

# Instructions for installing gwemopt on UNIX

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These are instructions for setting up the gwemopt tool primarily written by Michael Coughlin. These instructions were written for a machine running Ubuntu 16.04, but should work for most UNIX distributions. These instructions are also compatible with macOS.

In these instructions, `$ ls` means to run `ls`.

## 1 Installing Anaconda

Any Python 3.7 distribution will work, but Anaconda comes with many of the packages required and can be installed completely locally, so it is convenient to use. If you prefer not to use Anaconda, skip this step, but you may have to install additional packages not mentioned in these instructions.

1. Go to <https://www.anaconda.com/download> and download the Anaconda 3.7 installer. Put it in your home directory.
2. `$ cd ~`
3. `$ bash Anaconda-latest-Linux-x86_64.sh`
4. Hold down the enter key to skip through all the licensing, then type “yes” to agree to the terms.
5. We want to install this locally, so the `/anaconda2` location given by default is good.
6. When prompted, type “yes” to prepending to PATH in `/.bashrc`. This is so when you type `$ python` in the command line you get this Anaconda distribution of Python.
7. If you are installing Anaconda on macOS, instructions can be found at <https://docs.anaconda.com/anaconda/install/mac-os/>.
8. Next, set up a virtual environment by following the instructions here: <https://uoa-eresearch.github.io/eresearch-cookbook/recipe/2014/11/20/conda/>. Name it ‘gwemopt’ or something similar, and run `$ conda activate yourenvname` to ensure you are in your virtual environment.
9. Install pip by running `$ conda install pip`

## 2 Installing Python packages

1. Python packages can be installed using pip or conda. We will be using pip. First find the path to the virtual environment's pip by running `$ which pip`. In my case, the path comes up as `/opt/anaconda3/envs/gwemopt/bin/pip`.
2. Using this path, run `$ /opt/anaconda3/envs/gwemopt/bin/pip install lscsoft-glue healpy astroplan astropy ligo-gracedb pyephem astropy-pymultinest ligo-skymap`. Including the full path ensures everything is installed to your virtual environment, and not to the root env.

## 3 Downloading gwemopt

1. `$ git clone https://github.com/mcoughlin/gwemopt`. I did this in my home directory.
2. To install this, `$ cd gwemopt` and then `$ python setup.py install`

## 4 Installing MultiNest and PyMultiNest

MultiNest and its Python wrapper PyMultiNest are required, but have slightly more involved installation procedures. These instructions are a more detailed version of what is written here: <https://johannesbuchner.github.io/PyMultiNest/install.html>. To begin, in your home directory, `$ git clone https://github.com/JohannesBuchner/MultiNest` and `$ git clone https://github.com/JohannesBuchner/PyMultiNest.git`.

### 4.1 Installing cmake

The MultiNest installation requires a C compiler. If you have one already, feel free to skip this subsection.

1. If you are using macOS, first type into the terminal:  
`$ /bin/bash -c "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/master/install.sh)"` then run `$ brew install cmake`. Otherwise, follow the instructions below.
2. Go to <https://cmake.org/download/> and download the Unix .tar.gz tarball (cmake-3.17.3.tar.gz is the latest release at time of writing). I put it in my home directory.
3. To open up the tarball, run `$ tar -zxvf cmake-3.17.3.tar.gz`
4. `$ cd cmake-3.17-3`
5. `$ ./bootstrap && make && sudo make install`. This will take a few minutes, so go get some coffee.

### 4.2 Installing other dependencies for MultiNest

1. For macOS, run `$ brew install openblas`, and then run `$ brew install lapack`. Otherwise...
2. `$ sudo apt-get update` to update the list from where apt-get pulls.
3. `$ sudo apt-get install libblas-dev liblapack-dev`

### 4.3 Building MultiNest and PyMultiNest

1. `$ cd ~/MultiNest/build`
2. `$ cmake .. && make`
3. To add MultiNest to your path right now and forever (by adding it to your `./bashrc`),  
`$ export LD_LIBRARY_PATH=~/MultiNest/lib/:$LD_LIBRARY_PATH` and  
`$ echo 'export LD_LIBRARY_PATH=~/MultiNest/lib/:$LD_LIBRARY_PATH' >> ~/.bashrc`
4. `$ cd ~/PyMultiNest`
5. `$ python setup.py install`
6. Adding PyMultiNest to your path right now and forever,  
`$ export PATH=$PATH:$HOME/.local/bin/` and  
`$ echo 'export PATH=$PATH:$HOME/.local/bin/' >> ~/.bashrc`

## 5 Testing the installation

Now you should have everything installed. To test this, we will run a command which will return skymaps.

1. `$ cd ~/gwemopt/bin/`
2. Now go to <https://gracedb.ligo.org/superevents/public/03/> and scroll down to S190425z. Go to Data (under links) and download the LALInference.fits.gz file. Create a directory in gwemopt/data called “GW190425” and move the downloaded file there.
3. Now we will run the test command.

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```
$ python gwemopt_run --telescopes ZTF --do3D --doTiles --doPlots --doSchedule
--doSkymap --timeallocationType powerlaw --scheduleType greedy -o
"./output/GW190425/powerlaw_greedy" --gpstime 1240215503.0171 --skymap
"./data/GW190425/LALInference.fits.gz" --filters g,r --exposuretimes
30.0,30.0 --doSingleExposure --doAlternatingFilters
```

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4. This should return plots and skymaps in the `/gwemopt/output/hierarchical_powerlaw_greedy/` directory.