

Congreso Nacional de Sistemas Planetarios 2024

Getting Started Guide: Python

For the hands-on sessions, participants can choose to run the exercises from their own installation of Python or use Google Colaboratory notebooks. These instructions are for the Python notebooks.

Please note that *you should set up your Python distribution in advance of the workshop*; just follow the instructions below. In this document, we use the `Courier New` font to indicate a command you type into the command prompt.

The Python Distribution

In order to run the Jupyter notebooks used in the hands-on session, you first need a working installation of Python3. Even if your operating system comes with a system level Python distribution installed (e.g. most flavors of Linux include this), we recommend you follow these instructions to install the standalone Anaconda Python distribution. System level distributions are often far out of date, and are difficult to upgrade without breaking the entire operating system.

You can download the free Anaconda here: <https://www.anaconda.com/products/distribution>

You can find lots of information about the installation of Anaconda here:
<https://docs.anaconda.com/anaconda/install/>

If you prefer to use a specific version, check the repository here:
<https://repo.anaconda.com/archive/>

Versions exist for Windows, Mac, and Linux. *Choose the Python 3.9 download appropriate for your operating system.* Note that the Individual Edition is free, while the Team and Enterprise distributions require license agreements. For the Exoplanetas hands-on Workshop, and most data analysis you would do for independent research, the Individual Edition is sufficient.

These downloads are between 300 and 600 MB, depending on operating system, and need a minimum 5 GB of disk space for the download and installation. If your internet is limited in bandwidth, you can utilize the Miniconda distribution, which is much smaller (~50 MB; requires minimum 400 MB of disk space) at <https://docs.conda.io/en/latest/miniconda.html>. This gives you the same core packages as Anaconda, but strips out many extra packages that may not be needed. If you do need missing components later on, it is straightforward to add them individually (see below for a list of the main packages you would have to install).

Note: If you already have Python installed on your system, but would like to install the new packages in their own virtual environment, you can choose to install Python in a custom working environment (see the instructions below).

Windows and MacOS

The Windows and Mac versions of Anaconda and Miniconda are installed in the normal way by double-clicking the downloaded installer. Follow the prompts to install the Python distribution. Be patient as the installation can take as much as 15-20 min to complete.

You will interact with Python from a terminal prompt. On macOS you can reach the terminal from your Applications/Utilities directory. On Windows, use the search feature next to the start menu to search for Anaconda Navigator. From there open the Powershell to access the command line.

Linux

The Linux version is installed by running the ‘sh’ script from the command line in a terminal:

```
bash Anaconda3-2022.05-Linux-x86_64.sh
```

```
bash Anaconda3-2023.09-0-Linux-x86_64.sh
```

```
bash Anaconda3-2024.02-1-Linux-x86_64.sh
```

If you prefer a different version, check the repository here:

<https://repo.anaconda.com/archive/>

After accepting the license agreement, you will be asked for a location into which to install the distribution (e.g. the default /home/username/anaconda3). All of the Python packages we will be using will be installed under the directory you specified. This will take quite some time to complete. When you are asked “Do you wish the installer to initialize Anaconda3 by running conda init?”, answer “yes”. This will add code to your .bashrc file which initializes Anaconda Python whenever you open a new terminal window.

Now close the terminal and open another (so that the new .bashrc takes effect).

Update to the Latest Version (Windows, MacOS, Linux)

Next update the core conda package to the latest version by typing:

```
conda update conda
```

Answer “y” when asked if you wish to update, and wait for the update to finish.

If you would like to update *all* of the packages that come with Anaconda to their latest versions, type:

```
conda update --all
```

Note that this will take some time. This step is optional, since packages can also be updated individually as needed.

You now have a working Python distribution installed in your account.

Install Packages for the Workshop (Windows, MacOS, Linux)

We will use a few additional Python packages that may not be included in the Anaconda distribution. If not already installed, you should install them by typing:

```
conda install numpy
conda install scipy
conda install astropy
conda install pandas
conda install jupyter
conda install matplotlib
```

Custom Working Environment (*Optional*) (Windows, MacOS, Linux)

If you are developing code or running a program that requires you to install custom packages, it can be useful to create a virtual environment dedicated to that project. This environment allows you to create local installations of your Python environment for specific purposes; if you do something undesirable in a virtual environment, you can delete it and start over, without having to reinstall conda.

Note: This step is optional for the Exoplanetas hands-on Workshop. It can be useful for users who are already using Python for other projects, and want to keep the workshop materials separated out.

To create a virtual Python3 environment for use with the Exoplanetas hands-on Workshop, type the following:

```
conda create --name exoplanets python=3.9
```

This creates a directory `~/anaconda3/envs/exoplanets` (`C:\Users\username\anaconda3\envs\exoplanets` under Windows), which contains a local copy of your Python directory. You can modify the Python environment in here without risk of damaging the base install.

To ‘activate’ your custom environment, type:

```
conda activate exoplanets
```

Note: You may have to initialize your shell first, before this command can be run. To do this, type `conda init <Shell_name>`

where `<Shell_name>` should be either `bash`, `fish`, `tcsh`, `xonsh`, `zsh`, or `powershell`, then close and restart your shell.

Once you have activated your custom environment, the beginning of your terminal prompt should change to `[exoplanets]`, and any packages that you install now will end up in `~/anaconda3/envs/exoplanets`. Note that each new terminal you open needs to have the activate command run on it. In addition, you do not need to work in that directory, you work in any directory.

To 'deactivate' a custom environment, type:

```
conda deactivate or conda activate
```

(with no environment specified). That will return your terminal to the base environment.

By default, conda environments contain only a minimal set of packages. If you are working in an environment, you will need to install packages as necessary for the workshop; here are the main ones:

```
conda activate exoplanets
conda install numpy
conda install scipy
conda install astropy
conda install pandas
conda install jupyter
conda install matplotlib
```

Note: If any of the above commands does not work, instead of using

```
conda install package_name try conda install -c conda-forge package_name
```

An easier way to install all the necessary packages is to use the script that we provide. To create the environment, go to the congress directory "Taller" and type:

```
conda env create --file INFO/environment.yml
```

This will take some time. With this installation you will not need to install more applications.

Now all the packages will end up in `~/anaconda3/envs/exoplanets`. Note that each new terminal you open needs to have the activate command run on it.

To activate this environment, go to the working directory and type:

```
conda activate Exoplanets
```

Initialize your shell: bash, fish, tcsh, xonsh, zsh

```
conda init <Shell_name>
```

Start a new Terminal with that shell. Go to the working directory. Note that if you need to install other applications, you can do it while you have activated this environment, the applications will end up in `~/anaconda3/envs/exoplanets`.

To deactivate environment, use

```
conda deactivate
```

Python Jupyter Notebooks (Windows, MacOS, Linux)

Jupyter notebooks are a handy, interactive way to work through programming problems in a GUI environment in your web browser. They allow you to easily document your work (just like a real lab notebook) and visualize the results of each step in a computer program. The activities for the

Exoplanetas Workshop are in the form of Jupyter notebooks (files ending in 'ipynb'), so if you are not familiar with them, read the following instructions.

Jupyter comes included with the full Anaconda distribution.

If you installed miniconda, run the following to add the Jupyter notebook package:

```
conda install jupyter
```

You can start running a Jupyter notebook by typing the following command in a terminal window (you should type this in the directory where the Jupyter notebook is located, or any directory above it):

```
jupyter notebook
```

Note: Windows users can use Anaconda Navigator to access the Jupyter notebook interface.

This will launch the Jupyter kernel and load an interface in your local web browser where you can see the content of the directory where you started Jupyter. To open a Jupyter notebook, simply click on the file (it ends in 'ipynb'), and the notebook will open up in a new browser window. To execute code in a Jupyter notebook cell, type CTRL-Enter (or Shift-Enter). Note that Jupyter notebooks are automatically saved, so it is helpful to create a backup copy of any notebook before working with it.

When you are done, click on the Jupyter icon  in the upper left. This will return you to the directory interface, where you can load additional notebooks.

To close a Jupyter notebook, in the directory interface select the notebook and click on "Shutdown"; close the browser window. Then, if you launched the notebook from a terminal window, press Control-C twice in that window to shut down the notebook server. Another option to shut down the server is to click on "Quit" in the top right corner of the directory interface page and close the browser window.

Downloading Files for the Workshop

The directory Taller/INFO includes very important information. Do not forget to see the information in each file in this directory.

For the Jupyter notebooks below, simply save them from your browser window by using the menu option File→Save Page As, and then save the file with the ipynb extension for the links below.

CNSP2024_Jupyter_GaiaHandsOn-TransitingPlanetsDR3.ipynb notebook

https://astroscu.unam.mx/Exoplanetas/hands-on/CNSP2024_Jupyter_GaiaHandsOn-TransitingPlanetsDR3.ipynb

► Here is the notebook with answers (CNSP2024_Jupyter_GaiaHandsOn-TransitingPlanetsDR3_Answers.ipynb): https://astroscu.unam.mx/Exoplanetas/hands-on/CNSP2024_Jupyter_GaiaHandsOn-TransitingPlanetsDR3_Answers.ipynb

Challenge: Orbital Fitting of Gaia-like Data

https://astroscu.unam.mx/Exoplanetas/hands-on/CNSP2024_Jupyter_Orbit_Fit_Challenge.ipynb

► Here is the notebook with answers (CNSP2024_Jupyter_Orbital_Fit_Challenge_Answers.ipynb): https://astroscu.unam.mx/Exoplanetas/hands-on/CNSP2024_Jupyter_Orbit_Fit_Challenge_Answers.ipynb