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# Installing and setting up nuSIM

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## Introduction

This document summarises the steps needed to set-up and run nuSIM. A summary of the tasks that nuSIM performs may be found in [1]. nuSIM has been developed in python; python 3 is assumed.

## Getting the code

nuSIM is maintained using the GitHub version-control system. The latest release can be downloaded from the [nuSTORM wiki](https://www.nustorm.org/trac/wiki/Software-and-computing) (<https://www.nustorm.org/trac/wiki/Software-and-computing>).

## Dependencies and required packages

nuSIM requires the following packages:

- Python modules: `scipy`, `matplotlib`, and `pandas`;
- CERN programme library: `pyroot` (which may be installed using the standard `root` installers, see the documentation at <https://root.cern/install/>).

It may be convenient to run nuSIM in a “virtual environment”. To set this up, after updating your python installation to python 3, and installing `root`, execute the following commands:

1. `python3 -m venv --system-site-packages venv`
  - This creates the director `venv` that contains files related to the virtual environment.
2. `source venv/bin/activate`
3. `python -m pip install pandas scipy matplotlib`

To exit from the virtual environment, execute the command `deactivate`.

The command `source venv/bin/activate` places you back into the virtual environment.

## Unpacking the code, directories, and running the tests

After downloading the tar ball, the installation is created by “unzipping” and “untarring” it. The combined operation of unzipping and untarring will create a directory tree for which the top-level directory will have the name “`nuSTORM-M.m.P`”, where “`M`” is the major version number, “`m`” is the minor version number, and “`P`” is the patch number.

In the top directory (`nuSTORM-M.m.P`) you will find a “`README.md`” file which provides some orientation and instructions to run the code. In particular, a `bash` script “`startup.bash`” is provided which:

- Sets the “`nuSIMPAT`” environment variable so that the files that hold constants etc. required by the code can be located; and

- Adds “01-Code” (see below) to the PYTHONPATH. The scripts in “02-Tests” (see below) may then be run with the command “python 02-Tests/*filename*.py”.

Below the top directory, the directory structure in which the code is presented is:

01-Code: contains the python implementation as a series of modules. Each module contains a single class or a related set of methods.

02-Tests: contains self-contained test scripts that run the various methods and simulation packages defined in the code directory.

11-Parameters: contains the parameter set used in 02-Tests/RunSimulation.py to generate muon decays in the production straight.

The instruction in the README.md file should be followed to set up and run the code.

## Making a contribution

nuSIM is archived in the git repository `longkr/nuSTORM`. To clone the code using `git clone` you will need your own account on GitHub and permission to clone the code. Instructions to request such permission is posted on the nuSTORM wiki.

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## References

- [1] P. Kyberd and K. Long, “nuSIM: parameters for first simulation of neutrino spectra,” Tech. Rep. nuSIM-2021-01, March, 2021. <https://www.nustorm.org/trac/raw-attachment/wiki/Software-and-computing/Documentation/2021/nuSIM-doc-01.pdf>.