
mgcpy Documentation

Release beta

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mgcpy is a Python package containing tools for multiscale graph correlation and other statistical tests, that is capable of dealing with high dimensional and multivariate data.

Motivation

Examining and identifying relationships between variables is critical for many scientists to definitely establishing causality and deciphering these relationships in further studies. To approach this problem, the most commonly used statistic utilized is Pearson's Product-Moment Correlation (Pearson, 1895) but the test fails to address some of the issues that data scientists face today (Vogelstein et al., 2016). Other tests conventionally used include "energy statistics" such as Dcorr; kernel-based approaches such as Hilbert Schmidt Independence Criterion (HSIC) (Gretton and Györfi, 2010) which has recently been shown to be equivalent to "energy statistics" (Sejdinovic et al., 2013)(Shen and Vogelstein, 2018); Heller, Heller, and Gorfine's test (HHG) (Heller et al., 2012), and many others. These tests perform empirically well on either high dimensional linear data or low dimensional nonlinear data. No approach works well on high dimensional nonlinear data, and no approach addresses issues on how to interpret the data.

Multiscale graph correlation (MGC) attempts to alleviate these issues. The test utilizes features of other techniques such as k-nearest neighbors, kernel methods, and multiscale analysis to detect relationships (Vogelstein et al., 2016) in all types of data, including high dimensional nonlinear data. The test is also computationally efficient, requiring about half or one third of the number of samples to achieve the same statistical power (Vogelstein et al., 2016). In addition, the test provides information about the data's geometry (Vogelstein et al., 2016), allowing for more informed decision making of the underlying relationships in the data

CHAPTER 2

About

`mgcpy` aims to be a comprehensive independence testing package including all of the commonly used independence tests as mentioned above and additional functionality such as two sample independence testing and a novel random forest-based independence test. These tests are not only included to benchmark MGC but to have a convenient location for users if they would prefer to utilize those tests instead. The package utilizes a simple class structure to enhance usability while also allowing easy extension of the package for developers. The package can be installed on all major platforms (e.g. BSD, GNU/Linux, OS X, Windows) from Python Package Index (PyPI) and GitHub.

CHAPTER 3

Free software

mgcpy is free software; you can redistribute it and/or modify it under the terms of the *Apache-2.0*. We welcome contributions. Join us on [GitHub](#).

`mgcpy` is a hypothesis testing package in python.

4.1 Install

Below we assume you have the default Python environment already configured on your computer and you intend to install `mgcpy` inside of it. If you want to create and work with Python virtual environments, please follow instructions on [venv](#) and [virtual environments](#).

First, make sure you have the latest version of `pip` (the Python package manager) installed. If you do not, refer to the [Pip documentation](#) and install `pip` first.

4.1.1 Install the released version

Install the current release of `mgcpy` with `pip`:

```
$ pip install mgcpy
```

To upgrade to a newer release use the `--upgrade` flag:

```
$ pip install --upgrade mgcpy
```

If you do not have permission to install software systemwide, you can install into your user directory using the `--user` flag:

```
$ pip install --user mgcpy
```

Alternatively, you can manually download `mgcpy` from [GitHub](#) or [PyPI](#). To install one of these versions, unpack it and run the following from the top-level source directory using the Terminal:

```
$ pip install .
```

4.1.2 Install from Github

To install from Github, run the following from the top-level source directory using the Terminal:

```
$ git clone https://github.com/neurodata/mgcpy
$ cd mgcpy
$ python3 setup.py install
```

- sudo, if required
- `python3 setup.py build_ext --inplace` # for cython, if you want to test in-place, first execute this

4.1.3 Setting up the development environment

- To build image and run from scratch:
 - Install [docker](<https://docs.docker.com/install/>)
 - Build the docker image, `docker build -t mgcpy:latest .`
 - * This takes 10-15 mins to build
 - Launch the container to go into mgcpy's dev env, `docker run -it --rm --name mgcpy-env mgcpy:latest`
- Pull image from Dockerhub and run:
 - `docker pull tpsatish95/mgcpy:latest` or `docker pull tpsatish95/mgcpy:development`
 - `docker run -it --rm -p 8888:8888 --name mgcpy-env tpsatish95/mgcpy:latest`
- To run demo notebooks (from within Docker):
 - `cd demos`
 - `jupyter notebook --ip 0.0.0.0 --no-browser --allow-root`
 - Then copy the url it generates, it looks something like this: `http://(0de284ecf0cd or 127.0.0.1):8888/?token=e5a2541812d85e20026b1d04983dc8380055f2d16c28a6ad`
 - Edit this: (0de284ecf0cd or 127.0.0.1) to: 127.0.0.1, in the above link and open it in your browser
 - Then open `mgc.ipynb`
- To mount/load local files into docker container:
 - Do `docker run -it --rm -v <local_dir_path>:/root/workspace/ -p 8888:8888 --name mgcpy-env tpsatish95/mgcpy:latest,` replace `<local_dir_path>` with your local dir path.
 - Do `cd ../workspace` when you are inside the container to view the mounted files. The **mgcpy** package code will be in `/root/code` directory.

4.1.4 Python package dependencies

mgcpy requires the following packages:

- numpy

- scikit-learn
- scipy
- Cython
- pandas
- h5py
- seaborn

4.1.5 Hardware requirements

mgcpy package requires only a standard computer with enough RAM to support the in-memory operations.

4.1.6 OS Requirements

This package is supported for *macOS* and partly on *Linux*.

4.1.7 Testing

mgcpy uses the Python `pytest` testing package. If you don't already have that package installed, follow the directions on the [pytest homepage](#).

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CHAPTER 5

Indices and tables

- `genindex`
- `modindex`
- `search`