may result in an SSL error.

The migration tool is a Python script, `migrate_projects.py`, found in the Workbench installation tarball. It can be used in the following ways:

```
usage: migrate_projects.py [-h] [--parallel PARALLEL] [--log-file LOG_FILE]
                      [--force-migrate] [--scratch-dir SCRATCH_DIR]
                      --postgres-host POSTGRES_HOST
                      [--postgres-user POSTGRES_USER]
                      [--postgres-passwd POSTGRES_PASSWD]
                      [--origin-api-type {internal,bitbucket-v1-api,bitbucket-v2-api,
↪github-v3-api,gitlab-v4-api}]
                      --origin-api-url ORIGIN_API_URL
                      [--origin-username ORIGIN_USERNAME]
                      [--origin-token ORIGIN_TOKEN]
                      [--origin-organization ORIGIN_ORGANIZATION]
                      [--dest-api-type {internal,bitbucket-v1-api,bitbucket-v2-api,
↪github-v3-api,gitlab-v4-api}]
                      --dest-api-url DEST_API_URL
                      [--dest-username DEST_USERNAME]
                      [--dest-token DEST_TOKEN]
                      [--dest-organization DEST_ORGANIZATION]
                      --dest-user-mappings DEST_USER_MAPPINGS

optional arguments:
-h, --help            show this help message and exit
--cloud               Set if using Gitlab Cloud, or older version of Gitlab On-Prem
--parallel PARALLEL   Number of parallel migration jobs to spawn
--log-file LOG_FILE   Path prefix to log directory, suffixed with a
                    timestamp, e.g. migrate-projects-
                    log-1559234750640867208
--force-migrate       Forces migration by replacing local and destination
                    repositories
--scratch-dir SCRATCH_DIR
                    The scratch directory for cloning project repositories
--postgres-host POSTGRES_HOST
                    Hostname of Workbench  Postgres DB
--postgres-user POSTGRES_USER
                    Username of Workbench  postgres DB
--postgres-passwd POSTGRES_PASSWD
                    Password of Workbench  postgres DB
--origin-api-type {internal,bitbucket-v1-api,bitbucket-v2-api,github-v3-api,gitlab-v4-
↪api}
                    Origin git host API type
--origin-api-url ORIGIN_API_URL
                    Origin git host API URL (must be all lowercase)
--origin-username ORIGIN_USERNAME
                    Origin git host username
--origin-token ORIGIN_TOKEN
                    Origin git host auth token
--origin-organization ORIGIN_ORGANIZATION
                    Origin git host organization
--dest-api-type {internal,bitbucket-v1-api,bitbucket-v2-api,github-v3-api,gitlab-v4-api}
                    Destination git host API type
--dest-api-url DEST_API_URL
                    Destination git host API URL (must be all lowercase)
--dest-username DEST_USERNAME
                    Destination git host username
```

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```
--dest-token DEST_TOKEN
                    Destination git host auth token
--dest-organization DEST_ORGANIZATION
                    Destination git host organization
--dest-user-mappings DEST_USER_MAPPINGS
                    Colon-separated Workbench-to-git-host mappings file, e.g. ae-
                    user1:github-user1
```

For example, the tool can be used in the following way:

```
python migrate_projects.py \
  --postgres-host localhost --origin-api-url http://localhost:8443/ \
  --origin-username root --dest-api-type gitlab-v4-api \
  --dest-api-url https://mbrock-gitlab.anacondaenterprise.com/ \
  --dest-username root --dest-organization demo --dest-user-mappings \
  user-mappings-gitea-to-gitlab.txt --force-migrate --parallel 4
```

To ensure tokens are not visible in bash history, they can be omitted and can be entered via stdin when running the script.

Note: The postgres password can be left blank. When migrating *from* Workbench, the `origin-token` can be left blank. When migrating *to* Workbench, the `dest-token` can be left blank.

Note: When migrating to Gitlab Cloud, please use the `--cloud` flag.

Post-migration cleanup

After the script finishes migrating the projects, re-enable reverse proxy authentication by editing the key-value pair you previously added to the `git` section of the `anaconda-enterprise-anaconda-platform.yml` file, so it looks like the following:

```
reverse-proxy-auth: true
```

Caution: If you do not re-enable reverse proxy authentication, Workbench will not work.

To verify that the new repository is being used by Workbench, *edit an existing project* and *commit your changes to it*.

Adding collaborators

If you've migrated to https://github.com, whenever a user is *added to a project as a collaborator*, they'll be sent an invitation to collaborate via email. **They'll need to accept this invitation to be able to commit changes to the repository associated with the project.** *This does not apply to Github Enterprise.*

3.7.14 Mounting an external file share

Data Science & AI Workbench provides a mechanism to mount shared volumes into sessions, deployments, and jobs, using the `volumes:` section of the platform configuration YAML file. In Workbench 5.4 and earlier, this was limited strictly to NFS volumes.

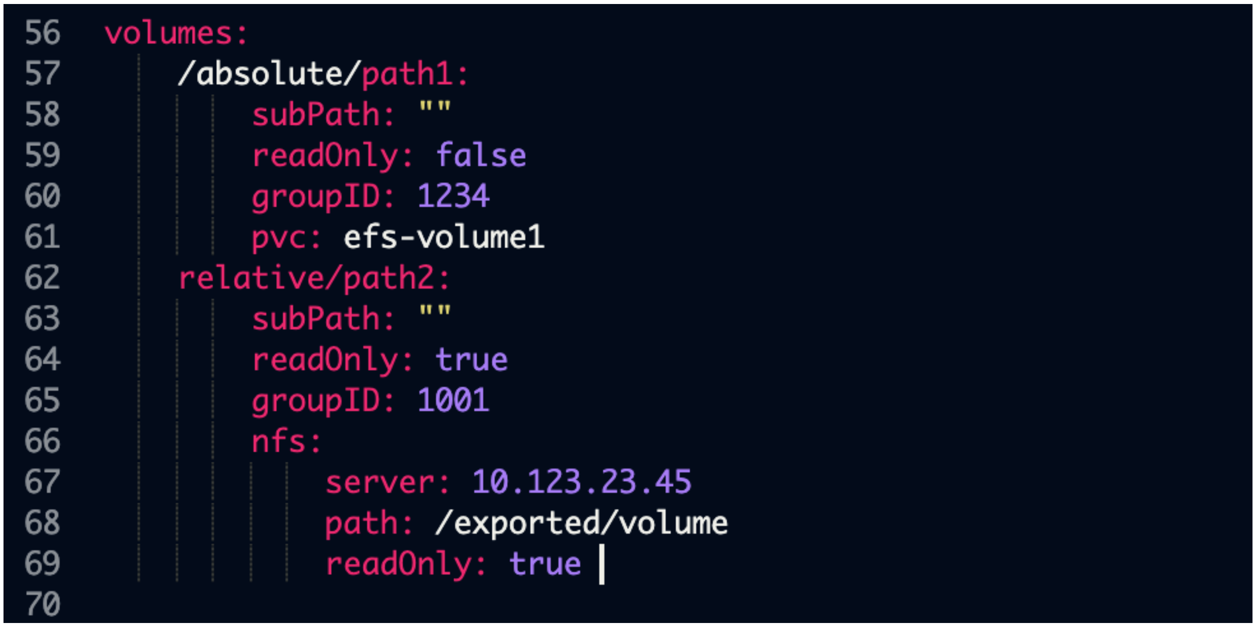
With Workbench version 5.5+ and the Bring Your Own Kubernetes (BYOK8s) option, this capability has been extended to support standard Kubernetes Persistent Volumes (PVs) and Persistent Volume Claims (PVCs). This addition allows sessions, deployments, and pods to access a much wider variety of shared volumes. The specific set choices available to you will depend on the specific Kubernetes implementation and host. See this section of the Kubernetes documentation for a list of volume types—but again, check the documentation for your specific Kubernetes provider for the subset of those choices available to you.

Before you begin:

Adding a new file share requires editing the Workbench configmap and restarting the workspace and deploy pods. For that reason, Anaconda recommends scheduling a maintenance window for this task and backing up the current version of `anaconda-enterprise-anaconda-platform.yml` before making changes to it.

Creating the volume list

Volume specifications are provided to Workbench in the `volumes:` section of the configmap, as seen in the following example:



```
volumes:
  /absolute/path1:
    subPath: ""
    readOnly: false
    groupID: 1234
    pvc: efs-volume1
  relative/path2:
    subPath: ""
    readOnly: true
    groupID: 1001
    nfs:
      server: 10.123.23.45
      path: /exported/volume
      readOnly: true
```

This section is a dictionary with one entry for each mount.

The dictionary key is the *mount* path for the volume. If the path does not begin with a forward slash `/`, then it is assumed to be *relative* to the `/data` subdirectory. So, for instance, the second mount path above will be `/data/relative/path2`.

`subPath` (optional): the subfolder of the shared filesystem to mount. Any leading slashes are ignored, and the path is assumed relative to the root of the exported mount. This is a somewhat advanced configuration; see *SubPaths and Template Expansion* section below for an advanced use case that can take advantage of this option.

readOnly (optional): if true, the file share will be mounted as read-only; that is, sessions, deployments, and jobs will not be able to write to the volume. If false, or omitted entirely, the file share will be mounted read-write.

Note: For back-compatibility, the readOnly flag can be provided in two different locations: either within the nfs specification or outside of it. The volume will be mounted read-only if either value is true.

groupID (optional): a Unix GID which has read and/or write access to the volume. See the section *Ensuring Access* below for more information.

Finally, the volume specification itself is given by *one* of the two entries: pvc or nfs.

pvc: the name of the Kubernetes Persistent Volume Claim. This PVC must meet the following criteria:

- The PVC must be *pre-created*. Workbench will *not* auto-create a PVC for you. Thus the PVC and the Persistent Volume (PV) it is bound to must already exist.
- If readOnly is false, it must have a ReadWriteMany access policy. If readOnly is true, it must be either ReadWriteMany or ReadOnlyMany.

nfs: this is an NFS import specification, and its syntax has not changed from Workbench 5.4—and remains the only option for multi-node, Gravity-based clusters.

- server: the FQDN or IP address of the NFS server.
- path: the exported path from the NFS server.
- readOnly: see above.

Ensuring access

For all mounted volumes, it is important to ensure that both read and write permissions are aligned with those of the session, deployment, and job containers. By default, containers run with a fixed, nonzero UID—identical across all users—and a GID of 0. Kubernetes also provides the facility to add supplemental groups to the containers, and we have added a limited ability to utilize this capability. To that end, here are the scenarios that Workbench supports in this standard case:

If the GID of the content on the volume is 0, then sessions, deployments, and pods will be able to access it without further configuration.

If the GID of the content is a single, nonzero value, then sessions, deployments, and pods can be given access to it by taking one of the following steps:

- Specify the GID using a pv.beta.kubernetes.io/gid Persistent Volume annotation. (This must be added to the PV, *not* to the PVC.) Many persistent volume providers do this automatically—if so, Workbench 5.5 will pick this up automatically as well, and no further configuration is needed.
- Specify the GID for the volume using the groupID option above.

In all of these scenarios, only one GID is allowed per volume. So, for instance, in the example configuration above, the GID list will be 0,1001,1234. Files accessible by any of these three GIDs will be accessible.

To access volumes with more complex Unix access permissions, including individual user permissions, the Authenticated NFS integration pattern will likely be necessary. See the dedicated documentation for that pattern for details.

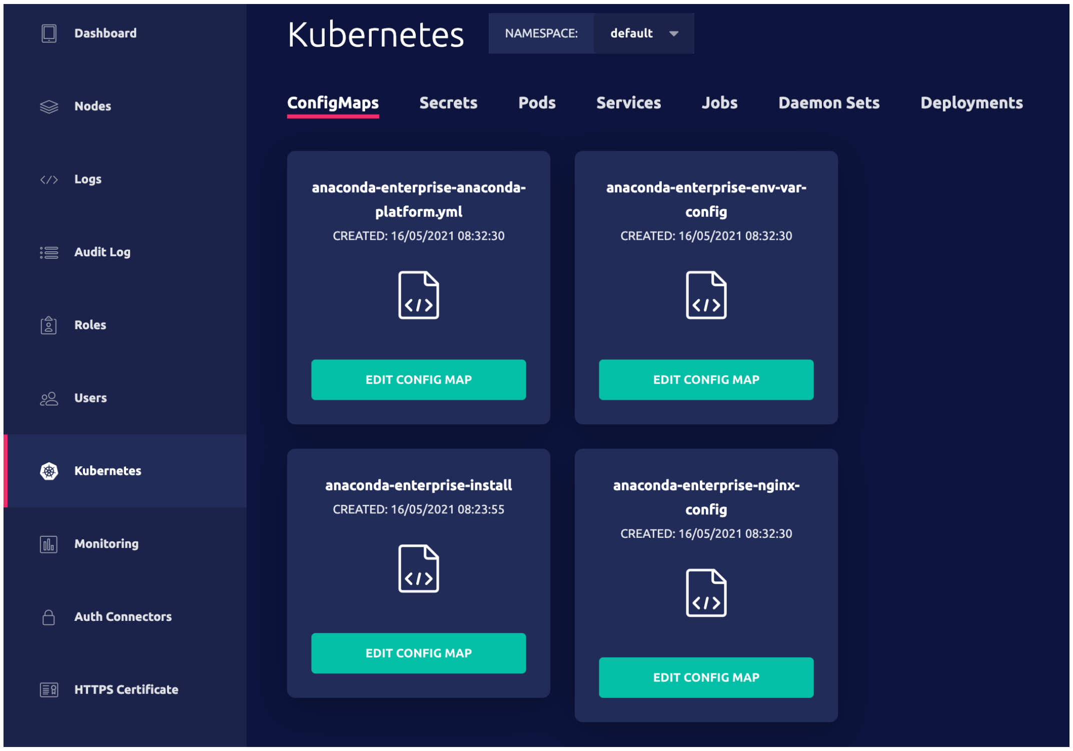
Adding the volume list to the configmap

Note: The example provided in this section is for Gravity installs. Bring your own Kubernetes installs do not have the Operations Center and need to use a different method of managing the configmap.

1. Log in to Workbench, select the **Menu** icon in the top right corner and click the **Administrative Console** link displayed at the bottom of the slide out window.
2. Click **Manage Resources**.
3. Log in to the Operations Center using the Administrator credentials *configured after installation*.
4. Select **Kubernetes** from the menu on the left.

   Note: At this point Anaconda recommends copying the existing configuration into a backup text file, should you need to restore it.

5. Under the **configmaps** tab, select the `anaconda-enterprise-anaconda-platform.yml` configuration file.


Dashboard
Nodes
Logs
Audit Log
Roles
Users
Kubernetes
Monitoring
Auth Connectors
HTTPS Certificate
Kubernetes
NAMESPACE:
default
ConfigMaps
Secrets
Pods
Services
Jobs
Daemon Sets
Deployments
anaconda-enterprise-anaconda-platform.yml
CREATED: 16/05/2021 08:32:30
EDIT CONFIG MAP
anaconda-enterprise-env-var-config
CREATED: 16/05/2021 08:32:30
EDIT CONFIG MAP
anaconda-enterprise-install
CREATED: 16/05/2021 08:23:55
EDIT CONFIG MAP
anaconda-enterprise-nginx-config
CREATED: 16/05/2021 08:32:30
EDIT CONFIG MAP

6. If the volume section is commented out, uncomment it. Whether it's commented out or not, replace it with the new volume configuration according to the *volume section* above. It is very important to respect the indentation of the volume section, so confirm that before saving.
7. Click **Apply** to save your changes to the configmap.
8. To update the Workbench server with your changes, restart services by running these commands *on the master node*:

```
sudo gravity enter
kubectl get pods | grep 'workspace\|deploy' | cut -d' ' -f1 | xargs kubectl delete pods
```

9. Wait about 10 seconds, and then run `kubectl get pods`. Examine the workspace and deploy pods. You may still see the old versions of the pods shutting down, which is expected. The new pods should be running as expected. If for some reason there are errors, it is likely because your configmap is improperly formatted. Double check your editing and repeat steps 5 through 7 above to correct the issue.
10. To verify that Workbench users can access the volumes you add, start a new project editing session or restart an existing one and confirm that the volumes are listed as available directories. See *Loading data* for more information.

Addressing file share downtime

If a server that you have configured as a volume mount in Workbench goes offline, editor sessions, applications and deployment jobs that use it will not start. If downtime occurs, Anaconda recommends disabling the mount until the server resumes proper functioning.

Disabling a volume mount

1. Stop any sessions, deployments, or jobs that rely on that shared volume.
2. Open the configmap and comment out the `volume` section.
3. Restart the workspace and deploy pods as described in step 8 above.

ADVANCED: SubPaths and Template Expansion

Note: The capability described in this section should be considered advanced and/or experimental in nature. Most customers can safely ignore this section. Instead, they should consider the new Managed Persistence feature, which leverages these capabilities in a very specific and tested manner. If you do find a novel use case for subPaths and templating, please share it with us!

The `subPath` option can be used to mount just a *subdirectory* of a shared volume at multiple mount points in the session. Anything above that subdirectory would not be visible within the container. For example, consider a shared volume with the following fileset:

```
/testA
/user1/testB
/user2/testC
```

Suppose this volume is exported via a PVC called `pv1`, and consider the following mount configuration:

```
mount1:
    pvc: pv1
    subPath: user1
mount2/mount3:
    pvc: pv1
    subPath: user2
```

If nothing else is mounted into the `/data` path, the container would see the following tree:

```
/data/mount1/testB
/data/mount2/mount3/testC
```

Notice that `testA` is not accessible at all, and the `user1` and `user2` are not even at the same “depth” of the directory tree anymore. As a result, sub path mounting offers a simple form of access control, allowing only portions of a shared volume to be made available to sessions, deployments, and jobs.

The usefulness of this subpath functionality has been enhanced with simple *templating* functionality. Specifically, the `subPath` value can include one or more of the following strings (braces included), and Workbench will dynamically substitute a relevant value in its place:

- `{user}`: the username of the person *running* the session, deployment, or job
- `{owner}`: the username of the owner of the project associated with the session, deployment, or job. These will differ in a collaboration scenario: if `userA` created a project and shared it with `userB`, who is now running a session, `{user}` would be `userB` and `{owner}` would be `userA`.
- `{id}`: the 32-character uuid of the session, deployment, or job.
- `{project}`: the 32-character uuid of the project itself. This will be the same across all sessions, deployments, and jobs associated with that project.

Using these templates, we can construct mounting configurations that dynamically select subdirectories based upon the context of the running container. For example, consider the following mount configuration:

```
shared_data:
    pvc: pv1
    subPath: owner/{owner}/{project}
unshared_data:
    pvc: pv1
    subPath: user/{user}/{project}
scratch:
    pvc: pv1
    subPath: scratch/{id}
```

Then given a project owned by `userA`, and a session being run by `userB`, the three subpaths might be

```
/data/shared_data -> owner/userA/23dc83c697ca4c21bdc3c96e6b7d2c86
/data/unshared_data -> user/userB/23dc83c697ca4c21bdc3c96e6b7d2c86
/data/scratch -> scratch/bf38438b5a8044d190de3c2899d6da9e
```

depending, of course, on the precise UUID values for the project and session.

As mentioned in the note in the beginning of this section, subpaths and templating represent an advanced feature and Anaconda recommends it only for experimental use. But they do sit at the core of our Managed Persistence support, so we are ensuring this functionality is tested and supported for that use case. If you find a new use for this capability, please let us know so that we can ensure it is included in our support.

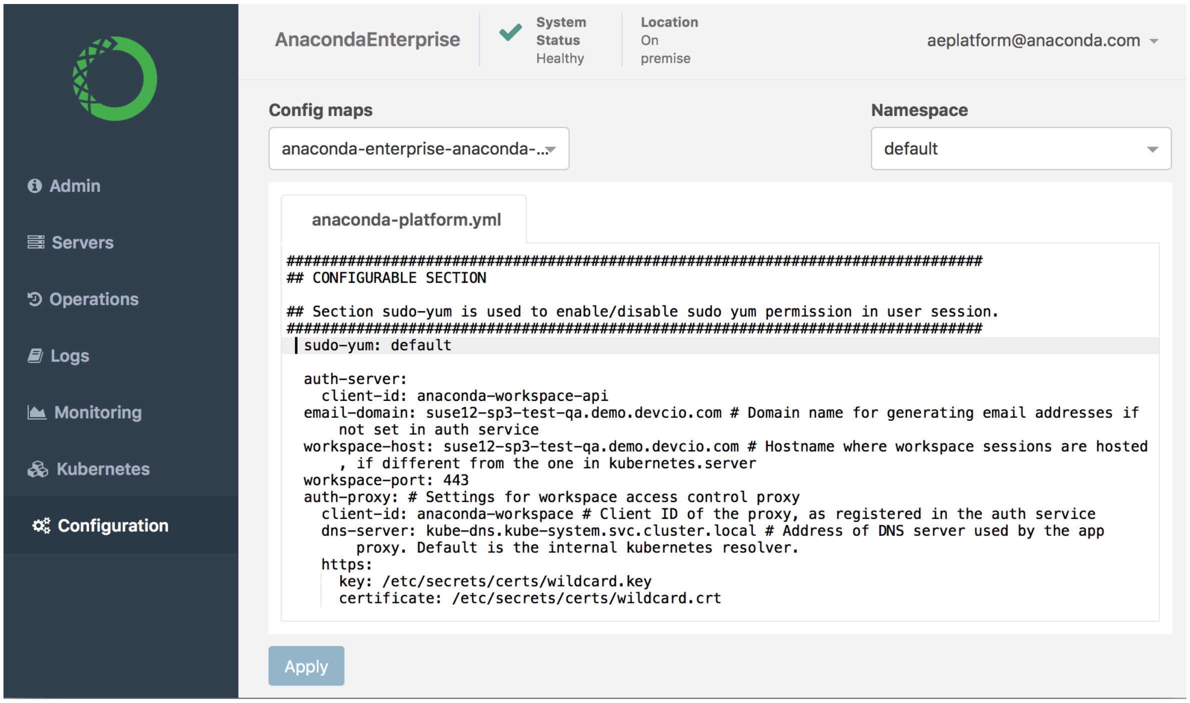
3.7.15 Disabling sudo for yum

By default, `sudo` access for `yum` is enabled on the Data Science & AI Workbench platform. You can easily disable it, however, if your organization requires it.

1. Log in to Workbench, select the **Menu** icon in the top right corner, and click the **Administrative Console** link displayed at the bottom of the slide out window.
2. Click **Manage Resources**.
3. Log in to the Operations Center using the Administrator credentials *configured after installation*.
4. Select **Configuration** from the menu on the left.
5. Verify that the `anaconda-enterprise-anaconda-platform.yml` configuration file is selected in the **Config map** drop-down menu.

   Note: Anaconda recommends that you make a backup copy of this file since you will be editing it directly.

6. Scroll down to the `sudo-yum` section of the Config map:



```
################################################################################
## CONFIGURABLE SECTION

## Section sudo-yum is used to enable/disable sudo yum permission in user session.
################################################################################
sudo-yum: default

  auth-server:
    client-id: anaconda-workspace-api
  email-domain: suse12-sp3-test-qa.demo.devcio.com # Domain name for generating email addresses if
      not set in auth service
  workspace-host: suse12-sp3-test-qa.demo.devcio.com # Hostname where workspace sessions are hosted
      , if different from the one in kubernetes.server
  workspace-port: 443
  auth-proxy: # Settings for workspace access control proxy
    client-id: anaconda-workspace # Client ID of the proxy, as registered in the auth service
    dns-server: kube-dns.kube-system.svc.cluster.local # Address of DNS server used by the app
        proxy. Default is the internal kubernetes resolver.
    https:
      key: /etc/secrets/certs/wildcard.key
      certificate: /etc/secrets/certs/wildcard.crt
```

7. Change the setting from `default` to `disable`:

```
sudo-yum: disable
```

8. Click **Apply** to save your changes.
9. To update the Workbench server with your changes, restart services by running these commands *on the master node*:

```
sudo gravity enter
kubectl get pods | grep ap- | cut -d' ' -f1 | xargs kubectl delete pods
```

To re-enable sudo yum, simply change this Config map setting back to `default`, save your changes, and restart services.

3.7.16 Specifying alternate wildcard domains

By default, Data Science & AI Workbench expects the wildcard domain to be the same for the primary platform server and the application domain.

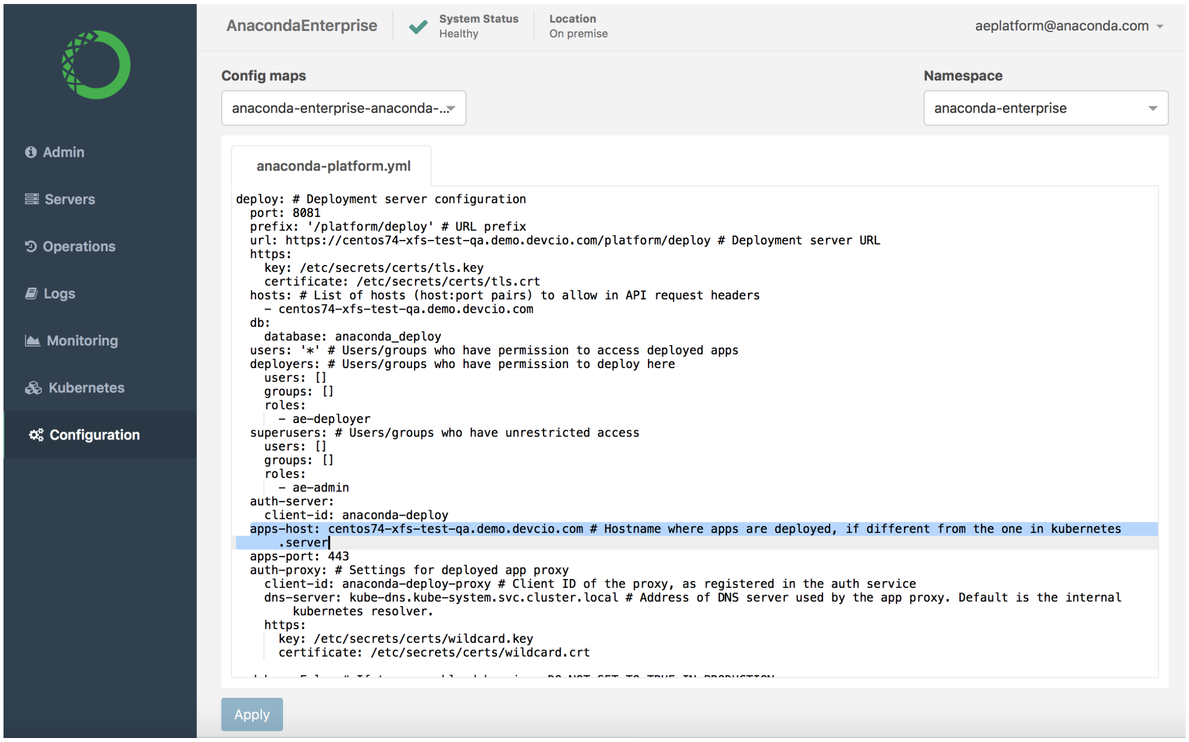
If your particular implementation uses different domains, you'll need to update the configuration file for the platform with the fully qualified domain name (FQDN) for each server.

Note: Make sure the wildcard domain has a TLS cert and DNS entry that meets *these requirements* before you follow the process below to specify it as an `apps-host` or `workspace-host`.

1. Log in to Workbench, select the **Menu** icon in the top right corner and click the **Administrative Console** link displayed at the bottom of the slide out window.
2. Click **Manage Resources**.
3. Log in to the Operations Center using the Administrator credentials *configured after installation*.
4. Select **Configuration** from the menu on the left.
5. Verify that the `anaconda-enterprise-anaconda-platform.yml` configuration file is selected in the **Config map** drop-down menu.

   Note: Any changes you make will impact how Workbench functions, so **we strongly recommend that you save a copy of the original file** before making any changes.

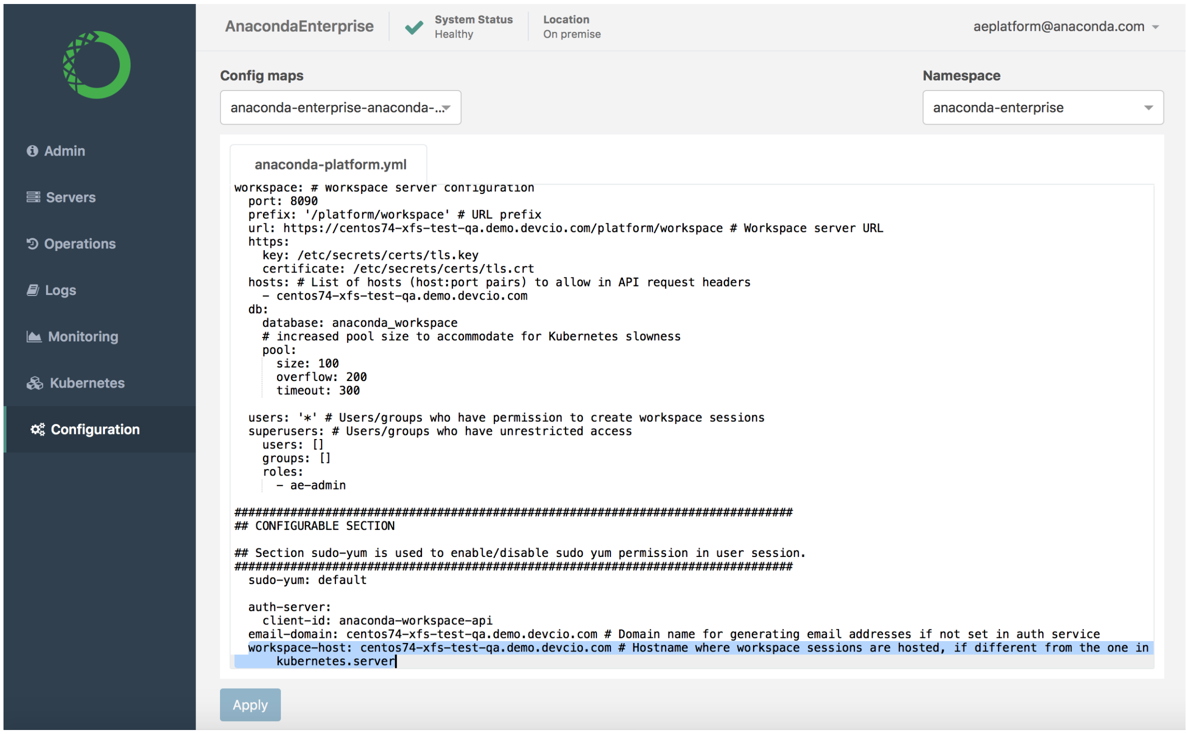
6. Scroll down to the `Deployment server configuration` section of the Config map:



```
deploy: # Deployment server configuration
  port: 8081
  prefix: '/platform/deploy' # URL prefix
  url: https://centos74-xfs-test-qa.demo.devcio.com/platform/deploy # Deployment server URL
  https:
    key: /etc/secrets/certs/tls.key
    certificate: /etc/secrets/certs/tls.crt
  hosts: # List of hosts (host:port pairs) to allow in API request headers
    - centos74-xfs-test-qa.demo.devcio.com
  db:
    database: anaconda_deploy
  users: '*' # Users/groups who have permission to access deployed apps
  deployers: # Users/groups who have permission to deploy here
    users: []
    groups: []
    roles:
      - ae-deployer
  superusers: # Users/groups who have unrestricted access
    users: []
    groups: []
    roles:
      - ae-admin
  auth-server:
    client-id: anaconda-deploy
  apps-host: centos74-xfs-test-qa.demo.devcio.com # Hostname where apps are deployed, if different from the one in kubernetes
      .server
  apps-port: 443
  auth-proxy: # Settings for deployed app proxy
    client-id: anaconda-deploy-proxy # Client ID of the proxy, as registered in the auth service
    dns-server: kube-dns.kube-system.svc.cluster.local # Address of DNS server used by the app proxy. Default is the internal
        kubernetes resolver.
    https:
      key: /etc/secrets/certs/wildcard.key
      certificate: /etc/secrets/certs/wildcard.crt
```

7. Search for and update the `apps-host` setting with the FQDN of the host server you'll be deploying apps to, if it's different than the default Kubernetes server.

8. Scroll down to the `Workspace server configuration` section of the Config map:



```
workspace: # workspace server configuration
  port: 8090
  prefix: '/platform/workspace' # URL prefix
  url: https://centos74-xfs-test-qa.demo.devcio.com/platform/workspace # Workspace server URL
  https:
    key: /etc/secrets/certs/tls.key
    certificate: /etc/secrets/certs/tls.crt
  hosts: # List of hosts (host:port pairs) to allow in API request headers
    - centos74-xfs-test-qa.demo.devcio.com
  db:
    database: anaconda_workspace
    # increased pool size to accommodate for Kubernetes slowness
    pool:
      size: 100
      overflow: 200
      timeout: 300

  users: '*' # Users/groups who have permission to create workspace sessions
  superusers: # Users/groups who have unrestricted access
    users: []
    groups: []
    roles:
      - ae-admin

################################################################################
## CONFIGURABLE SECTION

## Section sudo-yum is used to enable/disable sudo yum permission in user session.
################################################################################
  sudo-yum: default

  auth-server:
    client-id: anaconda-workspace-api
  email-domain: centos74-xfs-test-qa.demo.devcio.com # Domain name for generating email addresses if not set in auth service
  workspace-host: centos74-xfs-test-qa.demo.devcio.com # Hostname where workspace sessions are hosted, if different from the one in
      kubernetes.server
```

9. Update the `workspace-host` setting with the FQDN of the host server you'll be using as a workspace server, if it's different than the default Kubernetes server.

10. Click **Apply** to save your changes.

11. To update the Workbench server with your changes, restart services by running these commands *on the master node*:

```
sudo gravity enter
kubectl get pods | grep ap- | cut -d' ' -f1 | xargs kubectl delete pods
```

3.7.17 Connecting to external Postgres

Caution: Anaconda recommends that you connect to your external Postgres instance immediately after installation completes. If you do not, you will need to create a dump file from the internal Workbench Postgres instance, then import it into your own Postgres instance, ensuring that it mirrors the internal setup.

You can connect Workbench to your organization's pre-existing Postgres instance for both BYOK8s and Gravity installations. Connecting to an external Postgres instance enables you to take advantage of multiple High Availability/Disaster Recovery (HA/DR) options your organization may already have in place.

Workbench also supports connections to external Postgres instances that are hosted within the same overarching cluster environment. For example, your organization can have a multi-namespace/region deployment of Postgres within your Kubernetes cluster that connects to Workbench via the Service name. Combining this with dynamic block Persistent

Storage and Managed Persistence enables Workbench to rapidly relocate deployed projects from failing nodes to healthy ones utilizing standard Kubernetes pod scheduling.

Connecting to external Postgres

To connect to your external Postgres instance:

1. Create a Workbench account with read/write access and set the account's password.
2. Open your `anaconda-enterprise-anaconda-platform.yml` file and edit the following section:

```
db: # Database client configuration
 host: <IP/Hostname> # Database hostname
 port: 5432
 username: "<postgres-account>"
 password: "<password>"
```

3. Save your changes, then restart all pods:

```
kubectl get pods | grep ap- | cut -d' ' -f1 | xargs kubectl delete pods
```

4. Once the pods are in a running state, confirm that the following databases have been created in Postgres.

```
anaconda_auth
anaconda_auth_escrow
anaconda_deploy
anaconda_git
anaconda_operation_controller
anaconda_repository
anaconda_storage
anaconda_ui
anaconda_workspace
```

> **Caution:** If a pod shows a crashloop state, inspect the pod's logs. The most common cause of a crashloop state is a misconfiguration.

> **Caution:** If the `anaconda_auth` database is not created in Postgres, you must update the following environmental variables in the `anaconda-enterprise-ap-auth` deployment:

```
# Replace <POSTGRES> with the hostname or service name of the Postgres␣
↪instance
# Replace <POSTGRES-ACCOUNT> with the user account name for your␣
↪Postgres instance
# Replace <PASSWORD> with the user account password for your Postgres␣
↪instance

env:
  - name: WAIT_FOR_IT
    value: '<POSTGRES>:5432'
  - name: DB_USER
    value: <POSTGRES-ACCOUNT>
  - name: DB_PASSWORD
    value: <PASSWORD>
  - name: DB_ADDR
    value: <POSTGRES>
```

3.7.18 Upgrading Postgres version

Current versions of Workbench no longer support Postgres versions 9.6 and older. To align with these changes, you must update your Postgres to a supported version. To simplify this process, Anaconda provides a script that automates the update, minimizing downtime and ensuring a smooth transition. See which Postgres versions are compatible with your version of Workbench in the latest *release notes*.

Checking your Postgres version

You can check your current version of Postgres by running the following command in your cluster:

BYOK8s

```
# Replace <NAMESPACE> with your namespace (default is anaconda-enterprise)
kubectl exec -it anaconda-enterprise-postgres-0 -n <NAMESPACE> -- psql --version
```

Gravity

```
kubectl exec -it anaconda-enterprise-postgres-0 -- psql --version
```

Upgrading Postgres

You must place a compatible version of Postgres in the same registry as the current Postgres image prior to performing the upgrade.

> **Caution:** If you are upgrading your Workbench version, complete that process first, then return here.

1. *Create a backup of your cluster*.
2. Pause your instance of Workbench by running the following command:

   ```
   ae_pause.sh
   ```

3. Use the restore script to update your version of Postgres to a compatible version by running the following command:

   ```
   # Replace <VERSION> with the new Postgres version image number
   bash ae_restore.sh ae5_config_db_YYYYMMDDHHMM.tar.gz ae5_data_YYYYMMDDHHMM.
   ↪tar.gz --db-version=<VERSION>
   ```

4. Unpause your instance of Workbench by running the following command:

```
ae_unpause.sh
```

3.7.19 Migrating from Anaconda Enterprise 4 to Workbench

The process of migrating from Anaconda Enterprise 4 to Data Science & AI Workbench involves the following tasks:

For Administrators:

- *Export all packages* and package information from your Anaconda Enterprise 4 Repository.
- *Import the packages* into Workbench.

For Notebook users:

- *Export each project environment* to a `.yml` file.
- *Convert each project into a format compatible with Workbench*.
- *Upload each project into Workbench*.

Due to architectural changes between versions of the platform, there are some additional steps you may need to follow to *migrate code* between Anaconda Enterprise 4 and Workbench. These steps vary, based your current and new platform configurations.

Exporting packages

Workbench enables you to create a site dump of all packages used by your organization, including the owners and permissions associated with each package.

1. Log in to the Anaconda Enterprise 4 Repo and switch to the `anaconda-server` user.
2. To export your packages, run the following command on the server hosting your Anaconda Enterprise 4 Repository:

   ```
   anaconda-server-admin export-site
   ```

Running this command creates a directory structure containing all files and user information from your Anaconda Enterprise 4 Repository. For example:

```
site-dump/
├── anaconda-user-1
│   ├── 59921152446b5703f430383f--moto
│   ├── 5992115f446b5703fa30383e--pysocks
│   └── meta.json
├── anaconda-organization
│   ├── 5989fbd1446b575b99032652--future
│   ├── 5989fc1d446b575b99032786--iso8601
│   ├── 5989fc1f446b575b990327a8--simplejson
│   ├── 5989fc26446b575b99032802--six
│   ├── 5989fc31446b575b990328b0--xz
│   ├── 5989fc35446b575b990328c6--zlib
│   └── meta.json
└── anaconda-user-2
    └── meta.json
```

Each subdirectory of `site-dump` contains the contents of the Repository *as it pertains to a particular user*. For example `anaconda-user-1` has two packages, `moto` and `pysocks`. The `meta.json` file in each user directory contains information about any groups of end users that user belongs to, as well as their organizations.

Package directories contain the package files, prefixed with the id of the database. The `meta.json` file in each package directory contains metadata about the packages, including version, build number, dependencies, and build requirements.

Note: Other files included in the site-dump—such as projects and environments—are NOT imported by the package import tool. That's why users have to *export their Notebook projects* separately.

Importing packages

You can choose whether to import packages into Workbench by username or organization, or import all packages.

Before you begin:

- Anaconda recommends you compare the import options before proceeding, so you can choose the option that most closely aligns with the desired outcome for your organization.
- You'll be using the Workbench command line interface (CLI) to import the packages you exported, so be sure to *install the Workbench CLI* if you haven't already.

1. Log in to the command line interface using the following command:

   ```
   anaconda-enterprise-cli login
   ```

2. Follow the instructions below for the method you want to use to import packages.

To import packages by username or organization:

As you saw in the example above, the packages for each user are put in a separate directory in the site-dump. This means that the import process is the same whether you specify a directory based on a username or organization.

Import a single directory from the `site-dump` using the following command:

```
anaconda-enterprise-cli admin import site-dump/name
```

Replacing `name` with the actual name of the directory you want to import.

Note: You can also pass a list of directories to import.

To import all packages:

Run the following command to import all packages in the site dump:

```
anaconda-enterprise-cli admin import site-dump/*
```

How channels of imported packages are named

When you import packages by username, a new channel is created for each unique label the user has applied to their packages, using the username as a prefix. (The default package label "main" is not included in channel names.)

For example, if `anaconda-user-1` has the following packages:

- `moto-0.4.31-2.tar.bz2` with label `main`
- `pysocks-1.6.6-py35_0.tar.bz2` with label `test`

The following channels are created:

- anaconda-user-1 containing the package file moto-0.4.31-2.tar.bz2
- anaconda-user-1/test containing the package file pysocks-1.6.6-py35_0.tar.bz2

When you import all packages in an organization, a new channel is created for each organization, group, and label. The script appends any groups associated with the organization to the channel name it creates. (The default package label "main" and default organization label "Owner" are not included in channel names.)

For example, if anaconda-organization includes a group called Devs, and the site dump for anaconda-organization contains a package file named xz-5.2.2-1.tar.bz2 with the label Test, running the script will create the following channels:

- anaconda-organization – This channel contains all packages that the organization owner can access.
- anaconda-organization/Devs – This channel contains all packages that the Dev group can access.
- anaconda-organization/Devs/Test – This channel contains all packages labeled Test that the Dev group can access.

Granting access to channels and packages

After everything is uploaded, each channel created as part of the import process is shared with the appropriate users and groups. In the case of the example above,``anaconda-user-1`` is granted *read-write* access to the anaconda-user-1 and anaconda-user-1/test channels, and all members of the Devs group will have *read* permission for everything in the Devs channel.

You can change these access permissions as needed using the Workbench UI or CLI. See *Managing channels and packages* for more information.

Migrating Anaconda Enterprise 4 Notebook Projects

Before you begin:

- If your project refers to channels in your on-premises repository or other channels in anaconda.org, ask you System Administrator to *mirror those channels* and make them available to you in Workbench.
- If your project use non-conda packages, you'll need to *upload those packages* to Workbench.
- If your notebook refers to multiple kernels or environments, set the kernel to a single environment.
- If your project contains several notebooks, verify that they all are using the same kernel or environment.

Exporting your project

Exporting a project creates a yml file that includes all the environment information for the project.

1. Log in to your Anaconda Enterprise 4 Notebooks server.
2. Open a terminal window and activate conda environment 2.6 for your project.
3. Install anaconda project in the environment:

   ```
   conda install anaconda-project=0.6.0
   ```

   If you get a not found message, install it from anaconda.org:

   ```
   conda install -c anaconda anaconda-project=0.6.0
   ```

4. Export your environment to a file:

```
conda env export -n default -f _env.yml
```

<default> is the name of the environment where the notebook runs.

5. Verify that the format of the environment file looks similar to the following, and that the dependencies for each notebook in the project are listed:

```
yaml
channels:
- wakari
- r
- https://conda.anaconda.org/wakari
- defaults
- anaconda-adam
prefix: /projects/anaconda/MigrationExample/envs/default
dependencies:
- _license=1.1=py27_1
- accelerate=2.3.1=np111py27_0
- accelerate_cudalib=2.0=0
- alabaster=0.7.9=py27_0
# ... etc ...
```

If it contains any warning messages, run this script to modify the encoding and remove the warnings:

```
import ruamel_yaml
with open("_env.yml") as env_fd:
    env = ruamel_yaml.load(env_fd)
with open("environment.yml", "w") as env_fd:
    ruamel_yaml.dump(env, env_fd, Dumper=ruamel_yaml.RoundTripDumper)
```

Converting your project

To create a project that's compatible with Workbench, perform these steps:

1. Run the following command from an interactive shell:

```
anaconda-project init
```

2. Anaconda Enterprise 4 supports Linux only, so run the following command to remove the Windows and MacOS platforms from the project's `anaconda-project.yml` configuration file:

```
anaconda-project remove-platforms win-64 osx-64
```

3. Run the following command to verify the platforms were removed:

```
anaconda-project list-platforms
```

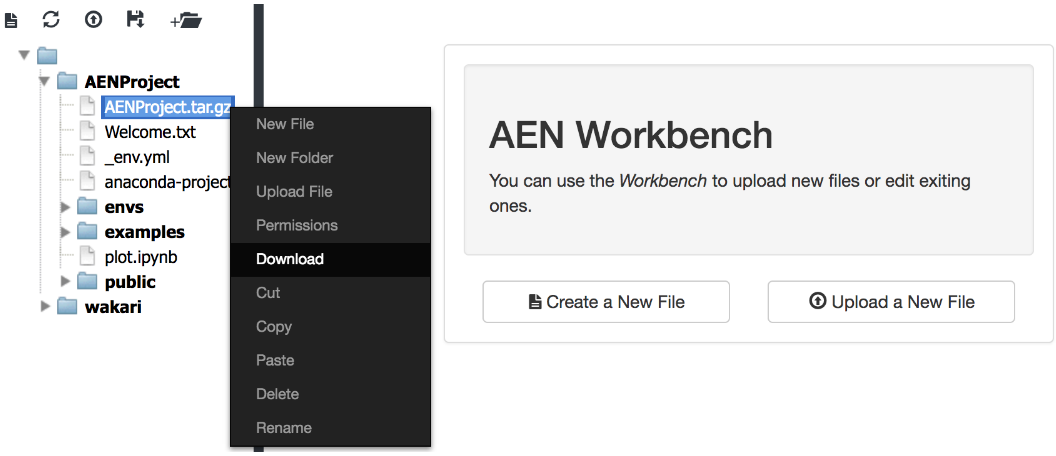
4. Add `/.indexer.pid` and `.git` to the `.projectignore` file.

5. Run the following command to compress your project:

```
# Replace <FILENAME> with a name for your project archive file
anaconda-project archive <FILENAME>.tar.gz
```

Caution: Project names cannot contain spaces or special characters. There is a 1GB size limit for project archive files.

6. In Anaconda Enterprise 4 Notebooks, from your project home page, open the AEN Workbench. Locate your project file (e.g., `AENProject.tar.gz` in the image below) in the file list, right-click and select **Download**.



Now your project is ready to be uploaded into Workbench.

Uploading your project to Workbench

Log in to Workbench and upload your project archive file `<FILENAME>.tar.gz`. See *Working with projects* for help.

Note: To maintain performance, there is a 1GB file size limit for project files you upload. Workbench projects are based on Git, so Anaconda recommends you commit only text-based files relevant to a project, and keep them under 100MB. Binary files are difficult for version control systems to manage, so Anaconda recommends using storage solutions designed for that type of data, and connecting to those data sources from within your sessions.

Migrating code

Anaconda Enterprise 4 and Workbench are based on a different architecture. This means that code inside your Anaconda Enterprise 4 notebooks might not run as expected in Workbench. Anaconda Enterprise 4 sessions ran directly on the host filesystem, where the libraries, drivers, packages, and connectors required to run them were available. Workbench sessions run in isolated containers with their own independent file system, so they don't necessarily have access to everything on the host.

This difference in architecture primarily impacts the following:

Connecting to external data sources

If you currently rely on ODBC/JDBC drivers to connect to specific databases such as Oracle and Impala, Anaconda recommends you use services that support this, such as Apache Impala and Apache Hive, instead. Additionally, using a language and platform agnostic connector such as Thrift allows you to create reproducible code that is more portable.

For best practices on how to connect to different external systems inside Workbench, see Connecting to the Hadoop and Spark ecosystem.

Service/System	Recommended
Apache Impala	impyla
Apache Hive	pyhive
Oracle	build conda package with their driver

If this is not possible, Anaconda recommends you obtain or *build conda packages* for the connectors and drivers you need. This enables you to *add them as package dependencies for your project* that will be installed when you start a Notebook session or deploy the project.

This has the added benefit of enabling you to update dependencies on connectors on a per-project basis.

Sharing custom Python and R libraries

It's quite common to share custom libraries by adding them to a location in the filesystem where all users can access the libraries they need. Workbench sessions and deployments run in isolated containers, so users cannot use this method to access shared libraries.

Instead, Anaconda recommends you *create a conda package for each library*. This enables you to control access to each package library and version—both essential to managing software at the enterprise level.

After you create the package, *upload it to the internal Workbench repository*, where it can be *shared with users* and *included as a dependency* in user sessions and deployments.

Installing external dependencies

If you typically install dependencies using system package managers such as `apt` and `yum`, you can continue to do so in Workbench. Dependencies installed from the command line are available during the current session only, however.

If you want them to persist across project sessions and deployments, add them as packages in the project's `anaconda-project.yml` configuration file. See *Configuring project settings* for more information.

If your project depends on a package that is not available in your internal Workbench Repository, search anaconda.org or build your own conda package using conda-build, then *upload the conda package* to the Workbench repository.

If you don't have the expertise required to build the custom packages your organization needs, consider engaging our consulting team to make your mission-critical analytics libraries available as conda packages.

CHAPTER

FOUR

USING WORKBENCH

4.1 Projects

In Data Science & AI Workbench, a project is a structured environment for developing, managing, and deploying data science and machine learning applications. This includes relevant packages, channels, scripts, notebooks, files, environment variables, services and commands, and a *core configuration file* named `anaconda-project.yml`. For more information, see *Project configurations*.

Project components are archived into a `.tar.bz2`, `.tar.gz`, or `.zip` file for portability purposes, allowing you to store the project and share it with others.

4.1.1 Creating a new project

1. From the **Projects** page click **Create +**, then select *New Project*.
2. Enter a name for your project.
3. Select an environment for your project.
4. Select a resource profile for your project.
5. If necessary, add any users or groups as collaborators.
6. Click **Create**.

4.1.2 Uploading an existing project

1. From the **Projects** page click **Create +**, then select *Upload Project*.
2. Click **Browse** and upload your project archive file to Workbench.
3. Enter a name for your project.
4. If necessary, add any users or groups as collaborators.
5. Click **Upload**.

4.1.3 Using sample projects

To access the sample project gallery, navigate to the **Projects** page, then click **Sample Projects**. Click **Add to your projects** on any sample project to copy it to the **Projects** page.

Anaconda provides you with a gallery of sample projects that include:

- Several base Anaconda Distribution for Python environments
- Minimal Python environments
- R notebooks and R Shiny apps
- Simplified Jupyter Notebooks for Matplotlib and HvPlot
- Dashboards for the Gapminder dataset, oil and gas, NYC taxi, and attractor equations
- TensorFlow apps for Flask, Tornado, and MINST trained data
- And tutorial projects for:
  - Using Intake to distribute and ingest data
  - Database access using SQLAlchemy, Pandas, and Dask
  - Visualizations with HoloViz.org tools
  - Building time-series forecasting models using statsmodels

These projects are intended to aid you with your own projects by demonstrating how to do a variety of things in Workbench.

Tip: Use the **Category** dropdown to filter the displayed sample projects.

4.1.4 Deleting a project

1. From the **Projects** page open the project you want to delete.
2. Click **Delete** at the bottom of the project settings page.
3. Click **Delete** again to confirm that you want to delete the project and end any active sessions and deployments from the project.

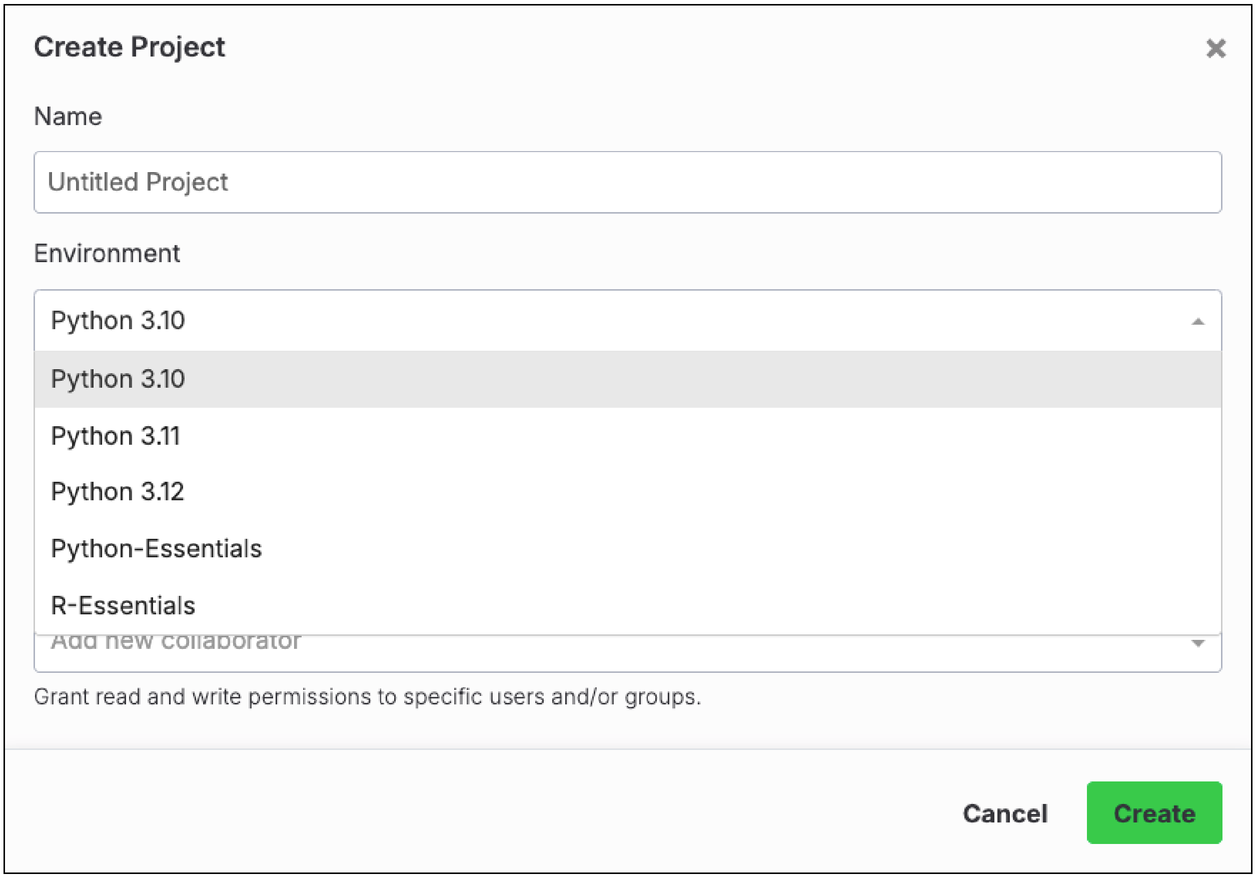
Warning: Deleting a project is irreversible. Project owners and administrators are the only users that can delete shared projects.

Project templates

Data Science & AI Workbench provides several minimal Python environments, along with a Python Essentials and an R Essentials template environment, to help you get started developing your projects.

These project templates are pre-solved conda environments with a curated set of pre-installed packages. Creating a new project from one of these templates clones the environment for exclusive use by that project. You can then use `anaconda-project` commands to *customize the project environment as needed*. These configuration changes will persist for the project environment, but will not affect the environment template.

To use one of the available templates, select it from the **Environment** dropdown when you create a new project:



Create Project

Name: Untitled Project

Environment: Python 3.10

Add new collaborator

Grant read and write permissions to specific users and/or groups.

If the provided template environments do not suit your needs, you can create custom environments and include them as templates for your users. For more information, see *Configuring persistent environments and sample projects*.

Working with projects

To perform work within a Data Science & AI Workbench project, open it from the **Projects** page. The project's **Settings** page opens by default. Use the left-hand navigation from here to work with and manage different aspects of your project:

Session - Sessions provide an Integrated Development Environment (IDE) for project development. They enable you to write code, explore and visualize data, and develop and evaluate models in a collaborative environment, incorporating familiar Git-based *branching and merging* workflows for version management. For more information, see *Project sessions*.

> **Caution:** If the total size of the files stored in your project's Git repository exceeds 1GB, your project will experience slowdowns or become unresponsive. Anaconda advises maintaining an individual file size of less than 50MB each. If you need to work with files that exceed this threshold, speak with your cluster administrator.
>
> Furthermore, binary files are difficult for version control systems to manage, so Anaconda recommends using storage solutions designed for that type of data and connecting to those data sources from within your Workbench sessions.

Deployments - Deployments make developed applications or models accessible for end-user interaction, or for automated tasks, such as a web service, REST API, or scheduled job. For more information, see *Deployments*.

Schedules - Setting a schedule for your project instructs it to perform specific tasks automatically at predetermined times. You can update data, generate a report, execute a pipeline, run backup operations, and more. For more information, see *Schedules*.

Runs - In Workbench, a run refers to the execution of a part of your project, similar to running a script or a program. When you initiate a run, Workbench allocates resources to execute the task. This could be any automated task you have established in your project.

Share - Sharing projects with collaborators in Workbench facilitates teamwork by ensuring that all team members have the ability to contribute and have access to the project's contents. Each project in Workbench has its own internal Git repository that is accessible by the project creator and collaborators that are added to the project. For more information, see *Adding collaborators to a project*.

Note: If your organization would prefer to use its own supported external version control repository, your administrator can configure Workbench to use that repository instead of the internal GitHub server. For more information, see *Connecting to an external version control repository*.

Once complete, you will be prompted for your personal access token before you create your first project in Workbench. For more information, see *Configuring user access to external version control*.

Audit Trail - The audit trail is like a project history timeline. It shows detailed records of all activities and changes made within a project. This includes user actions, version changes, access logs, deployment records, resource usage, and system notifications. The audit trail provides transparency, accountability, and is a useful resource when diagnosing issues within a project.

Settings - Project settings allow you to configure various aspects of your project. From this page, you can:

- Set your project's name.
- Select a resource profile. *This is a critical step for meeting computational demands of your project*. For more information, see *Understanding resource profiles*.
- Choose a default editor for your project. The default selection is *JupyterLab*.
- Assign tags to your project. For more information, see *Project tagging*.
- Delete the project. For more information, see *Deleting a project*.

Logs - Project logs provide comprehensive insights into the operational health of the project's components. Each project runs an `editor`, `sync`, and `proxy` container, and logs for each container are accessible to aid in troubleshooting issues you may encounter with your project. For more information, see *Project logs*.

Working offline

To work on a project offline, download an archived version (`tar.gz`) of the project from the projects page. When you are ready, you can upload the files you've modified back to the project in Workbench and commit your changes to make them available for other project collaborators. For more information, see *Saving and committing changes in a project*.

Branching and merging

Each project in Data Science & AI Workbench has its own Git repository that the files for the project are stored in. You can create branches off of your project to develop changes locally, then commit and push them to a collaborative remote project repository, where other users will then be able to pull your changes.

Creating a branch

New branches are *always created off of the currently active branch*.

From the **Projects** page:

1. Open your project and start a session.
2. Open the branch dropdown menu.
3. Click *Create branch*.
4. Provide a name for your branch.
5. Click **Create**.

Tip: The current active branch and its parent branch are always identified in the branch dropdown.

Switching between branches

You can switch between branches that exist in your project using the branch dropdown menu.

1. Open the branch dropdown menu.
2. Select the branch you want to work in.

Caution: Your working branch must be clean to switch between branches. *Commit and push* your work before switching branches!

Note: You may need to refresh your editor view for it to detect the most recent changes.

Pushing changes to a branch

1. Click **Commit and push changes**.
2. Select the files you want to commit to the remote branch from your local branch.
3. Enter a commit message for your changes.
4. If necessary, tag a version for your commit.
5. Click **Commit and Push**.

Merging changes to a parent branch

When the changes on your branch are ready, you can merge them into the parent branch using the branch dropdown menu.

1. Open the branch dropdown menu.
2. Click *Merge changes into parent branch*.
3. Click **Merge**.

Pulling changes from a parent or remote branch

If the parent or remote branch has changes applied to it that the active branch does not, you must pull the changes into your local branch to avoid merge conflicts before you push your commits.

1. Click the **Pull** icon.
2. Select the branch that contains changes you need to pull.
3. Open the **Pull** dropdown and select a pull method:

    Keep Theirs and Pull
    Discards your local changes in favor of content on the parent branch. Your changes will be lost.

    Keep Mine and Pull
    Discards changes on the parent branch in favor of your local changes. Changes on the parent branch will be overwritten.

    Keep Both and Pull
    Saves the conflicting files with different file names so you can compare their content and decide how you want to reconcile the differences manually.

Deleting a branch

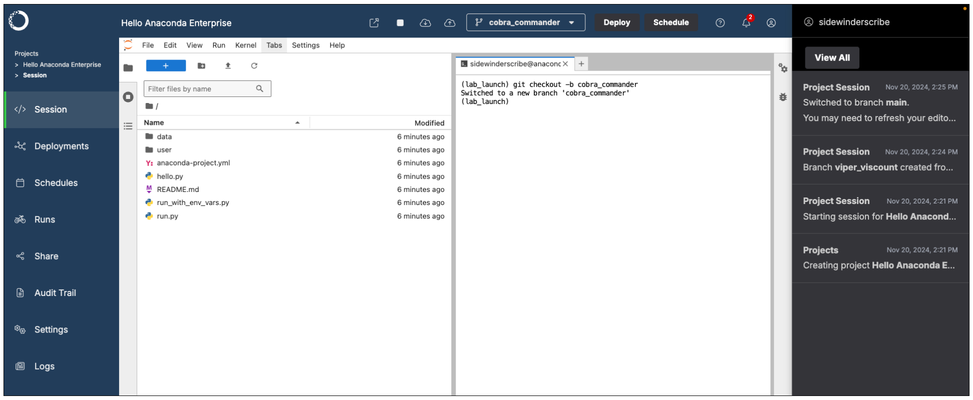
There is currently no method for deleting a branch from the UI. This feature will be added in a later release. However, you can still delete branches from your project manually if necessary. To delete a branch from a project:

1. Open your project and start a session.
2. Open a terminal in your project session.
3. Run the following commands:

```
# Replace <BRANCH> with the name of the branch you want to delete
git branch -D <BRANCH>
git push origin :<BRANCH>
```

Caution: If you attempt to delete a branch that another user currently has active, the branch will not be deleted.

Note: You can execute other Git commands from the project's terminal as well. However, Git actions performed at the command line are not recorded in your user activity log.



Name	Modified
data	6 minutes ago
user	6 minutes ago
anaconda-project.yml	6 minutes ago
hello.py	6 minutes ago
README.md	6 minutes ago
run_with_env_vars.py	6 minutes ago
run.py	6 minutes ago

```
(lab_launch) git checkout -b cobra_commander
Switched to a new branch 'cobra_commander'
(lab_launch)
```

Project Session Nov 20, 2024, 2:25 PM
Switched to branch **main**.
You may need to refresh your edito...

Project Session Nov 20, 2024, 2:24 PM
Branch **viper_viscount** created fro...

Project Session Nov 20, 2024, 2:21 PM
Starting session for **Hello Anacond...**

Projects Nov 20, 2024, 2:21 PM
Creating project **Hello Anaconda E...**

Project tagging

Tag projects you own to include additional options for project filtering, allowing you to efficiently locate projects when you need them.

Note: Administrator users can manage tags for any project.

Adding tags to a project

Projects can have up to four tags each. To add a tag to a project:

1. Click the Tag icon of any project to view its tags.
2. Click **Manage Tags** .
3. Open the **Tags** dropdown, then select existing tags and/or enter a new tag for your project.
4. Click **Save Tags**.

Tip: You can also add tags to a project from the project's settings page.

Managing tags

To manage project tags:

1. From the **Projects** page, click the Tag icon of any project to view its tags.
2. Click **Manage Tags** .
3. Add or remove tags as needed.
4. Click **Save Tags**.

Filtering tagged projects

Once you have added tags to your projects, you can use them to filter your projects, which will help you locate them efficiently. From the **Projects** page, open the Tag filter dropdown, then select the tags you need. The project list will filter to display only projects that contain those tags.

Project sessions

In Data Science & AI Workbench, sessions provide you with Integrated Development Environments (IDEs) for project development, enabling you to write code, explore and visualize data, develop and evaluate models, and apply project configurations in a centralized and collaborative environment.

Once you have created or cloned a project, you can immediately begin working with it by “Opening” a session.

Opening a project session

There are multiple ways to open a session for a project:

Project grid view

1. From the **Projects** page, click **Open session** within any project tile in the grid to open a session for that project.
2. Once the session has been successfully created, click **Return to session** to open an editor session for your project.

Project list view

1. From the **Projects** page, open the project’s actions menu and select *Open session*.
2. Click **Active session**, or open the project’s actions menu and select *Return to session*.

Within a project

1. From the **Projects** page, click on the title of any project. The project's settings page will open.
2. Select **Session** from the left-hand navigation.
3. Click **Open a session**.

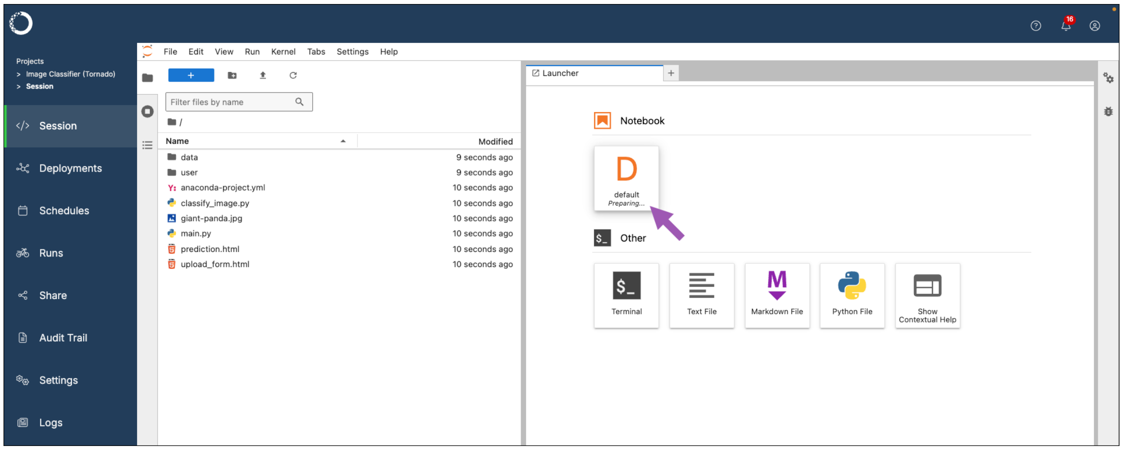
Tip: You can *change the default editor* for your project from the settings menu.

By default, projects in Workbench are created with their own internal Git repository, enabling you to leverage standard Git workflows to manage your project versions and collaborate on projects with others in the platform. For more information, see *Branching and merging*.

Tip:

- Click **Open session in new tab** to open your project session editor without the Workbench interface showing.
- For help managing environments, packages, environment variables, and commands for your project, see *Project Configurations*.
- Sessions are not shared. Each user creates a unique session for working with a given project.

Note: If your session opens before your environment has finished preparing, your environment tile displays the text `Preparing...`. Allow the environment time to complete before attempting to work in a notebook.



Name	Modified
data	9 seconds ago
user	9 seconds ago
anaconda-project.yml	10 seconds ago
classify_image.py	10 seconds ago
giant-panda.jpg	10 seconds ago
main.py	10 seconds ago
prediction.html	10 seconds ago
upload_form.html	10 seconds ago

Stopping project sessions

Anaconda recommends stopping project sessions when not actively working in them as a best practice to maintain system performance and reduce costs.

1. From a project session, click **Stop session** at the top of the page.
2. Click **Stop**.

Project configurations

In Data Science & AI Workbench, projects are structured around a core configuration file called `anaconda-project.yml`. This file is crucial for orchestrating a project's components for deployment and ensuring operational consistency over time. There are several parameters that must be included within each project's `anaconda-project.yml` file to ensure that it operates as intended:

- **Packages** - You must specify all conda or pip packages the project requires to function in its `anaconda-project.yml` file. By default, Workbench is configured to use packages from its internal repository to create project environments. However, it is possible to use packages from external repositories.
- **Environment** - You must define at least one named environment to accurately manage the project's packages and their dependencies, ensuring stability across different settings. Projects use template environments when they are initially created, which can be updated or replaced. For more information about template environments, see *Configuring persistent environments and sample projects*.
- **Commands** - You must define at least one command to properly deploy and run jobs for your project in its intended environment.
- **Environmental variables** - If necessary, set up the required environment variables needed to control how your project interacts with external resources and services.

> **Caution:** It is possible to edit a project's `anaconda-project.yml` file manually to add the required configurations; however, this method is prone to human error, especially for users who are unfamiliar with `.yml` file formatting.
>
> Instead, Anaconda recommends using `anaconda-project` commands from a terminal within your project to update its configurations when possible. For more information about `anaconda-project`, see the official documentation here.
>
> *All* `anaconda-project` commands *must* be run from the `lab_launch` environment! Enter the `lab_launch` environment by running the following command in a project terminal:
>
> ```
> conda activate lab_launch
> ```

Once you are finished configuring your project, Anaconda recommendeds that you *add a lock file* to your project to ensure its reproducibility across different environments at scale.

Configuring project environments

The conda environments in *standard project templates* are pre-solved to reduce initialization time when additional packages are added. However, you might want to create an environment specifically for your project.

To create a new environment with specific packages and add it to your project:

1. Create a new project.
2. Start a session.
3. Open a terminal within your session editor.
4. Create an environment and include the packages you need for it by running the following command:

```
# Replace <ENV_NAME> with the name of the environment you are creating to add to␣
↪your project's configuration
# Replace <PACKAGE_NAME> with the name of the packages you want to add to your␣
```

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```
↪project's configuration
anaconda-project add-env-spec --name <ENV_NAME> <PACKAGE_NAME> <PACKAGE_NAME>
```

5. Remove the template environment that you used to create your project by running the following command:

```
# Replace <TEMPLATE_ENV> with the name of the template environment you used to␣
↪initially create the project
anaconda-project remove-env-spec --name <TEMPLATE_ENV>
```

6. *Commit and push your updates to the project*.
7. Stop and re-start the project.

Caution: To edit and run notebooks in Jupyter Notebook or JupyterLab, you must include the `notebook` package in your project's environment.

Verify your environment is initialized for notebooks

1. Open a terminal within your session editor.
2. Run the following commands:

```
cd /opt/continuum/
ls
```

If the environment is being initialized, you will see a file named `preparing`. Once initialization is complete, you will see a file named `prepare.log`. To troubleshoot environment initialization, view the log from the terminal by running the following command:

```
cat /opt/continuum/prepare.log
```

Configuring project packages

Adding a package to a project's configuration file *persists for future project sessions and deployments*. This is different than using `conda install` to add a package using the conda environment during a session, which impacts the project *during the current session only*.

Note: Networks that are **air-gapped** (operate without internet access) must *mirror the Anaconda repository into your organization's internal package repository* to provide them to users.

Adding conda packages

To add a conda package to your project's `anaconda-project.yml` file:

1. Open your project.
2. If necessary, start a session.
3. Open a terminal within your session editor.
4. Verify that you are in the `lab_launch` environment.
5. Run the following command:

   #### Add packages command

   ```
   # Replace <PACKAGE_NAME> with the name of the packages you want to add to your␣
   ↪project's configuration
   anaconda-project add-packages <PACKAGE_NAME> <PACKAGE_NAME>
   ```

   #### From channel

   ```
   # Replace <CHANNEL_NAME> with the name of the channel that contains the packages␣
   ↪you want to add
   # Replace <PACKAGE_NAME> with the name of the packages you want to add to your␣
   ↪project's configuration
   anaconda-project add-packages -c <CHANNEL_NAME> <PACKAGE_NAME> <PACKAGE_NAME>
   ```

   #### From external repository

   To use packages from an external repository, you will need to specify the full channel URL in the command:

   ```
   # Replace <CHANNEL_URL> with the address of the channel that contains the packages␣
   ↪you want to add
   # Replace <PACKAGE_NAME> with the name of the packages you want to add to your␣
   ↪project's configuration
   anaconda-project add-packages <PACKAGE_NAME> -c <CHANNEL_URL>
   ```

   The command may take a moment to run as it solves the environment to collect dependencies and download packages. Once complete, the added packages appear in the project's `anaconda-project.yml` file. If the file is open when you run the command, close and reopen it to view your changes.

6. *Commit and push your updates to the project*.
7. Stop and re-start the project session.

Adding pip packages

If your project requires you to `pip` install a package, you can use `anaconda-project` to add it to your project's configuration.

To add a `pip` package to your project's `anaconda-project.yml` file:

1. Open your project.
2. If necessary, start a session.
3. Open a terminal within your session editor.
4. Verify that you are in the `lab_launch` environment.
5. Run the following command:

```
# Replace <PACKAGE_NAME> with the name of the packages you want to add to your␣
↪project's configuration
anaconda-project add-packages --pip <PACKAGE_NAME> <PACKAGE_NAME>
```

6. *Commit and push your updates to the project*.
7. Stop and re-start the project session.

Removing packages

To remove a package from your project's `anaconda-project.yml` file:

1. Open your project.
2. If necessary, start a session.
3. Open a terminal within your session editor.
4. Verify that you are in the `lab_launch` environment.
5. Run the following command:

```
# Replace <PACKAGE_NAME> with the name of the packages you want to remove from your␣
↪project's configuration
anaconda-project remove-packages <PACKAGE_NAME> <PACKAGE_NAME>
```

6. *Commit and push your updates to the project*.
7. Stop and re-start the project session.

Configuring project environment variables

Environment variables are key parameters that manage dynamic settings like API keys, database URLs, and memory limits without modifying the codebase. These variables are essential for deploying projects consistently.

To add environment variables with a default value to your project's `anaconda-project.yml` file:

1. Open your project.
2. If necessary, start a session.
3. Open a terminal within your session editor.
4. Verify that you are in the `lab_launch` environment.

5. Run the following command:

```
# Replace <VALUE> with the content of your environment variable
# Replace <VARIABLE> with the variable name
anaconda-project add-variable --default=<VALUE> <VARIABLE>
```

6. *Commit and push your updates to the project*.

7. Stop and re-start the project session.

For more information and advanced command arguments, see Working with environment variables in the official `anaconda-project` documentation.

Configuring project commands

To deploy a project in Workbench, it must contain at least one appropriate deployment command defined in its `anaconda-project.yml` file. These commands specify how the project's components, such as notebooks, scripts, or generic web frameworks, should be executed when the project is deployed.

To add a command to your project's `anaconda-project.yml` file:

1. Open your project.
2. If necessary, start a session.
3. Open a terminal within your session editor.
4. Verify that you are in the `lab_launch` environment.
5. Run the following command:

```
# Replace <CMD_NAME> with a name for your deployment command
# Replace <COMMAND> with the project filename that should be executed
anaconda-project add-command <CMD_NAME> <COMMAND>
```

6. *Commit and push your updates to the project*.

7. Stop and re-start the project session.

For more information and advanced command arguments, see Working with commands in the official `anaconda-project` documentation.

Example deployment commands

The following are example deployment commands you can use:

For a Notebook:

```
commands:
default:
   notebook: <FILE_NAME>.ipynb
```

For a Panel dashboard:

```
commands:
default:
   unix: panel serve <SCRIPT_OR_NOTEBOOK_FILE>
   supports_http_options: True
```

For a generic script or web framework, including Python or R:

```
commands:
default:
   unix: bash <YOUR-SCRIPT>.sh
   supports_http_options: true
```

```
commands:
default:
   unix: python <YOUR-SCRIPT>.py
   supports_http_options: true
```

```
commands:
default:
   unix: Rscript <YOUR-SCRIPT>.R
   supports_http_options: true
```

Validating project deployment commands

To validate the anaconda-project.yml and verify your project will deploy successfully:

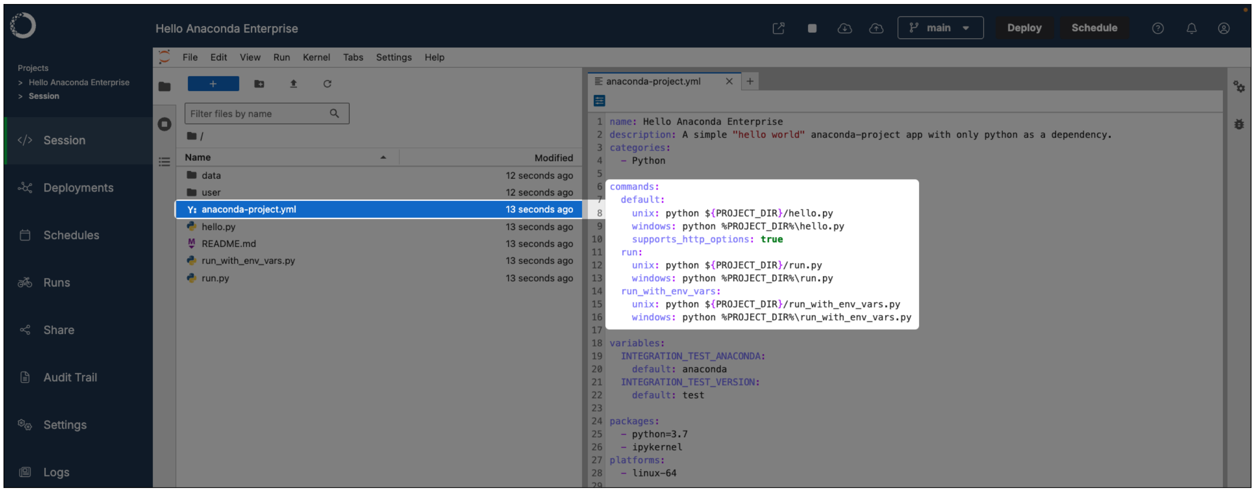
1. Open your project.
2. If necessary, start a session.
3. Open a terminal within your session editor.
4. Verify that you are in the lab_launch environment.
5. Prepare the environment and test the deployment command by running the following commands:

   ```
   # Replace <ENV_NAME> with the name of the project's environment
   # Replace <COMMAND> with the deployment command that you want to test
   anaconda-project prepare --env-spec <ENV_NAME>
   anaconda-project run <COMMAND>
   ```

   Any errors preventing a successful deployment are displayed in the terminal.

Testing project deployments

Once deployment commands are added to your project, you can test the deployment using the test_deployment command. This sets up a mini web application, allowing you to preview your deployment locally using a port within your session.



```yaml
name: Hello Anaconda Enterprise
description: A simple "hello world" anaconda-project app with only python as a dependency.
categories:
  - Python

commands:
  default:
    unix: python ${PROJECT_DIR}/hello.py
    windows: python %PROJECT_DIR%\hello.py
    supports_http_options: true
  run:
    unix: python ${PROJECT_DIR}/run.py
    windows: python %PROJECT_DIR%\run.py
  run_with_env_vars:
    unix: python ${PROJECT_DIR}/run_with_env_vars.py
    windows: python %PROJECT_DIR%\run_with_env_vars.py

variables:
  INTEGRATION_TEST_ANACONDA:
    default: anaconda
  INTEGRATION_TEST_VERSION:
    default: test

packages:
  - python=3.7
  - ipykernel
platforms:
  - linux-64
```

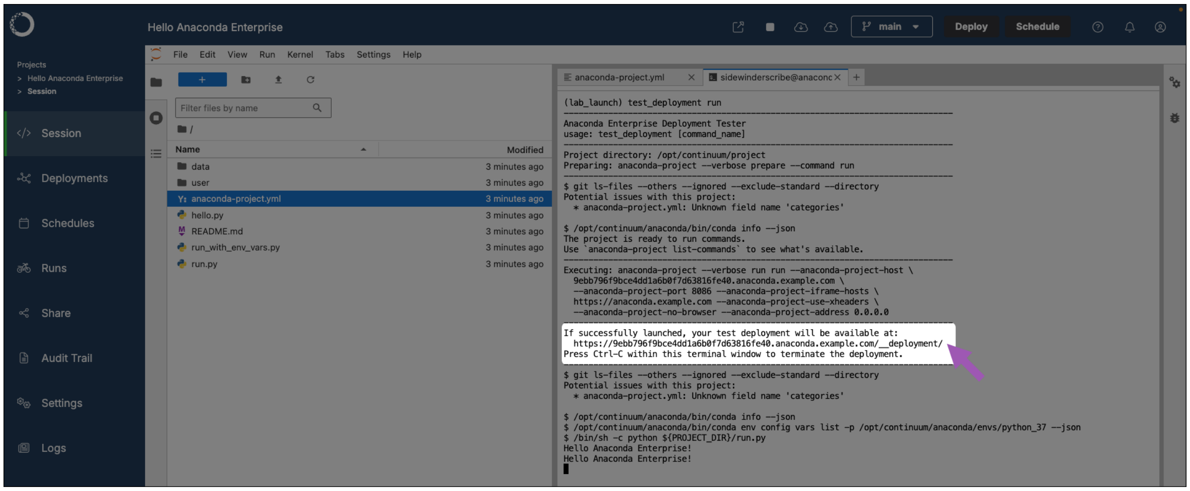
To test a project deployment:

1. Open your project.
2. If necessary, start a session.
3. Open a terminal within your session editor.
4. Verify that you are in the `lab_launch` environment.
5. Test a deployment command you've added to your project by running the following command:

```
# Replace <COMMAND> with an available deployment command
test_deployment <COMMAND>
```

Note: If you do not supply a deployment command to test, the first command listed under the `commands:` section of the projects `.yml` configuration file will be run.

6. Navigate to the web address returned by the command to verify your project deployed successfully.



```
(lab_launch) test_deployment run
--------------------------------------------------------------------------------
Anaconda Enterprise Deployment Tester
usage: test_deployment [command_name]
--------------------------------------------------------------------------------
Project directory: /opt/continuum/project
Preparing: anaconda-project --verbose prepare --command run
--------------------------------------------------------------------------------
$ git ls-files --others --ignored --exclude-standard --directory
Potential issues with this project:
  * anaconda-project.yml: Unknown field name 'categories'

$ /opt/continuum/anaconda/bin/conda info --json
The project is ready to run commands.
Use `anaconda-project list-commands` to see what's available.
--------------------------------------------------------------------------------
Executing: anaconda-project --verbose run run --anaconda-project-host \
  9ebb796f9bce4dd1a6b0f7d63816fe40.anaconda.example.com \
  --anaconda-project-port 8086 --anaconda-project-iframe-hosts \
  https://anaconda.example.com --anaconda-project-use-xheaders \
  --anaconda-project-no-browser --anaconda-project-address 0.0.0.0
--------------------------------------------------------------------------------
If successfully launched, your test deployment will be available at:
  https://9ebb796f9bce4dd1a6b0f7d63816fe40.anaconda.example.com/__deployment/
Press Ctrl-C within this terminal window to terminate the deployment.
--------------------------------------------------------------------------------
$ git ls-files --others --ignored --exclude-standard --directory
Potential issues with this project:
  * anaconda-project.yml: Unknown field name 'categories'

$ /opt/continuum/anaconda/bin/conda info --json
$ /opt/continuum/anaconda/bin/conda env config vars list -p /opt/continuum/anaconda/envs/python_37 --json
$ /bin/sh -c python ${PROJECT_DIR}/run.py
Hello Anaconda Enterprise!
Hello Anaconda Enterprise!
```

Locking project configurations

Project locking is a crucial step in ensuring your project is reproducible across multiple deployments at scale. It is best practice to lock your project once you have finalized configurations for your project, or if you are preparing to transition to a production or public deployment. For more information, see *Project reproducibility in Workbench*.

To lock your `anaconda-project.yml` file configurations to a fixed state:

1. Open your project.
2. If necessary, start a session.
3. Open a terminal within your session editor.
4. Verify that you are in the `lab_launch` environment.
5. Lock your project configurations by running the following command:

   ```
   anaconda-project lock
   ```

This instructs conda to solve the project's environment, lock all packages and their dependencies to their current versions, and generates an `anaconda-project-lock.yml` file for your project.

Project collaboration

Because Data Science & AI Workbench projects are structured as Git repositories, familiar Git rules apply for sharing your changes with project collaborators. Adding a user or group of users to a project as collaborators provides them with access to edit project files and commit changes to the project's remote Git repository. Workbench tracks all changes to projects and lets you know when files have been updated, so you can choose which version to work with.

Tip: The *only* project setting collaborators can edit is the default editor.

Adding collaborators to a project

To add a user or group of users as collaborators for a project:

1. From the **Projects** page, open the project you want to collaborate on.
2. Select **Share** from the left-hand navigation.
3. Begin typing a user or group name in the **Add New Collaborator** dropdown to search for matches. Select the correct entry, then click **Add**.

Collaborators added to your project will see it on their **Projects** page, and if others share their projects with you, they'll appear on yours.

Removing collaborators from a project

Removing collaborators from a project revokes their access to the project's remote repository, so they will no longer see the project or be allowed to commit and push changes to the repository.

To remove collaborators from a project:

1. From the **Projects** page, open the project you want to remove collaborators from.
2. Select **Share** from the left-hand navigation.
3. Click beside the collaborator you want to remove.
4. Click **Remove**.

> **Caution:** Removing collaborators from a project *while they have a session open* results in a `500 Internal Server Error` message for them. Communicate with collaborators prior to removing them from projects.

Saving vs. committing changes

When you open a project session, you're working with a local copy of the project's remote Git repository. Changes you *save* only affect your local project repository. When you're ready to update the project or share your updates with others, you must *commit and push* your changes to the project's remote repository.

Committing and pushing changes

1. From a project session, click **Commit and push changes** .
2. Select checkboxes for the files you want to commit to your project's remote repository.

   > **Caution:** If files you've added or modified aren't displayed in this list, verify the changes are saved locally, then try again.

   > **Note:** Some editors create hidden folders that are only used internally to capture the state of your files between auto-save operations. Anaconda recommends you add hidden folders to your project's .gitignore file, so they are excluded from version control.

3. Enter a commit message for your changes. Best practice for commit messages is to make the message descriptive of your changes.
4. If necessary, enter a meaningful label or version number as a **Tag** for your project. This enables you and your project collaborators to manage and deploy specific builds of the project.

   > **Tip:** Any commits pushed to the latest version of a project are included when the project is downloaded, even if you have not tagged the commits to a new version of the project.

5. Click **Commit and Push**. A notification appears informing you that your local changes have been pushed to the project's remote repository.

If your changes conflict with updates made by other collaborators, a list of impacted files will display in red. To resolve your conflicts:

- **Cancel** - This won't resolve any file conflicts, but it will cancel the commit.
- **Commit** - Overwrite your collaborators' changes. Exercise caution! Collaborators might not appreciate having their work overwritten, and important work could be lost!
- **Selectively Commit** - Commit only those files that don't have conflicts by unchecking the ones highlighted in red.

Note: Committing changes to the project's remote repository involves a full synchronization. This means that as you push your local repository changes, any updates that have been committed to the project that do not conflict with the changes you're committing are simultaneously pulled to your local project repository. This means that, after committing your changes, your local project repository will match the remote project repository.

Pulling changes

When working on a project with other users, you will need to manage keeping your local project repository current with changes that they have committed to the project's remote repository. A badge appears on the **Pull Changes** icon whenever a commit has been made to the project, indicating that you need to update your local project repository.

To pull changes to your local project repository:

From a project session, click **Pull Changes** . If there are no file conflicts, your local repository is updated.

If the remote repository contains conflicts with changes you have made locally, you can choose one of the following options:

- **Cancel** - This won't resolve any file conflicts, but it will cancel the pull.
- **Keep Theirs and Pull** - Discards your local changes in favor of theirs. Your changes will be lost.
- **Keep Mine and Pull** - Discards changes on the remote repository in favor of your local changes. Their changes will be overwritten.
- **Keep Both and Pull** - This saves the conflicting files with different filenames so you can compare the content of the files and decide how you want to reconcile the differences.

Caution: If you have a file open that has been modified by pulling changes, close and reopen the file for the changes to appear. If you do not, the next time you save the file, you will receive a `File has been overwritten on disk` alert in JupyterLab. This alert lets you choose whether to cancel the save, discard the current version and open the version of the file on disk, or overwrite the file on disk with the current version.

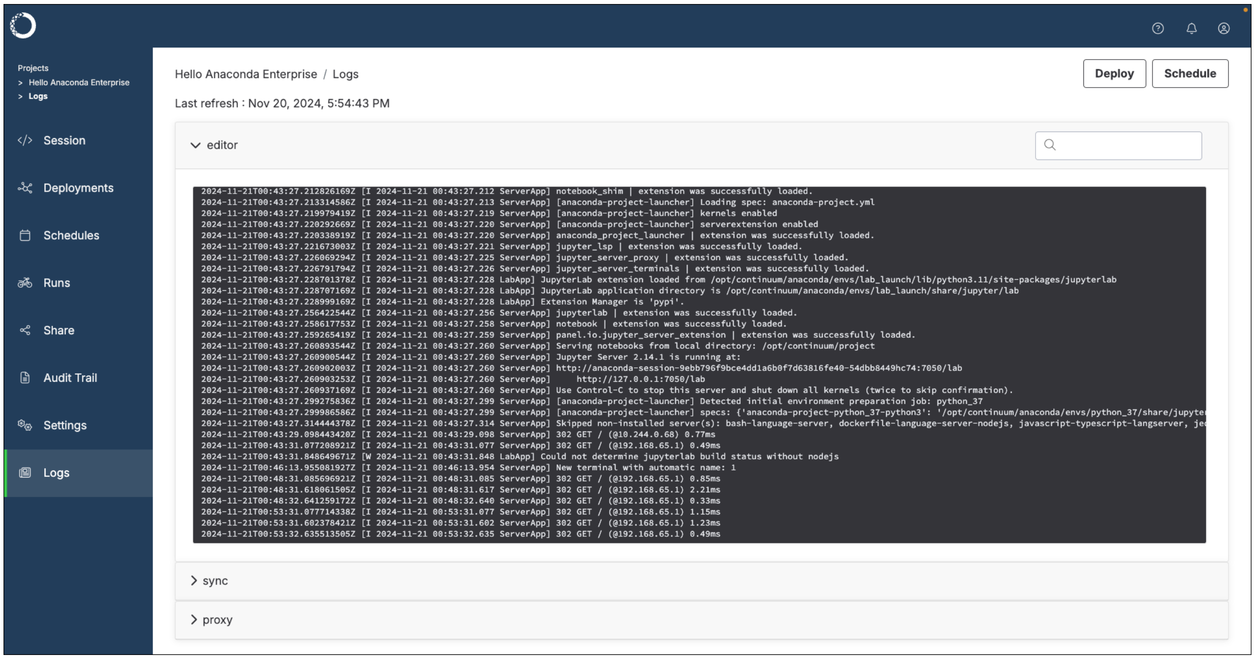
Project logs

Because Data Science & AI Workbench is built on top of a Kubernetes cluster, each project session is created as a pod. Each project session pod has an `editor`, `sync`, and `proxy` container, and logs for each container are accessible to aid you in troubleshooting issues you may encounter with your project. These logs can provide insights to the operational health of your project, possible configuration errors, and potential security issues.

Viewing project logs

To view a project session's logs:

1. Log in to Workbench.
2. Open a project.
3. If necessary, start a session in the project.
4. Select **Logs** from the left-hand navigation.
5. Open a container dropdown to view the logs for that container.



Last refresh : Nov 20, 2024, 5:54:43 PM

```
2024-11-21T00:43:27.212826169Z [I 2024-11-21 00:43:27.212 ServerApp] notebook_shim | extension was successfully loaded.
2024-11-21T00:43:27.213314586Z [I 2024-11-21 00:43:27.213 ServerApp] [anaconda-project-launcher] Loading spec: anaconda-project.yml
2024-11-21T00:43:27.219979419Z [I 2024-11-21 00:43:27.219 ServerApp] [anaconda-project-launcher] kernels enabled
2024-11-21T00:43:27.220292669Z [I 2024-11-21 00:43:27.220 ServerApp] [anaconda-project-launcher] serverextension enabled
2024-11-21T00:43:27.220338919Z [I 2024-11-21 00:43:27.220 ServerApp] anaconda_project_launcher | extension was successfully loaded.
2024-11-21T00:43:27.221673003Z [I 2024-11-21 00:43:27.221 ServerApp] jupyter_lsp | extension was successfully loaded.
2024-11-21T00:43:27.226069294Z [I 2024-11-21 00:43:27.225 ServerApp] jupyter_server_proxy | extension was successfully loaded.
2024-11-21T00:43:27.226791794Z [I 2024-11-21 00:43:27.226 ServerApp] jupyter_server_terminals | extension was successfully loaded.
2024-11-21T00:43:27.228701378Z [I 2024-11-21 00:43:27.228 LabApp] JupyterLab extension loaded from /opt/continuum/anaconda/envs/lab_launch/lib/python3.11/site-packages/jupyterlab
2024-11-21T00:43:27.228707169Z [I 2024-11-21 00:43:27.228 LabApp] JupyterLab application directory is /opt/continuum/anaconda/envs/lab_launch/share/jupyter/lab
2024-11-21T00:43:27.228999169Z [I 2024-11-21 00:43:27.228 LabApp] Extension Manager is 'pypi'.
2024-11-21T00:43:27.256422544Z [I 2024-11-21 00:43:27.256 ServerApp] jupyterlab | extension was successfully loaded.
2024-11-21T00:43:27.258617753Z [I 2024-11-21 00:43:27.258 ServerApp] notebook | extension was successfully loaded.
2024-11-21T00:43:27.259265419Z [I 2024-11-21 00:43:27.259 ServerApp] panel.io.jupyter_server_extension | extension was successfully loaded.
2024-11-21T00:43:27.260893544Z [I 2024-11-21 00:43:27.260 ServerApp] Serving notebooks from local directory: /opt/continuum/project
2024-11-21T00:43:27.260900544Z [I 2024-11-21 00:43:27.260 ServerApp] Jupyter Server 2.14.1 is running at:
2024-11-21T00:43:27.260902003Z [I 2024-11-21 00:43:27.260 ServerApp] http://anaconda-session-9ebb796f9bce4dd1a6b0f7d63816fe40-54dbb8449hc74:7050/lab
2024-11-21T00:43:27.260903253Z [I 2024-11-21 00:43:27.260 ServerApp]     http://127.0.0.1:7050/lab
2024-11-21T00:43:27.260937169Z [I 2024-11-21 00:43:27.260 ServerApp] Use Control-C to stop this server and shut down all kernels (twice to skip confirmation).
2024-11-21T00:43:27.299275836Z [I 2024-11-21 00:43:27.299 ServerApp] [anaconda-project-launcher] Detected initial environment preparation job: python_37
2024-11-21T00:43:27.299986586Z [I 2024-11-21 00:43:27.299 ServerApp] [anaconda-project-launcher] specs: {'anaconda-project-python_37-python3': '/opt/continuum/anaconda/envs/python_37/share/jupyte
2024-11-21T00:43:27.314444378Z [I 2024-11-21 00:43:27.314 ServerApp] Skipped non-installed server(s): bash-language-server, dockerfile-language-server-nodejs, javascript-typescript-langserver, je
2024-11-21T00:43:29.098443420Z [I 2024-11-21 00:43:29.098 ServerApp] 302 GET / (@10.244.0.68) 0.77ms
2024-11-21T00:43:31.077208921Z [I 2024-11-21 00:43:31.077 ServerApp] 302 GET / (@192.168.65.1) 0.49ms
2024-11-21T00:43:31.848649671Z [W 2024-11-21 00:43:31.848 LabApp] Could not determine jupyterlab build status without nodejs
2024-11-21T00:46:13.955081927Z [I 2024-11-21 00:46:13.954 ServerApp] New terminal with automatic name: 1
2024-11-21T00:48:31.085696921Z [I 2024-11-21 00:48:31.085 ServerApp] 302 GET / (@192.168.65.1) 0.85ms
2024-11-21T00:48:31.618061505Z [I 2024-11-21 00:48:31.617 ServerApp] 302 GET / (@192.168.65.1) 2.21ms
2024-11-21T00:48:32.641259172Z [I 2024-11-21 00:48:32.640 ServerApp] 302 GET / (@192.168.65.1) 0.33ms
2024-11-21T00:53:31.077714338Z [I 2024-11-21 00:53:31.077 ServerApp] 302 GET / (@192.168.65.1) 1.15ms
2024-11-21T00:53:31.602378421Z [I 2024-11-21 00:53:31.602 ServerApp] 302 GET / (@192.168.65.1) 1.23ms
2024-11-21T00:53:32.635513505Z [I 2024-11-21 00:53:32.635 ServerApp] 302 GET / (@192.168.65.1) 0.49ms
```

Tip: Use the search function to help you efficiently locate information in the container logs.

Editor container logs

The editor container is where the integrated development environment (IDE) set by the project configurations runs. Logs from this container can provide insights into the following:

- User actions performed within the editor, such as file edits, saves, and execution of code cells
- Errors or warnings related to the editor software, as opposed to Workbench software
- Problems that are caused by editor plug-ins or extensions

Sync container logs

The sync container is responsible for synchronizing project files and code between persistent storage and the editor. Logs from this container can provide insights into the following:

- Successes or failures when syncing files between the local user repository and the projects remote repository
- Issues encountered during file creation or deletion, or file modification attempts
- Problems accessing external resources the project relies on

Proxy container logs

The proxy container handles network traffic to and from the project's environment, and facilitates access to web interfaces and APIs. Logs from this container can provide insights into the following:

- Incoming and outgoing network requests, which is useful for identifying unauthorized access attempts
- Errors related to network connectivity, DNS issues, or failed attempts to connect to external services
- Information on request handling times and bottlenecks in network communication

4.2 Working with channels and packages

Data Science & AI Workbench uses *packages* to bundle software files and information about the software—such as its name, specific version and description—into a single file that can be easily installed and managed.

Packages are distributed via *channels*. Channels can point to a cloud-based repository or a private location on a remote or local repository that you or someone else in your organization created. For more information, see *channels and packages*.

Note: Workbench supports the use of both `.conda` and `.pip` packages in its repository. To manage channels and packages for your Workbench Repository using a command line interface (CLI), follow the steps for the *administration server setup* on your current machine to install the CLI.

Building a conda package requires familiarity with the conda package manager and command line interface (CLI), so not all Workbench users will create packages and channels.

Many Workbench users can interact with packages primarily within the context of *projects* and *deployments*. In this case, they will likely do the following:

- Access and download any packages and installers they need from the list of available channels.
- Work with the contents of the package as they create models and dashboards.
- *Add any packages the project depends on* to the project configurations before *deploying the project*.

Other users might primarily build packages, *upload them to channels*, and *share them with others* to access and download.

4.2.1 Building a conda package

You can build a conda package to bundle software files and information about the software—such as its name, specific version and description—into a single file that can be easily installed and managed.

Building a conda package requires installing conda build and creating a conda build recipe.

You then use the `conda build` command to build the conda package from the conda recipe.

Tip: If you are new to building packages with conda, here are some video tutorials that you may find helpful:

- **Production-grade Packaging with Anaconda | AnacondaCon 2018**
  This 41-minute presentation by Mahmoud Hashemi covers using conda and conda environments to build an OS package (RPM) and Docker images.
- **The Sheer Joy of Packaging | SciPy 2018 Tutorial**
  This 210-minute presentation by Michael Sarahan, Filipe Fernandes, Chris Barker, Matt Craig, Matt McCormick, Jean-Christophe Fillion-Robin, Jonathan Helmus, and Ray Donnelly provides end-to-end examples of packaging with PyPI and conda. You can find materials from the tutorial here.
- **Making packages and packaging "just work" | PyData 2017 Tutorial**
  This 40-minute presentation by Michael Sarahan walks you through critical topics such as the anatomy of a Python package, tools available to make packaging easier, plus how to automate builds and why you might want to do so.

You can build conda packages from a variety of source code projects, most notably Python. For help packaging a Python project, see the Setuptools documentation.

Note: Setuptools is a package development process library designed to facilitate packaging Python projects, and is not part of Anaconda, Inc. Conda-build uses the build system that's native to the language, so in the case of Python that's `setuptools`.

After you build the package, you can *upload it to a channel* for others to access.

4.2.2 Channels and packages

A channel is a repository location for storing software packages. Users with access to a given channel can download and install the software packages available within the channel.

If you've *built a conda package*, you can upload it to a channel to make it available for others to use.

Data Science & AI Workbench allows all users to create channels in the internal Workbench repository, and allows users with the `ae-uploader` role to upload packages to channels that they have read-write permissions for.

Note:

- For more information about user permissions, see *roles*.
- For more information about channel permissions, see *sharing channels*.
- For more information about how Workbench manages channels, see *configuring conda in Workbench*.

Viewing channels

To view channels you have access to:

1. Log in to Workbench.
2. Select **Channels** from the left-hand menu.

> **Note:** Channels that display a lock beside their name are private. For more information about private channels, see *sharing channels*.

Creating a channel

To create a channel in the internal Workbench repository:

1. Select **Channels** from the left-hand menu.
2. Click **Create** in the upper right corner.
3. Set the channel to public or private access.
4. Enter a name for the channel, then click **Create**.

Viewing channel packages

From the **Channels** page, click on a channel name to view its packages. You can see the supported platforms, latest versions, when each package in the channel was last modified, and the number of times each package has been downloaded.

Viewing package details

Each package in Workbench presents valuable information pertaining to the package, such as its platform architecture, version, license, number of downloads, and the last time the package was updated. You can also find *a command on this page to assist you with installing the package* in your environment.

From the channel packages page, select any package to view the package details page.

Tip: You can search for packages by name to locate them more efficiently.

Uploading a package to a channel

To add a package to an existing channel:

1. Select **Channels** from the left-hand menu.
2. Click **Upload**.
3. Click **Browse** and locate the package in your file system.
4. Click **Upload**.

Note:

- There is a 1GB file size limit for package file uploads.

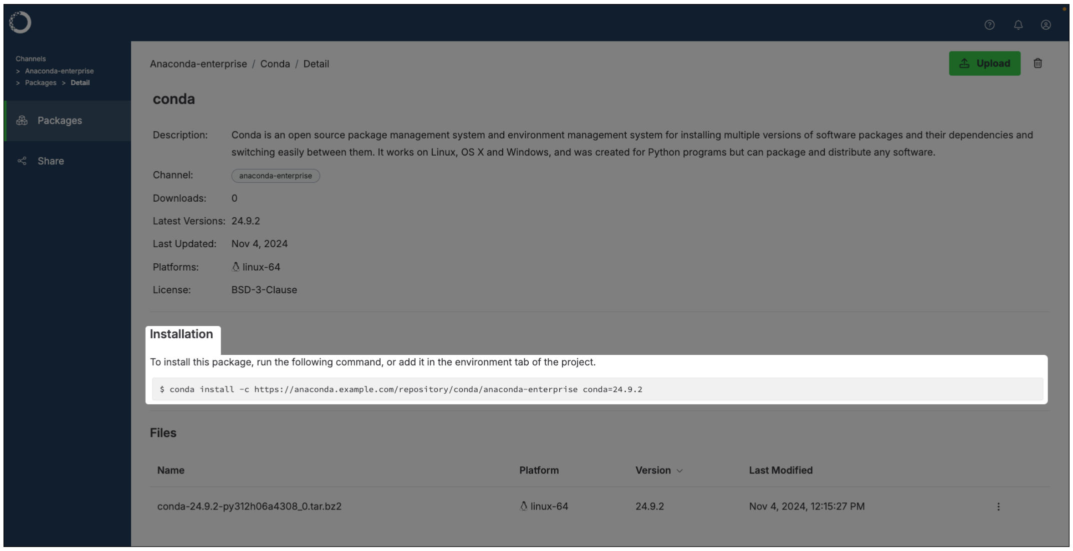
- If the **Upload** option is not available, you don't have permission to upload packages to the channel.

You can *share the channel* with others to provide them with access to the packages it contains.

Installing a package from a channel

To install a package from an internal Workbench channel:

1. From the **Channels** page, click on a channel name to view its packages.
2. Select any package to view the package details page.
3. Copy the installation command provided.
4. Run the copied command in the environment you want to install the package in.



conda

Description: Conda is an open source package management system and environment management system for installing multiple versions of software packages and their dependencies and switching easily between them. It works on Linux, OS X and Windows, and was created for Python programs but can package and distribute any software.

Channel: anaconda-enterprise

Downloads: 0

Latest Versions: 24.9.2

Last Updated: Nov 4, 2024

Platforms: linux-64

License: BSD-3-Clause

Installation

To install this package, run the following command, or add it in the environment tab of the project.

```
$ conda install -c https://anaconda.example.com/repository/conda/anaconda-enterprise conda=24.9.2
```

Files

Name	Platform	Version	Last Modified
conda-24.9.2-py312h06a4308_0.tar.bz2	linux-64	24.9.2	Nov 4, 2024, 12:15:27 PM

Removing a package from a channel

To remove a package from an internal Workbench channel:

1. From the **Channels** page, click on a channel name to view its packages.
2. Open the package's actions dropdown menu, then select *Delete*.
3. Click **Delete**.

Note: If the **Delete** option is not available, you don't have permission to remove packages from the channel.

Sharing channels

There are two types of channels within the internal Workbench repository, public and private. Channels are set to public access by default.

Sharing public channels

Public channels are accessible by non-authenticated users. In other words, people that do not have access to Workbench can still access packages in the internal Workbench repository channels.

To share a public channel:

1. From the **Channels** page, click on a channel name to view its details.
2. Select **Share** from the left-hand navigation.
3. Copy the channel address and distribute it to individuals who need access to the channel.

Sharing private channels

Private channels are accessible only to other Workbench users that you have added as collaborators to the channel.

To mark a channel as private:

1. From the **Channels** page, click on a channel name to view its details.
2. Select **Share** from the left-hand navigation.
3. Set the **Sharing** toggle to **Private**.

To share a private channel with other workbench users:

1. From the **Channels** page, click on a channel name to view its details.
2. Select **Share** from the left-hand navigation.
3. Begin typing a user or group name in the **Add New Collaborator** dropdown to search for matches. Select the correct entry, then click **Add**.

Note: By default, collaborators are granted read-write access to your shared channel. If you want to prevent collaborators from adding or removing packages in your channel, you'll need to *restrict them to read-only access using the CLI*.

Managing channels using the CLI

Log in to the CLI before you begin attempting to manage channels.

Creating a channel

Create a new channel in the internal Workbench repository by running the following command:

```
# Replace <CHANNEL_NAME> with the name of the channel you want to create
anaconda-enterprise-cli channels create <CHANNEL_NAME>
```

Uploading a package to a channel

Upload a conda package to a channel by running the following command:

```
anaconda-enterprise-cli upload --channel <path/to/package>
```

Listing all channels

Get a list of all the channels on the platform with the `channels list` command:

```
anaconda-enterprise-cli channels list
```

Sharing channels

Share and manage permissions for channels with the `share` command:

Share with user

```
# Replace <CHANNEL_NAME> with the name of the channel you want to share
# Replace <USERNAME> with the username of the user you want to share the channel with
anaconda-enterprise-cli channels share --user <USERNAME> <CHANNEL_NAME>
```

Share with group

```
# Replace <CHANNEL_NAME> with the name of the channel you want to share
# Replace <GROUP_NAME> with the name of group you want to share with
anaconda-enterprise-cli channels share --group <GROUP_NAME> <CHANNEL_NAME>
```

Note: By default, sharing a channel with a user or group provides them with read-write access to the channel. Restrict access to the channel to read-only by including `--level r` to before the <CHANNEL_NAME>.

For example:

```
anaconda-enterprise-cli channels share --group <GROUP_NAME> --level r <CHANNEL_NAME>
```

Revoking channel access

Revoke a user's or a group's access to a channel by running one of the following commands:

Revoke user access

```
# Replace <CHANNEL_NAME> with the name of the channel you want to revoke access to
# Replace <USERNAME> with the username of the user whose access you want to revoke
anaconda-enterprise-cli channels share --user <USERNAME> --remove <CHANNEL_NAME>
```

Revoke group access

```
# Replace <CHANNEL_NAME> with the name of the channel you want to revoke access to
# Replace <GROUP_NAME> with the name of the group whose access you want to revoke
anaconda-enterprise-cli channels share --group <GROUP_NAME> --remove <CHANNEL_NAME>
```

Setting a default channel

The `default_channel` value is not set when `anaconda-enterprise-cli` is installed. This means every time you run an `upload` command, you need to supply a specific channel name.

If you don't want to include the `--channel` option with each command, you can set a default channel by running the following command:

```
# Replace <CHANNEL_NAME> with the name of the channel you want to upload to by␣
↪default
anaconda-enterprise-cli config set default_channel <CHANNEL_NAME>
```

View your current default channel by running the following command:

```
# Replace <CHANNEL_NAME> with the name of the channel you want to upload to by␣
↪default
anaconda-enterprise-cli config get default_channel '<CHANNEL_NAME>'
```

Note: For more information about actions you can take with channels in the CLI, run the following command:

```
anaconda-enterprise-cli channels --help
```

4.2.3 Configuring conda

If you are familiar with conda and want to use it to install packages, you can configure conda to search a specific set of channels for packages by creating a `.condarc` file in the root directory of your local machine.

Caution: If your organization has configured conda at the *system level* to limit platform users' access to approved channels and packages only, *this will override your user-level configuration file*! If you are unsure if your organization has a system-level `.condarc` file, speak with your administrator.

The `.condarc` file is a configuration file that tells conda where to look for packages. Here is an example of what your `.condarc` file might look like:

```
channels:
  - defaults
default_channels:
  - <CHANNEL_NAME>
  - https://repo.anaconda.com/pkgs/main
```

The channels you specify can be *public* or *private*. Private channels require users to authenticate via `anaconda-enterprise-cli` before they can access packages from them. For more information about channel sharing, see *sharing channels*.

Conda searches for requested packages in the channel listed at the top of the `channels:` list first. If that channel contains the requested package, it is downloaded from that channel.

If the requested package is not located in that channel, conda will search for the package in the next entry of the `channels:` list.

When conda reaches the `defaults` entry of the `channels:` list, it searches the channels listed under the `default_channels:` list, in the same descending order.

In this example, conda will look for a requested package in your Workbench channel first, then will look in https://repo.anaconda.cloud/repo/main.

For more information regarding the `.condarc` file, see the official conda documentation.

4.3 Using installers, parcels and management packs

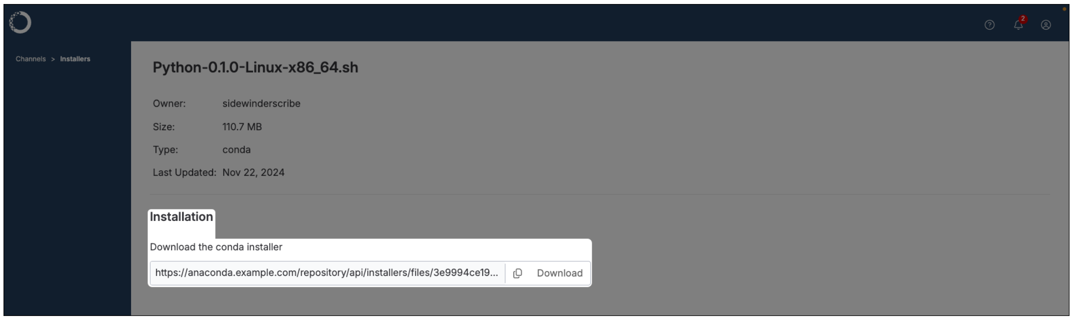
In addition to Anaconda and Miniconda installers, your administrator can create custom installers, Cloudera Manager parcels, or Hortonworks Data Manager management packs for you and your colleagues to use. They make these specific packages and their dependencies available to you via *channels*.

To view your available installers:

1. Select **Channels** from the left-hand navigation.
2. Click **Installers** in the top-right corner.

To download an installer:

1. Select an installer.
2. Click **Download**.



Python-0.1.0-Linux-x86_64.sh

Owner: sidewinderscribe

Size: 110.7 MB

Type: conda

Last Updated: Nov 22, 2024

Installation

Download the conda installer

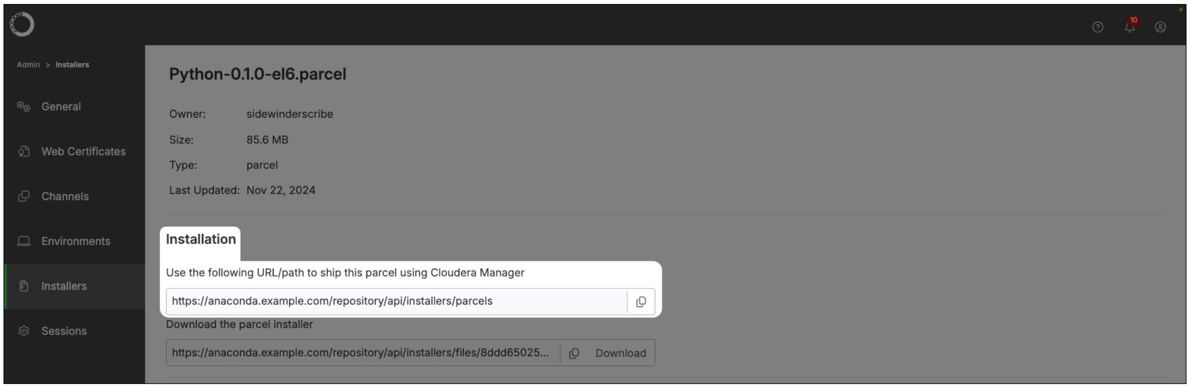
https://anaconda.example.com/repository/api/installers/files/3e9994ce19...

Note: If you don’t see an installer that you expected to see, please contact your administrator and ask them to *generate the installer* you need.

4.3.1 Creating Cloudera Data Platform (CDP) parcels

When working with CDP, create a parcel containing the conda environment you have created, then import the parcel into your CDP cluster.

1. Open the **My Account** dropdown menu and select *Admin Console*.
2. Select **Environments** from the left-hand navigation.
3. Select an environment to create a parcel for.
4. Click **Create Installer**, then select *Create Parcel (CDH,Linux)*.
5. Return to the Admin Console and select **Installers** from the left-hand navigation.
6. Select a parcel from the list.
7. Copy the URL/path to ship this parcel using Cloudera Manager.



Python-0.1.0-el6.parcel

Owner: sidewinderscribe
Size: 85.6 MB
Type: parcel
Last Updated: Nov 22, 2024

Installation

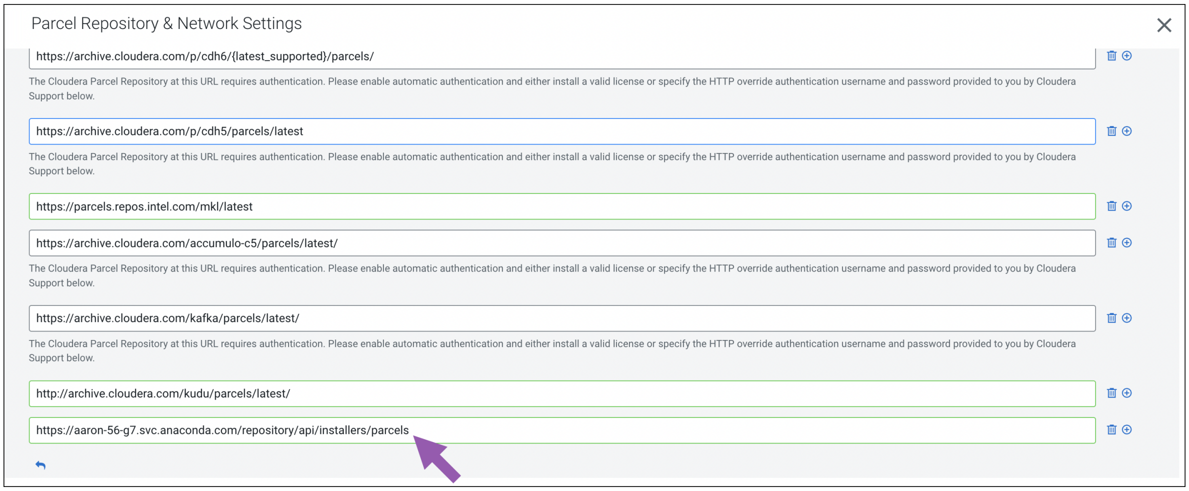
Use the following URL/path to ship this parcel using Cloudera Manager

https://anaconda.example.com/repository/api/installers/parcels

Download the parcel installer

https://anaconda.example.com/repository/api/installers/files/8ddd65025...

8. Add the URL to the CDP parcel configuration.



Parcel Repository & Network Settings

https://archive.cloudera.com/p/cdh6/{latest_supported}/parcels/

The Cloudera Parcel Repository at this URL requires authentication. Please enable automatic authentication and either install a valid license or specify the HTTP override authentication username and password provided to you by Cloudera Support below.

https://archive.cloudera.com/p/cdh5/parcels/latest

The Cloudera Parcel Repository at this URL requires authentication. Please enable automatic authentication and either install a valid license or specify the HTTP override authentication username and password provided to you by Cloudera Support below.

https://parcels.repos.intel.com/mkl/latest

https://archive.cloudera.com/accumulo-c5/parcels/latest/

The Cloudera Parcel Repository at this URL requires authentication. Please enable automatic authentication and either install a valid license or specify the HTTP override authentication username and password provided to you by Cloudera Support below.

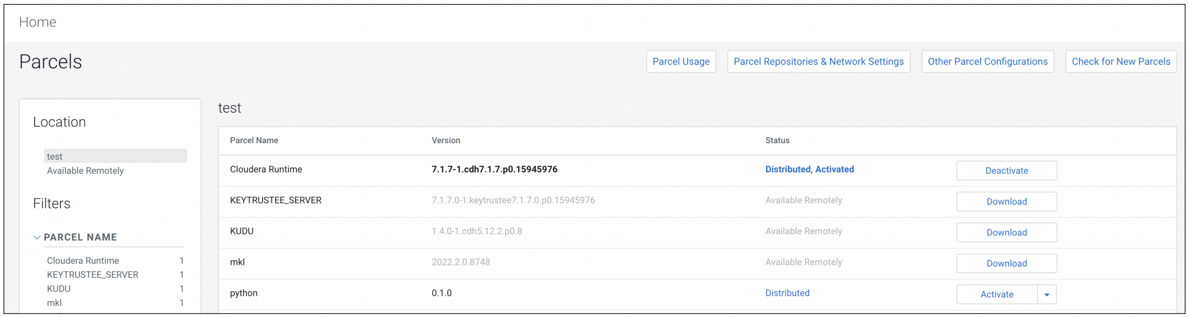
https://archive.cloudera.com/kafka/parcels/latest/

The Cloudera Parcel Repository at this URL requires authentication. Please enable automatic authentication and either install a valid license or specify the HTTP override authentication username and password provided to you by Cloudera Support below.

http://archive.cloudera.com/kudu/parcels/latest/

https://aaron-56-g7.svc.anaconda.com/repository/api/installers/parcels

9. Save your changes, check for new parcels, and download the new parcel.



test

Parcel Name	Version	Status	
Cloudera Runtime	7.1.7-1.cdh7.1.7.p0.15945976	Distributed, Activated	Deactivate
KEYTRUSTEE_SERVER	7.1.7.0-1.keytrustee7.1.7.0.p0.15945976	Available Remotely	Download
KUDU	1.4.0-1.cdh5.12.2.p0.8	Available Remotely	Download
mkl	2022.2.0.8748	Available Remotely	Download
python	0.1.0	Distributed	Activate

4.4 Working with data

4.4.1 Loading data into your project

Data Science & AI Workbench uses *projects* to encapsulate all of the components necessary to use or run an application: the relevant packages, channels, scripts, notebooks and other related files, environment variables, services and commands, along with a configuration file named `anaconda-project.yml`.

You can also access and load data in a variety of formats, stored in common sources including the following:

- *File systems*
- *NFS shared drives*
- *Databases*
- *Hadoop and Spark clusters*
- Distributed *version control repositories* such as Git and Bitbucket (if configured by your Administrator).

The amount of data you read into your project will impact the resources required to successfully run the project, whether in a notebook session or deployment. See the following section on *understanding resource profiles* to learn more.

Understanding resource profiles

Resource profiles are used to limit the amount of CPU cores and RAM available for use when running a project session or *deployment*.

Note: Choosing a resource profile with a greater number of available cores is not guaranteed to improve performance—it will also depend on whether the libraries used by the project can take advantage of multiple cores, for example.

Memory limits are enforced by the Linux kernel, so when the memory limit is exceeded the most recent process will crash. Be sure to select a resource profile that offers sufficient runtime resources required by your project to avoid such errors. A best practice recommendation is to **choose a resource profile with roughly double the amount of memory required by the size of data you need to read**.

To see the total memory in use, open a terminal and run the following command:

```
cat /sys/fs/cgroup/memory/memory.usage_in_bytes | awk '{print $1/1024/1024}'
```

Uploading files to a project

Open an editing session for the project, then choose the file you want to upload. The process of uploading files varies slightly, based on the editor used:

- In Jupyter Notebook, click **Upload** and select the file to upload. Then click the blue **Upload** button displayed in the file's row to add the file to the project
- In JupyterLab, click the Upload files icon and select the file. In the top right corner, click Commit Changes to add the file to your project.
- In Zeppelin, use the **Import note** feature to select a JSON file or add data from a URL.

Once a file is in the project, you can use code to read it. For example, to load the iris dataset from a comma separated value (CSV) file into a pandas DataFrame:

```
import pandas as pd
irisdf = pd.read_csv('iris.csv')
```

Accessing NFS shared drives

After your Administrator has *configured Workbench to mount an NFS share*, you'll be able to access it from within your notebooks. You'll just need to know the name of the volume, so you can access it. For example, if they named the configuration file section `myvolume`, the share will be mounted at `/data/myvolume`.

From a notebook you can use code such as this to read data from the share:

```
import pandas as pd
irisdf = pd.read_csv('/data/myvolume/iris.csv')
```

Accessing data stored in databases

You can also connect to the following database engines to access data stored within them:

- Cassandra
- Cockroach
- Cosmos
- Couchbase
- Db2
- Elasticsearch
- MariaDB
- MLDB
- MongoDB
- MS SQL
- MySQL
- Neo4j

- Oracle
- PostgreSQL
- Redis
- S3
- Snowflake
- Vertica

See *Secrets* for information about adding credentials to the platform, to make them available in your projects. Any secrets you add will be available across all sessions and deployments associated with your user account.

Hadoop Distributed File System (HDFS), Spark, Hive, and Impala

Loading data from HDFS, Spark, Hive, and Impala is discussed in ../spark-hadoop.

4.4.2 Exploring project data

With Data Science & AI Workbench, you can explore project data using visualization libraries such as Bokeh and Matplotlib, and numeric libraries such as NumPy, SciPy, and Pandas.

Use these tools to discover patterns and relationships in your datasets, and develop approaches for your analysis and deployment pipelines.

The following examples use the Iris flower data set, and this mini customer data set (`customers.csv`):

```
customer_id,title,industry
1,data scientist,retail
2,data scientist,academia
3,compiler optimizer,academia
4,data scientist,finance
5,compiler optimizer,academia
6,data scientist,academia
7,compiler optimizer,academia
8,data scientist,retail
9,compiler optimizer,finance
```

1. Begin by importing libraries, and reading data into a Pandas DataFrame:

   ```
   import pandas as pd
   import numpy as np
   import matplotlib.pyplot as plt
   irisdf = pd.read_csv('iris.csv')
   customerdf = pd.read_csv('customers.csv')

   %matplotlib inline
   ```

2. Then list column / variable names:

   ```
   print(irisdf.columns)
   ```

```
Index(['sepal_length', 'sepal_width', 'petal_length', 'petal_width', 'class'],␣
↪dtype='object')
```

3. Summary statistics include minimum, maximum, mean, median, percentiles, and more:

```
print('length:', len(irisdf)) # length of data set
print('shape:', irisdf.shape) # length and width of data set
print('size:', irisdf.size) # length * width
print('min:', irisdf['sepal_width'].min())
print('max:', irisdf['sepal_width'].max())
print('mean:', irisdf['sepal_width'].mean())
print('median:', irisdf['sepal_width'].median())
print('50th percentile:', irisdf['sepal_width'].quantile(0.5)) # 50th percentile,␣
↪also known as median
print('5th percentile:', irisdf['sepal_width'].quantile(0.05))
print('10th percentile:', irisdf['sepal_width'].quantile(0.1))
print('95th percentile:', irisdf['sepal_width'].quantile(0.95))
```

```
length: 150
shape: (150, 5)
size: 750
min: 2.0
max: 4.4
mean: 3.0573333333333337
median: 3.0
50th percentile: 3.0
5th percentile: 2.3449999999999998
10th percentile: 2.5
95th percentile: 3.8
```

#. Use the `value_counts` function to show the number of items in each category, sorted from largest to smallest. You can also set the `ascending` argument to `True` to display the list from smallest to largest.

```
print(customerdf['industry'].value_counts())
print()
print(customerdf['industry'].value_counts(ascending=True))
```

```
academia    5
finance     2
retail      2
Name: industry, dtype: int64

retail      2
finance     2
academia    5
Name: industry, dtype: int64
```

Categorical variables

In statistics, a categorical variable may take on a limited number of possible values. Examples could include blood type, nation of origin, or ratings on a Likert scale.

Like numbers, the possible values may have an order, such as from `disagree` to `neutral` to `agree`. The values cannot, however, be used for numerical operations such as addition or division.

Categorical variables tell other Python libraries how to handle the data, so those libraries can default to suitable statistical methods or plot types.

The following example converts the `class` variable of the Iris dataset from `object` to `category`.

```
print(irisdf.dtypes)
print()
irisdf['class'] = irisdf['class'].astype('category')
print(irisdf.dtypes)
```

```
sepal_length    float64
sepal_width     float64
petal_length    float64
petal_width     float64
class            object
dtype: object

sepal_length     float64
sepal_width      float64
petal_length     float64
petal_width      float64
class           category
dtype: object
```

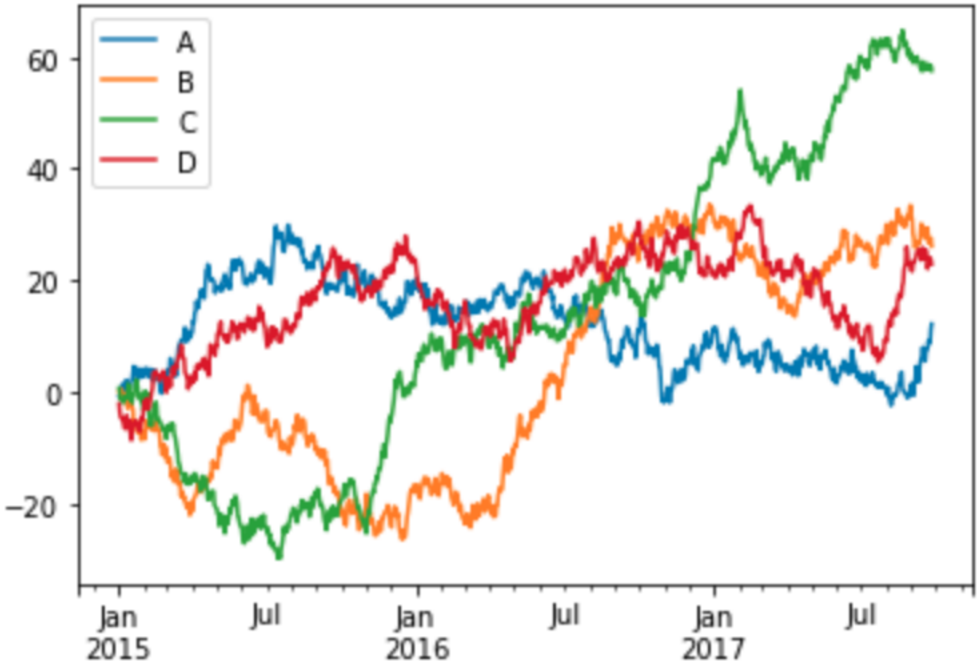
Within Pandas, this creates an array of the possible values, where each value appears only once, and replaces the strings in the DataFrame with indexes into the array. In some cases, this saves significant memory.

A categorical variable may have a logical order different than the lexical order. For example, for ratings on a Likert scale, the *lexical* order could alphabetize the strings and produce `agree, disagree, neither agree nor disagree, strongly agree, strongly disagree`. The *logical* order could range from most negative to most positive as `strongly disagree, disagree, neither agree nor disagree, agree, strongly agree`.

Time series data visualization

The following code sample creates four series of random numbers over time, calculates the cumulative sums for each series over time, and plots them.

```
timedf = pd.DataFrame(np.random.randn(1000, 4), index=pd.date_range('1/1/2015',␣
↪periods=1000), columns=list('ABCD'))
timedf = timedf.cumsum()
timedf.plot()
```

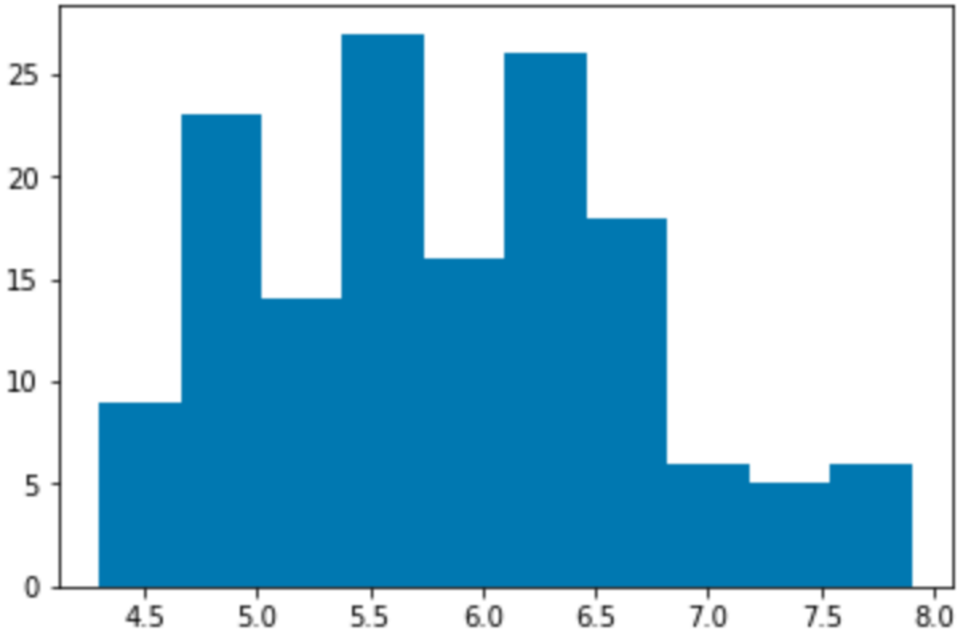


This example was adapted from http://pandas.pydata.org/pandas-docs/stable/visualization.html.

Histograms

This code sample plots a histogram of the sepal length values in the Iris data set:

```
plt.hist(irisdf['sepal_length'])
plt.show()
```



Bar charts

The following sample code produces a bar chart of the industries of customers in the customer data set.

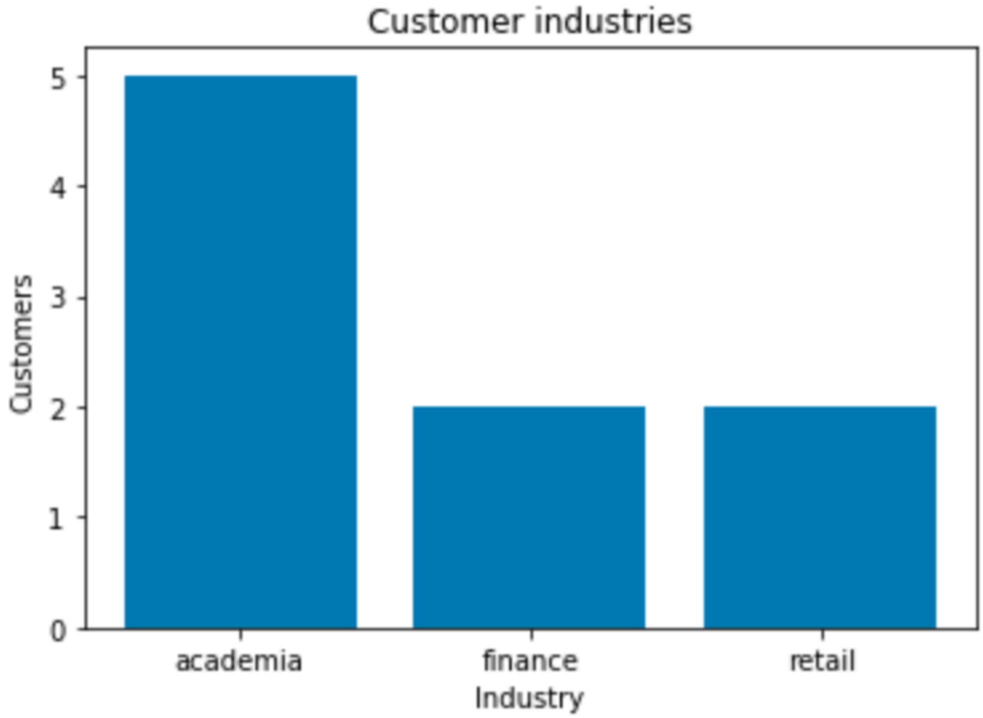
```
industries = customerdf['industry'].value_counts()

fig, ax = plt.subplots()

ax.bar(np.arange(len(industries)), industries)

ax.set_xlabel('Industry')
ax.set_ylabel('Customers')
ax.set_title('Customer industries')
ax.set_xticks(np.arange(len(industries)))
ax.set_xticklabels(industries.index)

plt.show()
```

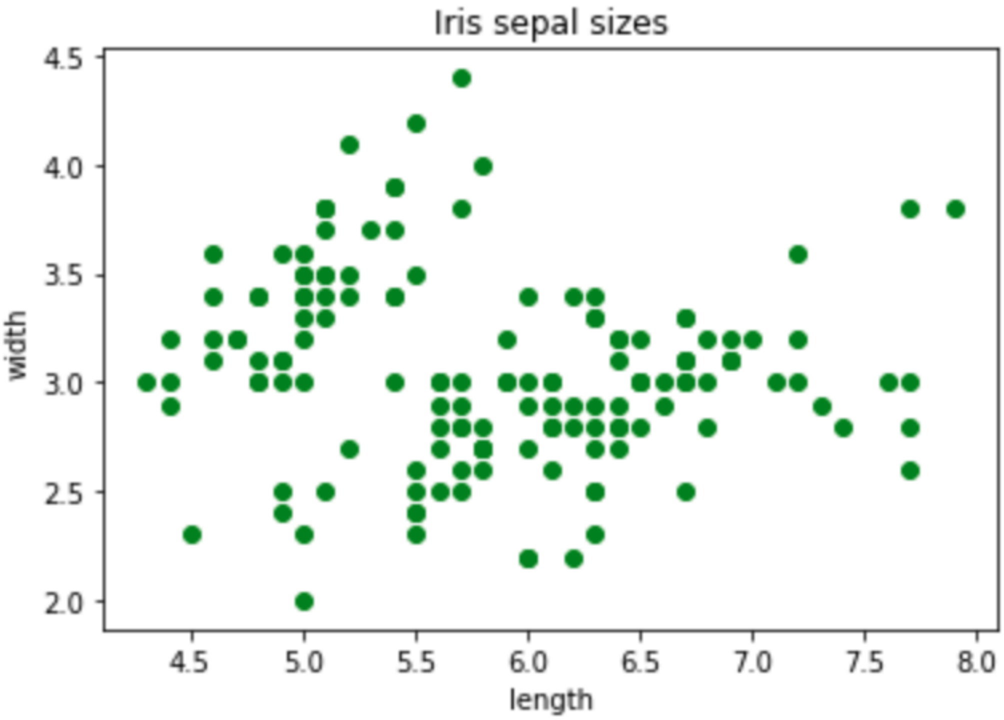


This example was adapted from https://matplotlib.org/gallery/statistics/barchart_demo.html.

Scatter plots

This code sample makes a scatter plot of the sepal lengths and widths in the Iris data set:

```
fig, ax = plt.subplots()
ax.scatter(irisdf['sepal_length'], irisdf['sepal_width'], color='green')
ax.set(
    xlabel="length",
    ylabel="width",
    title="Iris sepal sizes",
)
plt.show()
```



Sorting

To show the customer data set:

```
customerdf
```

row	customer_id	title	industry
0	1	data scientist	retail
1	2	data scientist	academia
2	3	compiler optimizer	academia
3	4	data scientist	finance
4	5	compiler optimizer	academia
5	6	data scientist	academia
6	7	compiler optimizer	academia
7	8	data scientist	retail
8	9	compiler optimizer	finance

To sort by industry and show the results:

```
customerdf.sort_values(by=['industry'])
```

row	customer_id	title	industry
1	2	data scientist	academia
2	3	compiler optimizer	academia
4	5	compiler optimizer	academia
5	6	data scientist	academia
6	7	compiler optimizer	academia
3	4	data scientist	finance
8	9	compiler optimizer	finance
0	1	data scientist	retail
7	8	data scientist	retail

To sort by industry and then title:

```
customerdf.sort_values(by=['industry', 'title'])
```

row	customer_id	title	industry
2	3	compiler optimizer	academia
4	5	compiler optimizer	academia
6	7	compiler optimizer	academia
1	2	data scientist	academia
5	6	data scientist	academia
8	9	compiler optimizer	finance
3	4	data scientist	finance
0	1	data scientist	retail
7	8	data scientist	retail

The `sort_values` function can also use the following arguments:

- `axis` to sort either rows or columns
- `ascending` to sort in either ascending or descending order
- `inplace` to perform the sorting operation in-place, without copying the data, which can save space
- `kind` to use the quicksort, merge sort, or heapsort algorithms

- na_position to sort not a number (NaN) entries at the end or beginning

Grouping

customerdf.groupby('title')['customer_id'].count() counts the items in each group, excluding missing values such as not-a-number values (NaN). Because there are no missing customer IDs, this is equivalent to customerdf.groupby('title').size().

```
print(customerdf.groupby('title')['customer_id'].count())
print()
print(customerdf.groupby('title').size())
print()
print(customerdf.groupby(['title', 'industry']).size())
print()
print(customerdf.groupby(['industry', 'title']).size())
```

```
title
compiler optimizer    4
data scientist        5
Name: customer_id, dtype: int64

title
compiler optimizer    4
data scientist        5
dtype: int64

title               industry
compiler optimizer  academia    3
                    finance     1
data scientist      academia    2
                    finance     1
                    retail      2
dtype: int64

industry  title
academia  compiler optimizer    3
          data scientist        2
finance   compiler optimizer    1
          data scientist        1
retail    data scientist        2
dtype: int64
```

By default groupby sorts the group keys. You can use the sort=False option to prevent this, which can make the grouping operation faster.

Binning

Binning or bucketing moves continuous data into discrete chunks, which can be used as ordinal categorical variables.

You can divide the range of the sepal length measurements into four equal bins:

```
pd.cut(irisdf['sepal_length'], 4).head()
```

```
0    (4.296, 5.2]
1    (4.296, 5.2]
2    (4.296, 5.2]
3    (4.296, 5.2]
4    (4.296, 5.2]
Name: sepal_length, dtype: category
Categories (4, interval[float64]): [(4.296, 5.2] < (5.2, 6.1] < (6.1, 7.0] < (7.0, 7.9]]
```

Or make a custom bin array to divide the sepal length measurements into integer-sized bins from 4 through 8:

```
custom_bin_array = np.linspace(4, 8, 5)
custom_bin_array
```

```
array([4., 5., 6., 7., 8.])
```

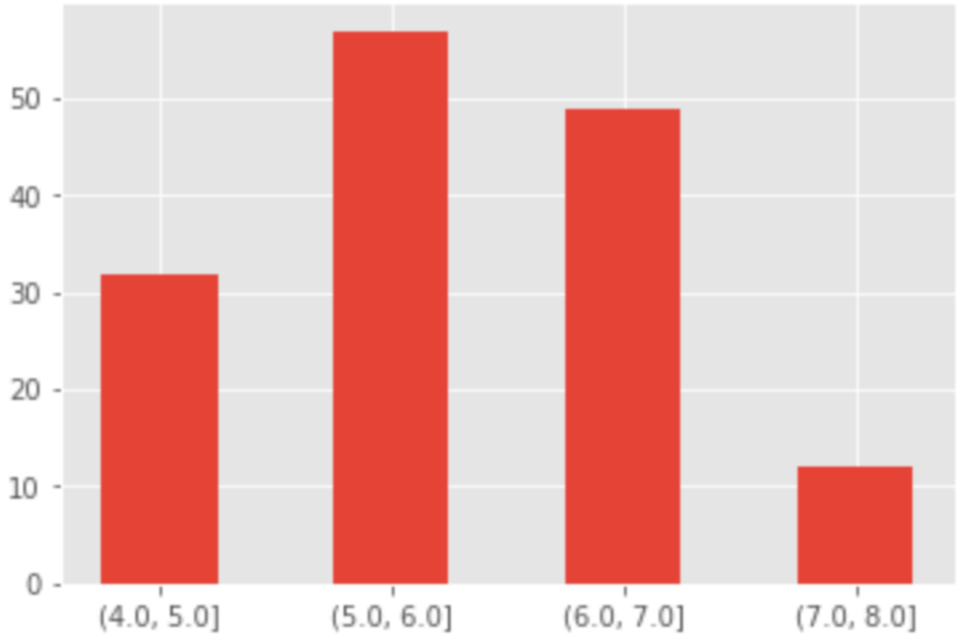
Copy the Iris data set, and apply the binning to it:

```
iris2=irisdf.copy()
iris2['sepal_length'] = pd.cut(iris2['sepal_length'], custom_bin_array)
iris2['sepal_length'].head()
```

```
0    (5.0, 6.0]
1    (4.0, 5.0]
2    (4.0, 5.0]
3    (4.0, 5.0]
4    (4.0, 5.0]
Name: sepal_length, dtype: category
Categories (4, interval[float64]): [(4.0, 5.0] < (5.0, 6.0] < (6.0, 7.0] < (7.0, 8.0]]
```

Then plot the binned data:

```
plt.style.use('ggplot')
categories = iris2['sepal_length'].cat.categories
ind = np.array([x for x, _ in enumerate(categories)])
plt.bar(ind, iris2.groupby('sepal_length').size(), width=0.5, label='Sepal length')
plt.xticks(ind, categories)
plt.show()
```



This example was adapted from http://benalexkeen.com/bucketing-continuous-variables-in-pandas/ .

4.4.3 Data preparation

Data Science & AI Workbench supports data preparation using numeric libraries such as NumPy, SciPy, and Pandas.

These examples use this small data file `vendors.csv`:

```
Vendor Number,Vendor Name,Month,Day,Year,Active,Open Orders,2015,2016,Percent Growth
"104.0",ACME Inc,2,15,2014,"Y",200,"$45,000.00",$54000.00,20.00%
205,Apogee LTD,8,12,2015,"Y",150,"$29,000.00","$30,450.00",5.00%
143,Zenith Co,4,5,2014,"Y",290,"$18,000.00",$23400.00,30.00%
166,Hollerith Propulsion,9,25,2015,"Y",180,"$48,000.00",$48960.00,2.00%
180,Airtek Industrial,8,2,2014,"N",Closed,"$23,000.00",$17250.00,-25.00%
```

The columns are the vendor ID number, vendor name, month day and year of first purchase from the vendor, whether the account is currently active, the number of open orders, purchases in 2015 and 2016, and percent growth in orders from 2015 to 2016.

Converting data types

Computers handle many types of data, including integer numbers such as 365, floating point numbers such as 365.2425, strings such as “ACME Inc”, and more.

An operation such as division may work for integers and floating point numbers, but produce an error if used on strings.

Often data libraries such as pandas will automatically use the correct types, but they do provide ways to correct and change the types when needed. For example, you may wish to convert between an integer such as 25, the floating point number 25.0, and strings such as “25”, “25.0”, or “$25.00”.

Pandas data types or `dtypes` correspond to similar Python types.

Strings are called `str` in Python and `object` in pandas.

Integers are called `int` in Python and `int64` in pandas, indicating that pandas stores integers as 64-bit numbers.

Floating point numbers are called `float` in Python and `float64` in pandas, also indicating that they are stored with 64 bits.

A boolean value, named for logician George Boole, can be either True or False. These are called `bool` in Python and `bool` in pandas.

Pandas includes some data types with no corresponding native Python type: `datetime64` for date and time values, `timedelta[ns]` for storing the difference between two times as a number of nanoseconds, and `category` where each item is one of a list of strings.

Here we import the vendor data file and show the dtypes:

```
import pandas as pd
import numpy as np
df = pd.read_csv('vendors.csv')
df.dtypes
```

```
Vendor Number     float64
Vendor Name        object
Month               int64
Day                 int64
Year                int64
Active             object
Open Orders        object
2015               object
2016               object
Percent Growth     object
dtype: object
```

Try adding the 2015 and 2016 sales:

```
df['2015']+df['2016']
```

```
0     $45,000.00$54000.00
1    $29,000.00$30,450.00
2     $18,000.00$23400.00
3     $48,000.00$48960.00
4     $23,000.00$17250.00
dtype: object
```

These columns were stored as the type "object", and concatenated as strings, not added as numbers.

Examine more information about the DataFrame:

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5 entries, 0 to 4
Data columns (total 10 columns):
Vendor Number     5 non-null float64
Vendor Name       5 non-null object
Month             5 non-null int64
Day               5 non-null int64
```

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```
Year               5 non-null int64
Active             5 non-null object
Open Orders        5 non-null object
2015               5 non-null object
2016               5 non-null object
Percent Growth     5 non-null object
dtypes: float64(1), int64(3), object(6)
memory usage: 480.0+ bytes
```

Vendor Number is a `float` and not an `int`. 2015 and 2016 sales, percent growth, and open orders are stored as objects and not numbers. The month, day, and year values should be converted to `datetime64`, and the active column should be converted to a boolean.

The data can be converted with the `astype()` function, custom functions, or pandas functions such as `to_numeric()` or `to_datetime()`.

astype()

The `astype()` function can convert the Vendor Number column to `int`:

```
df['Vendor Number'].astype('int')
```

```
0    104
1    205
2    143
3    166
4    180
Name: Vendor Number, dtype: int64
```

`astype()` returns a copy, so an assignment statement will convert the original data. This can be checked by showing the `dtypes`.

```
df['Vendor Number'] = df['Vendor Number'].astype('int')
df.dtypes
```

```
Vendor Number      int64
Vendor Name       object
Month              int64
Day                int64
Year               int64
Active            object
Open Orders       object
2015              object
2016              object
Percent Growth    object
dtype: object
```

However, trying to convert the 2015 column to a `float` or the Open Orders column to an `int` returns an error.

```
df['2015'].astype('float')
```

```
ValueError: could not convert string to float: '$23,000.00'
```

```
df['Open Orders'].astype('int')
```

```
ValueError: invalid literal for int() with base 10: 'Closed'
```

Even worse, trying to convert the Active column to a `bool` completes with no errors, but converts both Y and N values to `True`.

```
df['Active'].astype('bool')
```

```
0    True
1    True
2    True
3    True
4    True
Name: Active, dtype: bool
```

`astype()` works if the data is clean and can be interpreted simply as a number, or if you want to convert a number to a string. Other conversions require custom functions or pandas functions such as `to_numeric()` or `to_datetime()`.

Custom conversion functions

This small custom function converts a currency string like the ones in the 2015 column to a `float` by first removing the comma (`,`) and dollar sign (`$`) characters.

```
def currency_to_float(a):
    return float(a.replace(',','').replace('$',''))
```

Test the function on the 2015 column with the `apply()` function:

```
df['2015'].apply(currency_to_float)
```

```
0    45000.0
1    29000.0
2    18000.0
3    48000.0
4    23000.0
Name: 2015, dtype: float64
```

Convert the 2015 and 2016 columns and show the `dtypes`:

```
df['2015'] = df['2015'].apply(currency_to_float)
df['2016'] = df['2016'].apply(currency_to_float)
df.dtypes
```

```
Vendor Number       int64
Vendor Name        object
Month               int64
Day                 int64
Year                int64
```

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```
Active             object
Open Orders        object
2015              float64
2016              float64
Percent Growth     object
dtype: object
```

Convert the Percent Growth column:

```
def percent_to_float(a):
    return float(a.replace('%',''))/100
df['Percent Growth'].apply(percent_to_float)
```

```
0    0.20
1    0.05
2    0.30
3    0.02
4   -0.25
Name: Percent Growth, dtype: float64
```

```
df['Percent Growth'] = df['Percent Growth'].apply(percent_to_float)
df.dtypes
```

```
Vendor Number       int64
Vendor Name        object
Month               int64
Day                 int64
Year                int64
Active             object
Open Orders        object
2015              float64
2016              float64
Percent Growth    float64
dtype: object
```

NumPy's `np.where()` function is a good way to convert the Active column to `bool`. This code converts "Y" values to `True` and all other values to `False`, then shows the `dtypes`:

```
np.where(df["Active"] == "Y", True, False)
```

```
array([ True,  True,  True,  True, False])
```

```
df["Active"] = np.where(df["Active"] == "Y", True, False)
df.dtypes
```

```
Vendor Number       int64
Vendor Name        object
Month               int64
Day                 int64
Year                int64
Active               bool
```

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```
Open Orders         object
2015               float64
2016               float64
Percent Growth     float64
dtype: object
```

Pandas helper functions

The Open Orders column has several integers, but one string. Using `astype()` on this column would produce an error, but the `pd.to_numeric()` function built in to pandas will convert the numeric values to numbers and any other values to the “not a number” or “NaN” value built in to the floating point number standard:

```
pd.to_numeric(df['Open Orders'], errors='coerce')
```

```
0    200.0
1    150.0
2    290.0
3    180.0
4      NaN
Name: Open Orders, dtype: float64
```

In this case, a non-numeric value in this field indicates that there are zero open orders, so we can convert NaN values to zero with the function `fillna()`:

```
pd.to_numeric(df['Open Orders'], errors='coerce').fillna(0)
```

```
0    200.0
1    150.0
2    290.0
3    180.0
4      0.0
Name: Open Orders, dtype: float64
```

Similarly, the `pd.to_datetime()` function built in to pandas can convert the Month Day and Year columns to `datetime64[ns]`:

```
pd.to_datetime(df[['Month', 'Day', 'Year']])
```

```
0   2014-02-15
1   2015-08-12
2   2014-04-05
3   2015-09-25
4   2014-08-02
dtype: datetime64[ns]
```

Use these functions to change the DataFrame, then show the `dtypes`:

```
df['Open Orders'] = pd.to_numeric(df['Open Orders'], errors='coerce').fillna(0)
df['First Purchase Date'] = pd.to_datetime(df[['Month', 'Day', 'Year']])
df.dtypes
```

```
Vendor Number                    int64
Vendor Name                     object
Month                            int64
Day                              int64
Year                             int64
Active                            bool
Open Orders                    float64
2015                           float64
2016                           float64
Percent Growth                 float64
First Purchase Date     datetime64[ns]
dtype: object
```

Converting data as it is read

You can apply `dtype` and `converters` in the `pd.read_csv()` function. Defining `dtype` is like performing `astype()` on the data.

A `dtype` or a `converter` can only be applied once to a specified column. If you try to apply both to the same column, the `dtype` is skipped.

After converting as much of the data as possible in `pd.read_csv()`, use code similar to the previous examples to convert the rest.

```
df2 = pd.read_csv('vendors.csv',
                  dtype={'Vendor Number': 'int'},
                  converters={'2015': currency_to_float,
                              '2016': currency_to_float,
                              'Percent Growth': percent_to_float})
df2["Active"] = np.where(df2["Active"] == "Y", True, False)
df2['Open Orders'] = pd.to_numeric(df2['Open Orders'], errors='coerce').fillna(0)
df2['First Purchase Date'] = pd.to_datetime(df2[['Month', 'Day', 'Year']])
df2
```

```
   Vendor Number           Vendor Name  Month  Day  Year  Active  Open Orders     2015  ␣
↪  2016  Percent Growth First Purchase Date
0            104              ACME Inc      2   15  2014    True        200.0  45000.0 ␣
↪54000.0            0.20          2014-02-15
1            205            Apogee LTD      8   12  2015    True        150.0  29000.0 ␣
↪30450.0            0.05          2015-08-12
2            143             Zenith Co      4    5  2014    True        290.0  18000.0 ␣
↪23400.0            0.30          2014-04-05
3            166  Hollerith Propulsion      9   25  2015    True        180.0  48000.0 ␣
↪48960.0            0.02          2015-09-25
4            180     Airtek Industrial      8    2  2014   False          0.0  23000.0 ␣
↪17250.0           -0.25          2014-08-02
```

```
df2.dtypes
```

```
Vendor Number                    int64
Vendor Name                     object
```

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```
Month                            int64
Day                              int64
Year                             int64
Active                            bool
Open Orders                    float64
2015                           float64
2016                           float64
Percent Growth                 float64
First Purchase Date     datetime64[ns]
dtype: object
```

We thank http://pbpython.com/pandas_dtypes.html for providing data preparation examples that inspired these examples.

Merging and joining data sets

You can use pandas to merge DataFrames:

```
left = pd.DataFrame({'key': ['K0', 'K1', 'K2', 'K3'],
                     'A': ['A0', 'A1', 'A2', 'A3'],
                     'B': ['B0', 'B1', 'B2', 'B3']})
right = pd.DataFrame({'key': ['K0', 'K1', 'K2', 'K3'],
                      'C': ['C0', 'C1', 'C2', 'C3'],
                      'D': ['D0', 'D1', 'D2', 'D3']})
pd.merge(left, right, on='key')
```

```
  key   A   B   C   D
0  K0  A0  B0  C0  D0
1  K1  A1  B1  C1  D1
2  K2  A2  B2  C2  D2
3  K3  A3  B3  C3  D3
```

The available merge methods are `left` to use keys from the left frame only, `right` to use keys from the right frame only, `outer` to use the union of keys from both frames, and the default `inner` to use the intersection of keys from both frames.

This merge using the default inner join omits key combinations found in only one of the source DataFrames:

```
left = pd.DataFrame({'key1': ['K0', 'K0', 'K1', 'K2'],
                     'key2': ['K0', 'K1', 'K0', 'K1'],
                     'A': ['A0', 'A1', 'A2', 'A3'],
                     'B': ['B0', 'B1', 'B2', 'B3']})
right = pd.DataFrame({'key1': ['K0', 'K1', 'K1', 'K2'],
                      'key2': ['K0', 'K0', 'K0', 'K0'],
                      'C': ['C0', 'C1', 'C2', 'C3'],
                      'D': ['D0', 'D1', 'D2', 'D3']})
pd.merge(left, right, on=['key1', 'key2'])
```

```
  key1 key2   A   B   C   D
0   K0   K0  A0  B0  C0  D0
1   K1   K0  A2  B2  C1  D1
2   K1   K0  A2  B2  C2  D2
```

This example omits the rows with key1 and key2 set to K0, K1, K2, K1, or K2, K0.

Joins also copy information when necessary. The left DataFrame had one row with the keys set to K1, K0 and the right DataFrame had two. The output DataFrame has two, with the information from the left DataFrame copied into both rows.

The next example shows the results of a left, right, and outer merge on the same inputs. Empty cells are filled in with NaN values.

```
pd.merge(left, right, how='left', on=['key1', 'key2'])
```

```
  key1 key2   A   B    C    D
0   K0   K0  A0  B0   C0   D0
1   K0   K1  A1  B1  NaN  NaN
2   K1   K0  A2  B2   C1   D1
3   K1   K0  A2  B2   C2   D2
4   K2   K1  A3  B3  NaN  NaN
```

```
pd.merge(left, right, how='right', on=['key1', 'key2'])
```

```
  key1 key2    A    B   C   D
0   K0   K0   A0   B0  C0  D0
1   K1   K0   A2   B2  C1  D1
2   K1   K0   A2   B2  C2  D2
3   K2   K0  NaN  NaN  C3  D3
```

```
pd.merge(left, right, how='outer', on=['key1', 'key2'])
```

```
  key1 key2    A    B    C    D
0   K0   K0   A0   B0   C0   D0
1   K0   K1   A1   B1  NaN  NaN
2   K1   K0   A2   B2   C1   D1
3   K1   K0   A2   B2   C2   D2
4   K2   K1   A3   B3  NaN  NaN
5   K2   K0  NaN  NaN   C3   D3
```

If a key combination appears more than once in both tables, the output will contain the Cartesian product of the associated data.

In this small example a key that appears twice in the left frame and three times in the right frame produces six rows in the output frame.

```
left = pd.DataFrame({'A' : [1,2], 'B' : [2, 2]})
right = pd.DataFrame({'A' : [4,5,6], 'B': [2,2,2]})
pd.merge(left, right, on='B', how='outer')
```

```
   A_x  B  A_y
0    1  2    4
1    1  2    5
2    1  2    6
3    2  2    4
4    2  2    5
5    2  2    6
```

To prevent very large outputs and memory overflow, manage duplicate values in keys before joining large DataFrames.

While merging uses one or more columns as keys, joining uses the indexes, also known as row labels.

Join can also perform left, right, inner, and outer merges, and defaults to left.

```
left = pd.DataFrame({'A': ['A0', 'A1', 'A2'],
                     'B': ['B0', 'B1', 'B2']},
                    index=['K0', 'K1', 'K2'])
right = pd.DataFrame({'C': ['C0', 'C2', 'C3'],
                      'D': ['D0', 'D2', 'D3']},
                     index=['K0', 'K2', 'K3'])
left.join(right)
```

```
     A   B    C    D
K0  A0  B0   C0   D0
K1  A1  B1  NaN  NaN
K2  A2  B2   C2   D2
```

```
left.join(right, how='outer')
```

```
      A    B    C    D
K0   A0   B0   C0   D0
K1   A1   B1  NaN  NaN
K2   A2   B2   C2   D2
K3  NaN  NaN   C3   D3
```

```
left.join(right, how='inner')
```

```
     A   B   C   D
K0  A0  B0  C0  D0
K2  A2  B2  C2  D2
```

This is equivalent to using merge with arguments instructing it to use the indexes:

```
pd.merge(left, right, left_index=True, right_index=True, how='inner')
```

```
     A   B   C   D
K0  A0  B0  C0  D0
K2  A2  B2  C2  D2
```

You can join a frame indexed by a join key to a frame where the key is a column:

```
left = pd.DataFrame({'A': ['A0', 'A1', 'A2', 'A3'],
                     'B': ['B0', 'B1', 'B2', 'B3'],
                     'key': ['K0', 'K1', 'K0', 'K1']})
right = pd.DataFrame({'C': ['C0', 'C1'],
                      'D': ['D0', 'D1']},
                     index=['K0', 'K1'])
left.join(right, on='key')
```

```
    A   B key   C   D
0  A0  B0  K0  C0  D0
```

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```
1  A1  B1  K1  C1  D1
2  A2  B2  K0  C0  D0
3  A3  B3  K1  C1  D1
```

You can join on multiple keys if the passed DataFrame has a `MultiIndex`:

```
left = pd.DataFrame({'A': ['A0', 'A1', 'A2', 'A3'],
                     'B': ['B0', 'B1', 'B2', 'B3'],
                     'key1': ['K0', 'K0', 'K1', 'K2'],
                     'key2': ['K0', 'K1', 'K0', 'K1']})
index = pd.MultiIndex.from_tuples([('K0', 'K0'), ('K1', 'K0'),
                                   ('K2', 'K0'), ('K2', 'K1')])
right = pd.DataFrame({'C': ['C0', 'C1', 'C2', 'C3'],
                      'D': ['D0', 'D1', 'D2', 'D3']},
                     index=index)
right
```

```
        C   D
K0 K0  C0  D0
K1 K0  C1  D1
K2 K0  C2  D2
   K1  C3  D3
```

```
left.join(right, on=['key1', 'key2'])
```

```
    A   B key1 key2    C    D
0  A0  B0   K0   K0   C0   D0
1  A1  B1   K0   K1  NaN  NaN
2  A2  B2   K1   K0   C1   D1
3  A3  B3   K2   K1   C3   D3
```

Note that this defaulted to a left join, but other types are also available:

```
left.join(right, on=['key1', 'key2'], how='inner')
```

```
    A   B key1 key2   C   D
0  A0  B0   K0   K0  C0  D0
2  A2  B2   K1   K0  C1  D1
3  A3  B3   K2   K1  C3  D3
```

For more information, including examples of using merge to join a single index to a multi-index or to join two multi-indexes, see the pandas documentation on merging.

When column names in the input frames overlap, pandas appends suffixes to disambiguate them. These default to `_x` and `_y` but you can customize them:

```
left = pd.DataFrame({'k': ['K0', 'K1', 'K2'], 'v': [1, 2, 3]})
right = pd.DataFrame({'k': ['K0', 'K0', 'K3'], 'v': [4, 5, 6]})
pd.merge(left, right, on='k')
```

```
    k  v_x  v_y
0  K0    1    4
1  K0    1    5
```

```
pd.merge(left, right, on='k', suffixes=['_l', '_r'])
```

```
    k  v_l  v_r
0  K0    1    4
1  K0    1    5
```

Join has similar arguments `lsuffix` and `rsuffix`.

```
left = left.set_index('k')
right = right.set_index('k')
left.join(right, lsuffix='_l', rsuffix='_r')
```

```
    v_l  v_r
k
K0    1  4.0
K0    1  5.0
K1    2  NaN
K2    3  NaN
```

You can join a list or tuple of DataFrames on their indexes:

```
right2 = pd.DataFrame({'v': [7, 8, 9]}, index=['K1', 'K1', 'K2'])
left.join([right, right2])
```

```
    v_x  v_y    v
K0    1  4.0  NaN
K0    1  5.0  NaN
K1    2  NaN  7.0
K1    2  NaN  8.0
K2    3  NaN  9.0
```

If you have two frames with similar indices and want to fill in missing values in the left frame with values from the right frame, use the `combine_first()` method:

```
df1 = pd.DataFrame([[np.nan, 3., 5.],
                    [-4.6, np.nan, np.nan],
                    [np.nan, 7., np.nan]])
df2 = pd.DataFrame([[-42.6, np.nan, -8.2],
                    [-5., 1.6, 4]],
                   index=[1, 2])
df1.combine_first(df2)
```

```
     0    1    2
0  NaN  3.0  5.0
1 -4.6  NaN -8.2
2 -5.0  7.0  4.0
```

The method `update()` overwrites values in a frame with values from another frame:

```
df1.update(df2)
df1
```

```
      0    1    2
0   NaN  3.0  5.0
1 -42.6  NaN -8.2
2  -5.0  1.6  4.0
```

The pandas documentation on merging has more information, including examples of combining time series and other ordered data, with options to fill and interpolate missing data.

We thank the pandas documentation for many of these examples.

Filtering data

This example uses a vendors DataFrame similar to the one we used above:

```
import pandas as pd
import numpy as np
df = pd.DataFrame({'VendorNumber': [104, 205, 143, 166, 180],
               'VendorName': ['ACME Inc', 'Apogee LTD', 'Zenith Co', 'Hollerith␣
↪Propulsion', 'Airtek Industrial'],
               'Active': [True, True, True, True, False],
               'OpenOrders': [200, 150, 290, 180, 0],
               'Purchases2015': [45000.0, 29000.0, 18000.0, 48000.0, 23000.0],
               'Purchases2016': [54000.0, 30450.0, 23400.0, 48960.0, 17250.0],
               'PercentGrowth': [0.20, 0.05, 0.30, 0.02, -0.25],
               'FirstPurchaseDate': ['2014-02-15', '2015-08-12', '2014-04-05', '2015-09-
↪25', '2014-08-02']})
df['FirstPurchaseDate'] = df['FirstPurchaseDate'].astype('datetime64[ns]')
df
```

```
   VendorNumber            VendorName  Active  OpenOrders  Purchases2015  Purchases2016 ␣
↪PercentGrowth FirstPurchaseDate
0           104              ACME Inc    True         200        45000.0        54000.0 ␣
↪         0.20        2014-02-15
1           205            Apogee LTD    True         150        29000.0        30450.0 ␣
↪         0.05        2015-08-12
2           143             Zenith Co    True         290        18000.0        23400.0 ␣
↪         0.30        2014-04-05
3           166  Hollerith Propulsion    True         180        48000.0        48960.0 ␣
↪         0.02        2015-09-25
4           180     Airtek Industrial   False           0        23000.0        17250.0 ␣
↪        -0.25        2014-08-02
```

To filter only certain rows from a DataFrame, call the query method with a boolean expression based on the column names.

```
df.query('OpenOrders>160')
```

```
   VendorNumber            VendorName  Active  OpenOrders  Purchases2015  Purchases2016 ␣
↪PercentGrowth FirstPurchaseDate
```

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```
0           104              ACME Inc    True         200        45000.0        54000.0 ␣
↪          0.20        2014-02-15
2           143             Zenith Co    True         290        18000.0        23400.0 ␣
↪          0.30        2014-04-05
3           166  Hollerith Propulsion    True         180        48000.0        48960.0 ␣
↪          0.02        2015-09-25
```

Filtering can be done with indices instead of queries:

```
df[(df.OpenOrders < 190) & (df.Active == True)]
```

```
   VendorNumber            VendorName  Active  OpenOrders  Purchases2015  Purchases2016 ␣
↪PercentGrowth FirstPurchaseDate
1           205            Apogee LTD    True         150        29000.0        30450.0 ␣
↪          0.05        2015-08-12
3           166  Hollerith Propulsion    True         180        48000.0        48960.0 ␣
↪          0.02        2015-09-25
```

4.4.4 Using statistics

Data Science & AI Workbench supports statistical work using the R language and Python libraries such as NumPy, SciPy, Pandas, Statsmodels, and scikit-learn.

The following Jupyter notebook Python examples show how to use these libraries to calculate correlations, distributions, regressions, and principal component analysis.

These examples also include plots produced with the libraries seaborn and Matplotlib.

We thank these sites, from whom we have adapted some code:

- https://stackoverflow.com/questions/25571882/pandas-columns-correlation-with-statistical-significance/49040342
- https://joomik.github.io/Housing/

Start by importing necessary libraries and functions, including Pandas, SciPy, scikit-learn, Statsmodels, seaborn, and Matplotlib.

This code imports `load_boston` to provide the Boston housing dataset from the datasets included with scikit-learn.

```
import pandas as pd
import seaborn as sns
from scipy.stats import pearsonr
from sklearn.datasets import load_boston
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_squared_error
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.decomposition import PCA
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
import statsmodels.formula.api as sm

%matplotlib inline
```

Load the Boston housing data into a Pandas DataFrame:

```
#Load dataset and convert it to a Pandas dataframe
boston = load_boston()
df = pd.DataFrame(boston.data, columns=boston.feature_names)
df['target'] = boston.target
```

In the Boston housing dataset, the target variable is MEDV, the median home value.

Print the dataset description:

```
#Description of the dataset
print(boston.DESCR)
```

```
Boston House Prices dataset
===========================

Notes
------
Data Set Characteristics:

:Number of Instances: 506

:Number of Attributes: 13 numeric/categorical predictive

:Median Value (attribute 14) is usually the target

:Attribute Information (in order):
    - CRIM     per capita crime rate by town
    - ZN       proportion of residential land zoned for lots over 25,000 sq.ft.
    - INDUS    proportion of non-retail business acres per town
    - CHAS     Charles River dummy variable (= 1 if tract bounds river; 0 otherwise)
    - NOX      nitric oxides concentration (parts per 10 million)
    - RM       average number of rooms per dwelling
    - AGE      proportion of owner-occupied units built prior to 1940
    - DIS      weighted distances to five Boston employment centres
    - RAD      index of accessibility to radial highways
    - TAX      full-value property-tax rate per $10,000
    - PTRATIO  pupil-teacher ratio by town
    - B        1000(Bk - 0.63)^2 where Bk is the proportion of blacks by town
    - LSTAT    % lower status of the population
    - MEDV     Median value of owner-occupied homes in $1000's

:Missing Attribute Values: None

:Creator: Harrison, D. and Rubinfeld, D.L.

This is a copy of UCI ML housing dataset.
http://archive.ics.uci.edu/ml/datasets/Housing


This dataset was taken from the StatLib library which is maintained at Carnegie Mellon␣
↪University.

```

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```
The Boston house-price data of Harrison, D. and Rubinfeld, D.L. 'Hedonic
prices and the demand for clean air', J. Environ. Economics & Management,
vol.5, 81-102, 1978.   Used in Belsley, Kuh & Welsch, 'Regression diagnostics
...', Wiley, 1980.   N.B. Various transformations are used in the table on
pages 244-261 of the latter.

The Boston house-price data has been used in many machine learning papers that address␣
↪regression
problems.

**References**

- Belsley, Kuh & Welsch, 'Regression diagnostics: Identifying Influential Data and␣
↪Sources of Collinearity', Wiley, 1980. 244-261.
- Quinlan,R. (1993). Combining Instance-Based and Model-Based Learning. In Proceedings␣
↪on the Tenth International Conference of Machine Learning, 236-243, University of␣
↪Massachusetts, Amherst. Morgan Kaufmann.
- many more! (see http://archive.ics.uci.edu/ml/datasets/Housing)
```

Show the first five records of the dataset:

```
#Check the first five records
df.head()
```

```
row CRIM    ZN   INDUS CHAS NOX   RM    AGE  DIS    RAD TAX   PTRATIO B      LSTAT target
=== ======= ==== ===== ==== ===== ===== ==== ====== === ===== ======= ====== ===== ======
0   0.00632 18.0 2.31  0.0  0.538 6.575 65.2 4.0900 1.0 296.0 15.3    396.90 4.98  24.0
1   0.02731 0.0  7.07  0.0  0.469 6.421 78.9 4.9671 2.0 242.0 17.8    396.90 9.14  21.6
2   0.02729 0.0  7.07  0.0  0.469 7.185 61.1 4.9671 2.0 242.0 17.8    392.83 4.03  34.7
3   0.03237 0.0  2.18  0.0  0.458 6.998 45.8 6.0622 3.0 222.0 18.7    394.63 2.94  33.4
4   0.06905 0.0  2.18  0.0  0.458 7.147 54.2 6.0622 3.0 222.0 18.7    396.90 5.33  36.2
```

Show summary statistics for each variable: count, mean, standard deviation, minimum, 25th 50th and 75th percentiles, and maximum.

```
#Descriptions of each variable
df.describe()
```

```
stat  CRIM       ZN         INDUS      CHAS       NOX        RM         AGE        DIS   ␣
↪     RAD        TAX        PTRATIO    B          LSTAT      target
===== ========== ========== ========== ========== ========== ========== ==========␣
↪========== ========== ========== ========== ========== ========== ==========
count 506.000000 506.000000 506.000000 506.000000 506.000000 506.000000 506.000000 506.
↪000000 506.000000 506.000000 506.000000 506.000000 506.000000 506.000000
mean  3.593761   11.363636  11.136779  0.069170   0.554695   6.284634   68.574901  3.
↪795043  9.549407   408.237154 18.455534  356.674032 12.653063  22.532806
std   8.596783   23.322453  6.860353   0.253994   0.115878   0.702617   28.148861  2.
↪105710  8.707259   168.537116 2.164946   91.294864  7.141062   9.197104
min   0.006320   0.000000   0.460000   0.000000   0.385000   3.561000   2.900000   1.
↪129600  1.000000   187.000000 12.600000  0.320000   1.730000   5.000000
25%   0.082045   0.000000   5.190000   0.000000   0.449000   5.885500   45.025000  2.
↪100175  4.000000   279.000000 17.400000  375.377500 6.950000   17.025000
```

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```
50%   0.256510   0.000000   9.690000   0.000000   0.538000   6.208500   77.500000  3.
↪207450   5.000000   330.000000 19.050000  391.440000 11.360000  21.200000
75%   3.647423   12.500000  18.100000  0.000000   0.624000   6.623500   94.075000  5.
↪188425   24.000000  666.000000 20.200000  396.225000 16.955000  25.000000
max   88.976200  100.000000 27.740000  1.000000   0.871000   8.780000   100.000000 12.
↪126500  24.000000  711.000000 22.000000  396.900000 37.970000  50.000000
```

Correlation matrix

The correlation matrix lists the correlation of each variable with each other variable.

Positive correlations mean one variable tends to be high when the other is high, and negative correlations mean one variable tends to be high when the other is low.

Correlations close to zero are weak and cause a variable to have less influence in the model, and correlations close to one or negative one are strong and cause a variable to have more influence in the model.

```
#Here shows the basic correlation matrix
corr = df.corr()
corr
```

```
variable CRIM      ZN        INDUS     CHAS      NOX       RM        AGE       DIS       ␣
↪RAD       TAX       PTRATIO   B         LSTAT     target
======== ========= ========= ========= ========= ========= ========= ========= =========␣
↪========= ========= ========= ========= ========= =========
CRIM     1.000000  -0.199458 0.404471  -0.055295 0.417521  -0.219940 0.350784  -0.377904␣
↪0.622029  0.579564  0.288250  -0.377365 0.452220  -0.385832
ZN       -0.199458 1.000000  -0.533828 -0.042697 -0.516604 0.311991  -0.569537 0.664408 ␣
↪-0.311948 -0.314563 -0.391679 0.175520  -0.412995 0.360445
INDUS    0.404471  -0.533828 1.000000  0.062938  0.763651  -0.391676 0.644779  -0.708027␣
↪0.595129  0.720760  0.383248  -0.356977 0.603800  -0.483725
CHAS     -0.055295 -0.042697 0.062938  1.000000  0.091203  0.091251  0.086518  -0.099176␣
↪-0.007368 -0.035587 -0.121515 0.048788  -0.053929 0.175260
NOX      0.417521  -0.516604 0.763651  0.091203  1.000000  -0.302188 0.731470  -0.769230␣
↪0.611441  0.668023  0.188933  -0.380051 0.590879  -0.427321
RM       -0.219940 0.311991  -0.391676 0.091251  -0.302188 1.000000  -0.240265 0.205246 ␣
↪-0.209847 -0.292048 -0.355501 0.128069  -0.613808 0.695360
AGE      0.350784  -0.569537 0.644779  0.086518  0.731470  -0.240265 1.000000  -0.747881␣
↪0.456022  0.506456  0.261515  -0.273534 0.602339  -0.376955
DIS      -0.377904 0.664408  -0.708027 -0.099176 -0.769230 0.205246  -0.747881 1.000000 ␣
↪-0.494588 -0.534432 -0.232471 0.291512  -0.496996 0.249929
RAD      0.622029  -0.311948 0.595129  -0.007368 0.611441  -0.209847 0.456022  -0.494588␣
↪1.000000  0.910228  0.464741  -0.444413 0.488676  -0.381626
TAX      0.579564  -0.314563 0.720760  -0.035587 0.668023  -0.292048 0.506456  -0.534432␣
↪0.910228  1.000000  0.460853  -0.441808 0.543993  -0.468536
PTRATIO  0.288250  -0.391679 0.383248  -0.121515 0.188933  -0.355501 0.261515  -0.232471␣
↪0.464741  0.460853  1.000000  -0.177383 0.374044  -0.507787
B        -0.377365 0.175520  -0.356977 0.048788  -0.380051 0.128069  -0.273534 0.291512 ␣
↪-0.444413 -0.441808 -0.177383 1.000000  -0.366087 0.333461
LSTAT    0.452220  -0.412995 0.603800  -0.053929 0.590879  -0.613808 0.602339  -0.496996␣
↪0.488676  0.543993  0.374044  -0.366087 1.000000  -0.737663
```

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```
target   -0.385832 0.360445  -0.483725 0.175260  -0.427321 0.695360  -0.376955 0.249929 ␣
↪-0.381626 -0.468536 -0.507787 0.333461  -0.737663 1.000000
```

Format with asterisks

Format the correlation matrix by rounding the numbers to two decimal places and adding asterisks to denote statistical significance:

```
def calculate_pvalues(df):
    df = df.select_dtypes(include=['number'])
    pairs = pd.MultiIndex.from_product([df.columns, df.columns])
    pvalues = [pearsonr(df[a], df[b])[1] for a, b in pairs]
    pvalues = pd.Series(pvalues, index=pairs).unstack().round(4)
    return pvalues

# code adapted from https://stackoverflow.com/questions/25571882/pandas-columns-
↪correlation-with-statistical-significance/49040342
def correlation_matrix(df,columns):
    rho = df[columns].corr()
    pval = calculate_pvalues(df[columns])
    # create three masks
    r0 = rho.applymap(lambda x: '{:.2f}'.format(x))
    r1 = rho.applymap(lambda x: '{:.2f}*'.format(x))
    r2 = rho.applymap(lambda x: '{:.2f}**'.format(x))
    r3 = rho.applymap(lambda x: '{:.2f}***'.format(x))
    # apply marks
    rho = rho.mask(pval>0.01,r0)
    rho = rho.mask(pval<=0.1,r1)
    rho = rho.mask(pval<=0.05,r2)
    rho = rho.mask(pval<=0.01,r3)
    return rho

columns = df.columns
correlation_matrix(df,columns)
```

```
variable CRIM     ZN       INDUS    CHAS     NOX      RM       AGE      DIS      RAD      ␣
↪ TAX      PTRATIO  B        LSTAT    target
======== ======== ======== ======== ======== ======== ======== ======== ========␣
↪======== ======== ======== ======== ======== ========
CRIM     1.00***  -0.20*** 0.40***  -0.06    0.42***  -0.22*** 0.35***  -0.38*** 0.62***␣
↪ 0.58***  0.29***  -0.38*** 0.45***  -0.39***
ZN       -0.20*** 1.00***  -0.53*** -0.04    -0.52*** 0.31***  -0.57*** 0.66***  -0.
↪31*** -0.31*** -0.39*** 0.18***  -0.41*** 0.36***
INDUS    0.40***  -0.53*** 1.00***  0.06     0.76***  -0.39*** 0.64***  -0.71*** 0.60***␣
↪ 0.72***  0.38***  -0.36*** 0.60***  -0.48***
CHAS     -0.06    -0.04    0.06     1.00***  0.09**   0.09**   0.09*    -0.10**  -0.01   ␣
↪ -0.04    -0.12*** 0.05     -0.05    0.18***
NOX      0.42***  -0.52*** 0.76***  0.09**   1.00***  -0.30*** 0.73***  -0.77*** 0.61***␣
↪ 0.67***  0.19***  -0.38*** 0.59***  -0.43***
RM       -0.22*** 0.31***  -0.39*** 0.09**   -0.30*** 1.00***  -0.24*** 0.21***  -0.
```

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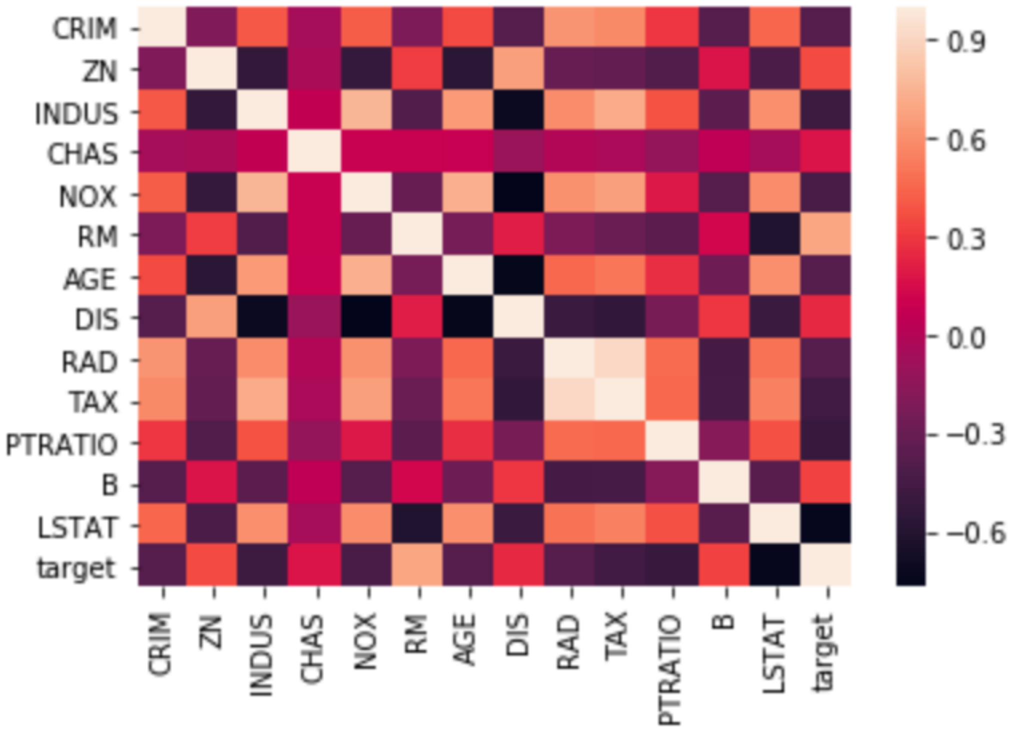
```
↪21*** -0.29*** -0.36*** 0.13***  -0.61*** 0.70***
AGE      0.35***  -0.57*** 0.64***  0.09*    0.73***  -0.24*** 1.00***  -0.75*** 0.46***␣
↪ 0.51***  0.26***  -0.27*** 0.60***  -0.38***
DIS      -0.38*** 0.66***  -0.71*** -0.10**  -0.77*** 0.21***  -0.75*** 1.00***  -0.
↪49*** -0.53*** -0.23*** 0.29***  -0.50*** 0.25***
RAD      0.62***  -0.31*** 0.60***  -0.01    0.61***  -0.21*** 0.46***  -0.49*** 1.00***␣
↪ 0.91***  0.46***  -0.44*** 0.49***  -0.38***
TAX      0.58***  -0.31*** 0.72***  -0.04    0.67***  -0.29*** 0.51***  -0.53*** 0.91***␣
↪ 1.00***  0.46***  -0.44*** 0.54***  -0.47***
PTRATIO  0.29***  -0.39*** 0.38***  -0.12*** 0.19***  -0.36*** 0.26***  -0.23*** 0.46***␣
↪ 0.46***  1.00***  -0.18*** 0.37***  -0.51***
B        -0.38*** 0.18***  -0.36*** 0.05     -0.38*** 0.13***  -0.27*** 0.29***  -0.
↪44*** -0.44*** -0.18*** 1.00***  -0.37*** 0.33***
LSTAT    0.45***  -0.41*** 0.60***  -0.05    0.59***  -0.61*** 0.60***  -0.50*** 0.49***␣
↪ 0.54***  0.37***  -0.37*** 1.00***  -0.74***
target   -0.39*** 0.36***  -0.48*** 0.18***  -0.43*** 0.70***  -0.38*** 0.25***  -0.
↪38*** -0.47*** -0.51*** 0.33***  -0.74*** 1.00***
```

Heatmap

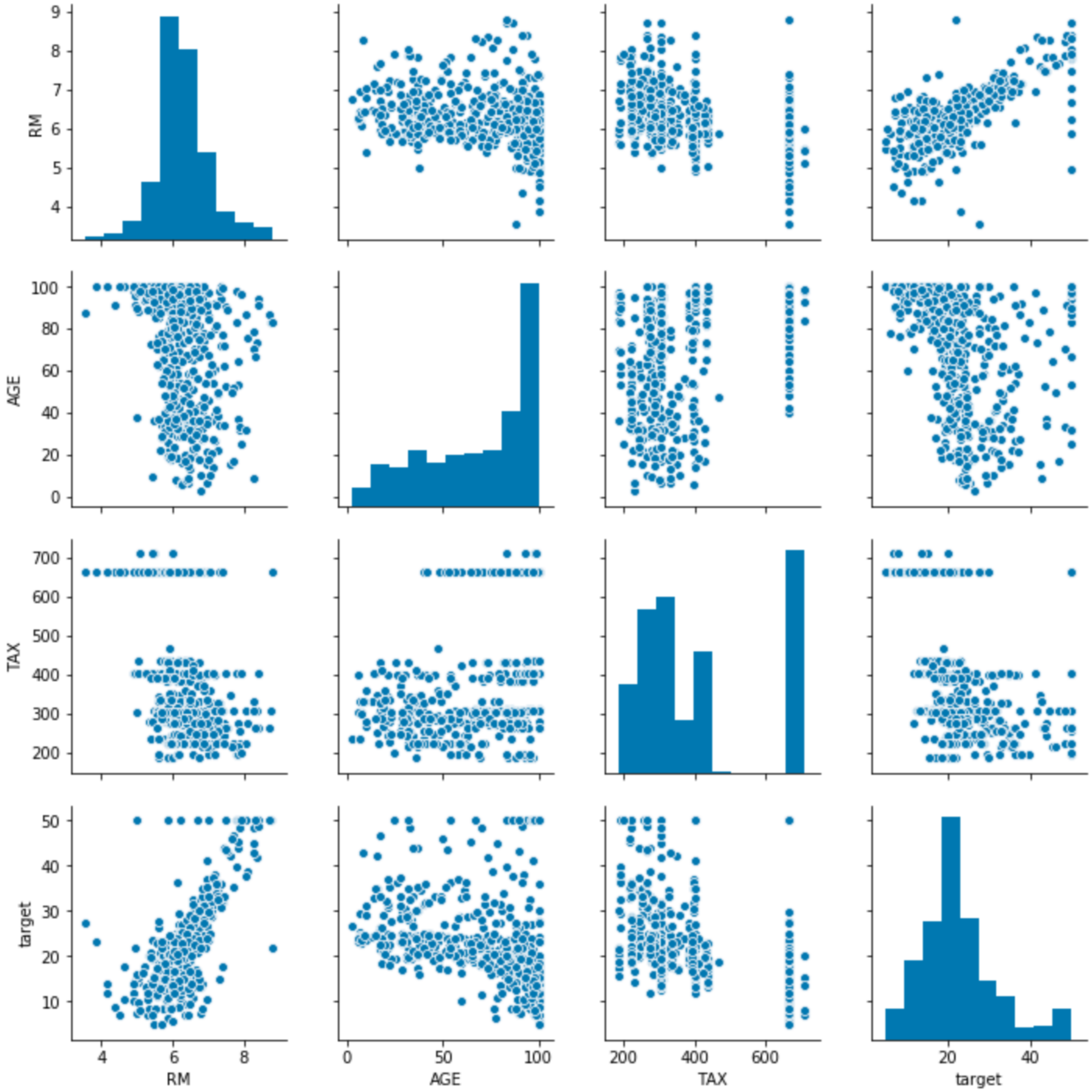
Heatmap of the correlation matrix:

```
sns.heatmap(corr,
        xticklabels=corr.columns,
        yticklabels=corr.columns)
```



Pairwise distributions with seaborn

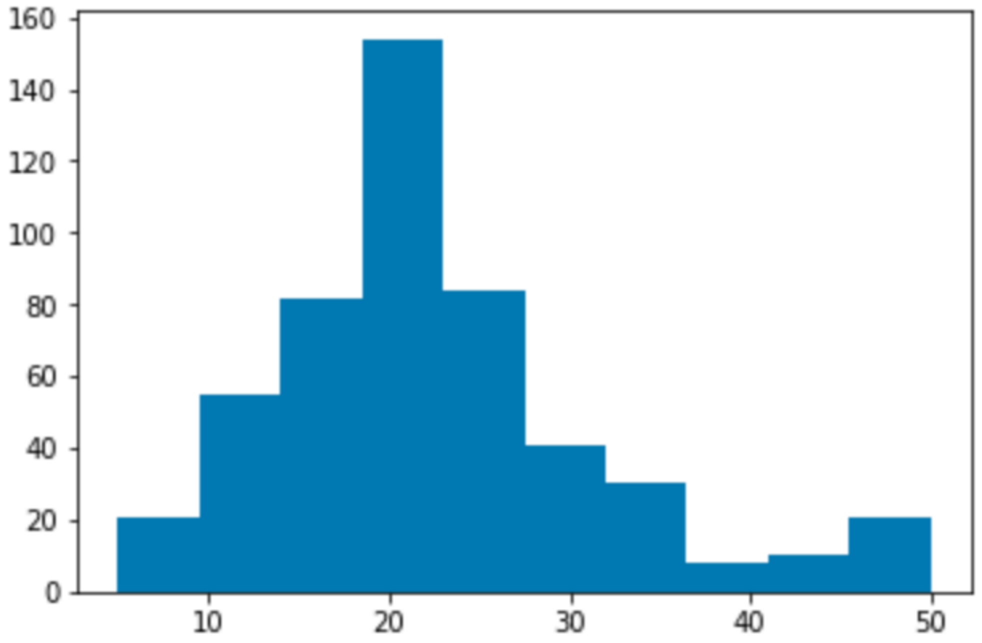
```
sns.pairplot(df[['RM', 'AGE', 'TAX', 'target']])
```



Target variable distribution

Histogram showing the distribution of the target variable. In this dataset this is “Median value of owner-occupied homes in $1000’s”, abbreviated MEDV.

```
plt.hist(df['target'])
plt.show()
```



Simple linear regression

The variable MEDV is the target that the model predicts. All other variables are used as predictors, also called features.

The target variable is continuous, so use a linear regression instead of a logistic regression.

```
# Define features as X, target as y.
X = df.drop('target', axis='columns')
y = df['target']
```

Split the dataset into a training set and a test set:

```
# Splitting the dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.25, random_state␣
↪= 0)
```

A linear regression consists of a coefficient for each feature and one intercept.

To make a prediction, each feature is multiplied by its coefficient. The intercept and all of these products are added together. This sum is the predicted value of the target variable.

The residual sum of squares (RSS) is calculated to measure the difference between the prediction and the actual value of the target variable.

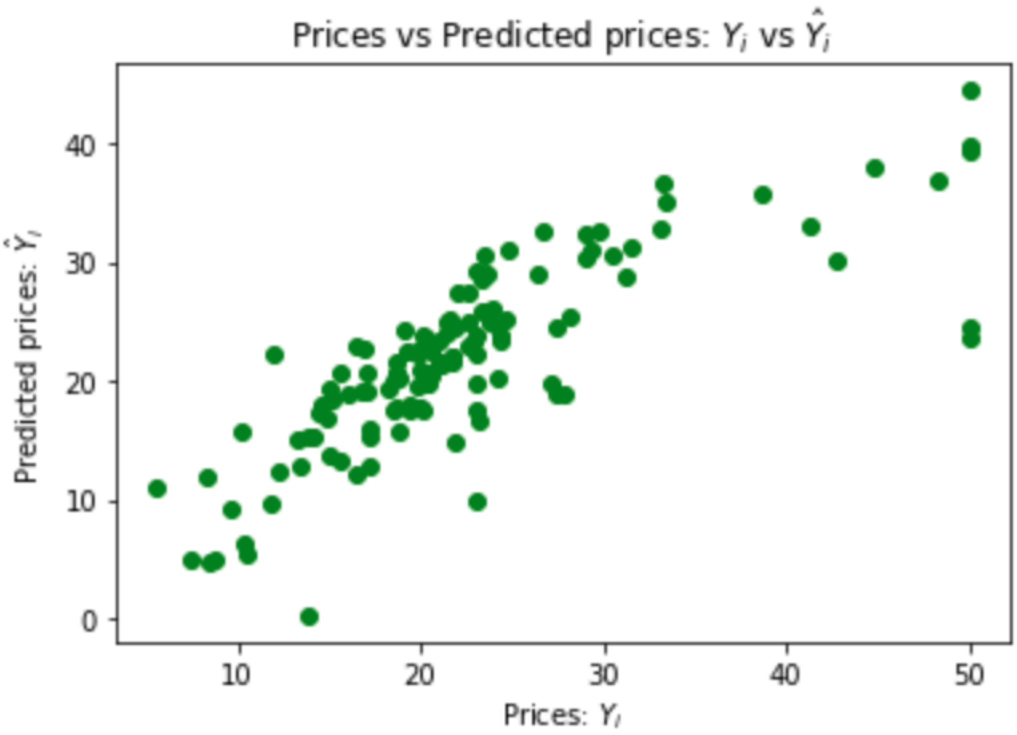
The function `fit` calculates the coefficients and intercept that minimize the RSS when the regression is used on each record in the training set.

```
# Fitting Simple Linear Regression to the Training set
from sklearn.linear_model import LinearRegression
regressor = LinearRegression()
regressor.fit(X_train, y_train)

# The intercept
print('Intercept: \n', regressor.intercept_)

# The coefficients
print('Coefficients: \n', pd.Series(regressor.coef_, index=X.columns, name='coefficients
↪'))
```

```
Intercept:
 36.98045533762056
Coefficients:
 CRIM       -0.116870
ZN          0.043994
INDUS      -0.005348
CHAS        2.394554
NOX       -15.629837
RM          3.761455
AGE        -0.006950
DIS        -1.435205
RAD         0.239756
TAX        -0.011294
PTRATIO    -0.986626
B           0.008557
LSTAT      -0.500029
Name: coefficients, dtype: float64
```

Now check the accuracy when this linear regression is used on new data that it was not trained on. That new data is the test set.

```
# Predicting the Test set results
y_pred = regressor.predict(X_test)

# Visualising the Test set results
# code adapted from https://joomik.github.io/Housing/
fig, ax = plt.subplots()
ax.scatter(y_test, y_pred, color='green')
ax.set(
    xlabel="Prices: $Y_i$",
    ylabel="Predicted prices: $\hat{Y}_i$",
    title="Prices vs Predicted prices: $Y_i$ vs $\hat{Y}_i$",
)
plt.show()
```



This scatter plot shows that the regression is a good predictor of the data in the test set.

The mean squared error quantifies this performance:

```
# The mean squared error as a way to measure model performance.
print("Mean squared error: %.2f" % mean_squared_error(y_test, y_pred))
```

```
Mean squared error: 29.79
```

Ordinary least squares (OLS) regression with Statsmodels

```
model = sm.ols('target ~ AGE + B + CHAS + CRIM + DIS + INDUS + LSTAT + NOX + PTRATIO +␣
↪RAD + RM + TAX + ZN', df)
result = model.fit()
result.summary()
```

```
OLS Regression Results
==============================================================================
Dep. Variable:                 target   R-squared:                       0.741
Model:                            OLS   Adj. R-squared:                  0.734
Method:                 Least Squares   F-statistic:                     108.1
Date:                Thu, 23 Aug 2018   Prob (F-statistic):          6.95e-135
Time:                        07:29:16   Log-Likelihood:                -1498.8
No. Observations:                 506   AIC:                             3026.
Df Residuals:                     492   BIC:                             3085.
Df Model:                          13
Covariance Type:            nonrobust
```

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```
==============================================================================
coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
Intercept     36.4911      5.104      7.149      0.000      26.462      46.520
AGE            0.0008      0.013      0.057      0.955      -0.025       0.027
B              0.0094      0.003      3.500      0.001       0.004       0.015
CHAS           2.6886      0.862      3.120      0.002       0.996       4.381
CRIM          -0.1072      0.033     -3.276      0.001      -0.171      -0.043
DIS           -1.4758      0.199     -7.398      0.000      -1.868      -1.084
INDUS          0.0209      0.061      0.339      0.735      -0.100       0.142
LSTAT         -0.5255      0.051    -10.366      0.000      -0.625      -0.426
NOX          -17.7958      3.821     -4.658      0.000     -25.302     -10.289
PTRATIO       -0.9535      0.131     -7.287      0.000      -1.211      -0.696
RAD            0.3057      0.066      4.608      0.000       0.175       0.436
RM             3.8048      0.418      9.102      0.000       2.983       4.626
TAX           -0.0123      0.004     -3.278      0.001      -0.020      -0.005
ZN             0.0464      0.014      3.380      0.001       0.019       0.073
==============================================================================
Omnibus:                      178.029   Durbin-Watson:                   1.078
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              782.015
Skew:                           1.521   Prob(JB):                    1.54e-170
Kurtosis:                       8.276   Cond. No.                     1.51e+04
==============================================================================

Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly␣
↪specified.
[2] The condition number is large, 1.51e+04. This might indicate that there are
strong multicollinearity or other numerical problems.
```

Principal component analysis

The initial dataset has a number of feature or predictor variables and one target variable to predict.

Principal component analysis (PCA) converts these features into a set of principal components, which are linearly uncorrelated variables.

The first principal component has the largest possible variance and therefore accounts for as much of the variability in the data as possible.

Each of the other principal components is orthogonal to all of its preceding components, but has the largest possible variance within that constraint.

Graphing a dataset by showing only the first two or three of the principal components effectively projects a complex dataset with high dimensionality into a simpler image that shows as much of the variance in the data as possible.

PCA is sensitive to the relative scaling of the original variables, so begin by scaling them:

```
# Feature Scaling
x = StandardScaler().fit_transform(X)
```

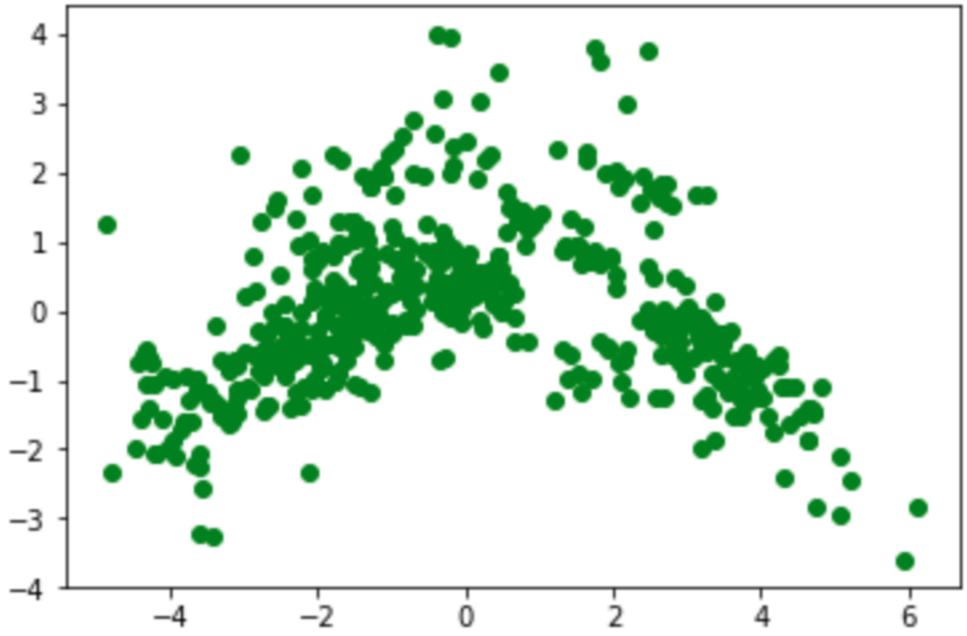
Calculate the first three principal components and show them for the first five rows of the housing dataset:

```
# Project data to 3 dimensions
pca = PCA(n_components=3)
principalComponents = pca.fit_transform(x)
principalDf = pd.DataFrame(
    data = principalComponents,
    columns = ['principal component 1', 'principal component 2', 'principal component 3
↪'])
principalDf.head()
```

row	principal component 1	principal component 2	principal component 3
0	-2.097842	0.777102	0.335076
1	-1.456412	0.588088	-0.701340
2	-2.074152	0.602185	0.161234
3	-2.611332	-0.005981	-0.101940
4	-2.457972	0.098860	-0.077893

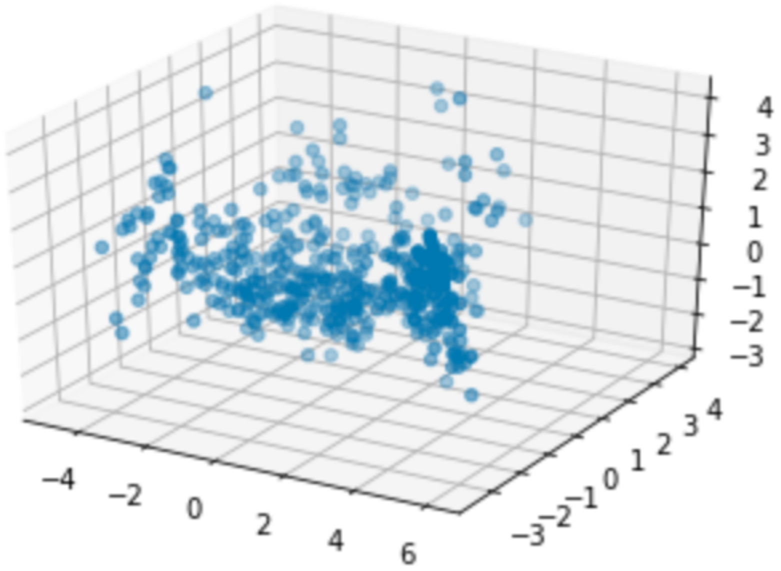
Show a 2D graph of this data:

```
plt.scatter(principalDf['principal component 1'], principalDf['principal component 2'],␣
↪color ='green')
plt.show()
```



Show a 3D graph of this data:

```
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.scatter(principalDf['principal component 1'], principalDf['principal component 2'],␣
↪principalDf['principal component 3'])
plt.show()
```



Measure how much of the variance is explained by each of the three components:

```
# Variance explained by each component
explained_variance = pca.explained_variance_ratio_
explained_variance
```

```
array([0.47097344, 0.11015872, 0.09547408])
```

Each value will be less than or equal to the previous value, and each value will be in the range from 0 through 1.

The sum of these three values shows the fraction of the total variance explained by the three principal components, in the range from 0 (none) through 1 (all):

```
sum(explained_variance)
```

```
0.6766062376563704
```

Predict the target variable using only the three principal components:

```
y_test_linear = y_test
y_pred_linear = y_pred
X = principalDf
y = df['target']
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.25, random_state␣
↪= 0)
regressor = LinearRegression()
regressor.fit(X_train, y_train)
y_pred = regressor.predict(X_test)
```

Plot the predictions from the linear regression in green again, and the new predictions in blue:

```
fig, ax = plt.subplots()
ax.scatter(y_test, y_pred, color='skyblue')
ax.scatter(y_test_linear, y_pred_linear, color = 'green')
```

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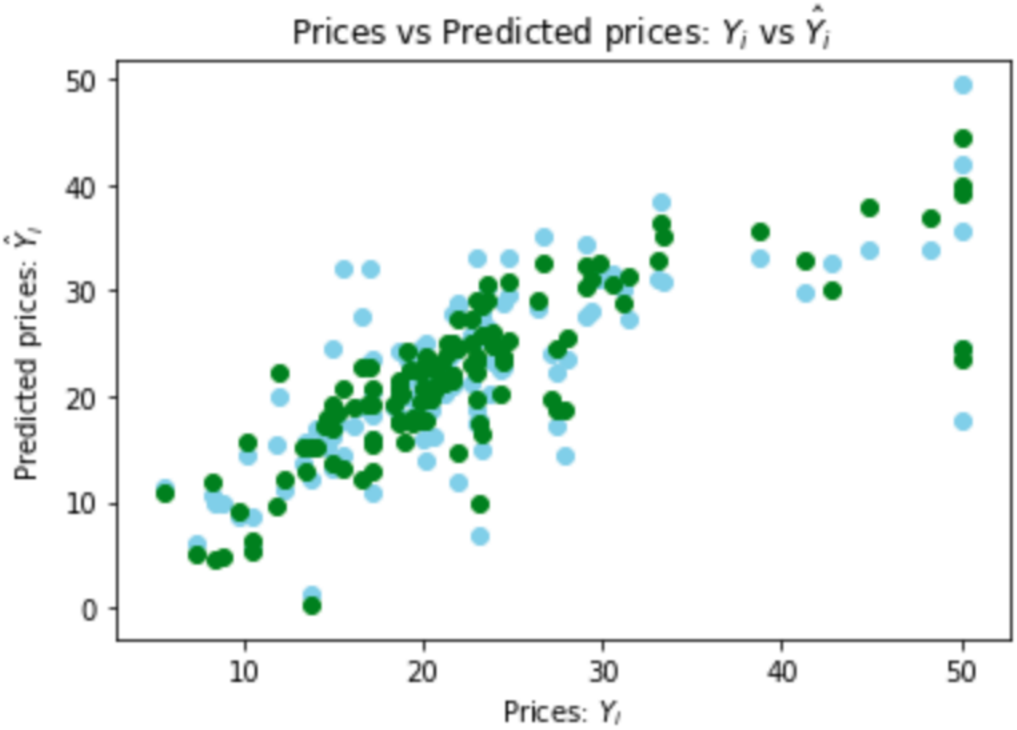
```
ax.set(
    xlabel="Prices: $Y_i$",
    ylabel="Predicted prices: $\hat{Y}_i$",
    title="Prices vs Predicted prices: $Y_i$ vs $\hat{Y}_i$",
)
plt.show()
```



The blue points are somewhat more widely scattered, but similar.

Calculate the mean squared error:

```
print("Linear regression mean squared error: %.2f" % mean_squared_error(y_test_linear, y_
↪pred_linear))
print("PCA mean squared error: %.2f" % mean_squared_error(y_test, y_pred))
```

```
Linear regression mean squared error: 29.79
PCA mean squared error: 43.49
```

4.5 Deployments

Deployments are methods for sharing parts of your data science projects and machine learning models with other users. You can create deployments for microservices such as interactive dashboard visualizations, web applications, REST APIs, or Jupyter Notebooks.

When you deploy a project, Data Science & AI Workbench finds and builds all of the software dependencies (the packages and libraries the project needs to operate properly) and encapsulates them into a self-contained artifact.

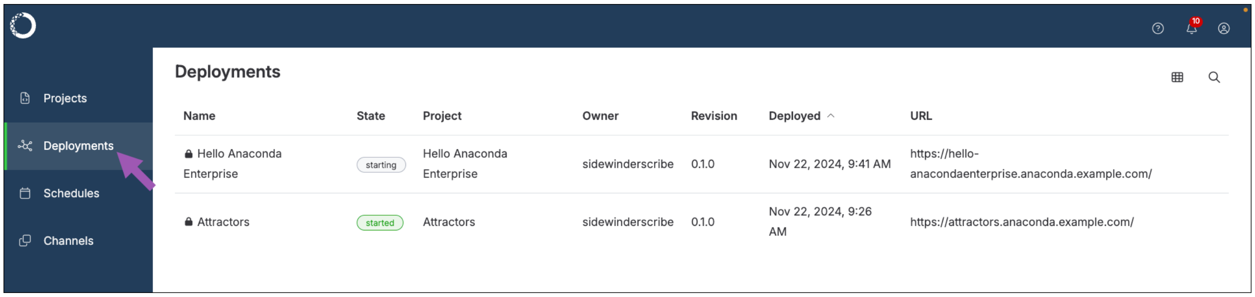
You can create multiple deployments from a single project. Each deployment can be a different version and can be *shared with others*.

4.5.1 Deployment commands

Deployments are defined as commands in your `anaconda-project.yml` file. Each project in Workbench can define any number of deployable commands. See *Adding deployment commands to a project* for more information.

4.5.2 Viewing all deployments

Select **Deployments** from the left-hand navigation to view a list of deployments across all projects you own or that have been shared with you.



Deployments

Name	State	Project	Owner	Revision	Deployed	URL
Hello Anaconda Enterprise	starting	Hello Anaconda Enterprise	sidewinderscribe	0.1.0	Nov 22, 2024, 9:41 AM	https://hello-anacondaenterprise.anaconda.example.com/
Attractors	started	Attractors	sidewinderscribe	0.1.0	Nov 22, 2024, 9:26 AM	https://attractors.anaconda.example.com/

4.5.3 Viewing a project's deployments

To view the deployments specific to a project:

1. From the **Projects** page select your project.
2. Select **Deployments** from the left-hand navigation.

4.5.4 Deploying a project

Deployments are run independently of development sessions for projects, and can be deployed to different hardware resource profiles.

1. From the **Projects** page, select the project you want to deploy.
2. Select **Deployments** from the left-hand menu.
3. Click **Deploy**.
4. Enter a name for your deployment.

5. Select a resource profile to run your deployment.

   Note: The configurations present in this dropdown are controlled by your Administrator. Check with them if you are unsure which profile to choose.

6. Select the project version associated with the deployment command you are running.
7. Select a deployment command.

   Caution: If there is no deployment command listed, you cannot deploy your project.

8. Set the URL for your deployment.

   Note: This is the URL you'll use to access your deployment from a web browser, and therefore *it must be unique*. Toggle **Static URL** `OFF` if you want Workbench to automatically generate a URL for your deployment.

9. Share your deployment with any other users or groups.
10. Set your deployment to private or public access:

    Private access
    Restricts access to authenticated platform users only. Private deployments display a lock icon to indicate their secure status.

    Public access
    Opens access to non-authenticated users.

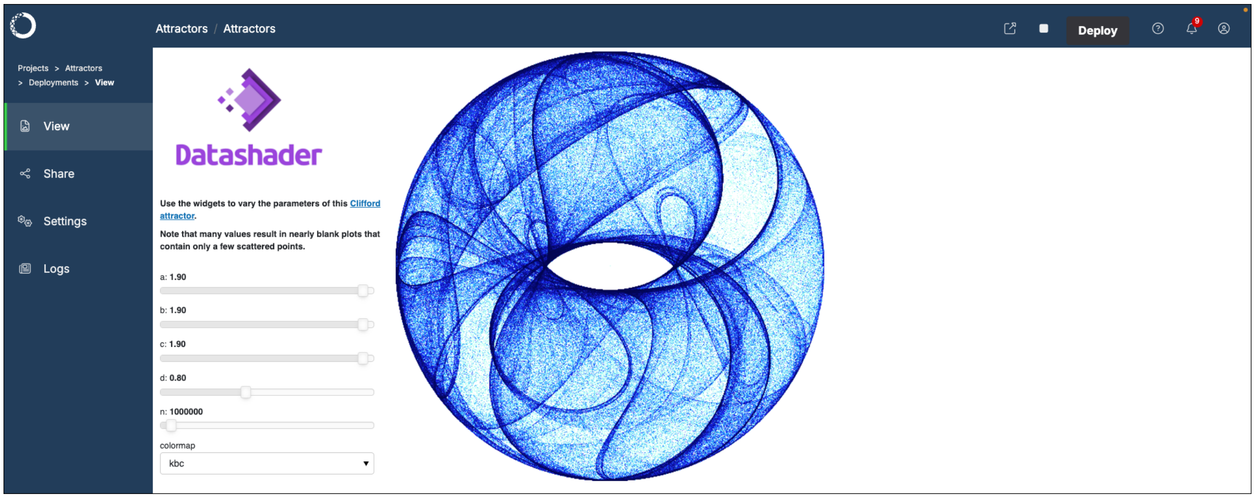
11. Click **Deploy**.

    Note: It can take several minutes to obtain and build all the dependencies for the project deployment.

You can also schedule a project to be deployed on a regular basis or at a specific time. For more information, see *Schedules*.

4.5.5 Interacting with deployments

To interact with your deployment, select it from the list of project deployments, or navigate to its URL in a web browser.



Use the widgets to vary the parameters of this Clifford attractor.

Note that many values result in nearly blank plots that contain only a few scattered points.

a: 1.90

b: 1.90

c: 1.90

d: 0.80

n: 1000000

colormap

kbc ▾

4.5.6 Terminating a deployment

Deployments that are no longer needed should be terminated to remove them from the server and free up cluster resources. Terminating a deployment does not affect the project that was used to create the deployment.

Caution: Terminating a deployment makes it unavailable to *any users you shared it with*.

To terminate a deployment:

1. From the **Projects** page, select **Deployments** from the left-hand navigation.
2. Select the deployment you want to terminate.
3. Click **Stop deployment** at the top of the page.
4. Click **Terminate** to confirm that you want to terminate the deployment.

Note: You can also terminate a deployment from its **Settings** page.

Deploying a REST API

Data Science & AI Workbench enables you to deploy your machine learning or predictive models as a REST API endpoint. You can then share your deployment with colleagues and have them query your model as you continue to update, improve, and redeploy as needed.

There are many tools available in the open-source market for building REST APIs within the Python and R ecosystems. This topic explains how to generate a REST API endpoint from a python function you've created within a Jupyter Notebook.

Note: REST API endpoints deployed using Workbench are secure and only accessible to users that you've shared the deployment with or users that have generated a token that can be used to query the REST API endpoint outside of

Workbench.

Install Tranquilizer

Open a session and run the following command to install Tranquilizer:

```
anaconda-project add-packages tranquilizer nbconvert
```

There are three essential skills you must understand in order to use Tranquilizer effectively:

- **Functions** - Defined sections of code that perform specific tasks.
- **Type Hints** - A method to statically indicate the type of a value within your Python code.
- **Docstrings** - Comments in the code that document what a given function does.

Note: Tranquilizer reads the function's docstring to automatically generate Swagger documentation for the REST API.

Decorate your function

Decorated functions are identified by the Tranquilizer server. These functions are executed when HTTP requests are made to the server.

Here is an example of a temperature conversion function with the tranquilizer decoration:

```
from tranquilizer import tranquilize

@tranquilize(method='get')
def to_celsius(fahrenheit: float):
    '''Convert degrees Fahrenheit to degrees Celsius

    :param fahrenheit: Degrees fahrenheit'''

    return (fahrenheit - 32) * 5/9
```

Note: When the Tranquilizer server starts, the entire Jupyter Notebook is executed. Consider carefully how you arrange operations that are heavy on CPU or memory usage, like reading data or loading models. Computations for reusable objects should be performed only once, rather than every time the function is called.

Add the command

With tranquilizer downloaded and your function decorated, you must now prepare the deployment command. Open your `anaconda-project.yml` file and add the following code:

```
commands:
   celsius_api:
      unix: tranquilizer converter.ipynb --name "Temperature Conversion"
      supports_http_options: True
```

Caution: Make sure your notebook file name is spelled correctly! If it is not, your commands will not work.

Alternatively, you can run the following command in the terminal to add the command to the anaconda-project.yml file:

```
anaconda-project add-command --type unix --supports-http-options celsius_api
↪"tranquilizer converter.ipynb --name 'Temperature Conversion'"
```

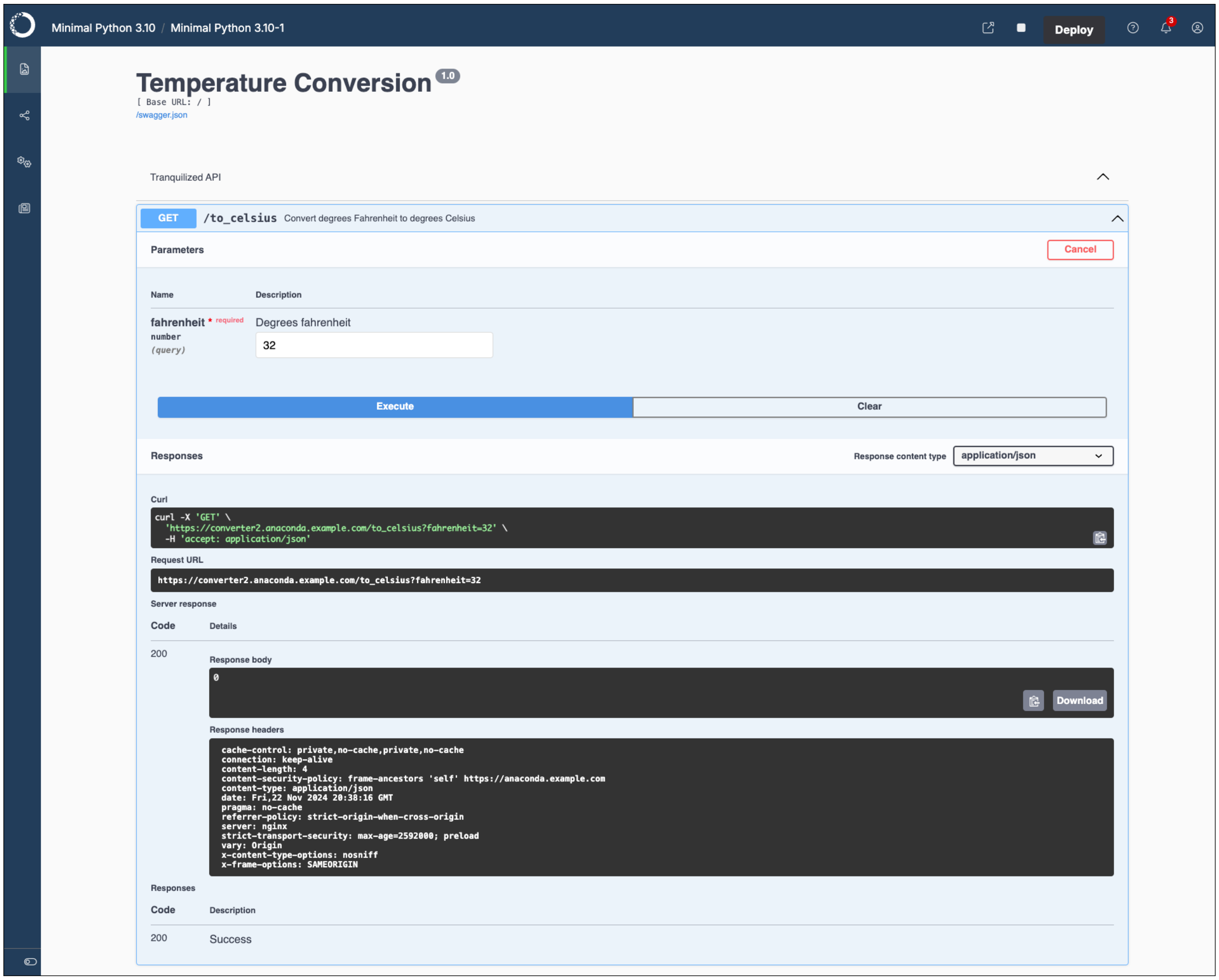
Commit and deploy

1. *Commit all changes to your project*.
2. *Deploy your project*.

   Note: Choose a unique URL for your deployment.

Verify deployment

Once the deployment has started, go to the deployment's **View** page and use swagger to verify that the API performs the correct function.



Temperature Conversion 1.0

[Base URL: /]
/swagger.json

Tranquilized API

GET /to_celsius Convert degrees Fahrenheit to degrees Celsius

Parameters

Name	Description
fahrenheit * required number (query)	Degrees fahrenheit 32

Responses

Response content type: application/json

Curl

```
curl -X 'GET' \
  'https://converter2.anaconda.example.com/to_celsius?fahrenheit=32' \
  -H 'accept: application/json'
```

Request URL

```
https://converter2.anaconda.example.com/to_celsius?fahrenheit=32
```

Server response

Code	Details
200	Response body

```
0
```

Response headers

```
cache-control: private,no-cache,private,no-cache
connection: keep-alive
content-length: 4
content-security-policy: frame-ancestors 'self' https://anaconda.example.com
content-type: application/json
date: Fri,22 Nov 2024 20:38:16 GMT
pragma: no-cache
referrer-policy: strict-origin-when-cross-origin
server: nginx
strict-transport-security: max-age=2592000; preload
vary: Origin
x-content-type-options: nosniff
x-frame-options: SAMEORIGIN
```

Responses

Code	Description
200	Success

Deploy a REST API with R

You can use the R Plumber package to build and deploy a REST API in R.

Run the following command to install `R Plumber`:

```
anaconda-project add-packages -c r r-plumber
```

The API is defined in a file called `api.R`

```
library(plumber)

#* @apiTitle Temperature Converter

#* Convert degrees Fahrenheit to Celsius
#* @param fahrenheit:numeric Degrees Fahrenheit
#* @get /to_celsius
function(fahrenheit) {
  (as.numeric(fahrenheit) - 32) * 5/9
}
```

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```
#* Redirect to Swagger documentation
#* @get /
function(res) {
   res$body <- "<html><meta http-equiv='refresh' content=\"0; URL='/__swagger__/'\" /></
↪html>"
   res
}
```

To separate your code into `api.r` and `run.R` scripts, add your command specification in the `anaconda-project.yml` file:

```
commands:
  api:
    unix: Rscript run.R
```

Then format your `run.R` script as follows:

```
plumber::plumb("api.R")$run(port = 8086, host = '0.0.0.0', swagger = TRUE)
```

Alternatively, you can place the contents of the the `run.R` script directly in the `anaconda-project.yml` file:

```
commands:
    api:
      unix: R -e 'plumber::plumb("api.R")$run(port = 8086, host = "0.0.0.0", swagger =␣
↪TRUE)'
```

Deploying a Flask application

The process of deploying a Flask application (website and REST APIs) on Data Science & AI Workbench involves the following:

1. Configuring Flask to *run behind a proxy*
2. Enabling Anaconda Project *HTTP command-line arguments*
3. Running Flask *on the deployed host and port*

Here is a small Flask application that includes the call to `.run()`. The file is saved to `server.py`.

This Flask application was written using Blueprints, which is useful for separating components when working with a large Flask application.

Here, the nested block in `if __name__ == '__main__'` could be in a separate file from the `'hello'` Blueprint.

```
from flask import Flask, Blueprint

hello = Blueprint('hello', __name__)

@hello.route('/')
def hello_world():
    return 'Hello, World!'

if __name__ == '__main__':
    app = Flask(__name__)
    app.register_blueprint(hello, url_prefix='/')
```

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```
    app.run()
```

Running behind an HTTPS proxy

Workbench maintains all HTTPS connections into and out of the server and deployed instances. When writing a Flask app, you only need to inform it that will be accessed from behind the proxy provided by Workbench.

The simplest way to do this is with the `ProxyFix` function from `werkzeug`. More information about proxies is provided here.

```
from flask import Flask, Blueprint
from werkzeug.contrib.fixers import ProxyFix

hello = Blueprint('hello', __name__)

@hello.route('/')
def hello_world():
    return 'Hello, World!'

if __name__ == '__main__':
    app = Flask(__name__)
    app.register_blueprint(hello, url_prefix='/')

    app.wsgi_app = ProxyFix(app.wsgi_app)
    app.run()
```

Enabling command-line arguments

In your `anaconda-project.yml` file, you define a deployable command as follows:

```
commands:
  default:
    unix: python ${PROJECT_DIR}/server.py
    supports_http_options: true
```

The flag `supports_http_options` means that `server.py` is expected to act on the following command line arguments defined in the Anaconda Project Reference.

This is easily accomplished by adding the following `argparse` code before calling `app.run()` in `server.py`

```
import sys
from argparse import ArgumentParser

# ... the Flask application blueprint

if __name__ == '__main__':
    # arg parser for the standard anaconda-project options
    parser = ArgumentParser(prog="hello_world",
                            description="Simple Flask Application")
    parser.add_argument('--anaconda-project-host', action='append', default=[],
```

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```
                        help='Hostname to allow in requests')
    parser.add_argument('--anaconda-project-port', action='store', default=8086,␣
↪type=int,
                        help='Port to listen on')
    parser.add_argument('--anaconda-project-iframe-hosts',
                        action='append',
                        help='Space-separated hosts which can embed us in an iframe per␣
↪our Content-Security-Policy')
    parser.add_argument('--anaconda-project-no-browser', action='store_true',
                        default=False,
                        help='Disable opening in a browser')
    parser.add_argument('--anaconda-project-use-xheaders',
                        action='store_true',
                        default=False,
                        help='Trust X-headers from reverse proxy')
    parser.add_argument('--anaconda-project-url-prefix', action='store', default='',
                        help='Prefix in front of urls')
    parser.add_argument('--anaconda-project-address',
                        action='store',
                        default='0.0.0.0',
                        help='IP address the application should listen on.')

    args = parser.parse_args()
```

Running your Flask application

The final step is to configure the Flask application with the Anaconda Project HTTP values and call `app.run()`. Note that registering the Blueprint provides a convenient way to deploy your application without having to rewrite the routes.

```
# ... the flask application blueprint

if __name__ == '__main__':
    # ... parse command line arguments

    app = Flask(__name__)
    app.register_blueprint(hello, url_prefix=args.anaconda_project_url_prefix)

    app.config['PREFERRED_URL_SCHEME'] = 'https'

    app.wsgi_app = ProxyFix(app.wsgi_app)
    app.run(host=args.anaconda_project_address, port=args.anaconda_project_port)
```

Here is the complete code for the Hello World application.

```
import sys
from flask import Flask, Blueprint
from argparse import ArgumentParser
from werkzeug.contrib.fixers import ProxyFix

hello = Blueprint('hello', __name__)

```

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```
@hello.route('/')
def hello_world():
    return "Hello, World!"

if __name__ == '__main__':

    # arg parser for the standard anaconda-project options
    parser = ArgumentParser(prog="hello_world",
                            description="Simple Flask Application")
    parser.add_argument('--anaconda-project-host', action='append', default=[],
                        help='Hostname to allow in requests')
    parser.add_argument('--anaconda-project-port', action='store', default=8086,␣
↪type=int,
                        help='Port to listen on')
    parser.add_argument('--anaconda-project-iframe-hosts',
                        action='append',
                        help='Space-separated hosts which can embed us in an iframe per␣
↪our Content-Security-Policy')
    parser.add_argument('--anaconda-project-no-browser', action='store_true',
                        default=False,
                        help='Disable opening in a browser')
    parser.add_argument('--anaconda-project-use-xheaders',
                        action='store_true',
                        default=False,
                        help='Trust X-headers from reverse proxy')
    parser.add_argument('--anaconda-project-url-prefix', action='store', default='',
                        help='Prefix in front of urls')
    parser.add_argument('--anaconda-project-address',
                        action='store',
                        default='0.0.0.0',
                        help='IP address the application should listen on.')

    args = parser.parse_args()

    app = Flask(__name__)
    app.register_blueprint(hello, url_prefix = args.anaconda_project_url_prefix)

    app.config['PREFERRED_URL_SCHEME'] = 'https'

    app.wsgi_app = ProxyFix(app.wsgi_app)
    app.run(host=args.anaconda_project_address, port=args.anaconda_project_port)
```

Sharing deployments

After you have *deployed a project*, you can share the deployment with others to provide them with access to view or interact with it. You can share a deployment publicly, with other Data Science & AI Workbench users, or both.

Any *collaborators* you add to your deployment will see your deployment in *their* **Deployments** list when they log in to Workbench.

Note: Your Workbench Administrator configures the available users and groups with whom you can share your deployments, so check with them if you need a new group created.

Sharing a deployment

Deployments can be shared from the global Deployments page, or directly from the project itself:

Sharing from Deployments

From the **Projects** page:

1. Select **Deployments** from the left-hand navigation.
2. Select the specific deployment you want to share, then select **Share** in the left-hand navigation.

Sharing from a Project

From the **Projects** page:

1. Open a project you have deployed, then select **Deployments** in the left-hand navigation.
2. Select the specific deployment you want to share, then select **Share** in the left-hand navigation.

Public deployment

Public deployments are accessible to anyone who has the deployment URL. To share a public deployment, copy and distribute the URL that is generated when you *deploy the project*.

Private deployment

To limit access to the deployment to only those users with an access token, switch the **Sharing** toggle from **Public** to **Private**.

Private deployments can only be shared with other Workbench users by *adding them as collaborators*.

If you want your project to be able to be referenced in other code, you must also *generate and supply a deployment access token* that can be used to connect to the associated deployment.

Deployment access tokens should be protected like passwords!

Caution: If your deployment will serve as an endpoint for other code (e.g., a REST API), *provide a static URL* when *deploying your project*. Using the generated URL risks breaking references to your deployment, as any changes to the deployment will replace the URL.

Generating a deployment access token

From the **Projects** page:

1. Select **Deployments** from the left-hand navigation.
2. Select the specific deployment you want to generate a token for.
3. Select **Settings** in the left-hand navigation.
4. Click **Generate** under **Generate tokens**.

Deployment logs

When you “deploy” your project, Data Science & AI Workbench creates various Kubernetes resources, including a Kubernetes Deployment, which manages the lifecycle of pods—including their creation, scaling, and updating as necessary. Each project deployment is created as a Kubernetes pod.

Each pod has an `app` and `proxy` container, and logs for each container are accessible to assist you in troubleshooting issues that can occur within your project’s deployment. These logs can provide insights into the operational health of your deployment, possible configuration errors, and detecting potential security issues. You can also access Kubernetes event logs to aid you in troubleshooting your cluster.

Viewing deployment logs

To view a deployment’s logs:

1. Log in to Workbench.
2. Open a project.
3. Select **Deployments** from the left-hand navigation.
4. If necessary, deploy your project.
5. Select your project deployment.
6. Select **Logs** from the left-hand navigation.
7. Open a container dropdown to view the logs for that container.

Tip: Use the search function to help you efficiently locate information in the container logs.

App container logs

The app container is where your project application code runs. Logs from this container can provide insights into the following:

- Standard output (stdout) and standard error (stderr) from your application
- Error messages and stack traces when exceptions occur
- Information related to the applications resource usage and processing times

Proxy container logs

The proxy container handles network traffic to the application from both the internet and from other internal Kubernetes services. Logs from this container can provide insights into the following:

- Records of incoming and outgoing requests, including timestamps, HTTP status codes, URLs, and client IP addresses
- Records of unauthorized access attempts to help identify and address irregularities in network traffic
- Information about network-related errors, such as failed connections, timeouts, or DNS issues

Events logs

The events logs contain actions taken by Kubernetes as it schedules pods for creation on the node (as they consume cluster resources), pulls the image, and then starts each of the pod's `app` and `proxy` containers. These logs provide insights into the following:

- Information about the automatic scaling actions taken by Kubernetes in response to workload demands
- Records of new version deployments, configuration updates, and their success or failure
- Results of health-check events to ensure your application is healthy

4.6 Schedules

If you have a project that requires regular updates for tasks (such as data processing or monthly/weekly reports) or a model that needs to be retrained on updated data sources at regular intervals, Data Science & AI Workbench enables you to schedule your deployments to automate project executions. Strategically scheduling deployments minimizes manual intervention and can reduce system load during peak hours, maintaining optimal performance for your cluster.

Note: Scheduled tasks can read data previously committed to a project, but cannot be used to commit any new data to the project. Any data written to a scheduled deployment's container is deleted immediately after the scheduled task completes. Anaconda recommends you ensure data is read from and written to an *external data source*.

4.6.1 Scheduling a deployment

1. From the **Projects** page, open the project you want to schedule a deployment for.
2. Select **Schedules** from the project's left-hand navigation.
3. Click **Schedule**.
4. Complete the **Create a Schedule** form:
   1. Enter a name for your schedule that clearly establishes its purpose.
   2. Specify whether you want to deploy the latest version of the project, or select a particular version.
   3. Select a deployment command.

      Note:

      - Because schedules are intended for automatic or non-interactive execution of script files or notebooks, only `unix:` commands are supported.

- If there is no command listed, you cannot schedule a deployment.

4. Select a resource profile for the deployment to use.
5. Set the frequency for your scheduled deployment to occur.

Tip:

- You can use the interface to determine when you want to schedule the deployment frequency, or select *Custom* and enter a valid cron expression.
- If you need to deploy right away—without creating a schedule—select *Run Now*.

6. Select a timezone for your scheduled deployment.
7. Click **Schedule / Run Now**.

4.6.2 Viewing schedule details

1. From the **Projects** page, select **Schedules** from the left-hand navigation.
2. Click on a schedule in the list to view its details.

From here you can see previous *Runs* of a scheduled task or *manage the schedule*.

4.6.3 Managing a schedule

From a schedule's details view, you can use the controls at the top of the page to pause or resume, edit, or delete a selected schedule.

Note: If you attempt to delete a schedule that is currently running or is scheduled to run, you will be prompted to confirm that you want to force the deletion.

4.6.4 Runs

Each time a scheduled task is executed, its run is automatically logged. You can view all runs associated with a schedule in its details view. Selecting a specific run from the list displays the corresponding log for that execution.

Tip:

- If something went wrong with your deployment, the runs log can be a helpful tool in troubleshooting the issue.
- Selecting a run opens the *Project's* **Runs** view.

4.7 Using GPUs in sessions and deployments

Data Science & AI Workbench enables you to leverage the compute power of graphics processing units (GPUs) from within your editor sessions. To do so, you can select a resource profile that features a GPU when you first create the project, or use the project's **Settings** tab to select a resource profile after the project is created.

To enable access to a GPU while running a *deployed application*, select the appropriate resource profile when you *deploy the associated project*.

In either case, if the resource profile you need isn't listed, ask your Administrator to *configure one for you to use*.

4.8 User settings

Data Science & AI Workbench allows you to maintain certain settings for your user account, based on how your system was configured by your administrator.

4.8.1 Configuring user settings

To access your user account settings:

1. Open the **My account** dropdown menu, then select *Settings*.
2. Click **Advanced Settings** to open your Keycloak account management page.
3. From the Keycloak account management page, you can modify the following settings:

> **Note:** Fields that you are not permitted to edit appear disabled.

Personal info

Manage your basic information about your account, such as your username and email address.

Account security

Change your account password and enable two-factor authentication.

Applications

View a list of Workbench applications currently running and the permissions you have been granted for them.

4.9 Secrets

Secrets are a core component of Kubernetes that enable you to securely store sensitive information such as usernames, passwords, API keys, or authentication tokens for external resource authentication. When you create a secret, it is stored as a base64 encoded file within the Kubernetes cluster, with the name of the secret corresponding to the name of the file.

These encoded secrets can be accessed by mounting the file into your project sessions and deployments, allowing your applications to securely retrieve and use this sensitive information without exposing it in your source code.

Note: Anaconda *strongly* recommends using secrets as opposed to including credentials in your project, due to the security risk associated with storing them in version control.

4.9.1 Creating a secret

1. Open the **My account** dropdown menu in the top navigation, then select *Settings*.
2. Under **Secrets**, click **Add**.
3. Enter a name and value for the secret you want to store, then click **Add**.

   Note: Because secret names are file names, they can only contain alphanumeric characters and underscores.

Secrets you create are listed here, and are stored in the /var/run/secrets/user_credentials/ directory.

4.9.2 Using secrets

To use a secret in a project, you must install the ae5-tools package in your project's environment.

Note:

- The ae5-tools package is available from Workbench's internal repository.
- If you are using an external package repository, you can pull the ae5-tools package from anaconda.org.
- If you are working in an airgapped environment, you can download the package here, then transfer it to your cluster.

Then, from within your project, add the following code:

```
import os
from ae5_tools import load_ae5_user_secrets
```

This function reads all secrets stored in the /var/run/secrets/user_credentials/ directory and creates environment variables for each defined secret.

For example, let's say you have defined the following secrets:

```
MLFLOW_ACCESS_SECRET = "Pa55w0rd"
REDIS_ACCESS_TOKEN = "N0Haxh3r3"
```

From within one of your projects, you could do the following:

```
import os
from ae5_tools import load_ae5_user_secrets

mlflow_secret: str = os.environ["MLFLOW_ACCESS_SECRET"]
redis_secret: str = os.environ["REDIS_ACCESS_TOKEN"]

print(mlflow_secret)
print(redis_secret)
```

Tip: There are multiple ways to call environment variables! For example, you could also import the `demand_env_var` function from the `ae5-tools` package and call environment variables like this:

```
import os
from ae5_tools import load_ae5_user_secrets, demand_env_var

mlflow_secret: str = os.environ["MLFLOW_ACCESS_SECRET"]
redis_secret: str = demand_env_var("REDIS_ACCESS_TOKEN")

print(mlflow_secret)
print(redis_secret)
```

4.9.3 Editing a secret

1. Open the **My account** dropdown menu, then select *Settings*.
2. Open the actions dropdown menu for your secret and select *Edit*.
3. Update the Value for your secret, then click **Save**.

Note: If you edit the name of a secret, a new secret is created instead.

4.9.4 Deleting a secret

1. Open the **My account** dropdown menu, then select *Settings*.
2. Open the actions dropdown menu for your secret and select *Delete*.
3. Click **Delete**.

4.10 Configuring user access to external version control

If your organization is using an external version control repository, Workbench requires you to provide your authentication credentials to access the repository prior to creating your first project.

Tip: Anaconda recommends that you create a personal access token with no expiration date to retain permanent access to your files from within Workbench.

Your auth token must have the following permissions:

GitHub

repo:status, repo_deployment, public_repo, repo:invite, and delete_repo

GitLab

Select the `api` access checkbox when creating your access token.

Bitbucket

Bitbucket requires you to provide an App password that has Admin level permissions for Projects and Repositories.

4.10.1 Adding an access token

1. Open the **My account** dropdown menu, then select *Settings*.
2. Under **External Version Control Credentials**, click **Add**.
3. Enter the Username and Personal Access Token you generated to access the repository in the relevant fields.
4. Click **Add** to update the platform with your credentials.

Now that you've configured access, you'll be able access the repository within your sessions and deployments without having to leave the platform. Workbench creates a repository for each *project that you create*.

4.10.2 Editing an access token

1. Open the **My account** dropdown menu, then select *Settings*.
2. Open the actions dropdown menu for your access token and select *Edit*.
3. Update your repository Username and/or Personal Access Token value, then click **Save**.

4.10.3 Deleting an access token

1. Open the **My account** dropdown menu, then select *Settings*.
2. Open the actions dropdown menu for your access token and select *Delete*.
3. Click **Delete**.

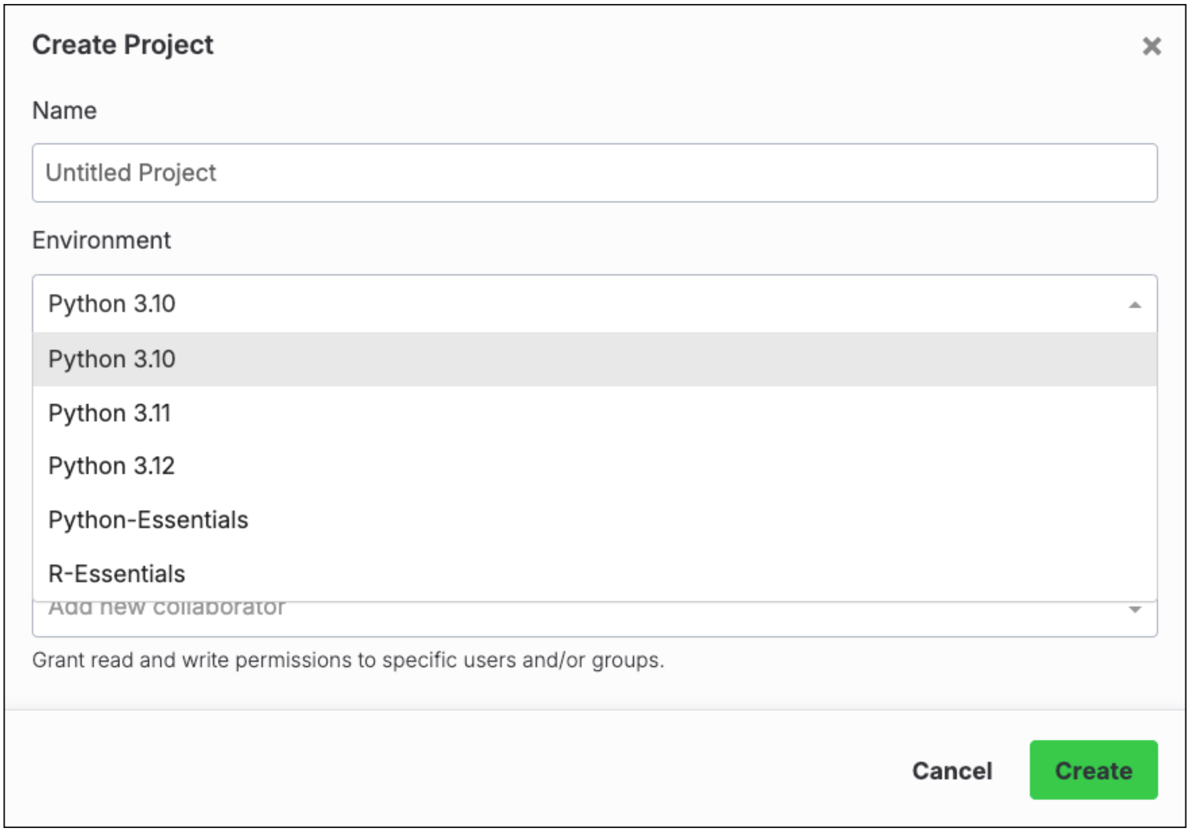
4.11 Visualizations and dashboards

Data Science & AI Workbench makes it easy for you to create and share interactive data visualizations, live notebooks or machine learning models built using popular libraries such as Bokeh and HoloViews.

To get you started quickly, Workbench provides sample projects of Bokeh applications for clustering and cross filtering data. There are also several examples of Workbench projects that use HoloViz here.

To create an interactive plot:

1. From the **Projects** view, create a new project using the minimal Python templates:



Create Project

Name: Untitled Project

Environment: Python 3.10

Grant read and write permissions to specific users and/or groups.

2. Open a session for your newly created project.
3. Open a terminal.
4. Run the following command to install `hvplot` and `panel`:

```
anaconda-project add-packages hvplot panel
```

5. Create a new Notebook and rename it to `tips.ipynb`.
6. Add the following code to `tips.ipynb`:

```
import pandas as pd
import hvplot.pandas
import panel

panel.extension()

df = pd.read_csv('http://bit.ly/tips-csv')
p = df.hvplot.scatter(x='total_bill', y='tip', hover_cols=['sex','day','size
↪'])
pn.panel(p).servable()
```

Note: In this example, the data is being read from the Internet. Alternatively, you could download the `.csv` and upload it to the project.

7. Open the project's `anaconda-project.yml` file, and add the following deployment command:

```
commands:
  scatter-plot:
  unix: panel serve tips.ipynb
  supports_http_options: True
```

8. *Save and commit your changes*.
9. *Deploy the project*.

Tip: For a deeper dive into data visualization, follow this HoloViz tutorial.

4.12 Machine learning and deep learning

Data Science & AI Workbench facilitates machine learning and deep learning by enabling you to *develop models*, *train them*, and *deploy them*. You can also use Workbench to *query and score models* that have been *deployed as a REST API*.

To help get you started, Workbench includes several sample notebooks for common repetitive tasks. You can access them from the gallery of Sample Projects available from **Projects**. See *Projects* for more information.

We've also provided a walkthrough of the process for *creating an interactive data visualization*.

4.12.1 Developing models

Data Science & AI Workbench makes it easy for you to create models that you can *train* to make predictions and facilitate machine learning based on deep learning neural networks.

You can *deploy* your trained model as a REST API, so that it can be *queried and scored*.

The following libraries are available in Workbench to help you develop models:

- **Scikit-learn**–for algorithms and model training.
- **TensorFlow**–to express numerical computations as stateful dataflow graphs.
- **XGBoost**–a gradient boosting framework for C++, Java, Python, R and Julia.
- **Theano**–expresses numerical computations & compiles them to run on CPUs or GPUs.
- **Keras**–contains implementations of commonly used neural network building blocks to make working with image and text data easier.
- **Lasagne**–contains recipes for building and training neural networks in Theano.
- **Neon**–deep learning framework for building models using Python, with Math Kernel Library (MKL) support.
- **MXNet**–framework for training and deploying deep neural networks.
- **Caffe**–deep learning framework with a Python interface geared towards image classification and segmentation.
- **CNTK**–cognitive toolkit for working with massive datasets to facilitate distributed deep learning. Describes neural networks as a series of computational steps via a directed graph.

4.12.2 Training models

Data Science & AI Workbench provides machine learning libraries such as scikit-learn and Tensorflow that you can use to train the models you create.

To train a model:

When you are ready to run an algorithm against your model and tune it, download the `scikit-learn` or `Tensorflow` package from the `anaconda` channel. If you don't see this channel or these packages in your **Channels** list, contact your Administrator to *mirror these packages* to make them available to you.

Serializing your model:

When you are ready to convert your model or application into a format that can be easily distributed and reconstructed by others, use Workbench to *deploy it*.

- YAML – supports non-hierarchical data structures & scalar data
- JSON – for client-server communication in web apps
- HD5 – designed to store large amounts of hierarchical data; works well for time series data (stored in arrays)

Note: Your model or app must be written in a programming language that supports object serialization, such as Python, PHP, R or Java.

4.12.3 Deploying models as endpoints

Data Science & AI Workbench enables you to deploy machine learning models as endpoints to make them available to others, so the models can be *queried and scored*. You can then save users' input data as part of the training data, and retrain the model with the new training dataset.

Versioning your model:

To enable you to test variations of a model, you can *deploy multiple versions of the model*. You can then direct different sets of users to each of the versions, to facilitate A/B testing.

Deploying your model as an endpoint:

Deploying a model as an endpoint involves these simple steps:

1. *Create a project* to tell Workbench where to look for the artifacts that comprise the model.
2. *Deploy the project* to build the model and all of its dependencies. Now you—and others with whom you *share the deployment*—can interact with the app, and select different datasets and algorithms.

4.12.4 Querying and scoring models

Data Science & AI Workbench enables you to query and score models that have been created in Python, R, or another language such as Curl, CLI, Java or Javascript. The model doesn't have to have been created using Workbench, as long as the model has been *deployed as an endpoint*.

Scoring can be incredibly useful to an organization, including the following "real world" examples:

- By financial institutions, to determine the level of risk that a loan applicant represents.
- By debt collectors, to predict the likelihood of a debtor to repay their debt.
- By marketers, to predict the likelihood of a subscriber list member to respond to a campaign.
- By retailers, to determine the probability of a customer to purchase a product.

A scoring engine calculates predictions or makes recommendations based on your model. A model's score is computed based on the model and query operators used:

- Boolean queries—specify a formula
- Vector space queries—support free text queries (with no query operators necessarily connecting them)
- Wildcard queries—match any pattern

Using an external scoring engine

Advanced scoring techniques used in machine learning algorithms can automatically update models with new data gathered. If you have an external scoring engine that you prefer to use on your models, you can do so within Workbench.

CHAPTER FIVE

TROUBLESHOOTING

Anaconda's Data Science & AI Workbench provides detailed logs and monitoring information related to the Kubernetes services and containers it uses. Gravity-based installations can use the provided Operations Center and Kubernetes CLI to access this information, to help diagnose and debug errors that you or other users may encounter while using the platform.

5.1 Gravity troubleshooting

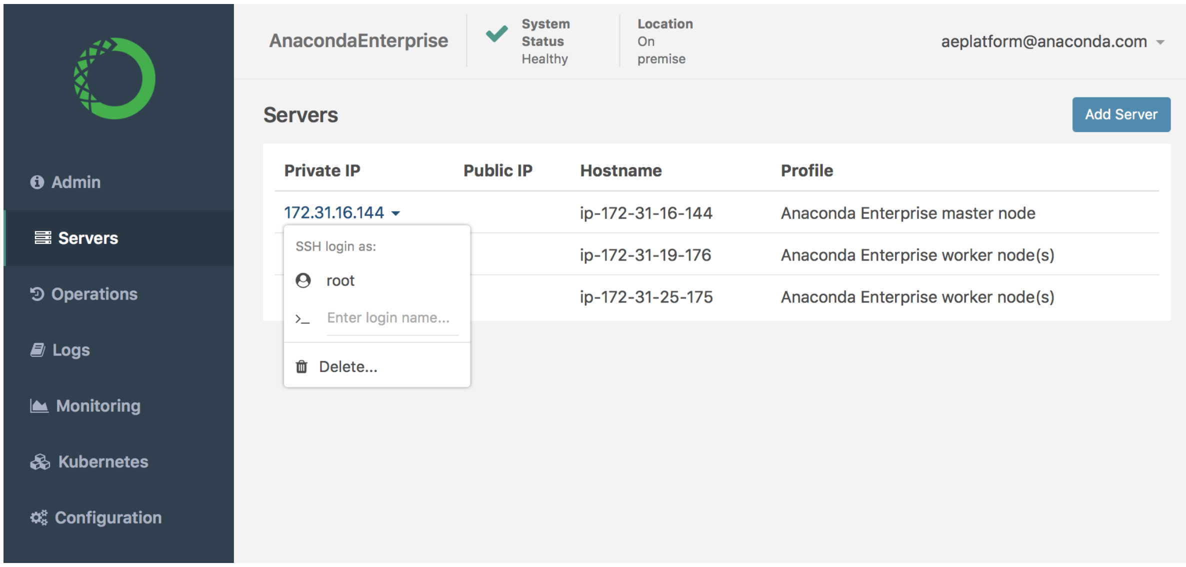
Administrators can access the Operations Center to configure, monitor, and troubleshoot the platform.

To access the Operations Center:

1. Log in to Workbench, select the **Menu** icon in the top right corner, and click the **Administrative Console** link displayed at the bottom of the slide out window.
2. Click **Manage Resources**.
3. Login to the Operations Center using the Administrator credentials *configured after installation*.

To view resource utilization:

1. Select **Servers** in the menu on the left.
2. Click on the Private IP address of the Workbench master node, and select **SSH login as root**.

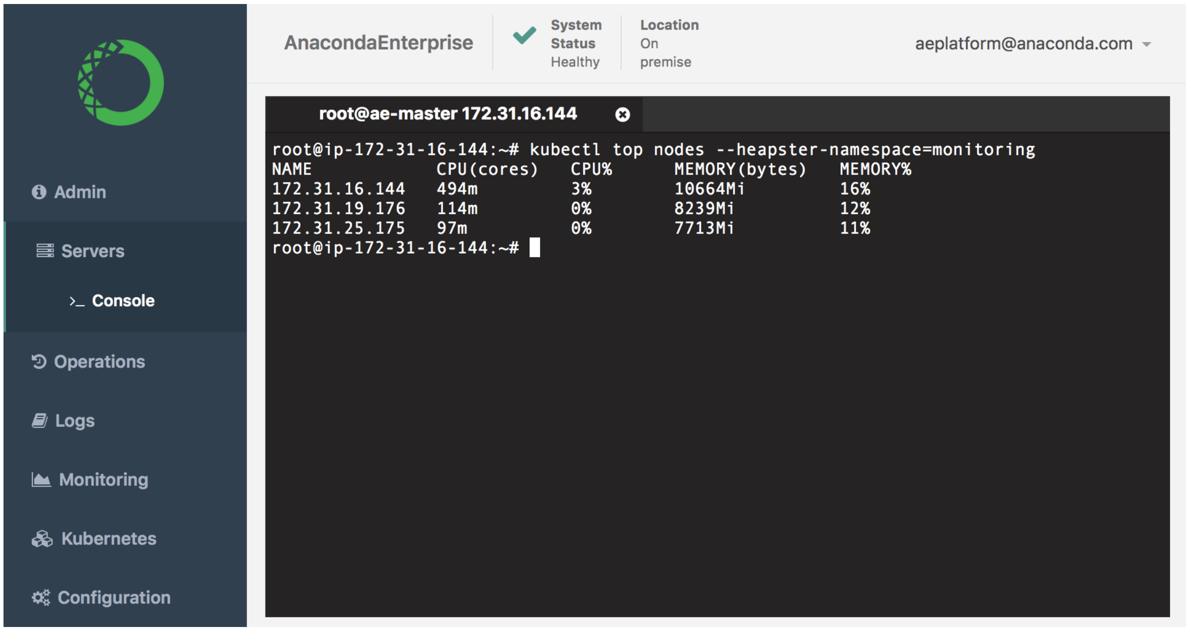


Servers

Private IP	Public IP	Hostname	Profile
172.31.16.144		ip-172-31-16-144	Anaconda Enterprise master node
		ip-172-31-19-176	Anaconda Enterprise worker node(s)
		ip-172-31-25-175	Anaconda Enterprise worker node(s)

3. To display the current resource utilization of each *node* in the cluster, run this command:

```
kubectl top nodes --heapster-namespace=monitoring
```

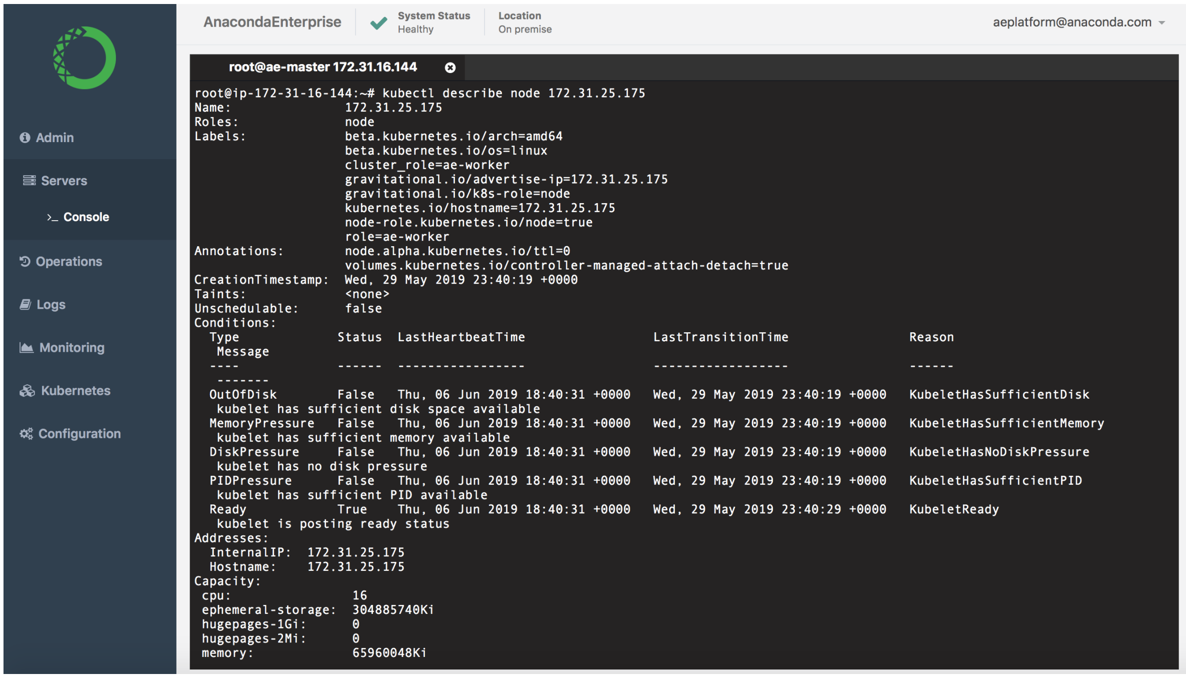


```
root@ip-172-31-16-144:~# kubectl top nodes --heapster-namespace=monitoring
NAME            CPU(cores)   CPU%      MEMORY(bytes)   MEMORY%
172.31.16.144   494m         3%        10664Mi         16%
172.31.19.176   114m         0%        8239Mi          12%
172.31.25.175   97m          0%        7713Mi          11%
root@ip-172-31-16-144:~#
```

Note: This is actual resource utilization, not limits or requests.

4. To view utilization *and requests* for a particular node, run the `kubectl describe node` command against the IP address for the node (listed under `NAME`). For example:

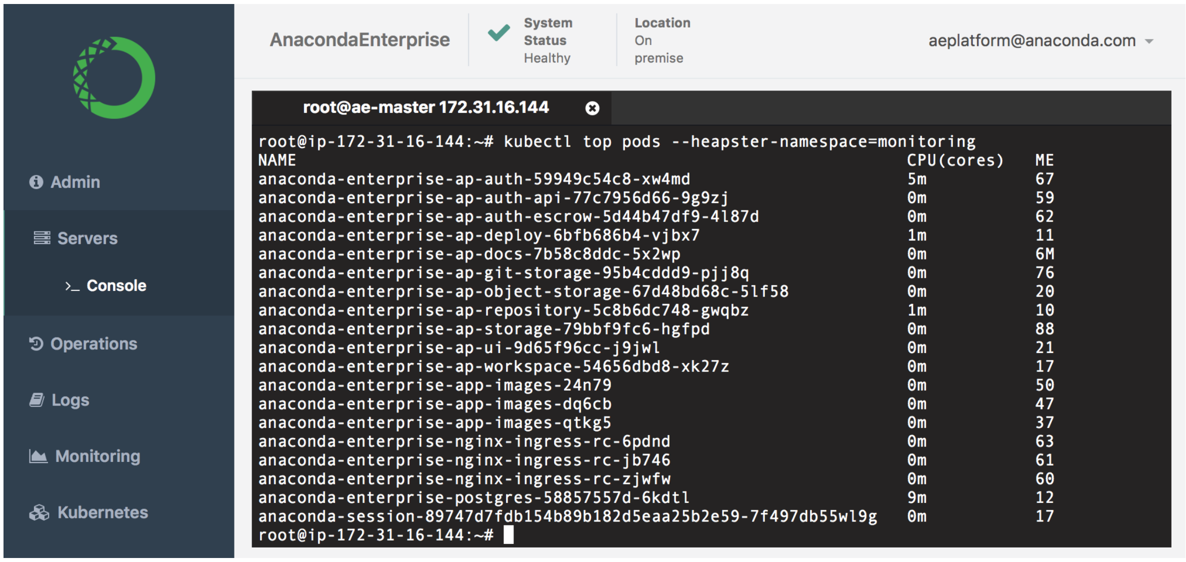
```
kubectl describe node 172.31.25.175
```



```
root@ip-172-31-16-144:~# kubectl describe node 172.31.25.175
Name:               172.31.25.175
Roles:              node
Labels:             beta.kubernetes.io/arch=amd64
                    beta.kubernetes.io/os=linux
                    cluster_role=ae-worker
                    gravitational.io/advertise-ip=172.31.25.175
                    gravitational.io/k8s-role=node
                    kubernetes.io/hostname=172.31.25.175
                    node-role.kubernetes.io/node=true
                    role=ae-worker
Annotations:        node.alpha.kubernetes.io/ttl=0
                    volumes.kubernetes.io/controller-managed-attach-detach=true
CreationTimestamp:  Wed, 29 May 2019 23:40:19 +0000
Taints:             <none>
Unschedulable:      false
Conditions:
  Type             Status  LastHeartbeatTime                 LastTransitionTime                Reason
   Message
  ----             ------  -----------------                 ------------------                ------
   -------
  OutOfDisk        False   Thu, 06 Jun 2019 18:40:31 +0000   Wed, 29 May 2019 23:40:19 +0000   KubeletHasSufficientDisk
   kubelet has sufficient disk space available
  MemoryPressure   False   Thu, 06 Jun 2019 18:40:31 +0000   Wed, 29 May 2019 23:40:19 +0000   KubeletHasSufficientMemory
   kubelet has sufficient memory available
  DiskPressure     False   Thu, 06 Jun 2019 18:40:31 +0000   Wed, 29 May 2019 23:40:19 +0000   KubeletHasNoDiskPressure
   kubelet has no disk pressure
  PIDPressure      False   Thu, 06 Jun 2019 18:40:31 +0000   Wed, 29 May 2019 23:40:19 +0000   KubeletHasSufficientPID
   kubelet has sufficient PID available
  Ready            True    Thu, 06 Jun 2019 18:40:31 +0000   Wed, 29 May 2019 23:40:29 +0000   KubeletReady
   kubelet is posting ready status
Addresses:
  InternalIP:  172.31.25.175
  Hostname:    172.31.25.175
Capacity:
 cpu:                16
 ephemeral-storage:  304885740Ki
 hugepages-1Gi:      0
 hugepages-2Mi:      0
 memory:             65960048Ki
```

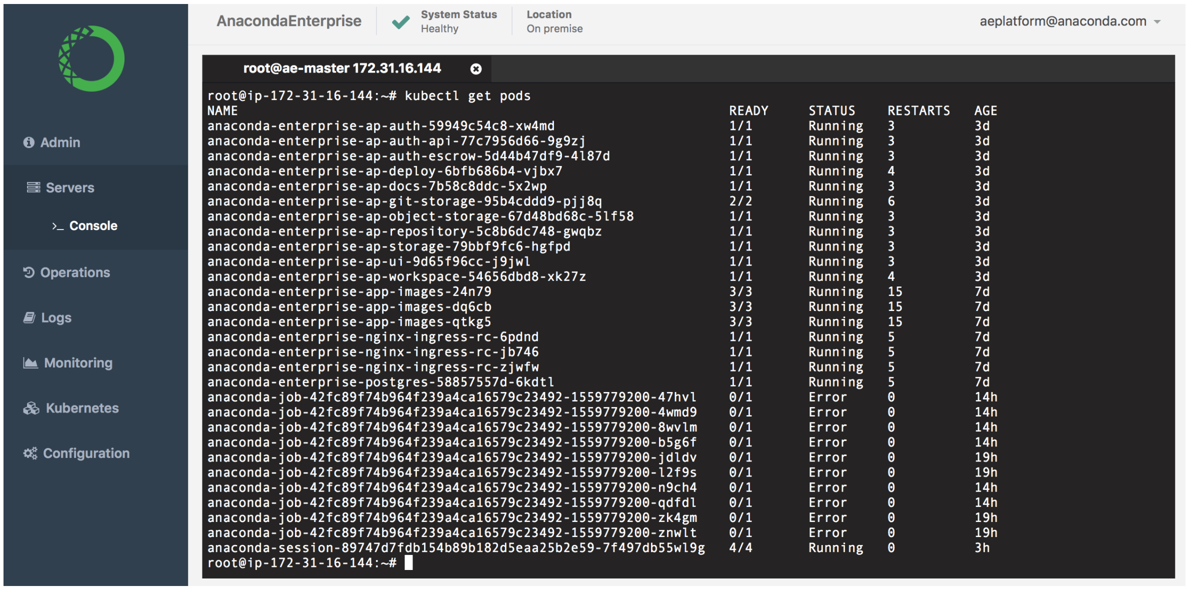
5. To view the resource utilization per *pod*, run this command:

```
kubectl top pods --heapster-namespace=monitoring
```



```
root@ip-172-31-16-144:~# kubectl top pods --heapster-namespace=monitoring
NAME                                                             CPU(cores)   ME
anaconda-enterprise-ap-auth-59949c54c8-xw4md                     5m           67
anaconda-enterprise-ap-auth-api-77c7956d66-9g9zj                 0m           59
anaconda-enterprise-ap-auth-escrow-5d44b47df9-4187d              0m           62
anaconda-enterprise-ap-deploy-6bfb686b4-vjbx7                    1m           11
anaconda-enterprise-ap-docs-7b58c8ddc-5x2wp                      0m           6M
anaconda-enterprise-ap-git-storage-95b4cddd9-pjj8q               0m           76
anaconda-enterprise-ap-object-storage-67d48bd68c-51f58           0m           20
anaconda-enterprise-ap-repository-5c8b6dc748-gwqbz               1m           10
anaconda-enterprise-ap-storage-79bbf9fc6-hgfpd                   0m           88
anaconda-enterprise-ap-ui-9d65f96cc-j9jwl                        0m           21
anaconda-enterprise-ap-workspace-54656dbd8-xk27z                 0m           17
anaconda-enterprise-app-images-24n79                             0m           50
anaconda-enterprise-app-images-dq6cb                             0m           47
anaconda-enterprise-app-images-qtkg5                             0m           37
anaconda-enterprise-nginx-ingress-rc-6pdnd                       0m           63
anaconda-enterprise-nginx-ingress-rc-jb746                       0m           61
anaconda-enterprise-nginx-ingress-rc-zjwfw                       0m           60
anaconda-enterprise-postgres-58857557d-6kdtl                     9m           12
anaconda-session-89747d7fdb154b89b182d5eaa25b2e59-7f497db55wl9g   0m           17
root@ip-172-31-16-144:~# █
```

6. To view the current status of all pods in the cluster, run `kubectl get pods`.



```
root@ip-172-31-16-144:~# kubectl get pods
NAME                                                              READY     STATUS    RESTARTS   AGE
anaconda-enterprise-ap-auth-59949c54c8-xw4md                      1/1       Running   3          3d
anaconda-enterprise-ap-auth-api-77c7956d66-9g9zj                  1/1       Running   3          3d
anaconda-enterprise-ap-auth-escrow-5d44b47df9-4187d               1/1       Running   3          3d
anaconda-enterprise-ap-deploy-6bfb686b4-vjbx7                     1/1       Running   4          3d
anaconda-enterprise-ap-docs-7b58c8ddc-5x2wp                       1/1       Running   3          3d
anaconda-enterprise-ap-git-storage-95b4cddd9-pjj8q                2/2       Running   6          3d
anaconda-enterprise-ap-object-storage-67d48bd68c-51f58            1/1       Running   3          3d
anaconda-enterprise-ap-repository-5c8b6dc748-gwqbz                1/1       Running   3          3d
anaconda-enterprise-ap-storage-79bbf9fc6-hgfpd                    1/1       Running   3          3d
anaconda-enterprise-ap-ui-9d65f96cc-j9jwl                         1/1       Running   3          3d
anaconda-enterprise-ap-workspace-54656dbd8-xk27z                  1/1       Running   4          3d
anaconda-enterprise-app-images-24n79                              3/3       Running   15         7d
anaconda-enterprise-app-images-dq6cb                              3/3       Running   15         7d
anaconda-enterprise-app-images-qtkg5                              3/3       Running   15         7d
anaconda-enterprise-nginx-ingress-rc-6pdnd                        1/1       Running   5          7d
anaconda-enterprise-nginx-ingress-rc-jb746                        1/1       Running   5          7d
anaconda-enterprise-nginx-ingress-rc-zjwfw                        1/1       Running   5          7d
anaconda-enterprise-postgres-58857557d-6kdtl                      1/1       Running   5          7d
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-47hvl    0/1       Error     0          14h
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-4wmd9    0/1       Error     0          14h
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-8wvlm    0/1       Error     0          14h
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-b5g6f    0/1       Error     0          14h
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-jdldv    0/1       Error     0          19h
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-l2f9s    0/1       Error     0          19h
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-n9ch4    0/1       Error     0          14h
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-qdfdl    0/1       Error     0          14h
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-zk4gm    0/1       Error     0          19h
anaconda-job-42fc89f74b964f239a4ca16579c23492-1559779200-znwlt    0/1       Error     0          19h
anaconda-session-89747d7fdb154b89b182d5eaa25b2e59-7f497db55wl9g   4/4       Running   0          3h
root@ip-172-31-16-144:~# █
```

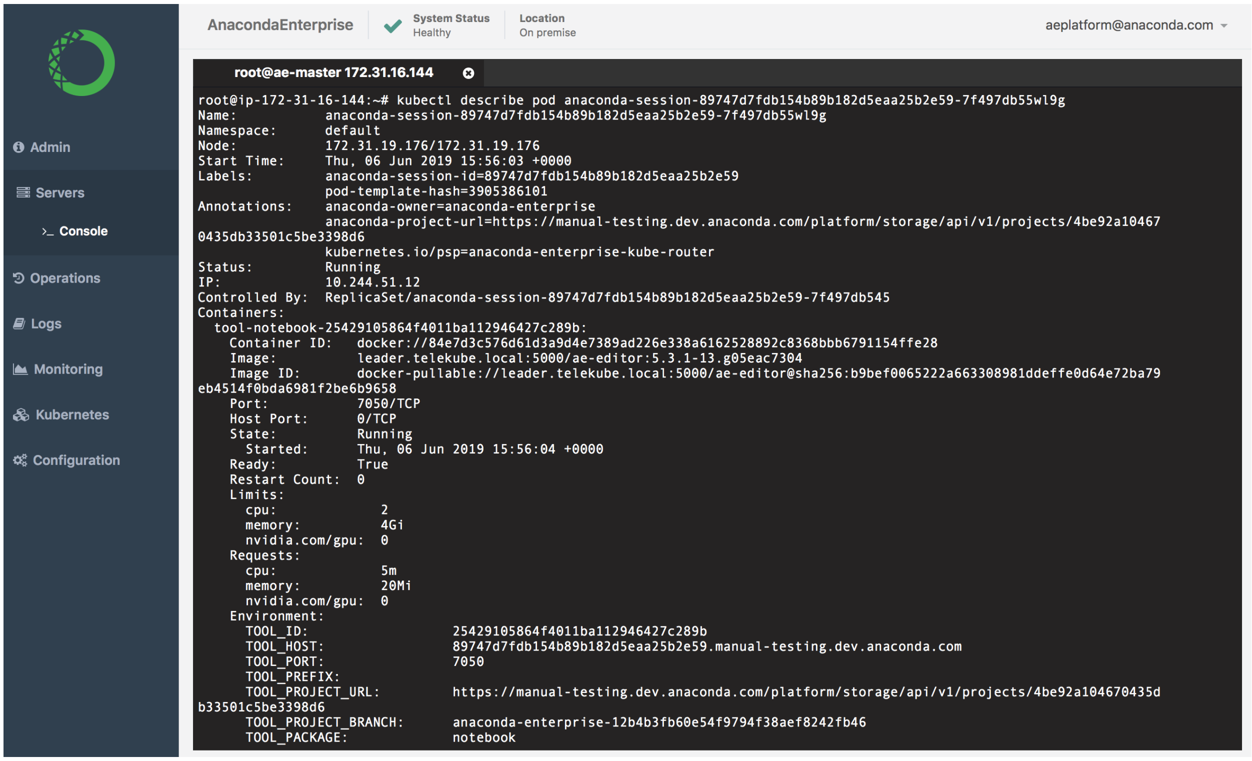
The following table summarizes common pod states:

Status	Description
Running	The pod has been bound to a node, and at least one container is running.
Pending	The pod is waiting for one or more container images to be created.
Terminating	The pod is in the process of being terminated.
Error	An error has occurred with the pod.
Init:CrashLoopBackoff	The pod failed to start, and will make another attempt in a few minutes.

7. To view information for a particular pod, run the `kubectl describe pod` command against the pod (listed

under NAME). For example:

```
kubectl describe pod anaconda-session-89747d7fdb154b89b182d5eaa25b2e59-7f497db55wl9g
```

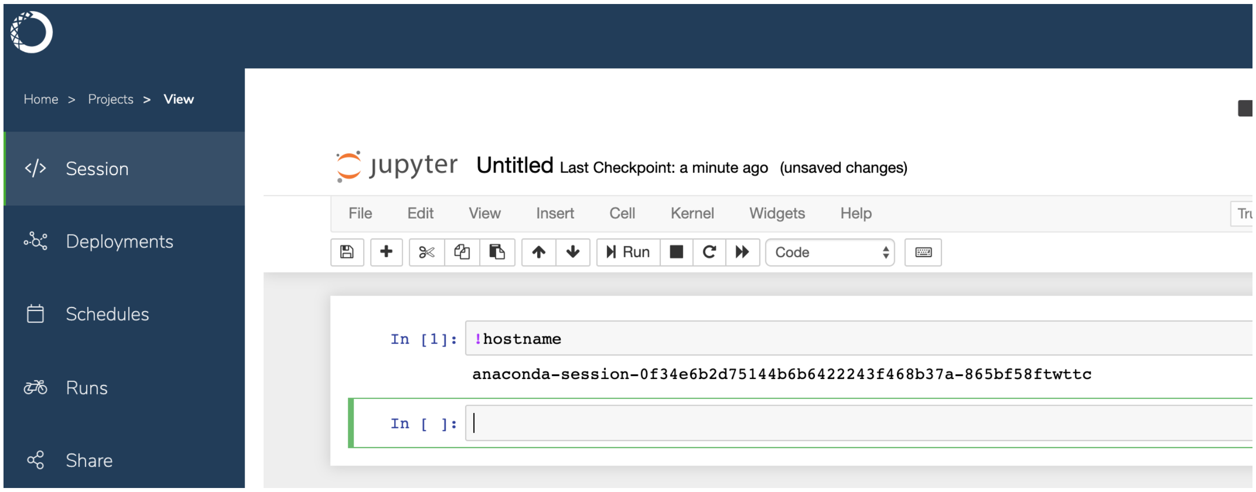


```
root@ip-172-31-16-144:~# kubectl describe pod anaconda-session-89747d7fdb154b89b182d5eaa25b2e59-7f497db55wl9g
Name:           anaconda-session-89747d7fdb154b89b182d5eaa25b2e59-7f497db55wl9g
Namespace:      default
Node:           172.31.19.176/172.31.19.176
Start Time:     Thu, 06 Jun 2019 15:56:03 +0000
Labels:         anaconda-session-id=89747d7fdb154b89b182d5eaa25b2e59
                pod-template-hash=3905386101
Annotations:    anaconda-owner=anaconda-enterprise
                anaconda-project-url=https://manual-testing.dev.anaconda.com/platform/storage/api/v1/projects/4be92a10467
0435db33501c5be3398d6
                kubernetes.io/psp=anaconda-enterprise-kube-router
Status:         Running
IP:             10.244.51.12
Controlled By:  ReplicaSet/anaconda-session-89747d7fdb154b89b182d5eaa25b2e59-7f497db545
Containers:
  tool-notebook-25429105864f4011ba112946427c289b:
    Container ID:   docker://84e7d3c576d61d3a9d4e7389ad226e338a6162528892c8368bbb6791154ffe28
    Image:          leader.telekube.local:5000/ae-editor:5.3.1-13.g05eac7304
    Image ID:       docker-pullable://leader.telekube.local:5000/ae-editor@sha256:b9bef0065222a663308981ddeffe0d64e72ba79
eb4514f0bda6981f2be6b9658
    Port:           7050/TCP
    Host Port:      0/TCP
    State:          Running
      Started:      Thu, 06 Jun 2019 15:56:04 +0000
    Ready:          True
    Restart Count:  0
    Limits:
      cpu:             2
      memory:          4Gi
      nvidia.com/gpu:  0
    Requests:
      cpu:             5m
      memory:          20Mi
      nvidia.com/gpu:  0
    Environment:
      TOOL_ID:                  25429105864f4011ba112946427c289b
      TOOL_HOST:                89747d7fdb154b89b182d5eaa25b2e59.manual-testing.dev.anaconda.com
      TOOL_PORT:                7050
      TOOL_PREFIX:
      TOOL_PROJECT_URL:         https://manual-testing.dev.anaconda.com/platform/storage/api/v1/projects/4be92a104670435d
b33501c5be3398d6
      TOOL_PROJECT_BRANCH:      anaconda-enterprise-12b4b3fb60e54f9794f38aef8242fb46
      TOOL_PACKAGE:             notebook
```

You can also use the Operations Center **Logs** to gain insights into pod behavior and troubleshoot issues. See *logging* for more information.

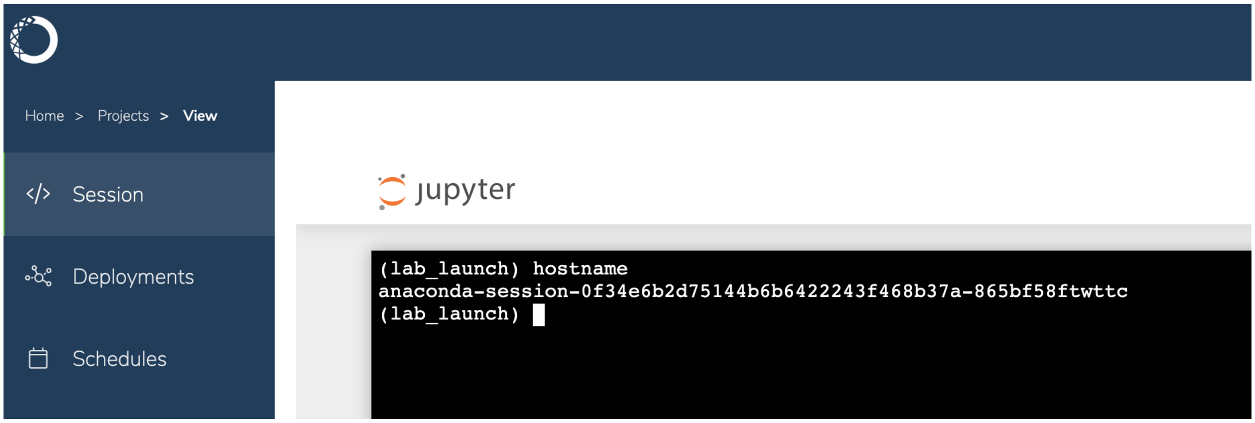
5.2 User errors

If a user experiences issues within a Notebook session, have them send you the name of the pod associated with their project session. They can obtain this information by running the hostname command from within a Jupyter Notebook or terminal window.



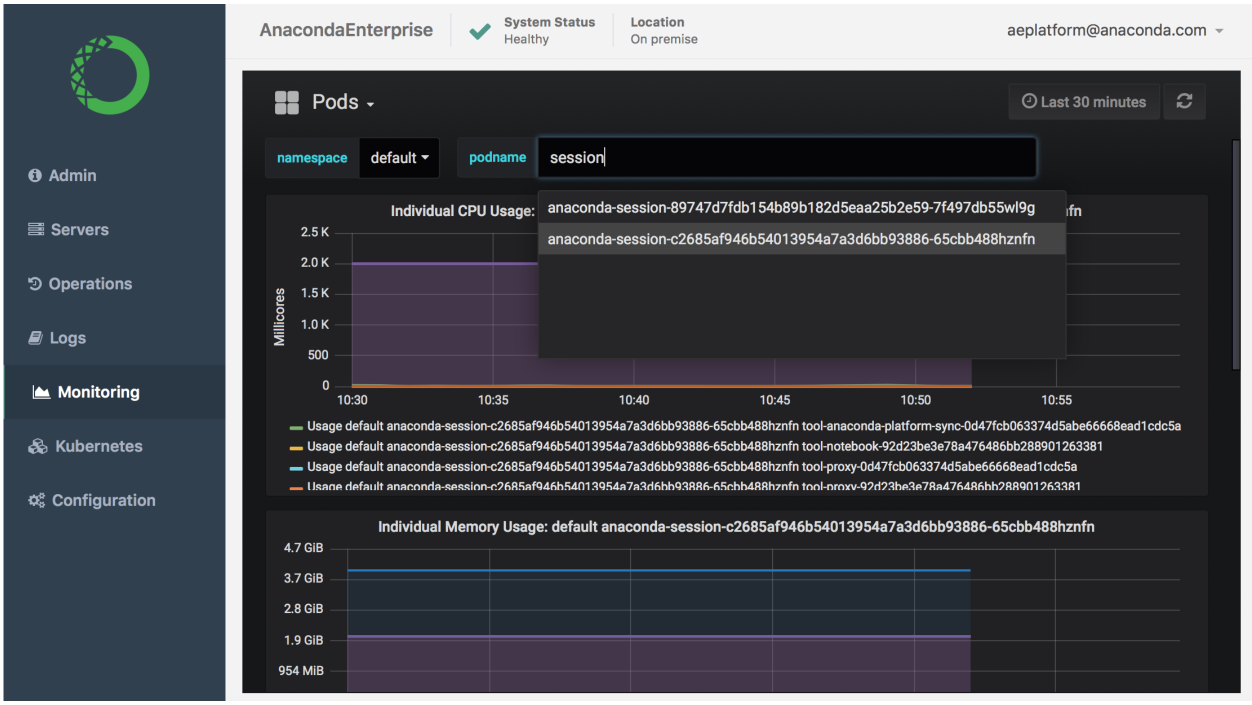
```
In [1]: !hostname
        anaconda-session-0f34e6b2d75144b6b6422243f468b37a-865bf58ftwttc

In [ ]:
```



```
(lab_launch) hostname
anaconda-session-0f34e6b2d75144b6b6422243f468b37a-865bf58ftwttc
(lab_launch)
```

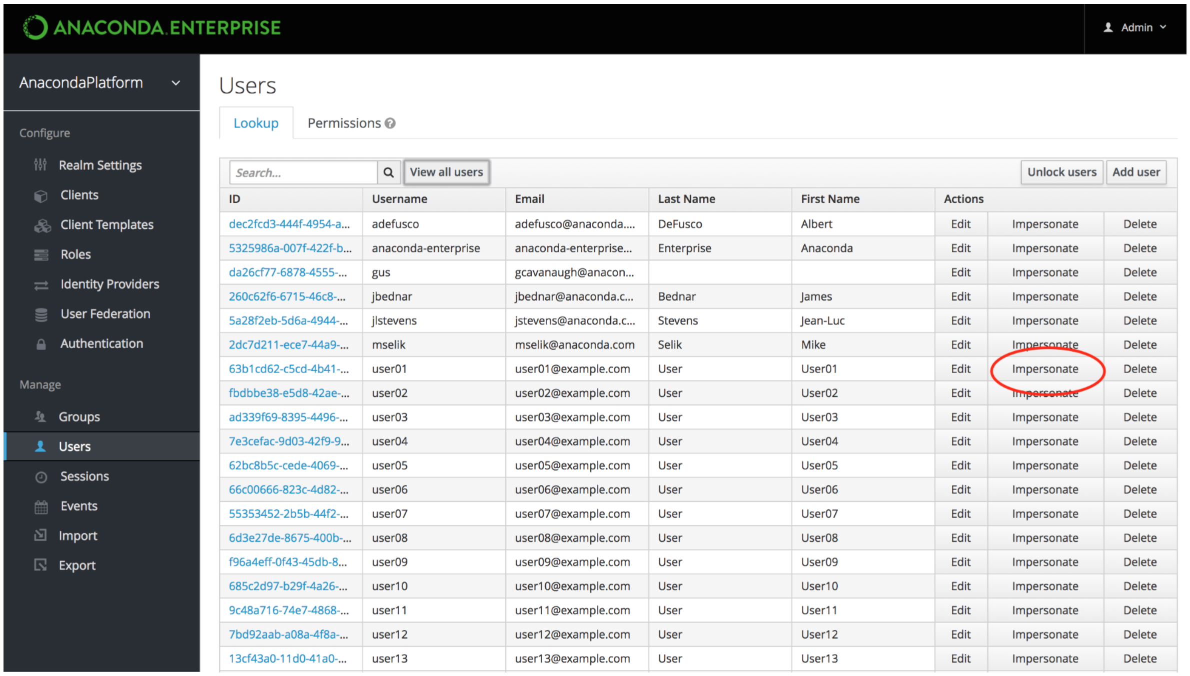
You can then use the commands described above or the Operation Center's **Monitoring** and **Logs** features to investigate the issue. See *Monitoring sessions and deployments* for more information.


AnacondaEnterprise
System Status
Healthy
Location
On premise
aeplatform@anaconda.com
Admin
Servers
Operations
Logs
Monitoring
Kubernetes
Configuration
Pods
Last 30 minutes
namespace
default
podname
session
anaconda-session-89747d7fdb154b89b182d5eaa25b2e59-7f497db55wl9g
anaconda-session-c2685af946b54013954a7a3d6bb93886-65cbb488hznfn
Individual CPU Usage:
2.5 K
2.0 K
1.5 K
1.0 K
500
0
Millicores
10:30
10:35
10:40
10:45
10:50
10:55
Usage default anaconda-session-c2685af946b54013954a7a3d6bb93886-65cbb488hznfn tool-anaconda-platform-sync-0d47fcb063374d5abe66668ead1cdc5a
Usage default anaconda-session-c2685af946b54013954a7a3d6bb93886-65cbb488hznfn tool-notebook-92d23be3e78a476486bb288901263381
Usage default anaconda-session-c2685af946b54013954a7a3d6bb93886-65cbb488hznfn tool-proxy-0d47fcb063374d5abe66668ead1cdc5a
Usage default anaconda-session-c2685af946b54013954a7a3d6bb93886-65cbb488hznfn tool-proxy-92d23be3e78a476486bb288901263381
Individual Memory Usage: default anaconda-session-c2685af946b54013954a7a3d6bb93886-65cbb488hznfn
4.7 GiB
3.7 GiB
2.8 GiB
1.9 GiB
954 MiB

Tip: As an Administrator, you can also use the Authentication Center to impersonate a user to try to reproduce the problem they are experiencing.

To access the Authentication Center:

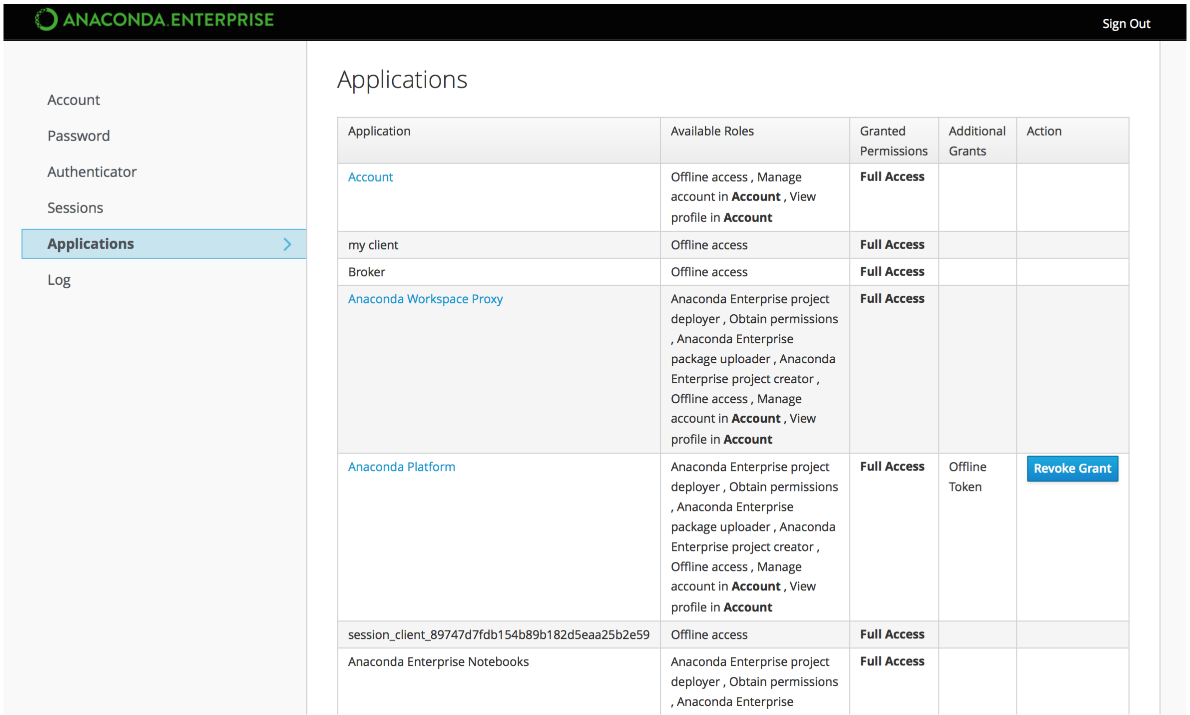
1. Log in to Workbench, click the **Menu** icon in the top right corner, then click the **Administrative Console** link in the bottom of the slideout menu.
2. Click **Manage Users**.
3. In the Manage menu on the left, click **Users**.
4. On the **Lookup** tab, click **View all users** to list every user in the system, or search the user database for all users that match the criteria you enter, based on their first name, last name, or email address.



Users

ID	Username	Email	Last Name	First Name	Actions		
dec2fcd3-444f-4954-a...	adefusco	adefusco@anaconda....	DeFusco	Albert	Edit	Impersonate	Delete
5325986a-007f-422f-b...	anaconda-enterprise	anaconda-enterprise...	Enterprise	Anaconda	Edit	Impersonate	Delete
da26cf77-6878-4555-...	gus	gcavanaugh@anacon...			Edit	Impersonate	Delete
260c62f6-6715-46c8-...	jbednar	jbednar@anaconda.c...	Bednar	James	Edit	Impersonate	Delete
5a28f2eb-5d6a-4944-...	jlstevens	jstevens@anaconda.c...	Stevens	Jean-Luc	Edit	Impersonate	Delete
2dc7d211-ece7-44a9-...	mselik	mselik@anaconda.com	Selik	Mike	Edit	Impersonate	Delete
63b1cd62-c5cd-4b41-...	user01	user01@example.com	User	User01	Edit	Impersonate	Delete
fbdbbe38-e5d8-42ae-...	user02	user02@example.com	User	User02	Edit	Impersonate	Delete
ad339f69-8395-4496-...	user03	user03@example.com	User	User03	Edit	Impersonate	Delete
7e3cefac-9d03-42f9-9...	user04	user04@example.com	User	User04	Edit	Impersonate	Delete
62bc8b5c-cede-4069-...	user05	user05@example.com	User	User05	Edit	Impersonate	Delete
66c00666-823c-4d82-...	user06	user06@example.com	User	User06	Edit	Impersonate	Delete
55353452-2b5b-44f2-...	user07	user07@example.com	User	User07	Edit	Impersonate	Delete
6d3e27de-8675-400b-...	user08	user08@example.com	User	User08	Edit	Impersonate	Delete
f96a4eff-0f43-45db-8...	user09	user09@example.com	User	User09	Edit	Impersonate	Delete
685c2d97-b29f-4a26-...	user10	user10@example.com	User	User10	Edit	Impersonate	Delete
9c48a716-74e7-4868-...	user11	user11@example.com	User	User11	Edit	Impersonate	Delete
7bd92aab-a08a-4f8a-...	user12	user12@example.com	User	User12	Edit	Impersonate	Delete
13cf43a0-11d0-41a0-...	user13	user13@example.com	User	User13	Edit	Impersonate	Delete

5. Click **Impersonate** in the row of **Actions** for the user to display a table of all **Applications** this user has interacted with on the platform, including editor sessions and deployments.



Applications

Application	Available Roles	Granted Permissions	Additional Grants	Action
Account	Offline access , Manage account in **Account** , View profile in **Account**	**Full Access**		
my client	Offline access	**Full Access**		
Broker	Offline access	**Full Access**		
Anaconda Workspace Proxy	Anaconda Enterprise project deployer , Obtain permissions , Anaconda Enterprise package uploader , Anaconda Enterprise project creator , Offline access , Manage account in **Account** , View profile in **Account**	**Full Access**		
Anaconda Platform	Anaconda Enterprise project deployer , Obtain permissions , Anaconda Enterprise package uploader , Anaconda Enterprise project creator , Offline access , Manage account in **Account** , View profile in **Account**	**Full Access**	Offline Token	Revoke Grant
session_client_89747d7fdb154b89b182d5eaa25b2e59	Offline access	**Full Access**		
Anaconda Enterprise Notebooks	Anaconda Enterprise project deployer , Obtain permissions , Anaconda Enterprise	**Full Access**		

6. Click the **Anaconda Platform** link to interact with Workbench as the user.

See *Managing users* for more information on managing users.

5.3 Editor sessions

To help you troubleshoot issues with editor sessions, it might be helpful to understand what is happening “behind the scenes”.

- When a user starts a session, Workbench launches the appropriate editor for them to work with their project files. In the background, the editor environment and other services are running in Docker containers.
- To improve startup time for projects, the editor container includes conda environments for each of the *project template environments* provided by the platform. These environments are stored in `/opt/continuum/anaconda/envs`, along with any custom environments created *during the editor session*.
- The project repository is cloned into `/opt/continuum/project`. (Only changes to files in this directory can be saved to the repository.)
- The `anaconda-project prepare` command runs, scans the project’s `anaconda-project.yml` file for new packages and environments, and installs them into the running session.

  During this phase, you can monitor the progress by watching the output of `/opt/continuum/preparing`.

  When this process completes, the `/opt/continuum/prepare.log` is created.

Caution: Any changes made to the container image will be lost when the session stops, so any packages installed from the command line are available during the current session only. To persist package installs across sessions, they must be added to the project’s `anaconda-project.yml` file.

CHAPTER

SIX

REFERENCE MATERIALS

The following information is provided for your reference, to help you understand some of the core terminology used in Data Science & AI Workbench, and what changes were made between releases.

We also include answers to common questions you may have, and workarounds for known issues you may encounter while using the platform.

Additional information to help you get the most out of Anaconda features is available at https://support.anaconda.com/.

6.1 Release notes

The following notes are provided to help you understand the major changes made between releases, and therefore may not include minor bug fixes and updates. If you are experiencing issues using Data Science & AI Workbench, consider *reviewing the known issues documented here* to find workarounds.

6.1.1 Data Science & AI Workbench 5.8.1

Released: December 20, 2024

What's New

- The application has undergone a UI refresh for an improved user experience with a more modern look and feel.
- Administrative project session management has been added to the application.
- Filters have been added to the sample project gallery to help users locate sample projects efficiently.

Improvements

- GPU support for k3s has been added to the platform.

Security Updates

- UBI version has been updated to version 9.5
- code-server (VSCode) has been updated to version 4.95.2
- RStudio has been updated to v2024.09.1+394
- Keycloak has been updated to version 26.0.5
- **External version control repository supported versions have been updated:**
    - GitHub Enterprise Server - 2.15 through 3.14.1
    - Bitbucket Server/Data Center - 5.9.1 through 8.9.0

  - GitLab Self-Managed - 10.4.2 through 17.4

6.1.2 Data Science & AI Workbench 5.8.0

Released: July 29, 2024

What's New

- **New features have been included for additional cluster resource monitoring!**
  - A Kubernetes dashboard has been integrated to provide general information about cluster and pod health.
  - Prometheus has been integrated into the platform to expose system metrics.
  - Use Prometheus' AlertManager to establish and monitor system alerts, keeping you informed of your system's health and your users' resource consumption.
  - Grafana has been integrated as an optional component of Workbench! Customize dashboards to get at-a-glance information about your system's health.
- Support for installing on K3s—a certified, lightweight distribution of Kubernetes—has been included with this release of Workbench to provide an alternate implementation solution for our Gravity customers. Gravity customers need to migrate their clusters at their earliest convenience.

Improvements

- You can now change the timezone of your deployment.
- Residual zip files left behind from installation are now automatically cleaned up.
- Projects now include all commits made to the latest version of the project when it is downloaded, even if you did not tag a new version of the project.

Security Updates

- JupyterLab has been updated to version 4.0.11
- code-server (VSCode) has been updated to version 4.90.1
- RStudio has been updated to v2024.04.2+764
- Keycloak has been updated to version 24.0.5
- nginx-ingress has been updated to version 3.5.2
- UBI version has been updated to version 9.4-1123
- **Postgres support added for the following versions**
  - 16.3
  - 14.12
  - 12.19
  - 9.6.24

What's Fixed?

- Fixed a bug that falsely reported projects as "failed" if they took too long to start.
- Fixed a bug that caused scheduled jobs to intermittently fail.
- Fixed a bug that caused `anaconda-mirror` to encounter an SSL error.

- Fixed a bug that prevented files that were committed to a project without a version tag from being included when the project was downloaded.

6.1.3 Data Science & AI Workbench 5.7.1

Released: April 5, 2024

What's New

- Significant improvements have been made to the log viewing interface. Project and deployment logs now have a set window height, automatically scroll as information comes in, and provide search functionality, allowing you to locate information efficiently.
- Existing user secrets are now editable from the **Advanced Settings** page.

Improvements

- Pod metadata now contains more useful information, such as project name, project-session, project-deployment, and jobs.
- The **Scheduling** tab is now only available to users who have the `ae-deployer` role assigned to them.

Security Updates

- System pods have been updated to ubi9.3-1610.
- Keycloak has been updated to version 23.0.7.
- Angular has been updated to version 16.
- Incorporated security updates for a number of our core dependencies, including `sqlalchemy`, `nginx-ingress`, `pillow`, and `libwebp`.
- **Postgres support added for the following versions**
  - 16.2
  - 14.11
  - 12.18
  - 9.6.24

What's Fixed?

- Fixed a bug preventing notebook files from opening in VSCode.
- Fixed a bug that caused intermittent issues with scheduled jobs.

6.1.4 Data Science & AI Workbench 5.7.0

Released: November 7, 2023

What's New

- Anaconda Enterprise is now "Data Science & AI Workbench", or more simply, "Workbench".
- The Anaconda Assistant is available to install and use with your Jupyter Notebooks.
- You can now create branches within projects in Workbench for additional utility in collaborating on work.
- You can add tags to your projects and locate them quickly using the project tag filter.

Improvements

- Collaborators can now be added to projects and deployments when they are created.
- Additional UI has been added to include MLFlow in the left-hand navigation once installed.
- Projects can be configured to have reloadable MLFlow model endpoints so that the model can be retrained without having to restart the deployment.

Security Updates

- System pods have been updated to ubi9.
- Keycloak has been updated to version 22.0.5.
- Redis has been removed from the system images.
- **Postgres support added for the following versions**
    - 12.17
    - 9.6.24

What's Fixed?

- Fixed a bug that prevented scheduled jobs from converting back to run-once jobs.
- The **Manage Resources** button has been removed from BYOK8s installations.
- The UI pod recovers more gracefully if Redis is down.
- Various updates have been made to UI notification messages for consistency and clarity.

6.1.5 Anaconda Enterprise 5.6.2

Released: Aug 4, 2023

What's New

- MLFlow can now be installed as an optional component.
- Package license information is now available in the UI.
- You can now filter projects by owner.

Improvements

- Keycloak has been configured to apply the 'secure' flag to its cookies to prevent them from being sent over insecure HTTP connections.

Security Updates

- Several system images have been updated:
    - Python 3.11
    - Kubernetes 1.26
    - Keycloak 21.1.1
    - Angular 13.4.0
    - NodeJS 16.13.1
    - Redis 7.0.11
    - **Postgres support added for the following versions**
        - 12.13
        - 9.6.24

What's Fixed?

- Various UI bugs have been fixed.
- Fixed a bug that prevented collaborators from being removed from deployments/projects correctly.
- Fixed a bug that prevented users from saving changes to their projects from Jupyter lab sessions.

6.1.6 Anaconda Enterprise 5.6.1

Released: February 28, 2023

What's New

- Introducing: Project filtering!
  - Use the newly added filter on the project dashboard to sort your projects by owner and/or show only projects with active sessions.
  - Applied filters will also limit the results returned from using the **Search** field.
  - Applied filters persist as you navigate Anaconda Enterprise, and as you create and delete projects!
  - Hide the filter if you don't need it! You will still be informed if filters are being applied to your view.
- Projects dashboard improvements:
  - Newly created/uploaded/added projects are moved to the top left of the projects dashboard for 60 seconds. Once you refresh the dashboard, the project will be sorted into the "active sessions" group at the top of the dashboard, alphanumerically, according to its title.
  - Whenever you start a session for an existing project it is sorted into the "active sessions" group at the top of the dashboard, alphanumerically, according to its title. You will be returned to the top of the dashboard after starting the session.

Improvements

- Improved integration with Anaconda Server!
  - Use the same credentials to sign in to both Anaconda Server and Anaconda Enterprise!
  - Create secure channels by applying filters to mirrors in Anaconda Server, then use those channels with projects in Anaconda Enterprise!

Security Updates

- Several system images have been updated:
  - Base image to ubi8.7-1054
  - Redis to 7.0.8
  - Keycloak to 20.0.3
  - **Postgres support added for the following versions**
    - 12.13
    - 9.6.24

What's Fixed?

- Groups with an external version control system are no longer available when adding collaborators to a project from the project's **Share** page.
- The "Oil and Gas" sample project can now be deployed successfully.

- External version control credentials are now properly saved when entered.

6.1.7 Anaconda Enterprise 5.6.0

Released: October 3, 2022

What's New

- Keycloak has been upgraded to version 18.0.2 to resolve known vulnerabilities in the vendor-supplied containers for Keycloak. We've also eliminated AE5's direct access to the postgres database storing Keycloak's data. This information is now retrieved using Keycloak API calls.
- Documentation Updates:
  - Added instructions on how to use RStudio as an in browser IDE.
  - Updated instructions on how to wrap your python functions using `tranquilizer` and deploy them as REST API endpoints within AE5.
  - Updated instructions for upgrading between versions of AE5.
- JupyterLab has been updated to version 3.4.

Improvements

- Added a dashboard to view all of a user's scheduled jobs.
- A Python 3.10 environment has been added to the sample projects dashboard.
- Updated `openssl`, `ca-certificates`, `certifi`, and the Python minor version in each existing environment.
- UI improvements have been made for an overall better experience when deploying a project or scheduling a project for deployment.
- European date format is now accepted when committing to a job.

Security Updates

- Java has been removed from the editor image.
- Several system images have been updated:
  - Base image to ubi8.6-855
  - Redis to 6.2.7
  - Keycloak to 18.0.2
  - **Postgres support added for the following versions**
    - 12.12
    - 9.6.24

What's fixed?

- Users can now edit and delete jobs with an empty schedule (a.k.a. run once jobs). When a job is edited, it can be converted into a cronjob.
- User now has the ability to tag a commit in the UI after they have already committed all the code changes.
- Deleting a project now deletes all its job run records as well.
- Updated the error message that displays when a user attempts to use an invalid certificate.

6.1.8 Anaconda Enterprise 5.5.2

Released: March 10, 2022

What's New

- Added `libnsl.so.1` to the user container to enable database connections.
- Added Docker-free RStudio installation method by mounting a shared volume at `/usr/lib/rstudio-server`, writable (temporarily) by a standard Anaconda Enterprise user.
- Ensured that all of the following repo configurations can persist: `anaconda-client`, `conda-repo-cli`, and `conda-token`.
- **Eliminated the isolated package cache for deployments and jobs.**
  - Deployments and jobs get their own package cache, and therefore do not reuse the shared package cache users rely on for deployments, which slows down the conda install process for deployments.
- Added clear instructions for platform administrators to add projects to samples/templates, with the ability to rebuild index.json to include customer-driven indexing of the sample projects.

Improvements

- **Properly initialize storage and persistence subdirectories via Helm.**
  - The Helm install succeeds with managed persistence enabled, with empty storage and persistence directories.
  - **Once the pods stabilize all subdirectories should be properly created and permissioned:**
    - storage: `git`, `object`, `pgdata`
    - persistence: `projects`, `environments`, `gallery`
- **Ability to update the helm chart without forcing certs to be modified.**
  - Allows existing secrets to be preserved; eliminated `kube-system` ssl secret
  - **Added three different certificate generation modes:**
    - `generate` or boolean `True`: use our generateCerts helper
    - `load` or boolean `False`: load certificates from the certs/ subdirectory of the helm chart
    - any other string: do nothing
- **Updated "concurrencyPolicy" for cronjobs to prevent a cronjob from scheduling a new job if one is still running, by setting the "concurrencyPolicy" to "Forbid" for scheduled jobs.**
  - This will alleviate a scheduled job that had inadvertently used a deployment command instead of a batch job command, resulting in the job creating a new pod for each run of the job, all of which just stayed running eventually causing the total requests for these jobs to fill available memory.
- CVE-2020-36242 - Upgraded package `cryptography` to version 3.3.2 or above to address vulnerability.
- **Zeppelin has been updated to version 0.9.0 and made an installable tool**
  - https://zeppelin.apache.org/download.html
  - Note that Zeppelin seems not to support Python 3.8 or later yet.
- Updated "Run stopped" notification when a run is deleted, notification is now "Run Deleted successfully"
- **Improved behavior of the UI when the operation-controller API fails, so that when the UI is assembling the project grid it queries the operation-controller for the status of created jobs.**
  - If the operation-controller pod is restored to health, the full project list comes back and all is well.

  - If an error is detected, the user is notified that there was an error querying the project creation queue.

- **Quickly deleted projects will no longer show up in the project grid.**
  - The operation controller will omit from the list the jobs that are completed and removed from the project grid.
- Removed the free channel from the default `condarc`.
- Updated the project creation jobs to respect affinity settings, which are now present in the yaml file.

Bug Fixes

- **Corrected job scheduling with Kubernetes - Since Kubernetes behaves according to its default behavior, a job that exits with a non-zero exit code causes Kubernetes to retry the exact same task over again.**
  - Currently, AE5 looks at the job and only runs it once (success or failure) since our backend monitors the execution of jobs, and if a re-attempt is launched, AE5 actually detects that and shuts it down.
  - This can cause an issue since there's a chance that user code is run twice and the user may be unaware of this.
  - Setting the Kubernetes "backoffLimit" parameter to `0` will ensure that the retries are fully suppressed.
- Corrected the api.py loop in `anaconda-enterprise-cli` to perform retries with backoff in response to "SSLError" or "ConnectionError" exceptions.
- Updated `cas-mirror` to correct error when updating an existing channel with new packages via mirroring; "Error DECRYPTION_FAILED_OR_BAD_RECORD_MAC"
- **Whitelisted a set of environment variables and placed them in `.Renviron`. This whitelist currently does not include admin-supplied variables such as `HTTPS_PROXY`.**
  - RStudio does not pass proxy variables through to the user.
  - RStudio Server filters out all of the environment variables before starting a session.
- **Corrected corrupt anaconda-platform.yml preventing git commit.**
  - When the anaconda-platform.yml file within a tagged commit cannot be parsed for any reason, the attempted git commit will fail.
  - This is due to an unexpected error in the post-metadata.py file.
  - User must remove the offending tags (this must be done even if the corruption is detected and fixed; commits will still fail).
- **Corrected the AE5 deployment restart to respect git version tag.**
  - The version is the same as the original deployment versus changing to latest.
- **Corrected issue where deleting a deployment would lead to UI timeout errors; "HTTP 599 Timeout error"**
  - This is caused because of the `shutil.rmtree` call inside the directory deletion process.
  - Corrected by discarding the directory and let user session CPU cycles clean them up on background.
- Corrected the ability to edit a scheduled job so that, when you perform a new run, the scheduled job will use the new version you specify.
- **Corrected managed persistence GID to be preserved by changing the primary group of the user process from `0` to the GID of `/opt/continuum/project`.**
  - GID `0` should still be offered as a supplemental group to ensure that all existing files are accessible.
- **Corrected uploading large size files. The commit should now be successful.**
  - max-commit-file-size is `50000000`.

- **Updated the openldap library.**
  - Optionally, you can install openldap 2.4 in the R conda environment to fix the RStudio issue due to broken openldap package.

6.1.9 Anaconda Enterprise 5.5.1

Released: August 23, 2021

Expanded support for Bring Your Own Kubernetes

- **Updated internal Kubernetes API support to include versions up to 1.21**
  - Previous versions of AE5 were limited to Kubernetes 1.15 and earlier, which are no longer available in most environments.
  - **Verified on multiple Kubernetes offerings**
    - Google Kubernetes Engine (GKE)
    - Amazon Elastic Kubernetes Service (EKS)
    - OpenShift (up to OCP 4.7)
  - Tested with Anthos/GKE and OpenShift on-prem
- **Expanded support for Managed Persistence volumes**
  - AE 5.5.1 allows the administrator to specify a custom group ID (GIDs) for the mounted volume, in order to support a wider variety of attached storage providers

User-facing changes

- Improved upon the “session failed” notification: when a session is started on the project grid page, a spinner now shows the session is working in the background.
- Collaborator can be successfully removed from a project (from the UI), and a project with at least one collaborator can be successfully deleted.
- If you use an internal proxy for accessing external resources, you can (and should) set the global proxy in `anaconda-enterprise-env-var-config` and restart the workspace pod. This will enable the session to start successfully.
- Changed the value of `kubernetes.run_as_root` from *false* to *true* in the configmap, so that sessions, deployments, and jobs will run as UID from the start. This enables features like authenticated NFS and the sparkconfig script. This also resolved the issue with sessions taking a long time to open.
- Values you put in `conda.other_variables` appear in the log list and are available in sessions, deployments, and job.
- JupyterLab and Jupyter Notebook both notify the user that the session is ready instead of the “failed to start session” message.
- Corrected an issue in the UI pod where, when a user deletes a session, the UI will still ask for file changes (e.g. the git commit UI) before it completely cleans out references to that session, causing a traceback.
- Corrected the traceback that occurred whenever a user closed or navigated away from a window with JupyterLab running.
- **Fixed the dnf issue related to the new repo added for sssd.**
  - Launch a session

  - Open a terminal
  - **Run sudo dnf list , which should not cause errors:**
    - `sudo dnf install --installroot=/opt vim 2`
    - `Sudo dnf list`
- Ability to successfully commit, push and/or revert the commit from cli.
- Resolved an issue with JupyterLab staying on screen when a session is stopped. Users are unlikely to have two JupyterLab windows open, but even when a user does, and they stop the underlying session in one window, it should be understood that the other window will lose its connection as well. The main window will go back to the "No open sessions" page.
- Resolved an issue around config file secrets, where run-once and scheduled jobs were not getting the spark-config config file secret. As a result, the sssd.conf was not set up properly for authenticated NFS on jobs.
- Modified the startup logic so that 1) all project sessions can share a common package cache, and 2) deployments and jobs get their own separate package cache.
- A proper validation message will now be displayed when saving web certificates to inform the user which field the error is coming from.
- Ability to allow `/opt/continuum/project` to persist, allowing the existing volume mount support to apply to `/opt/continuum/project` and not lose uncommitted data. This will ensure any changes the user has made to the conda environment will be properly encapsulated into changes to `anaconda-project.yml`.
- Documented a new volume configuration syntax: *Mounting an external file share*.
- Clarified steps for migrating projects to or from Bitbucket repository in the instructions for *migrating projects between repositories*. If a user wants to migrate to or from Bitbucket repository, they must use their Bitbucket account ID instead of Bitbucket username in the user mappings file.
- In sessions and deployments, you now have the ability to comment out environment variables or add a digit in the name of the global variable within `env-var-config.yml`.

6.1.10 Anaconda Enterprise 5.5.0

Released: April 14, 2021

Administrator-facing changes

- **Support for installation on customer-supplied Kubernetes platforms**
  - Initial release: support for OpenShift 4.2 and GKE with k8s 1.15 or earlier
  - Additional platforms and OCP/k8s versions to come in a fast-follow release
- **Managed Persistence: leverages a persistent, shared volume, allowing administrators to easily customize:**
  - Sample and template projects
  - Pre-baked conda environments

User-facing changes

- **Managed Persistence: Users benefit from persistent storage of relevant content, with appropriate user-level and project-level access controls:**
  - Project session code, data, and conda environments
  - Server and database credentials, software preferences

- **Worked on several key areas to ensure the release meets the requirements outlined by customers:**
    - Error and warning notification
    - Scheduling workflow
    - Log workflow
    - User Interface
    - Improved experience with projects, search, authentication
    - Improved support and updates which include validation of sample projects along with template environments & `lab_launch` environment

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6.1.11 Anaconda Enterprise 5.4.1

Released: April 15, 2020

Administrator-facing changes

- Updated *minimum and recommended requirements*
- You can now **configure size limits for files** (Default value of 50MB) being committed into the internal git by changing the related values on the *config map flag*. This ensures that projects don't get bogged down by oversized internal storage. Anaconda recommends keeping files below 50MB and using external file storage for large data sets. (AENT-5922)
- You can now **set the number of max concurrent queue jobs** and **enable/disable project creation** with a queue using a *config map flag*. By implementing a queue, Kubernetes jobs for project creation are performed only when resources are available, ensuring that project creation doesn't fail due to lack of cluster resources. (AENT-5801)
- Default **SSO Timeout increased** to 1 day.

User-facing changes

- You now have the ability to **see whether your project is in the queue** or actively being created.
- You will now be **alerted when your commits fail**, saving time and work.
- You can now **schedule your deployment in multiple timezones** via a dropdown in the Scheduler UI. Note that these scheduled deployment times will be displayed in UTC.
- You can now **access public channels and deployments** if not added as collaborators.
- **CRON string validation** has been added to schedules UI.

Backend improvements (non-visible changes)

- There was an issue with users trying to create multiple projects at a time, overwhelming the cluster resources and ultimately causing some projects to fail to create. We've fixed that by **implementing a job queue**, limiting the number of simultaneous project creations based on configuration and available system resources.
- GPU support fixed, **built on CUDA 10.x**.
- Job pods **automatically clean up** upon completion of jobs.

6.1.12 Anaconda Enterprise 5.4.0

Released: October 31, 2019

Administrator-facing changes

- Updated *minimum and recommended requirements*
- Added support for installing the Anaconda Enterprise cluster on *Centos/RHEL 7.7, 8.0*
- Upgraded Gravity to version 6.1.9 (and Kubernetes 1.15.05) with updated *monitoring dashboards*
- Ability to configure external Postgres database
- Authenticated NFS mounts
- Customize Sample Gallery and new project template collection. Requires AE5 Tools.

User-facing changes

- New UI look-and-feel
- New *sample gallery projects*
- Fixed JupyterLab and Jupyter Notebook timeout
- Upgraded Conda to version 4.6.14 and anaconda-project to version 0.8.3. Provide faster package installs and improved error messages
- NFS mounts now work with scheduled jobs

Backend improvements (non-visible changes)

- Upgraded nginx to version 1.17.2, which uses nginx-ingress version 1.5.2, to address CVEs.

6.1.13 Anaconda Enterprise 5.3.1

Released: July 17, 2019

Administrator-facing changes

- Added support for using *on-premises versions of Bitbucket and GitLab*, and removed the previous requirement to connect to your repository endpoint over SSL.
- Added support for installing the Anaconda Enterprise cluster on *RHEL/CentOS 7.6*.
- Added support for NVIDIA CUDA 10.0 drivers on *GPU worker nodes*.
- Added the ability to *set global environment variables via a new configuration file*, making them available across all containers. This method can be used to *address the issue* where values in custom `.condarc` files could be overwritten if the file was placed in a directory of "lower priority" that the user's home directory.

User-facing changes

- Patched JupyterLab and Jupyter Notebook to address "session timeout" and "failed to fetch" issues. Users may still see an error, but if they reload their notebook, they can continue working without losing any work.
- Fixed issue where users were being asked to confirm the environment when creating a project from the Hadoop-Spark template.
- Fixed issue where the UI makes it appear that changes made by collaborators on a project have not been committed, when they have been, leading the user to believe that an error has occurred.
- Improved the usability of the *Schedules UI*.

Backend improvements (non-visible changes)

- Upgraded Jupyter Notebook to version 5.7.8 to address CVEs.

6.1.14 Anaconda Enterprise 5.3.0

Released: March 22, 2019

Administrator-facing changes

- Increased the *minimum and recommended disk space requirements* for the master node.
- Added recommendation to setup partitions on the master node using Logical Volume Management (LVM) to accommodate easier future expansion.
- Added `noarch` to the default platforms in the `anaconda.yaml` mirror config file.
- Added a bootstrap executable that you can run to install conda to the Anaconda Enterprise installer.
- Changed the process for *installing and configuring the Anaconda Enterprise cli and cas-mirror* slightly.

User-facing changes

- Added ability to *deploy projects* to user-supplied, static URLs.
- Improved UI notifications on behind-the-scenes processes, and added a Notification Center.
- Optimized database operations and made other performance improvements.
- Added a sample project for connecting to an S3 bucket.
- Fixed issue where users couldn't use Kerberos authentication (kinit) to access a Spark/Hadoop cluster from within a notebook.
- Fixed issue where incorrect default kernels were being used for projects created from the Hadoop-Spark template.
- Improved error message handling to clarify errors and provide instructions on how to workaround or recover from them.
- Added usability improvements related to scheduling deployment runs, audit trail logging, and session initialization.

6.1.15 Anaconda Enterprise 5.2.4

Released: January 21, 2019

Administrator-facing changes

- Fixed issue where custom resource profiles weren't being captured during in-place upgrades.
- Added security fixes.

6.1.16 Anaconda Enterprise 5.2.3

Released: January 2, 2019

- Included fix to address a vulnerability in Kubernetes which allowed for permission escalation. You can learn more about the vulnerability here.

User-facing changes

- Added ability for users to store secrets that can be used to access file systems, data stores and other enterprise resources from within sessions and deployments. Any secrets added to the platform will be available across all projects associated with the user's account. For more information, see *Secrets*.
- Fixed issue that required users to modify the `anaconda-project.yml` file to make the Hadoop-Spark environment template work properly.
- Added ability to view each project's owner, and sort the list of projects based on this column.
- Fixed various issues to improve project and session performance.

6.1.17 Anaconda Enterprise 5.2.2

Released: October 10, 2018

Administrator-facing changes

- Added ability to configure an external Git repository (instead of the internal Git repository) to store projects containing version-controlled notebooks, code, and other files. Supported external Git version control systems include Atlassian BitBucket, GitHub and GitHub Enterprise, and GitLab.
- Administrators can optionally configure GPU worker nodes to be used only for sessions and deployments that require a GPU (by preventing CPU-only sessions and deployments from accessing GPU resources).
- In-place upgrades can now be performed from AE 5.2.x to AE 5.2.2.
- Improved functionality in backup script related to backup location and disk capacity requirements.
- Implemented multiple security enhancements related to cache control headers, HTTP strict transport security, and default ciphers and protocols across all services.
- Administrators no longer need to generate separate TLS/SSL certificates for the Operations Center.
- Improved validation of custom TLS/SSL certificates in the Administrator Console.
- Administrators can now disable access to `sudo yum` operations in sessions across the platform.
- Fixed an issue related to orphaned clients for sessions and deployments not being removed from Authentication Center.
- Tokens for user notebook sessions and deployments are now stored in encrypted format.
- Renamed platform-wide conda settings to `default_channels`, `channel_alias`, `ssl_verify` settings in the `conda` section of configmap to be consistent with `conda` configuration settings.
- Administrators can now specify the channel priority order when creating environments/installers.
- Fixed an issue related to sorting of package versions when creating environments/installers.
- Fixed an issue with download links for custom Anaconda parcels.
- Improved behavior of package mirroring tool to only remove existing packages when clean mode is active.
- Fixed an issue related to mirroring pip packages from PyPI repository.

- Added support for noarch packages in package mirroring tool.
- Improved logging and error handling in package mirroring tool.
- Fixed an issue related to projects failing to be created due to special characters in usernames.
- Fixed an issue related to authorization center errors when syncing large number of users from external identity providers.
- Added logout functionality to anaconda-enterprise-cli.

User-facing changes

- Apache Zeppelin is now available as a notebook editor for projects (in addition to Jupyter Notebooks and JupyterLab). Apache Zeppelin is a web-based notebook that enables data-driven, interactive data analytics and collaborative documents with interpreters for Python, R, Spark, Hive, HDFS, SQL, and more.
- Conda channels in the repository can be made publicly available (default), or access can be restricted to specific authenticated users or groups.
- A single notebook kernel (associated with the active conda environment used within a project) is now displayed by default in Jupyter Notebooks and JupyterLab.
- Collaborators can now select a different default editor for projects that have been shared with them.
- Implemented various fixes to configuration parameters for scheduled jobs within a project.
- Improved input/form validation related to projects, deployments, packages, and settings across the platform.
- Improved error messaging/handling across the platform, along with the ability to view errors and logs from underlying services.
- Improved notifications for tasks such as uploading projects and copying sample projects.
- Users are now prompted to delete all related sessions, deployments, jobs, and runs (including those used by collaborators) when deleting a project.
- Fixed an issue that caused numerous erroneous job runs to be spawned based on the default job scheduling parameters.

6.1.18 Anaconda Enterprise 5.2.1

Released: August 30, 2018

User-facing changes

- Fixed issue with loading spinner appearing on top of notebook sessions
- Fixed issue related to missing projects and copying sample projects when upgrading from AE 5.1.x
- Improved visual feedback when loading notebook sessions/deployments and performing actions such as creating/copying projects

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6.1.19 Anaconda Enterprise 5.2.0

Released: July 27, 2018

Administrator-facing changes

- New administrative console with workflows for managing channels and packages, creating installers, and other distinct administrator tasks
- Added ability to mirror pip packages from PyPI repository
- Added ability to define custom hardware resource profiles based on CPU, RAM, and GPU for user sessions and deployments
- Added support for GPU worker nodes that can be defined in resource profiles
- Added ability to explicitly install different types of master nodes for high availability
- Added ability to specify NFS file shares that users can access within sessions and deployments
- Significantly reduced the amount of time required for backup/restore operations
- Added channel and package management tasks to UI, including downloading/uploading packages, creating/sharing channels, and more
- Anaconda Livy is now included in the Anaconda Enterprise installer to enable remote Spark connectivity
- All network traffic for services is now routed on standard HTTPS port 443, which reduces the number of external ports that need to be configured and accessed by end users
- Notebook/editor sessions are now accessed via subdomains for security and isolation
- Reworked documentation for administrator workflows, including managing cluster resources, configuring authentication, generating custom installers, and more
- Reduced verbosity of console output from anaconda-enterprise-cli
- Suppressed superfluous database errors/warnings

User-facing changes

- Added support for selecting GPU hardware in project sessions and deployments, to accelerate model training and other computations with GPU-enabled packages
- Added ability to select custom hardware resource profiles based on CPU, RAM, and GPU for individual sessions and deployments
- Added support for scheduled and batch jobs, which can be used for recurring tasks such as model training or ETL pipelines
- Added support for connecting to external Git repositories in a project session or deployment using account-wide credentials (SSH keys or API tokens)
- New, responsive user interface, redesigned for data science workflows
- Added ability to share deployments with unauthenticated users outside of Anaconda Enterprise
- Changed the default editor in project sessions to Jupyter Notebooks (formerly JupyterLab)
- Added ability to specify default editor on a per-project basis, including Jupyter Notebooks and JupyterLab
- Added ability to work with data in mounted NFS file shares within sessions and deployments
- Added ability to export/download projects from Anaconda Enterprise to local machine
- Added package and channel management tasks to UI, including uploading/downloading packages, creating/sharing channels, and more

- Reworked documentation for data science workflows, including working with projects/deployments/packages, using project templates, machine learning workflows, and more
- Added ability to use plotting/Javascript libraries in JupyterLab
- Added ability to force delete a project with running sessions, shared collaborators, etc.
- Improved messaging when a session or deployment cannot be scheduled due to limited cluster resources
- The last modified date/time for projects now accounts for commits to the project
- Unique names are now enforced for projects and deployments
- Fixed bug in which project creator role was not being enforced

Backend improvements (non-visible changes)

- Updated to Kubernetes 1.9.6
- Added RHEL/CentOS 7.5 to supported platforms
- Added support for SELinux passive mode
- Anaconda Enterprise now uses the Helm package manager to manage and upgrade releases
- New version (v2) of backend APIs with more comprehensive information around projects, deployments, packages, channels, credentials and more
- Fixed various bugs related to custom Anaconda installer builds
- Fixed issue with `kube-router` and a `CrashLoopBackOff` error

6.1.20 Anaconda Enterprise 5.1.3

Released: June 4, 2018

Backend improvements (non-visible changes)

- Fixed issue when generating custom Anaconda installers that contain packages with duplicate files
- Fixed multiple issues related to memory errors, file size limits, and network transfer limits that affected the generation of large custom Anaconda installers
- Improved logging when generating custom Anaconda installers

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6.1.21 Anaconda Enterprise 5.1.2

Released: March 16, 2018

Administrator-facing changes

- Fixed issue with image/version tags when upgrading AE

Backend improvements (non-visible changes)

- Updated to Kubernetes 1.7.14

6.1.22 Anaconda Enterprise 5.1.1

Released: March 12, 2018

Administrator-facing changes

- Ability to specify custom UID for service account at install-time (default UID: 1000)
- Added pre-flight checks for kernel modules, kernel settings, and filesystem options when installing or adding nodes
- Improved initial startup time of project creation, sessions, and deployments after installation. Note that all services will be in the `ContainerCreating` state for 5 to 10 minutes while all AE images are being pre-pulled, after which the AE user interface will become available.
- Improved upgrade process to automatically handle upgrading AE core services
- Improved consistency between GUI- and CLI-based installation paths
- Improved security and isolation between internal database from user sessions and deployments
- Added capability to configure a custom trust store and LDAPS certificate validation
- Simplified installer packaging using a single tarball and consistent naming
- Updated documentation for system requirements, including XFS filesystem requirements and kernel modules/settings
- Updated documentation for mirroring packages from channels
- Added documentation for configuring AE to point to online Anaconda repositories
- Added documentation for securing the internal database
- Added documentation for configuring RBAC, role mapping, and access control
- Added documentation for LDAP federation and identity management
- Improved documentation for backup/restore process
- Fixed issue when deleting related versions of custom Anaconda parcels
- Added command to remove channel permissions
- Fixed issue related to Ops Center user creation in post-install configuration
- Silenced warnings when using `verify_ssl` setting with `anaconda-enterprise-cli`
- Fixed issue related to default admin role (`ae-admin`)
- Fixed issue when generating TLS/SSL certificates with FQDNs greater than 64 characters
- Fixed issue when using special characters with AE Ops Center accounts/passwords
- Fixed bug related to Administrator Console link in menu

User-facing changes

- Improvements to collaborative workflow: Added notification when collaborators make changes to a project, ability to pull changes into a project, and ability to resolve conflicting changes when saving or pulling changes into a project.
- Additional documentation and examples for connecting to remote data and compute sources: Spark, Hive, Impala, and HDFS
- Optimized startup time for Spark and SAS project templates

- Improved initial startup time of project creation, sessions, and deployments by pre-pulling images after installation.
- Increased upload limit of projects from 100 MB to 1 GB
- Added capability to `sudo yum install` system packages from within project sessions
- Fixed issue when uploading projects that caused them to fail during partial import
- Fixed R kernel in R project template
- Fixed issue when loading `sparklyr` in Spark Project
- Fixed issue related to displaying kernel names and Spark project icons
- Improved performance when rendering large number of projects, packages, etc.
- Improved rendering of long version names in environments and projects
- Render full names when sharing projects and deployments with collaborators
- Fixed issue when sorting collaborators and package versions
- Fixed issue when saving new environments
- Fixed issues when viewing installer logs in IE 11 and Safari

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6.1.23 Anaconda Enterprise 5.1.0

Released: January 19, 2018

Administrator-facing changes

- New post-installation administration GUI with automated configuration of TLS/SSL certificates, administrator account, and DNS/FQDN settings; significantly reduces manual steps required during post-installation configuration process
- New functionality for administrators to generate custom Anaconda installers, parcels for Cloudera CDH, and management packs for Hortonworks HDP
- Improved backup and restore process with included scripts
- Switched from groups to roles for role-based access control (RBAC) for Administrator and superuser access to AE services
- Clarified system requirements related to system modules and IOPS in documentation
- Added ability to specify fractional CPUs/cores in global container resource limits
- Fixed consistency of TLS/SSL certificate names in configuration and during creation of self-signed certificates
- Changed use of `verify_ssl` to `ssl_verify` throughout AE CLI for consistency with `conda`
- Fixed configuration issue with licenses, including field names and online/offline licensing documentation

User changes

- Updated default project environments to Anaconda Distribution 5.0.1
- Improved configuration and documentation on using Sparkmagic and Livy with Kerberos to connect to remote Spark clusters
- Fixed R environment used in sample projects and project template
- Fixed UI rendering issue on package detail view of channels, downloads, and versions

- Fix multiple browser compatibility issues with Microsoft Edge and Internet Explorer 11
- Fixed multiple UI issues with Anaconda Project JupyterLab extension

Backend improvements (non-visible changes)

- Updated to Kubernetes 1.7.12
- Updated to conda 4.3.32
- Added SUSE 12 SP2/SP3, and RHEL/CentOS 7.4 to supported platform matrix
- Implemented TLS 1.2 as default TLS protocol; added support for configurable TLS protocol versions and ciphers
- Fixed default superuser roles for repository service, which is used for initial/internal package configuration step
- Implemented secure flag attribute on all session cookies containing session tokens
- Fixed issue during upgrade process that failed to vendor updated images
- Fixed `DiskNodeUnderPressure` and cluster stability issues
- Fixed Quality of Service (QoS) issue with core AE services on under-resourced nodes
- Fixed issue when using access token instead of ID token when fetching roles from authentication service
- Fixed issue with authentication proxy and session cookies

Known issues

- IE 11 compatibility issue when using Bokeh in notebooks (including sample projects)
- IE 11 compatibility issue when downloading custom installers

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6.1.24 Anaconda Enterprise 5.0.6

Released: November 9, 2017

6.1.25 Anaconda Enterprise 5.0.5

Released: November 7, 2017

6.1.26 Anaconda Enterprise 5.0.4

Released: September 12, 2017

6.1.27 Anaconda Enterprise 5.0.3

Released: August 31, 2017 (General Availability Release)

6.1.28 Anaconda Enterprise 5.0.2

Released: August 15, 2017 (Early Adopter Release)

6.1.29 Anaconda Enterprise 5.0.1

Released: March 8, 2017 (Early Adopter Release)

Features:

- Simplified, one-click deployment of data science projects and deployments, including live Python and R notebooks, interactive data visualizations and REST APIs.
- End-to-end secure workflows with SSL/TLS encryption.
- Seamlessly managed scalability of the entire platform
- Industry-grade productionization, encapsulation, and containerization of data science projects and applications.

6.2 Known issues

We are aware of the following issues using Data Science & AI Workbench. If you're experiencing other unexpected behavior, consider checking our Support Knowledge Base.

6.2.1 Project is stuck in loading state on creation when email address is used as username

You cannot use an email address for a username in Workbench. If your username is an email address and you attempt to create a project, it will appear to be stuck in a loading state. The project will disappear when you refresh the page.

Workaround

Log in to your Keycloak admin console and update the username to some other entry that is not an email address. Usernames cannot be all numeric entries.

6.2.2 Subsequent Jobs using the "Run Now" schedule do not consume GPU resources

When scheduling a job using the "Run Now" schedule, the first run will consume GPU resources if a GPU resource profile is used. Each subsequent job after the first will not consume a GPU resource when the **Run schedule** button is used.

Please note that this only occurs when the **Run schedule** button is selected multiple times for a job that is scheduled using the "Run Now" schedule. This does not affect any job scheduled with a cron expression.

Workaround

Do not run the same job multiple times on the "Run Now" schedule, using the **Run schedule** button. Instead, schedule the job with a cron expression.

6.2.3 Unable to obtain Zeppelin credentials

After selecting **Credential** and clicking the question mark icon in the Zeppelin editor, the user should be redirected to Zeppelin documentation explaining the process for obtaining credentials. However, that link is broken.

Workaround

Rather than committing something sensitive in your code/repository through Zeppelin, create a Kubernetes secret in JSON format.

6.2.4 Attempting to install new PyViz packages in JupyterLab results in error

The new PyViz libraries aren't compatible with the version of JupyterLab used in Workbench. For more information on PyViz compatibility, see https://github.com/pyviz/pyviz_comms#compatibility.

Workaround

Open the project in Jupyter Notebook.

6.2.5 Unable to download files when running JupyterLab in Chrome browser

If you attempt to download a file from within a JupyterLab project running on Chrome, you may see a `Failed/Forbidden` error, preventing you from being unable to download the file.

Workaround

Open the project in Jupyter Notebook or another supported browser, such as Firefox or Safari, and download the file.

6.2.6 Unexpected metadata in a package breaks Workbench channel

The `cspice` and `spiceypy` packages mirrored from conda-forge include incompatible metadata, which causes a `channeldata.json` build failure, and makes the entire channel inaccessible.

Workaround

Remove these packages from the Workbench channel, or update your conda-forge mirror to pull in the latest packages.

6.2.7 Custom conda configuration file may be overwritten

If you add a custom `.condarc` file to your project using the `anaconda-enterprise-cli spark-config` command, it may get overwritten with the default config options when you deploy the project.

Workaround

Place the `.condarc` file in a directory other than your home directory (`/opt/continuum/.condarc`).

Note that the conda config settings are loaded from all of the files on the conda config search path. The config settings are merged together, with keys from higher priority files taking precedence over keys from lower priority files. If you need extra settings, start by adding the `.condarc` file to a lower priority file first and see if this works for you.

For more information on how directory locations are prioritized, see this blog post.

Starting in Workbench 5.3.1, you can also *set global config variables via a config map*, as an alternative to using the Workbench CLI.

6.2.8 Incorrect information in command output

When running the `anaconda-enterprise-cli spark-config` command to *connect to a remote Hadoop Spark cluster from within a project*, the output says you need to specify the namespace by including `-n anaconda-enterprise`.

Workaround

You must omit `-n anaconda-enterprise` from the command, as Workbench is installed in the `default` namespace.

6.2.9 Error creating an environment immediately after installation

At least one project must exist on the platform before you can *create an environment*. If you attempt to create an environment first, the logs will say that the associated job is `running`, and the container isn't ready.

Workaround

Create a project first. The environment creation process will continue and successfully complete after a few minutes.

6.2.10 Cluster performance may degrade after extended use

The default limit for `max_user_watches` may be insufficient, and can be increased to improve cluster longevity.

Workaround

Run the following command *on each node in the cluster*, to help the cluster remain active:

```
sysctl -w fs.inotify.max_user_watches=1048576
```

To ensure this change persists across reboots, you'll also need to run the following command:

```
sudo echo -e "fs.inotify.max_user_watches = 1048576" > /etc/sysctl.d/10-fs.inotify.max_
↪user_watches.conf
```

6.2.11 Invalid issuer URL causes library to get stuck in a sync loop

When using the Workbench Operations Center to create an OIDC Auth Connector, if you enter an invalid issuer url in the spec, the `go-oidc` library can get stuck in a sync loop. This will affect *all* connectors.

Workaround

On a single node cluster, you'll need to do the following shut down gravity:

1. Find the gravity services: `systemctl list-units | grep gravity`.

   You will see output like this:

   ```
   # systemctl list-units | grep gravity
   gravity__gravitational.io__planet-master__0.1.87-1714.service          loaded␣
   ↪active running
       Auto-generated service for the gravitational.io/planet-master:0.1.87-1714␣
   ↪package
   gravity__gravitational.io__teleport__2.3.5.service                      loaded␣
   ↪active running
       Auto-generated service for the gravitational.io/teleport:2.3.5 package
   ```

2. Shut down the `teleport` service:

```
systemctl stop gravity__gravitational.io__teleport__2.3.5.service
```

3. Shut down the `planet-master` service:

   ```
   systemctl stop gravity__gravitational.io__planet-master__0.1.87-1714.service
   ```

On a multi-node cluster, you'll need to shut down gravity AND all `gravity-site` pods:

```
kubectl delete pods -n kube-system gravity-site-XXXXX
```

In both cases, you'll need to restart gravity services:

```
systemctl start gravity__gravitational.io__planet-master__0.1.87-1714.service
systemctl start gravity__gravitational.io__teleport__2.3.5.service
```

6.2.12 GPU affinity setting reverts to default during upgrade

When upgrading Workbench from a version that supports the ability to reserve GPU nodes to a newer version (e.g., 5.2.x > 5.2.3), the `nodeAffinity` setting reverts to the default value, thus allowing CPU sessions and deployments to run on GPU nodes.

Workaround

If you had commented out the `nodeAffinity` section of the Config map in your previous installation, you'll need to do so again after completing the upgrade process. See *Setting resource limits* for more information.

6.2.13 Install and post-install problems

Failed installations

If an installation fails, you can view the failed logs as part of the support bundle in the failed installation UI.

After executing `sudo gravity enter` you can check `/var/log/messages` to troubleshoot a failed installation or these types of errors.

After executing `sudo gravity enter` you can run `journalctl` to look at logs to troubleshoot a failed installation or these types of errors:

```
journalctl -u gravity-23423lkqjfefqpfh2.service
```

Note: Replace `gravity-23423lkqjfefqpfh2.service` with the name of your gravity service.

You may see messages in `/var/log/messages` related to errors such as "etcd cluster is misconfigured" and "etcd has no leader" from one of the installation jobs, particularly `gravity-site`. This usually indicates that `etcd` needs more compute power, needs more space or is on a slow disk.

Workbench is very sensitive to disk latency, so we usually recommend using a better disk for `/var/lib/gravity` on target machines and/or putting `etcd` data on a separate disk. For example, you can mount `etcd` under `/var/lib/gravity/planet/etcd` on the hosts.

After a failed installation, you can *uninstall Workbench* and start over with a fresh installation.

Failed on pulling gravitational/rbac

If the node refuses to install and fails on pulling gravitational/rbac, create a new directory `TMPDIR` before installing and provide write access to user 1000.

“Cannot continue” error during install

This bug is caused by a previous failure of a kernel module check or other preflight check and subsequent attempt to reinstall.

Stop the install, make sure the preflight check failure is resolved, and restart the install again.

Problems during post-install or post-upgrade steps

Post-install and post-upgrade steps run as Kubernetes jobs. When they finish running, the pods used to run them are **not** removed. These and other stopped pods can be found using:

```
kubectl get pods -A
```

The logs in each of these three pods will be helpful for diagnosing issues in the following steps:

Pod	Issues in this step
`ae-wagonwheel`	post-install UI
`install`	installation step
`postupdate`	post-update steps

Post-install configuration doesn’t complete

After completing the post-install steps, clicking **FINISH SETUP** may not close the screen, and prevent you from continuing.

You can complete the process by running the following commands within gravity.

To determine the site name:

```
SITE_NAME=$(gravity status --output=json | jq '.cluster.token.site_domain' -r)
```

To complete the post-install process:

```
gravity --insecure site complete
```

Re-starting the post-install configuration

In order to reinitialize the post-install configuration UI—to regenerate temporary (self-signed) SSL certificates or re-configure the platform based on your domain name—you must re-create and re-expose the service on a new port.

First, export the deployment’s resource manifest:

```
helm template --name anaconda-enterprise /var/lib/gravity/local/packages/unpacked/
↪gravitational.io/AnacondaEnterprise/5.X.X/resources/Anaconda-Enterprise/ -x /var/lib/
↪gravity/local/packages/unpacked/gravitational.io/AnacondaEnterprise/5.X.X/resources/
↪Anaconda-Enterprise/templates/wagonwheel.yaml > wagon.yaml
```

Edit `wagon.yaml`, replacing `image: ae-wagonwheel:5.X.X` with `image: leader.telekube.local:5000/ae-wagonwheel:5.X.X`

Then recreate the ae-wagonwheel deployment using the updated YAML file:

```
kubectl create -f /var/lib/gravity/site/packages/unpacked/gravitational.io/
↪AnacondaEnterprise/5.X.X/resources/wagon.yaml -n kube-system
```

Note: Replace 5.X.X with your actual version number.

To ensure the deployment is running in the system namespace, execute `sudo gravity enter` and run:

```
kubectl get deploy -n kube-system
```

One of these should be `ae-wagonwheel`, the post-install configuration UI. To make this visible to the outside world, run:

```
kubectl expose deploy ae-wagonwheel --port=8000 --type=NodePort --name=post-install -n kube-system
```

This will run the UI on a new port, allocated by Kubernetes, under the name `post-install`.

To find out which port it is listening under, run:

```
kubectl get svc -n kube-system | grep post-install
```

Then navigate to `http://<your domain>:<this port>` to access the *post-install UI*.

6.2.14 Kernel parameters may be overwritten and cause networking errors

If networking starts to fail in Workbench, it may be because a kernel parameter related to networking was inadvertently overwritten.

Workaround

On the master node running Workbench, run `gravity status` and verify that all kernel parameters are set correctly. If the `Status` for a particular parameter is `degraded`, follow *the instructions here* to reset the kernel parameter.

6.2.15 Removing collaborator from project with open session generates error

If you remove a collaborator from a project while they have a session open for that project, they might see a `500 Internal Server Error` message.

Workaround

Add the user as a collaborator to the project, have them stop their notebook session, then remove them as a collaborator. For more information, see *how to share a project*.

To prevent collaborators from seeing this error, ask them to close their running session before you remove them from the project.

Affected versions

5.2.x

6.2.16 Workbench auth pod throws OutOfMemory Error

If you see an exception similar to the following, Workbench has exceeded the maximum heap size for the JVM:

```
Exception: java.lang.OutOfMemoryError thrown from the UncaughtExceptionHandler in thread
↪"default task-248"
2018-08-29 23:13:26.327 UTC ERROR    XNIO001007: A channel event listener threw an␣
↪exception: java.lang.OutOfMemoryError: Java heap space (default I/O-36) [org.xnio.
↪listener]
2018-08-29 23:12:32.823 UTC ERROR    UT005023: Exception handling request to /auth/
↪realms/AnacondaPlatform/protocol/openid-connect/token: java.lang.OutOfMemoryError:␣
↪Java heap space (default task-86) [io.undertow.request]
2018-08-29 23:13:01.353 UTC ERROR    XNIO001007: A channel event listener threw an␣
↪exception: java.lang.OutOfMemoryError: Java heap space
```

Workaround

Increase the JVM max heap size by doing the following:

1. Open the `anaconda-enterprise-ap-auth` deployment spec by running the following command in a terminal:

```
$ kubectl edit deploy anaconda-enterprise-ap-auth
```

2. Increase the value for `JAVA_OPTS` (example below):

```
spec:
  containers:
  - args:
    - cp /standalone-config/standalone.xml /opt/jboss/keycloak/standalone/
↪configuration/
      && /opt/jboss/keycloak/bin/standalone.sh -Dkeycloak.migration.action=import
      -Dkeycloak.migration.provider=singleFile -Dkeycloak.migration.file=/etc/
↪secrets/keycloak/keycloak.json
      -Dkeycloak.migration.strategy=IGNORE_EXISTING -b 0.0.0.0
  command:
  - /bin/sh
  - -c
  env:
  - name: DB_URL
    value: anaconda-enterprise-postgres:5432
  - name: SERVICE_MIGRATE
    value: auth_quick_migrate
  - name: SERVICE_LAUNCH
    value: auth_quick_launch
  - name: JAVA_OPTS
    value: -Xms64m -Xmx2048m -XX:MetaspaceSize=96M -XX:MaxMetaspaceSize=256m
```

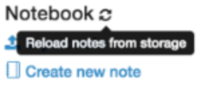
Affected versions

5.2.1

6.2.17 Fetch changes behavior in Apache Zeppelin may not be obvious to new users

A Fetch changes notification appears, but the changes do not get applied to the editor. This is how Zeppelin works, but users unfamiliar with the editor may find it confusing.

If a collaborator makes changes to a notebook that's also open by another user, the user needs to pull the changes that the collaborator made AND click the small reload arrows to refresh their notebook with the changes (see below).



Affected versions

5.2.2

6.2.18 Apache Zeppelin can't locate conflicted files or non-Zeppelin notebook files

If you need to access files other than Apache Zeppelin notebooks within a project, you can use the `%sh` interpreter from within a Zeppelin notebook to work with files via bash commands, or use the **Settings** tab to change the default editor to Jupyter Notebooks or JupyterLab and use the file browser or terminal.

Affected versions

5.2.2

6.2.19 Create and Installer buttons are not visible on Channels page

When the Channels page is viewed initially, the Create and Installers buttons are not visible on the top right section of the screen. This prevents the user from creating channels or viewing a list of installers.

Workaround

To make the Create and Installer buttons visible on the Channels page, perform one of the following steps:

- Click on the top-level Channels navigation link again when viewing the Channels page
- Click on a specific channel to view its detail page, then return to the Channels page

Affected versions

5.2.1

6.2.20 Updating a package from the Anaconda metapackage

When updating a package dependency of a project, if that dependency is part of the Anaconda metapackage the package will be installed once but a subsequent `anaconda-project` call will uninstall the upgraded package.

Workaround

When updating a package dependency remove the `anaconda` metapackage from the list of dependencies at the same time add the new version of the dependency that you want to update.

Affected versions

5.1.0, 5.1.1, 5.1.2, 5.1.3

6.2.21 File size limit when uploading files

Unable to upload new files inside of a project that are larger than the current restrictions:

- The limit of file uploads in JupyterLab is 15 MB

Affected versions

5.1.0, 5.1.1, 5.1.2, 5.1.3, 5.2.0, 5.2.1, 5.2.2, 5.2.3

6.2.22 IE 11 compatibility issue when using Bokeh in projects (including sample projects)

Bokeh plots and applications have had a number of issues with Internet Explorer 11, which typically result in the user seeing a blank screen.

Workaround

Upgrade to the latest version of Bokeh available. On Anaconda 4.4 the latest is 0.12.7. On Anaconda 5.0 the latest version of Bokeh is 0.12.13. If you are still having issues, consult the Bokeh team or support.

Affected versions

5.1.0, 5.1.1, 5.1.2, 5.1.3

6.2.23 IE 11 compatibility issue when downloading custom Anaconda installers

Unable to download a custom Anaconda installer from the browser when using Internet Explorer 11 on Windows 7. Attempting to download a custom installer with this setup will result in an error that “This page can’t be displayed”.

Workaround

Custom installers can be downloaded by refreshing the page with the error message, clicking the “Fix Connection Error” button, or using a different browser.

Affected versions

5.1.0, 5.1.1, 5.1.2, 5.1.3

6.2.24 Project names over 40 characters may prevent JupyterLab launch

If a project name is more than 40 characters long, launching the project in JupyterLab may fail.

Workaround

Rename the project to a name less than 40 characters long and launch the project in JupyterLab again.

Affected versions

5.1.1, 5.1.2, 5.1.3

6.2.25 Long-running jobs may falsely report failure

If a job (such as an installer, parcel, or management pack build) runs for more than 10 minutes, the UI may falsely report that the job has failed. The apparent job failure occurs because the session/access token in the UI has expired.

However, the job will continue to run in the background, the job run history will indicate a status of "running job" or "finished job", and the job logs will be accessible.

Workaround

To prevent false reports of failed jobs from occurring in the UI, you can extend the access token lifespan (default: 10 minutes).

To extend the access token lifespan, log in to the Workbench Authentication Center, navigate to Realm Settings > Tokens, then increase the Access Token Lifespan to be at least as long as the jobs being run (e.g., 30 minutes).

Affected versions

5.1.0, 5.1.1, 5.1.2, 5.1.3

6.2.26 New Notebook not found on IE11

On Internet Explorer 11, creating a new Notebook in a Classic Notebook editing session may produce the error "404: Not Found". This is an artifact of the way that Internet Explorer 11 locates files.

Workaround

If you see this error, click "Back to project", then click "Return to Session". This refreshes the file list and allows IE11 to find the file. You should see the new notebook in the file list. Click on it to open the notebook.

Affected versions

5.0.4, 5.0.5

6.2.27 Disk pressure errors on AWS

If your Workbench instance is on Amazon Web Services (AWS), overloading the system with reads and writes to the directory `/opt/anaconda` can cause disk pressure errors, which may result in the following:

- Slow project starts.
- Project failures.
- Slow deployment completions.
- Deployment failures.

If you see these problems, check the logs to verify whether disk pressure is the cause:

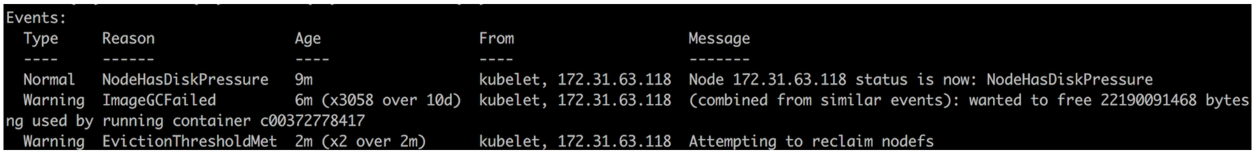
1. To list all nodes, run:

   ```
   kubectl get node
   ```

2. Identify which node is experiencing issues, then run the following command against it, to view the log for that node:

   ```
   kubectl describe node <master-node-name>
   ```

If there is disk pressure, the log will display an error message similar to the following:



```
Events:
  Type     Reason                Age                 From                   Message
  ----     ------                ----                ----                   -------
  Normal   NodeHasDiskPressure   9m                  kubelet, 172.31.63.118  Node 172.31.63.118 status is now: NodeHasDiskPressure
  Warning  ImageGCFailed         6m (x3058 over 10d)  kubelet, 172.31.63.118  (combined from similar events): wanted to free 22190091468 bytes
ng used by running container c00372778417
  Warning  EvictionThresholdMet  2m (x2 over 2m)     kubelet, 172.31.63.118  Attempting to reclaim nodefs
```

Workaround

To relieve disk pressure, you can add disks to the instance by adding another Elastic Block Store (EBS) volume. If the disk pressure is being caused by a back up, you can move the backed up file somewhere else (e.g., to an NFS mount). See *Backing up and restoring Workbench* for more information.

To add disks to the instance by adding another Elastic Block Store (EBS) volume.

1. Open the AWS console and add a new EBS volume provisioned to 3000 IOPS. A typical disk size is 500 GB.
2. Attach the volume to your Workbench master.
3. To find your new disk's name run `fdisk -l`. Our example disk's name is `/dev/nvme1n1`. In the rest of the commands on this page, replace `/dev/nvme1n1` with your disk's name.
4. Format the new disk: `fdisk /dev/nvme1n1`

   To create a new partition, at the first prompt press `n` and then the return key.

   Accept all default settings.

   To write the changes, press `w` and then the return key. This will take a few minutes.
5. To find your new partition's name, examine the output of the last command. If the name is not there, run `fdisk -l` again to find it.

   Our example partition's name is `/dev/nvme1n1p1`. In the rest of the commands on this page, replace `/dev/nvme1n1p1` with your partition's name.
6. Make a file system on the new partition: `mkfs /dev/nvme1n1p1`
7. Make a temporary directory to capture the contents of `/opt/anaconda`: `mkdir /opt/aetmp`
8. Mount the new partition to `/opt/aetmp`: `mount /dev/nvme1n1p1 /opt/aetmp`
9. Shut down the Kubernetes system.

   Find the gravity services: `systemctl list-units | grep gravity`

   You will see output like this:

   ```
   # systemctl list-units | grep gravity
   gravity__gravitational.io__planet-master__0.1.87-1714.service          loaded␣
   ↪active running
      Auto-generated service for the gravitational.io/planet-master:0.1.87-1714␣
   ↪package
   gravity__gravitational.io__teleport__2.3.5.service                      loaded␣
   ↪active running
      Auto-generated service for the gravitational.io/teleport:2.3.5 package
   ```

   Shut down the `teleport` service: `systemctl stop gravity__gravitational.io__teleport__2.3.5.service`

   Shut down the `planet-master` service: `systemctl stop gravity__gravitational.io__planet-master__0.1.87-1714.service`
10. Copy everything from `/opt/anaconda` to `/opt/aetmp`: `rsync -vpoa /opt/anaconda/* /opt/aetmp`

11. Include the new disk at the `/opt/anaconda` mount point by adding this line to your file systems table at `/etc/fstab`:

    ```
    /dev/nvme1n1p1   /opt/anaconda   ext4    defaults        0 0
    ```

    Use mixed spaces and tabs in this pattern: `/dev/nvme1n1p1<tab>/opt/anaconda<tab>ext4<tab>defaults<tab>0<space>0`

12. Move the old `/opt/anaconda` out of the way to `/opt/anaconda-old`: `mv /opt/anaconda /opt/anaconda-old`

    If you're certain the `rsync` was successful, you may instead delete `/opt/anaconda`: `rm -r /opt/anaconda`

13. Unmount the new disk from the `/opt/aetmp` mount point: `umount /opt/aetmp`
14. Make a new `/opt/anaconda` directory: `mkdir /opt/anaconda`
15. Mount all the disks defined in `fstab`: `mount -a`
16. Restart the gravity services:

    ```
    systemctl start gravity__gravitational.io__planet-master__0.1.87-1714.service
    systemctl start gravity__gravitational.io__teleport__2.3.5.service
    ```

6.2.28 Disk pressure error during backup

If a disk pressure error occurs *while backing up your configuration*, the amount of data being backed up has likely exceeded the amount of space available to store the backup files. This triggers the Kubernetes eviction policy defined in the `kubelet` startup parameter and causes the backup to fail.

To check your eviction policy, run the following commands *on the master node*:

```
sudo gravity enter
systemctl status | grep "/usr/bin/kubelet"
```

Workaround

Restart the backup process, and specify a location with sufficient space (e.g., an NFS mount) to store the backup files. See *Backing up and restoring Workbench* for more information.

6.2.29 General diagnostic and troubleshooting steps

Entering a Gravity Workbench environment

To enter the Workbench environment and gain access to `kubectl` and other commands within Workbench, use the command:

```
sudo gravity enter
```

Moving files and data

Occasionally you may need to move files and data from the host machine to the Workbench environment. If so, there are two *shared mounts* to pass data back and forth between the two environments:

- host: `/opt/anaconda/` -> Workbench environment: `/opt/anaconda/`
- host: `/var/lib/gravity/planet/share` -> Workbench environment: `/ext/share`

If data is written to either of the locations, that data will be available on both the host machine and within the Workbench environment

Debugging

AWS Traffic needs to handle the public IPs and ports. You should either use a canonical security group with the proper ports opened or manually add the specific ports listed in *Network Requirements*.

Problems during air gap project migration

The command anaconda-project lock over-specifies the channel list resulting in a conda bug where it adds defaults from the internet to the list of channels.

Solution:

Add to the .condarc: "default_channels". This way, when conda adds "defaults" to the command it is adding the internal repo server and not the repo.continuum.io URLs.

EXAMPLE:

```
default_channels:
- anaconda
channels:
  - our-internal
  - out-partners
  - rdkit
  - bioconda
  - defaults
  - r-channel
  - conda-forge
channel_alias: https://:8086/conda
auto_update_conda: false
ssl_verify: /etc/ssl/certs/ca.2048.cer
```

LDAP error in ap-auth

`[LDAP: error code 12 - Unavailable Critical Extension]; remaining name 'dc=acme, dc=com'`

This error can be caused when pagination is turned on. Pagination is a server side extension and is not supported by some LDAP servers, notably the Sun Directory server.

Session startup errors

If you need to troubleshoot session startup, you can use a terminal to view the session startup logs. When session startup begins the output of the `anaconda-project prepare` command is written to `/opt/continuum/preparing`, and when the command completes the log is moved to `/opt/continuum/prepare.log`.

6.3 Frequently asked questions

6.3.1 General

When was the general availability (GA) release of Workbench v5?

Our GA release was August 31, 2017 (version 5.0.3). Our most recent version was released February 28, 2023 (version 5.6.1).

Which integrated development environments (IDEs) can I use with Workbench?

Workbench supports the use of Jupyter Notebooks and JupyterLab, which are the most popular integrated data science environments for working with Python and R notebooks. You can also install and utilize both RStudio and VSCode for use in building your Workbench projects.

Can I deploy multiple data science applications to Workbench?

Yes, you can deploy multiple data science applications and languages across a Workbench cluster. Each data science application runs in a secure and isolated environment with all of the dependencies from Anaconda that it requires.

A single node can run multiple applications based on the amount of compute resources (CPU and RAM) available on a given node. Workbench handles all of the resource allocation and application scheduling for you.

Does Workbench support high availability deployments?

Partially. Some of the Workbench services and user-deployed apps will be automatically configured when installed to three or more nodes. Workbench provides several automatic mechanisms for fault tolerance and service continuity, including automatic restarts, health checks, and service migration.

For more information, see *Fault tolerance in Workbench*.

Which identity management and authentication protocols does Workbench support?

Workbench comes with out-of-the-box support for the following:

- LDAP / AD
- SAML
- Kerberos

For more information, see *Connecting to external identity providers*.

Does Workbench support two-factor authentication (including one-time passwords)?

Yes, Workbench supports single sign-on (SSO) and two-factor authentication (2FA) using FreeOTP, Google Authenticator or Google Authenticator compatible 2FA.

You can configure one-time password policies in Workbench by navigating to the authentication center and clicking on Authentication and then OTP Policy.

6.3.2 System requirements

What operating systems are supported for Workbench?

Please see *operating system requirements*.

Note: Linux distributions other than those listed in the documentation can be supported on request.

What are the minimum system requirements for Workbench nodes?

Please see *system requirements*.

Which browsers are supported for Workbench?

Please see *browser requirements*.

Does Workbench come with a version control system?

Yes, Workbench includes an internal Git server, which allows users to save and commit versions of their projects.

Can Workbench integrate with my own Git server?

Yes, as described in *Connecting to an external version control repository*.

6.3.3 Installation

How do I install Workbench?

The Workbench installer is a single tarball that includes Docker, Kubernetes, system dependencies, and all of the components and images necessary to run Workbench. The system administrator runs one command on each node.

Can Workbench be installed on-premises?

Yes, including airgapped environments.

Can Workbench be installed on cloud environments?

Yes, including Amazon AWS, Microsoft Azure, and Google Cloud Platform.

Does Workbench support air gapped (off-line) environments?

Yes, the Workbench installer includes Docker, Kubernetes, system dependencies, and all of the components and images necessary to run Workbench on-premises or on a private cloud, with or without internet connectivity. We can deliver the installer to you on a USB drive.

Can I build Docker images for the install of Workbench?

No. The installation of Workbench is supported only by using the single-file installer. The Workbench installer includes Docker, Kubernetes, system dependencies, and all of the components and images necessary for Workbench.

Can I install Workbench on my own instance of Kubernetes?

Yes, please refer to our *BYOK8s environment preparation guide*.

Can I get the Workbench installer packaged as a virtual machine (VM), Amazon Machine Image (AMI) or other installation package?

No. The installation of Workbench is supported only by using the single-file installer.

Which ports are externally accessible from Workbench?

Please see *network requirements*.

Can I use Workbench to connect to my Hadoop/Spark cluster?

Yes. Workbench supports connectivity from notebooks to local or remote Spark clusters by using the Sparkmagic client and a Livy REST API server. Workbench provides Sparkmagic, which includes Spark, PySpark, and SparkR notebook kernels for deployment.

How can I manage Anaconda packages on my Hadoop/Spark cluster?

An administrator can generate custom Anaconda parcels for Cloudera CDH or custom Anaconda management packs for Hortonworks HDP using Workbench. A data scientist can use these Anaconda libraries from a notebook as part of a Spark job.

On how many nodes can I install Workbench?

You can install Workbench in the following configurations during the initial installation:

- One node (one master node)
- Two nodes (one master node, one worker node)
- Three nodes (one master node, two worker nodes)
- Four nodes (one master node, three worker nodes)

After the initial installation, you can add or remove worker nodes from the Workbench cluster at any time.

One node serves as the master node and writes storage to disk, and the other nodes serve as worker nodes. Workbench services and user-deployed applications run seamlessly on the master and worker nodes.

Can I generate certificates manually?

Yes, if automatic TLS/SSL certificate generation fails for any reason, you can generate the certificates manually. Follow these steps:

1. Generate self-signed temporary certificates. On the master node, run:

   ```
   cd path/to/Anaconda/Enterprise/unpacked/installer
   cd DIY-SSL-CA
   bash create_noprompt.sh DESIRED_FQDN
   cp out/DESIRED_FQDN/secret.yaml /var/lib/gravity/planet/share/secrets.yaml
   ```

   Replace `DESIRED_FQDN` with the fully-qualified domain of the cluster to which you are installing Workbench.

   Saving this file as `/var/lib/gravity/planet/share/secrets.yaml` on the Workbench master node makes it accessible as `/ext/share/secrets.yaml` within the Workbench environment which can be accessed with the command `sudo gravity enter`.

2. Update the `certs` secret

   Replace the built-in `certs` secret with the contents of `secrets.yaml`. Enter the Workbench environment and run these commands:

   ```
   $ kubectl delete secrets certs
   secret "certs" deleted
   $ kubectl create -f /ext/share/secrets.yaml
   secret "certs" created
   ```

6.3.4 GPU Support

How can I make GPUs available to my team of data scientists?

If your data science team plans to use version 5.2 of the Workbench AI enablement platform, here are a few approaches to consider when planning your GPU cluster:

- *Build a dedicated GPU-only cluster.*

  If GPUs will be used by specific teams only, creating a separate cluster allows you to more carefully control GPU access.

- *Build a heterogeneous cluster.*

  Not all projects require GPUs, so a cluster containing a mix of worker nodes—with and without GPUs—can serve a variety of use cases in a cost-effective way.

- *Add GPU nodes to an existing cluster.*

  If your team's resource requirements aren't clearly defined, you can start with a CPU-only cluster, and add GPU nodes to create a heterogeneous cluster when the need arises.

Workbench supports heterogeneous clusters by allowing you to create different "resource profiles" for projects. Each resource profile describes the number of CPU cores, the amount of memory, and the number of GPUs the project needs. Administrators typically will create "Regular", "Large", and "Large + GPU" resource profiles for users to select from when running their project. If a project requires a GPU, Workbench will run it on only those cluster nodes with an available GPU.

What software is GPU accelerated?

Anaconda provides a number of GPU-accelerated packages for data science. For deep learning, these include:

- Keras (`keras-gpu`)

- TensorFlow (`tensorflow-gpu`)
- Caffe (`caffe-gpu`)
- PyTorch (`pytorch`)
- MXNet (`mxnet-gpu`)

For boosted decision tree models:

- XGBoost (`py-xgboost-gpu`)

For more general array programming, custom algorithm development, and simulations:

- CuPy (`cupy`)
- Numba (`numba`)

Note: Unless a package has been specifically optimized for GPUs (by the authors) and built by Anaconda with GPU support, it will not be GPU-accelerated, even if the hardware is present.

What hardware does each of my cluster nodes require?

Anaconda recommends installing Workbench in a cluster configuration. Each installation should have an odd number of master nodes, and Anaconda recommends at least one worker node. The master node runs all Workbench core services and does not need a GPU.

Using EC2 instances, a *minimal configuration* is one master node running on a `m4.4xlarge` instance and one GPU worker node running on a `p3.2xlarge` instance. More users will require more worker nodes—and possibly a mix of CPU and GPU worker nodes.

See *Hardware requirements* for the baseline requirements for Workbench.

How many GPUs does my cluster need?

A best practice for machine learning is for each user to have exclusive use of their GPU(s) while their project is running. This ensures they have sufficient GPU memory available for training, and provides more consistent performance.

When a Workbench user launches a notebook session or deployment that requires GPUs, those resources are reserved for as long as the project is running. When the notebook session or deployment is stopped, the GPUs are returned to the available pool for another user to claim.

The number of GPUs required in the cluster can therefore be determined by the number of concurrently running notebook sessions and deployments that are expected. Adding nodes to a Workbench cluster is straightforward, so organizations can start with a conservative number of GPUs and grow as demand increases.

To get more out of your GPU resources, Workbench supports scheduling and running unattended jobs. This enables you to execute periodic retraining tasks—or other resource-intensive tasks—after regular business hours, or at times GPUs would otherwise be idle.

What kind of GPUs should I use?

Although the Anaconda Distribution supports a wide range of NVIDIA GPUs, Workbench deployments for data science teams developing models should use one of the following GPUs:

- Tesla V100 (recommended)
- Tesla P100 (adequate)

Can I mix GPU models in one cluster?

Kubernetes cannot currently distinguish between different GPU models in the same cluster node, so Workbench requires all GPU-enabled nodes *within a given cluster* to have the same GPU model (for example, all Tesla V100). Different clusters (e.g., “production” and “development”) can use different GPU models, of course.

Can I use cloud GPUs?

Yes, Workbench 5.2 can be installed on cloud VMs with GPU support. Amazon Web Services (AWS), Google Cloud Platform, and Microsoft Azure all offer Tesla GPU options.

6.3.5 Anaconda Project

What operating systems and Python versions are supported for Anaconda Project?

Anaconda Project supports Windows, macOS and Linux, and tracks the latest Anaconda releases with Python 2.7, 3.5, 3.6, and 3.7.

How is encapsulation with Anaconda Project different from creating a workspace or project in Spyder, PyCharm, or other IDEs?

A workspace or project in an IDE is a directory of files on your desktop. Anaconda Project encapsulates those files, but also includes additional parameters to describe how to run a project with its dependencies. Anaconda Project is portable and allows users to run, share, and deploy applications across different operating systems.

What types of projects can I deploy?

Anaconda Project is very flexible and can deploy many types of projects with conda or pip dependencies. Deployable projects include:

- Notebooks (Python and R)
- Bokeh applications and dashboards
- REST APIs in Python and R (including machine learning scoring and predictions)
- Python and R scripts
- Third-party apps, web frameworks, and visualization tools such as Tensorboard, Flask, Falcon, deck.gl, plot.ly Dash, and more.

Any generic Python and R script or webapp can be configured to serve on port 8086, which will show the app in Workbench when deployed.

Does Workbench include Docker images for my data science projects?

Workbench includes data science application images for the editor and deployments. You can install additional packages in either environment using Anaconda Project. Anaconda Project includes the information required to reproduce the project environment with Anaconda, including Python, R, or any other conda package or pip dependencies.

After upgrading Workbench my projects no longer work

If you've upgraded to Workbench 5.4 and are getting package install errors you may need to re-write your `anaconda-project.yml` file.

If you were using modified template `anaconda-project.yml` files for Python 2.7, 3.5, or 3.6 it is best to leave the package list empty in the `env_specs` section. Then you should add your required packages and their versions to the global package list.

Here's an example using the Python 3.6 template `anaconda-project.yml` file from Workbench version 5.3.1 where the package list has been removed from the `env_specs` and the required packages added to the global list.

```
name: Python 3.6

description: A comprehensive project template that contains all of the packages␣
↪available in the Anaconda Distribution v5.0.1 for Python 3.6. Get started with the␣
↪most popular and powerful packages in data science.
```

(continues on next page)

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```
channels: []
packages:
  - python=3.6
  - notebook
  - pandas=0.25
  - psycopg2
  - holoviews

platforms:
  - linux-64
  - osx-64
  - win-64

env_specs:
  anaconda50_py36:
    packages: []
    channels: []
```

6.3.6 Notebooks

Are the deployed, self-service notebooks read-only?

Yes, the deployed versions of self-service notebooks are read-only, but they can be executed by collaborators or viewers. Owners of the project that contain the notebooks can edit the notebook and deploy (or re-deploy) them.

What happens when other people run the notebook? Does it overwrite any file, if notebook is writing to a file?

A deployed, self-service notebook is read-only but can be executed by other collaborators or viewers. If multiple users are running a notebook that writes to a file, the file will be overwritten unless the notebook is configured to write data based on a username or other environment variable.

Can I define environment variables as part of my data science project?

Yes, Anaconda Project supports environment variables that can be defined when deploying a data science application. Only project collaborators can view or edit environment variables, and they cannot be accessed by viewers.

How are Anaconda Project and Workbench available?

Anaconda Project is free and open-source. Workbench is a commercial product.

Where can I find example projects for Workbench?

Sample projects are included as part of the Workbench installation, which include sample workflows and notebooks for Python and R such as financial modeling, natural language processing, machine learning models with REST APIs, interactive Bokeh applications and dashboards, image classification, and more.

The sample projects include examples with visualization tools (Bokeh, deck.gl), pandas, scipy, Shiny, Tensorflow, Tensorboard, xgboost, and many other libraries. Users can save the sample projects to their Workbench account or download the sample projects to their local machine.

Does Workbench support batch scoring with REST APIs?

Yes, Workbench can be used to deploy machine learning models with REST APIs (including Python and R) that can be queried for batch scoring workflows. The REST APIs can be made available to other users and accessed with an API token.

Does Workbench provide tools to help define and implement REST APIs?

Yes, a data scientist can basically create a model without much work for the API development. Workbench includes an API wrapper for Python frameworks that builds on top of existing web frameworks in Anaconda, making it easy to expose your existing data science models with minimal code. You can also deploy REST APIs using existing API frameworks for Python and R.

6.3.7 Help and training

Do you offer support for Workbench?

Yes! You can submit support tickets to your Technical Account Manager (TAM) if you need assistance.

Do you offer training for Workbench?

Yes, we offer product training for collaborative, end-to-end data science workflows with Workbench.

Do you have a question not answered here?

Please contact us for more information.

6.4 Understanding Workbench system requirements

Data Science & AI Workbench is a DS/AI/ML development and deployment platform built on top of the industry standard Kubernetes container orchestration system. Workbench leverages Kubernetes to create and manage sessions, deployments, and jobs. During normal operation, users and administrators are insulated from this underlying complexity. Workbench is truly at its best when running on a stable, performant Kubernetes cluster.

When issues arise that compromise the operation of Kubernetes, on the other hand, the operation of Workbench itself suffers. We have found that it is helpful to share with our customers more detail about the system requirements that Kubernetes demands. By doing so, we hope to clarify and motivate our documented requirements, and to help customers appreciate why the implementation process requires precision, persistence, and patience.

For our Gravity-based customers, the *installation process* hides much of that complexity. The main step in the installation process—the execution of the `sudo ./gravity install` command—is actually performing the following steps:

- Perform a variety of pre-flight checks to verify the satisfaction of important system requirements
- Install and configure Docker
- Install and configure Planet, a containerized implementation of Kubernetes bundled with a set of custom cluster management tools
- Install Helm, an industry standard tool for installing Kubernetes applications
- Load the Workbench container images into the internal Docker registry
- Use a standard Helm process to install the Workbench application
- Run final Anaconda-specific application configuration tasks

Enumerating these steps helps to illustrate just how "thin" the steps specific to Workbench truly are. The bulk of the Gravity implementation effort involves the construction of a stable, performant Kubernetes cluster.

6.4.1 Hardware considerations

CPU and Memory: node considerations

In our Gravity implementation, the primary node—where the central Kubernetes services and Workbench system containers run—does not host user workloads. Our standard recommendation of 16 cores and 64GB RAM provides ample headroom to ensure the correct operation of these functions.

For worker nodes, where user workloads (sessions, deployments, and jobs) are scheduled, the most important quantities are the *total number of cores and total amount of RAM across all worker nodes*. That said, nodes with more cores and RAM are better than smaller nodes for two reasons: first, because it allows aggregate user workload to be accommodated with less total hardware; and second, so that the system can accommodate truly large-memory workloads when necessary.

CPU and Memory: user workloads

Do not compromise the compute resources offered to your users.

A decent data science laptop today ships with 6 cores and 16GB of RAM. While some of these resources are consumed by the operating system and other processes, their data science workloads are free to consume the vast majority.

Not all users are likely to be active at any given time, so it is not necessary to mirror this allocation on a 1:1 basis on your Workbench cluster. Kubernetes supports the notion of *oversubscription*, enabling CPU and memory allocations to exceed 100%. If we adopt a relatively standard oversubscription ratio of 4:1, we still need *75 cores and 200GB of RAM* to support 50 users. Rounding that down to 64 cores and 192GB of RAM seems reasonable, at least to start. Economizing further will come at the cost of productivity—and additional resources tend to be significantly less expensive than the data scientists who will use them!

The laptop comparison is imperfect in a very important respect. On a laptop, *swap space* can be employed to temporarily allow memory consumption in excess of the physical limit. Not so with Kubernetes: a process will be *terminated* if it exceeds its memory limit, likely resulting in a loss of work. This further emphasizes the need to ensure that users are given a generous memory limit, determined not by their average usage, but rather their peak.

Some installations operate with just a single node—serving both control plane and user workload functions. For installations with a small number of simultaneous users, this is a feasible approach, as long as the node is sized aggressively—say, 64 cores and 256GB RAM.

VM QoS / Oversubscription / Overcommitment

Many on-premise data centers employ virtualization technology such as VMWare to better manage compute resources. A common practice in such scenarios is *oversubscription*—the ability to schedule a greater number of virtual CPUs (vCPUs) than the number of *physical* CPUs (pCPUs) present on the system. Oversubscription is an essential component of cost effective virtual machine management, since machines rarely see constant 100% usage levels.

Unfortunately, this approach is *not* necessarily compatible with Kubernetes. Kubernetes employs its *own* resource management strategy, including a notion of oversubscription. Our recommended practice for Workbench is to employ a ratio of 4:1 for user workloads. If this were compounded with, say, a 4:1 ratio at the virtual machine level, and the *true* overcommitment level is closer to 16:1. With no control over the *other* workloads sharing the same physical cores, there is a real risk of sporadic performance loss that impacts overall cluster health.

For this reason, we *strongly* recommend that any virtual machine intended to serve as a Workbench node be assigned to a *guaranteed* service class that ensures that its CPU and memory reservations are fully honored, with no oversubscription at the VM level. *Allow the Kubernetes layer to manage oversubscription exclusively.*

GPUs

One of the more challenging aspects of implementation is the enablement of GPU computation within Workbench. It is our view that NVidia is still in the process of maturing their “story” around the use of GPUs within Docker containers in general and Kubernetes in particular. As of February 2022, the official Kubernetes documentation about GPU scheduling marks it as an “experimental” feature.

In our experience, customers *can* be successful deploying GPUs in Workbench. Workbench ships a standard CUDA 11 library in user-facing containers, and the underlying Planet implementation is built with NVidia support components. That said, our experience leads us to offer these cautions proactively.

- GPUs cannot be shared between sessions, deployments, and jobs. That means that if a user launches a session with a GPU resource profile, that GPU is reserved for their container, *even if it is idle*.
- Not all versions of the NVidia driver set are compatible with GPU container runtime.
- For *some* versions of the NVidia drivers, some manual rearrangement of the installed driver files are sometimes required in order for the Gravity/Planet container to “find” them.

In short, the enablement of GPUs within Workbench is a challenge, but one that many customers have nevertheless found worthwhile.

6.4.2 Operating system

In this section, we highlight a number of the important considerations for our Gravity-based offering. For BYOK8s customers, these types of concerns are likely “baked-in” to the general objective of standing up a performance cluster. However, customers who build their own on-premise Kubernetes clusters will likely encounter similar concerns.

Kernel modules and settings

The system requirements provide sufficient detail on the kernel modules and other OS settings required to ensure effective operation of the Kubernetes layer. A common mistake is the failure to ensure that these settings are preserved upon reboot—so the cluster operates without incident until a system modification forces a reboot. System management software (see below) can often prevent these settings from persisting properly.

Firewall settings

Kubernetes itself actively manages the firewall settings on the master and worker nodes to ensure proper communication management between nodes and pods. Introducing additional firewall settings runs the risk of interrupting Workbench functionality. Please make sure that additional firewall configurations are disabled or confirmed to be compatible with Workbench. This is another common configuration that can be corrupted by automated system management tools.

The Linux audit daemon (auditd)

The Linux audit system provides a flexible method to detect and log a variety of system issues, and is a genuinely useful tool that is commonly enabled on the Kubernetes stack. For this reason, we have the following guidelines for exceptions and exclusions:

- `/var/lib/gravity` *must* be excluded from auditd monitoring.
- `/opt/anaconda` *should* be excluded as well. That said, we do not have strong evidence that system instability can be tied to monitoring of that directory.

- If managed persistence is hosted on the master node, then we encourage the exclusion of that directory as well. Conda environment management performs a significant number of disk operations, and slowing these operations can significantly diminish the user experience.

Antivirus / antimalware

Our customers utilize a variety of Linux antivirus and antimalware scanning tools, some of which include an on-demand scanning component. As with auditd, this scanning introduces a significant burden on proper Kubernetes operation. For this reason, our guidance for on-demand scanning mirrors that of auditd. In particular, `/var/lib/gravity` *must* be excluded from on-demand scanning.

System management software

One frequent culprit involved in sudden loss of Workbench functionality are system management tools such as Chef or Puppet. Tools such as these are designed to automate and simplify the management of large numbers of servers. Where they run afoul of Workbench is when the application requires *exceptions* to configurations enforced by these tools. It is *essential* that those exceptions are properly enabled. Otherwise, these tools can make fatal modifications to the underlying operating system unannounced: removing necessary kernel modules, reinstalling firewall rules, removing auditd exceptions, and others. If your organization uses tools such as these, please review the Workbench system requirements with them and confirm that the necessary exceptions are *permanently* engaged, with clear documentation as to why. Otherwise, we find that customers will eventually encounter administrators who remove these important configuration details and thereby disrupt the operation of Workbench.

Backup solutions

Many organizations will employ backup solutions on any server running critical applications, or production environments. It is important to exclude Gravity from any scheduled backup as this will cause severe disk pressure. Workbench has its own scripts that can be used to make a backup of the application on a regular basis.

6.4.3 Disks

Disk space

The disk space requirements specified for Gravity installations for `/var/lib/gravity`, `/opt/anaconda`, and `/tmp` must be respected. The installer includes disk space checks in its pre-flight checks.

With managed persistence, generous disk space allocations are even more important. This disk holds a copy of every project (and one copy for each collaborator), and every custom conda environment created by users. A single conda environment can consume multiple gigabytes. For this reason, we encourage that the size of this disk should *start* at 1TB, and preferably support live resizing.

I/O performance

Low disk latency and high throughput in the `/var/lib/gravity` directory is essential for the stability of the platform. In particular, the master node hosts the Kubernetes etcd key-value store there.

In practice, we have found that the use of platter disks for `/var/lib/gravity` is a primary cause of system instability. *Use of an SSD for this directory is effectively required*. Direct-attached storage is preferred whenever possible, but we do believe that a sufficiently performant network-attached storage volume for /opt/anaconda is acceptable. Indeed, our positive experience with shared storage for BYOK8s installations validate this belief.

Auditing and antivirus software

As mentioned above, auditd daemons and antivirus software can significantly impact effective disk performance. For this reason, we mention here as well that the guidelines listed above for these tools must be honored.

Managed persistence

The new Managed Persistence functionality of Workbench requires the use of a shared volume that is accessible from all nodes, master and worker. So far, our customers have found that a performant enterprise NAS offers sufficient performance for their needs.

In theory, it is possible to export a directory from the master node via NFS. If an independent file sharing option is available, Anaconda recommends that instead, to ensure that the master node may focus on Kubernetes-related duties. But we have multiple successful implementations using this approach.

As our real-world experience with this feature is more limited, we will update these recommendations as more information comes in.

Cloud-specific concerns

Ensuring sufficient disk I/O performance is essential for a successful cloud-based implementation of Workbench. Fortunately, the common cloud providers make this a relatively straightforward thing to achieve. If possible, select VMs with attached SSDs large enough to hold `/var/lib/gravity`. When it is necessary to use additional attached block volumes, respect the IOPS recommendations in our system requirements. Each cloud provider offers different mechanisms for ensuring disk performance.

- In practice, the larger the disk, the higher the base IOPS performance. If you are generous with disk space, you are less likely to have issues.
- With some providers (e.g., Azure), the *only* mechanism for increasing performance is to increase the disk size.
- Providers like AWS offer *managed IOPS*, allowing you to provision size and IOPS separately. This is a reasonable approach, and *may* enable lower costs, but Anaconda recommends at least studying the cost of a larger disk instead of simply boosting IOPS.

6.4.4 Network

It is vitally important that the nodes of the cluster have unfettered access to each other. Whenever network performance is impacted by hardware or operating system issues, the Kubernetes cluster will be unstable, and thus so will Workbench itself.

Private networking

For very understandable reasons, customers usually need to place Workbench behind a firewall or VPN. It is important that this firewall does not interrupt communication between nodes, however. If possible, use *private networking* to connect the nodes to each other so that they may communicate over more direct connections even as the public-facing access to the cluster is restricted.

Load balancing

Workbench does not currently support being placed behind an *SSL termination* load balancer. Our experience is that it will function properly behind an *SSL passthrough* load balancer, however.

Proxies

Proxies may be required to access external data stores, repositories, and so forth. However, they must not be required for the nodes to speak with each other, and proxies must not be enabled at the OS/system level.

WAN accelerators (IDS, packet caching, etc.)

Network acceleration technology should be disabled. Kubernetes needs to manage its own traffic shaping.

Shared volume (NFS) access

As is commonly understood, losing access to an external NFS share can cause disk waits and other significant issues on Unix machines. This is true for Kubernetes clusters as well. The platform can be expected to behave unreliably until access to any attached NFS volumes is restored. Interruptions to access for the managed persistence volume in particular will be severely disruptive.

6.4.5 Cloud vs. On-premise

Most of our customers know in advance whether or not they will be deploying onto on-premise hardware or on a major cloud provider (AWS, Google, Azure). Others have the option to choose either option, and look to us for advice on which to prefer.

In our experience, cloud installations are smoother and more reliable for a number of reasons:

- It is easier to ensure that the hardware requirements are met. For each of the major cloud providers, we can recommend specific instance types that are known to provide good performance for Workbench.
- There tends to be less additional software installed on cloud hardware, reducing the likelihood of unexpected behavior caused by interactions with the Gravity stack.
- The provisioning process is faster, as is the process of adding additional nodes or disk when required.
- We have found it significantly easier to ensure a compatible GPU configuration in the cloud. On-premise GPU nodes often require BIOS modifications or other configuration changes to successfully deploy.

That is not to say that cloud installations are always perfectly smooth. Indeed, all of the guidance in this document applies to both cloud and on-premise installations, and we have included cloud-specific amplifications above.

6.4.6 Bring Your Own Kubernetes

At a high level, many of the recommendations offered above have been developed with the assumption of an Anaconda-supplied, Gravity/Planet-based Kubernetes stack. In contrast, our BYOK8s customers will be able to leverage existing Kubernetes resources—either an on-premise Kubernetes cluster already configured to support multiple tenants, or a managed Kubernetes offering such as EKS (AWS), AKS (Azure), GKE (Google). In these scenarios, many of the above concerns are not relevant:

- Concerns about disk performance for `/var/lib/gravity` are tied to the need to ensure a performant Kubernetes stack.
- Operating system requirements will likely be settled either by the Kubernetes administrator or the managed Kubernetes provider.
- Workbench will likely *not have access* to the Kubernetes control plane; instead, its own application containers will be running on worker nodes alongside user workloads.

In short, most of the system requirements we have historically offered for Workbench center around *ensuring a reliable and performant Kubernetes cluster*. Most of our requirements, therefore, are *superseded* by the requirements imposed by your cluster.

Assuming the existence of a stable Kubernetes cluster, therefore, here is a list of some of the remaining “requirements” that remain. These include some special caveats that we have accumulated from experience with customers who may be new to the use of Kubernetes to deploy resource-intensive data science workloads.

Docker image sizes

Our Docker images are larger than many Kubernetes administrators are accustomed to. In particular, the Docker image on which users run their sessions, deployments, and jobs is nearly *20GB uncompressed*. This is probably the most difficult requirement for some Kubernetes administrators to swallow. Here are a couple of points to emphasize when discussing this with your administrators.

First: this does *not* imply that every session, deployment, and job will consume 20GB of disk space. Docker images are *shared* across all containers that utilize them. Therefore, the disk space consumed by the image is *amortized* across all of its uses on a given node

Second: the primary reason for this disk consumption is the set of pre-baked, global data science environments contained in this image. Future versions of Workbench will have the option to remove those environments or move them to shared storage; however, the image size is likely to never drop below 5GB.

In our experience, the response to our image sizes among Kubernetes administrators is somewhat bimodal: some react strongly negatively to it, while others have already seen images of comparable size.

Resource profiles

In our experience, Kubernetes administrators who are not accustomed to serving data science workloads will be surprised by our requirements. For many microservice workloads, CPU limits of less than a single core, and memory limits of less than 1GB, will be very common. Data science workloads require several times this much per session.

On the other hand, our standard oversubscription recommendation of 4:1—that is, the ratio between our memory/CPU *limits* and *requests* values—is a somewhat standard choice. Higher levels of oversubscription will result in sporadic performance issues for your users.

We reiterate here what we emphasized in the CPU and Memory section above: *do not compromise the CPU and memory allocations for your users*.

Storage

The `/opt/anaconda/storage` volume does not have the same strict performance requirements that `/var/lib/gravity` has on a Gravity installation. However, we definitely encourage the use of a "premium" performance tier for this volume if possible, as well as for the managed persistence volume.

A high-performance storage tier should be chosen for the managed persistence volume as well. Remember, users will be interacting with that volume to create Python environments and run data science workloads. Performance limitations on this volume will directly impact the user experience.

Security

In Openshift (OCP), containers by default will not run as root, and will use the Restricted Security Context Constraint (SCC). However, to use certain features such as authenticated NFS, we may need to allow pods to use the "anyuid" SCC.

Replacing the Ops Center

If you have administered a Gravity-based Workbench installation, you are accustomed to using the Ops Center for cluster configuration / management / monitoring. This was a feature unique to Gravitational installs, as it was provided by the Gravity site pod. In a BYOK8s environment, you will need to use the built-in management / configuration / monitoring tools provided by your k8s platform.

Autoscaling

We do not yet support autoscaling, but we are investigating it for feasibility. It is important to note however that scaling *down* Anaconda Enterprise—that is, reducing the number of nodes consumed—is not likely to be feasible in an automatic fashion. This is because downscaling requires moving workload from the nodes being decommissioned onto the remaining nodes. For user sessions, that is not something you should do without warning or planning, as doing so can interrupt active work.

6.5 Gravity update policy

Updated November 2023

Data Science & AI Workbench includes support for customer-supplied Kubernetes clusters in both cloud-hosted and on-premise environments. This is the preferred method of installation host for Workbench. Here, we explain the rationale behind this decision and provide guidance for our existing Gravity-based customers.

6.5.1 Background

Gravity is an open-source application delivery system, developed by Teleport (formerly Gravitational). Gravity creates installers that bundle application assets with Planet, a containerized Kubernetes stack. Gravity has enabled us to deliver Workbench to customers for installation on bare metal or virtual machine clusters with no existing Kubernetes support.

The benefits of the Gravity approach come with a number of practical challenges. The most important of these challenges stems from recent changes to Gravity's support model. Until recently, Teleport offered paid commercial support, providing us with fast access to technical experts when needed. In 2021, they chose to sunset that offering completely. At the end of June of 2023, Teleport suspended further support for Gravity.

This change has important practical consequences:

- Reliance solely on community support limits our velocity and ability to diagnose low-level performance or functionality issues.
- There are no longer upstream developers to deliver bug and security fixes for the platform. As a result, we are unable to resolve CVEs related to Kubernetes or the underlying virtualization layer.
- The latest production version of Gravity ships with Kubernetes 1.17.9, with versions 1.19.15 and 1.21.5 are in pre-release only. In contrast, the latest upstream Kubernetes release as of the writing of this document is 1.28.3.

In addition to these logistical challenges, our experience is that Gravity performance is very sensitive to the precise underlying operating system configuration. Our document *Understanding Workbench system requirements* represents a compendium of the challenges our customers have experienced.

We have observed that many of these configuration issues are a natural consequence of standard, legitimate IT policies that are not designed with Kubernetes in mind. Transferring ownership of Kubernetes uptime to your IT department, therefore, should help ensure a stable, performant platform for users. It also allows them to make security decisions about the Kubernetes stack that properly balance application stability with security risk.

6.5.2 Gravity build roadmap

We recognize that, for many of our customers, the benefits of Gravity outweigh these practical concerns. Their IT departments simply may not be prepared to formally support Kubernetes infrastructure. For these reasons, *Anaconda intends to continue to create Gravity installers* for Workbench. Here are our plans moving forward:

- The production build of Workbench 5.7.0 is built on top of Gravity 7.0.39, which utilizes Kubernetes 1.17.9. This installer has received our full QA cycle, including tests of upgrades from an existing Gravity environment.
- In some environments, in-place upgrades that update the major version of Gravity can fail. For this reason, Anaconda has developed a uninstall/reinstall cycle that preserves existing data. This alternative upgrade approach has received our full QA cycle.

6.5.3 Migration policy

When a customer is ready to migrate from Gravity to an in-house Kubernetes platform, Anaconda is committed to working with them to ensure that this process proceeds smoothly. To that end, Anaconda can support the following migration workflow:

- In a standard pre-implementation meeting, we review our Kubernetes system requirements with your cluster administrators.
- We assist in the installation of a new instance of Workbench on a customer-supplied Kubernetes cluster—running in parallel with an existing, Gravity-based cluster.
- We use our standard DR & Sync tooling to transfer a snapshot of the current cluster's content to the new cluster, so that users can exercise the new environment.
- Once the customer is satisfied that the new cluster is ready to be promoted to production, we transfer a final snapshot, including the hostname and SSL certificate, and update the DNS records to point to the new cluster.
- Once the cutover is complete, the customer is free to retire the old cluster.

Some logistical notes:

- We cannot provide direct assistance with the specification and provisioning of your new Kubernetes cluster. However, our *documentation* offers a set of templates and provisioning details for the the major Kubernetes offerings, both cloud and on-premise, that your administrators are free to build from. Our installation process leverages Helm, making it compatible with all major Kubernetes platforms.
- We consider it essential that both clusters are running simultaneously for at least a brief validation period. For this reason, we do not support an in-place "upgrade" of a production Gravity-based cluster to an alternative Kubernetes platform.
- It is reasonable to consider initially under-provisioning the destination Kubernetes cluster. That is, the initial allocation of worker nodes to the new cluster can be smaller, in anticipation that the nodes from the Gravity cluster will be converted to additional workers once validation is complete. In this scenario, it would be necessary only to ensure that the new cluster has enough resources to complete the validation process before the cutover.
- Many Kubernetes administrators are accustomed to hosting workloads that are less resource intensive than a data science development session or machine learning model. In particular, our Docker image sizes and recommended resource profiles are likely to surprise them. We encourage you to review the BYOK8s section of our document *Understanding Workbench system requirements* with your Kubernetes team prior to firming up a migration plan. They should also review the *BYOK8s installation requirements* and work through the *pre-installation checklist* on that page.

Finally, let us address two concerns about cost.

- There will be *no license charge* levied for a parallel installation, as long as the intent is to fully migrate workloads to the new cluster, and decommission the original, once the installation is verified.
- When migrating from Gravity to an alternative Kubernetes cluster, particularly one with multiple tenants, you may find it necessary to allow Workbench to run on more worker nodes to support the same workload. There will be *no additional per-node charges* levied as a result of this migration. Upon renewal, we will cap your per-node fees.

6.6 Project reproducibility in Workbench

6.6.1 Why do I need to worry about project reproducibility?

Project reproducibility ensures that your work retains its integrity and utility over time and across different environments. This guarantees that your code will consistently produce the same results, or continue to operate as intended, regardless of where it is run. If you do not ensure that your project is reproducible, you risk having code that could suddenly stop functioning in the future due to changes in the project's software environment.

6.6.2 How can I achieve project reproducibility?

While software tools can aid in project reproducibility, the only way to ensure complete project reproducibility is by encouraging users to adhere to the best practices described here at an organizational level.

Using `anaconda-project` for basic reproducibility:

The most reliable way to ensure your project remains reproducible indefinitely is to utilize the `anaconda-project lock` command to create a fully specified environment; one that has all packages used in the project and their dependencies locked to a specific version. This ensures that your project will be reproduced exactly as it was initially configured, because there will never be an unexpected update or change if new package dependencies are released. For more information about the `anaconda-project-lock.yml` file, see the official Anaconda Project documentation.

Project locking is not automatically enforced because it is a time-consuming process and isn't necessary when running development instances of the deployment. Therefore, it is up to the user to perform the locking procedure.

Tip: Run the `anaconda-project lock` command when you have finalized work on a project, or if you are ready to move a specific version of your project to a production environment (i.e. you are ready for your project to be interacted with or used publicly).

Managing environments for reproducibility

While locking your project is essential, it is ultimately the responsibility of the user to create and commit the lock file to the project. Furthermore, `anaconda-project` will run a "solve" (i.e. a resolution of dependencies) every time the project deploys, which can introduce potential issues for project reproducibility if the conda solver version has changed.

With Workbench versions 5.5 and newer, administrators can create and distribute pre-solved "persistent environments" to their users. These environments are like preconfigured workspaces set up by an administrator that have all the necessary tools and software already in place so their team can work without needing to make changes to the environment.

Because these environments are pre-solved and fixed, they don't require a new solve with each deployment. This means deployments from these environments are created more quickly, and guarantee that your project will run as expected every time, regardless of any external changes such as updates to the conda resolver itself.

For instructions on configuring persistent environments and supplying them to your users, see *Configuring persistent environments and sample projects*.

Best practices for managing environments for reproducibility:

Create comprehensive environments - Ensure that every managed environment is set up with all necessary libraries and packages that users might need for their work, including proprietary or internal packages unique to your organization. This will allow users to perform their tasks without needing to modify the environment.

Avoid unnecessary modifications - Encourage users to avoid independently modifying the `anaconda-project.yml` file of persistent environments that are provided by administrators. This practice helps maintain the integrity and reproducibility of the environment.

Promote project locking if modifications are required - If users must make changes, they should use the `anaconda-project lock` command to lock the environment afterwards, ensuring it can be precisely recreated later. They must also inform the administrator of these changes, so future environments can be adjusted to incorporate these needs without further modifications. For step-by-step instructions on locking your project, see *Locking project configurations*.

Tip: Run the `anaconda-project lock` command when you move to production, even if you created your project using a persistent environment with no configuration modifications!

Continuous updates - Administrators should routinely create new persistent environments to incorporate updates to packages and their dependencies. This keeps the environments up to date with the latest features and security patches.

Naming conventions - It's advisable to name these environments systematically, including the date of creation, which helps in identifying and managing them. For example, you could adopt the following structure: `<GROUP>_<YYYY><MM>` (where `<GROUP>` denotes the intended users for the environment and `<YYYY><MM>` is the year and month).

Deprecate old environments safely - Before an administrator deprecates an old environment, it's critical to ensure that it is not in use. Removing an environment that is still in use could disrupt ongoing projects.