NumPy, Matplotlib, SciPy, NeuroTools, PyNN

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Overview

**NumPy** - fundamental package needed for scientific computing

**Matplotlib** - matplotlib is a python 2D plotting library

**SciPy** - package for mathematics, science, and engineering

**PyNN** - simulator-independent language for building neuronal network models

**NeuroTools** - collection of tools to support all tasks associated with a neural simulation projects

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How to present code and its results?
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Complex, time-consuming way: Copy&paste code and figures into a presentation

```python
import NeuroTools.stgen as stgen
import pylab

sg = stgen.StGen()
duration = 1000.
rate_independent = 100. #Hz
rate_shared = 10. #Hz, 10 % correlation

st1 = sg.poisson_generator(rate=rate_independent, t_stop = duration)
print "Spiketrain 1:"
print "mean rate: %f" % st1.mean_rate()
Out: 94.0
print "coefficient of variation: %f" % st1.cv_isi()
Out: 1.03099116849
print "fano factor: %f" % st1.fano_factor_isi()
Out: 11.211944837
st1.raster_plot(display=True)
```
Complex, time-consuming way:
Copy & paste code and figures into a presentation

```python
import NeuroTools.stgen as stgen
import pylab
pylab.close('all')

sg = stgen.StGen()
duration = 1000.
rate_independent = 100. #Hz
rate_shared = 10. #Hz

st1 = sg.poisson_generator(rate=rate_independent, t_stop = duration)
print "Spiketrain 1:
print "mean rate: %f" % st1.mean_rate()
print "coefficient of variation: %f" % st1.cv_isi()
print "fano factor: %f" % st1.fano_factor_isi()
st1.raster_plot(display=True)
```
Easy, efficient way: pyreporrt

http://gael-varoquaux.info/computers/pyreporrt/

pyreporrt is a program that runs a python script and captures its output, compiling it to a pretty report in a pdf or an html file.

It can display the output embedded in the code that produced it and can process special comments (literate comments) according to markup languages (rst or LaTeX) to compile a very readable document.

This allows for extensive literate programing in python, for generating reports out of calculations written in python, and for making nice tutorials.
Easy, efficient way: pyreport

pyreport sfn_example_stgen.py

open sfn_example_stgem.pdf
NumPy

- http://numpy.scipy.org

NumPy is the fundamental package needed for scientific computing with Python. It contains:
- a powerful N-dimensional array object
- basic linear algebra functions
- basic Fourier transforms
- sophisticated random number capabilities
- ...

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Information about NumPy

General information: http://www.scipy.org/NumPy

Reference: http://docs.scipy.org/doc/numpy/reference/

Examples for each function: http://www.scipy.org/Numpy_Example_List_With_Doc

Cookbook: http://www.scipy.org/Cookbook
NumPy examples

show examples pdf
Matplotlib

• matplotlib is a python 2D plotting library which produces publication quality figures

• matplotlib can be used in python scripts, the python and ipython shell (ala matlab or mathematica), web application servers, and six graphical user interface toolkits

• matplotlib tries to make easy things easy and hard things possible

• You can generate plots, histograms, power spectra, bar charts, errorcharts, scatterplots, etc, with just a few lines of code
Information about Matplotlib

General information: http://matplotlib.sourceforge.net/

Examples: http://matplotlib.sourceforge.net/examples/index.html

Cookbook: http://www.scipy.org/Cookbook/Matplotlib


Gallery: http://matplotlib.sourceforge.net/gallery.html
Matplotlib examples

show examples pdf
SciPy

- SciPy (pronounced "Sigh Pie") is open-source software for mathematics, science, and engineering.

- The SciPy library depends on NumPy

- The SciPy library is built to work with NumPy arrays, and provides many user-friendly and efficient numerical routines such as routines for numerical integration and optimization.
Information about SciPy

General information: http://www.scipy.org


Cookbook: http://www.scipy.org/Cookbook
SciPy examples

show examples pdf
PyNN (pronounced 'pine') is a simulator-independent language for building neuronal network models.
PyNN

General information: http://neuralensemble.org/trac/PyNN

PyNN examples

show examples pdf
NeuroTools

- NeuroTools is a collection of tools to support all tasks associated with a neural simulation project which are not handled by the simulation engine.

- NeuroTools provides modules to facilitate simulation setup, parameterization, data management, analysis and visualization.
NeuroTools

NeuroTools examples

show examples pdf
Contributors:
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Exercises

• Simple exercises on the Wiki

• More complex exercise: build a visual system using numpy, matplotlib and NeuroTools

• Go through some examples in the cookbooks of numpy, scipy, matplotlib
More complex exercise:
Build a visual system model

V1 simple cell receptive field

Adapted from Hubel & Wiesel 1987

DeAngelis et al.
Trends Neurosci 1995

Adapted from Contreras & Palmer
J Neurosci 2003
More complex exercise: Build a visual system model
More complex exercise:
Build a visual system model

**Stimulus**
- 3D numpy array
  - e.g. `numpy.sin`

**V1 RF**
- 2D numpy array
  - e.g. Gabor function

**Spiking mechanism**
- e.g. `NeuroTools.stgen.StGen.inh_poisson_generator`

Filtered Stimulus (1D)

Stimulus induced spikes