traces¶

A Python library for unevenly-spaced time series analysis.

Why?

Taking measurements at irregular intervals is common, but most tools are primarily designed for evenly-spaced measurements. Also, in the real world, time series have missing observations or you may have multiple series with different frequencies: it's can be useful to model these as unevenly-spaced.

Traces aims to make it simple to write *readable code* to:

- **Munge**. Read, write, and manipulate unevenly-spaced time series data
- **Explore**. Perform basic analyses of unevenly-spaced time series data without making an awkward / lossy transformation to evenly-spaced representations
- **GTFO**. Gracefully transform unevenly-spaced times series data to evenly-spaced representations

Traces was designed by the team at Datascope based on several practical applications in different domains, because it turns out unevenly-spaced data is actually pretty great, particularly for sensor data analysis.

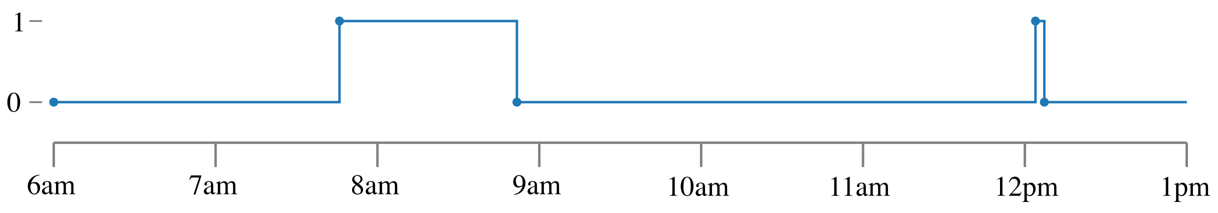
Installation

To install traces, run this command in your terminal:

```
$ pip install traces
```

Quickstart: using traces

To see a basic use of traces, let's look at these data from a light switch, also known as *Big Data from the Internet of Things*.



The main object in traces is a TimeSeries, which you create just like a dictionary, adding the five measurements at 6:00am, 7:45:56am, etc.

```
>>> time_series = traces.TimeSeries()
>>> time_series[datetime(2042, 2, 1,  6,  0,  0)] = 0 #  6:00:00am
>>> time_series[datetime(2042, 2, 1,  7, 45, 56)] = 1 #  7:45:56am
>>> time_series[datetime(2042, 2, 1,  8, 51, 42)] = 0 #  8:51:42am
>>> time_series[datetime(2042, 2, 1, 12,  3, 56)] = 1 # 12:03:56am
>>> time_series[datetime(2042, 2, 1, 12,  7, 13)] = 0 # 12:07:13am
```

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What if you want to know if the light was on at 11am? Unlike a python dictionary, you can look up the value at any time even if it's not one of the measurement times.

```
>>> time_series[datetime(2042, 2, 1, 11,  0, 0)] # 11:00am
0
```

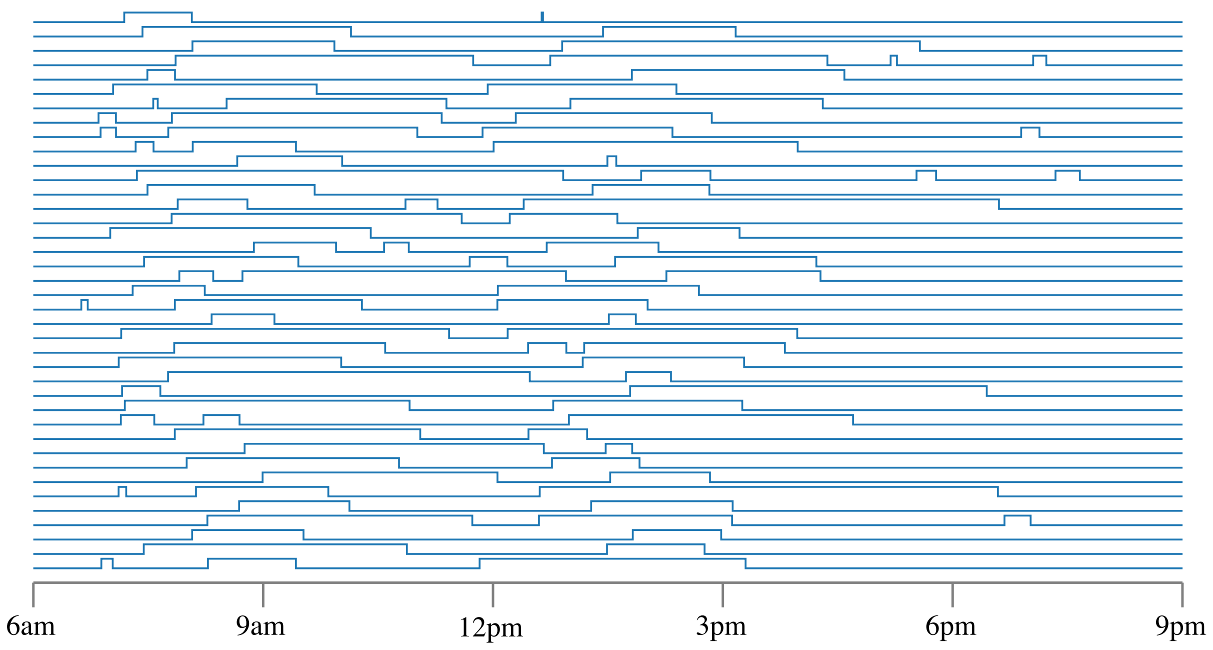
The `distribution` function gives you the fraction of time that the `TimeSeries` is in each state.

```
>>> time_series.distribution(
>>>   start=datetime(2042, 2, 1,  6,  0,  0), # 6:00am
>>>   end=datetime(2042, 2, 1,  13,  0,  0)   # 1:00pm
>>> )
Histogram({0: 0.8355952380952381, 1: 0.16440476190476191})
```

The light was on about 16% of the time between 6am and 1pm.

Adding more data...

Now let's get a little more complicated and look at the sensor readings from forty lights in a house.



How many lights are on throughout the day? The merge function takes the forty individual `TimeSeries` and efficiently merges them into one `TimeSeries` where the each value is a list of all lights.

```
>>> trace_list = [... list of forty traces.TimeSeries ...]
>>> count = traces.TimeSeries.merge(trace_list, operation=sum)
```

We also applied a `sum` operation to the list of states to get the `TimeSeries` of the number of lights that are on.

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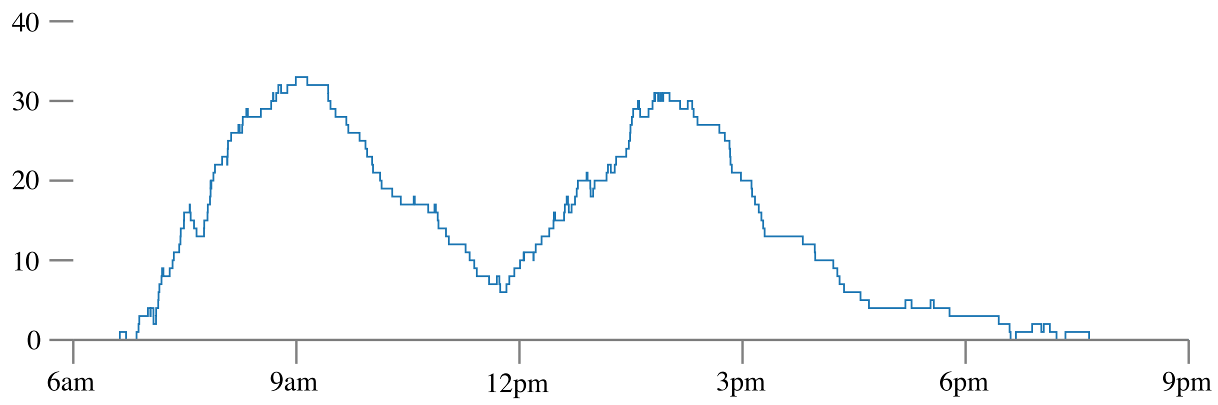

How many lights are on in the building on average during business hours, from 8am to 6pm?

```
>>> histogram = count.distribution(
>>>   start=datetime(2042, 2, 1,  8,  0,  0),   # 8:00am
>>>   end=datetime(2042, 2, 1,  12 + 6,  0,  0) # 6:00pm
>>> )
>>> histogram.median()
17
```

The `distribution` function returns a Histogram that can be used to get summary metrics such as the mean or quantiles.

It's flexible

The measurements points (keys) in a `TimeSeries` can be in any units as long as they can be ordered. The values can be anything.

For example, you can use a `TimeSeries` to keep track the contents of a grocery basket by the number of minutes within a shopping trip.

```
>>> time_series = traces.TimeSeries()
>>> time_series[1.2] = {'broccoli'}
>>> time_series[1.7] = {'broccoli', 'apple'}
>>> time_series[2.2] = {'apple'}          # puts broccoli back
>>> time_series[3.5] = {'apple', 'beets'} # mmm, beets
```

To learn more, check the examples and the detailed reference.

More info

- Examples
  - Read and manipulate
  - Basic analysis
  - Transform to evenly-spaced
- API Reference
  - TimeSeries
  - Histogram

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Contributing

Contributions are welcome and greatly appreciated! Please visit the repository for more info.

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