
D-Wave Tabu

Release 0.4.2

D-Wave Systems Inc.

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A C/C++ implementation of the [MST2 multistart tabu search algorithm](#) for quadratic unconstrained binary optimization (QUBO) problems with a [dimod sampler](#) Python interface.

EXAMPLE

This example solves a two-variable Ising model.

```
>>> from tabu import TabuSampler  
>>> response = TabuSampler().sample_ising({'a': -0.5, 'b': 1.0}, {'(a', 'b)': -1})
```


DOCUMENTATION

Note: This documentation is for the latest version of [dwave-tabu](#). Documentation for the version currently installed by [dwave-ocean-sdk](#) is here: [dwave-tabu](#).

2.1 Introduction

Samplers are processes that sample from low energy states of a problem's objective function. A binary quadratic model (BQM) sampler samples from low energy states in models such as those defined by an Ising equation or a Quadratic Unconstrained Binary Optimization (QUBO) problem and returns an iterable of samples, in order of increasing energy. A [dimod sampler](#) provides 'sample_qubo' and 'sample_ising' methods as well as the generic BQM sampler method.

The `TabuSampler` sampler implements the [MST2 multistart tabu search algorithm](#) for quadratic unconstrained binary optimization (QUBO) problems with a [dimod](#) Python wrapper.

For a description of the tabu search algorithm, see [tabu search](#).

2.1.1 Example

This example solves a two-variable Ising model.

```
>>> from tabu import TabuSampler
>>> response = TabuSampler().sample_ising({'a': -0.5, 'b': 1.0}, {'(a', 'b)': -1})
```

2.2 Reference Documentation

Release 0.4.2

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2.2.1 D-Wave Tabu Sampler

A dimod [sampler](#) that uses the MST2 multistart tabu search algorithm.

class TabuSampler

A tabu-search sampler.

Examples

This example solves a two-variable Ising model.

```
>>> from tabu import TabuSampler
>>> samples = TabuSampler().sample_ising({'a': -0.5, 'b': 1.0}, {'ab': -1})
>>> list(samples.data())
[Sample(sample={'a': -1, 'b': -1}, energy=-1.5, num_occurrences=1)]
>>> samples.first.energy
-1.5
```

parameters = None

properties = None

sample(*bqm*, *initial_states*=None, *initial_states_generator*='random', *num_reads*=None, *seed*=None, *tenure*=None, *timeout*=20, *num_restarts*=1000000, *energy_threshold*=None, ***kwargs*)

Run a multistart tabu search on a given binary quadratic model.

Parameters

- **bqm** (BinaryQuadraticModel) – The binary quadratic model (BQM) to be sampled.
- **initial_states** (SampleSet, optional, default=None) – One or more samples, each defining an initial state for all the problem variables. Initial states are given one per read, but if fewer than *num_reads* initial states are defined, additional values are generated as specified by *initial_states_generator*.
- **initial_states_generator** (*str*, 'none'/'tile'/'random', optional, default='random') – Defines the expansion of *initial_states* if fewer than *num_reads* are specified:
 - **"none"**: If the number of initial states specified is smaller than *num_reads*, raises ValueError.
 - **"tile"**: Reuses the specified initial states if fewer than *num_reads* or truncates if greater.
 - **"random"**: Expands the specified initial states with randomly generated states if fewer than *num_reads* or truncates if greater.
- **num_reads** (*int*, optional, default=len(*initial_states*) or 1) – Number of reads. Each read is generated by one run of the tabu algorithm. If *num_reads* is not explicitly given, it is selected to match the number of initial states given. If initial states are not provided, only one read is performed.
- **seed** (*int* (32-bit unsigned integer), optional) – Seed to use for the PRNG. If the *timeout* parameter is not None, results from the same seed may not be identical between runs due to finite clock resolution.
- **tenure** (*int*, optional) – Tabu tenure, which is the length of the tabu list, or number of recently explored solutions kept in memory. Default is a quarter of the number of problem variables up to a maximum value of 20.

- **timeout** (*int*, *optional*, *default=20*) – Total running time per read in milliseconds.
- **num_restarts** (*int*, *optional*, *default=1,000,000*) – Number of tabu search restarts per read.
- **energy_threshold** (*float*, *optional*) – Terminate when an energy lower than `energy_threshold` is found.

Returns A *dimod* `SampleSet` object.

Return type `SampleSet`

Examples

This example samples a simple two-variable Ising model.

```
>>> import dimod
>>> bqm = dimod.BQM.from_ising({}, {'ab': 1})
```

```
>>> import tabu
>>> sampler = tabu.TabuSampler()
```

```
>>> samples = sampler.sample(bqm)
>>> samples.record[0].energy
-1.0
```

2.3 Installation

Install from a wheel on PyPI:

```
pip install dwave-tabu
```

or install from source:

```
pip install git+https://github.com/dwavesystems/dwave-tabu.git#egg=dwave-tabu
```

Note: installation from source involves a “cythonization” step. To install project requirements automatically, make sure to use a PEP-517 compliant pip, e.g. `pip>=10.0`.

To build from source:

```
pip install -r requirements.txt
python setup.py build_ext --inplace
python setup.py install
```

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Version 2.0, January 2004

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