Session 1: Introduction to Python from the Matlab perspective

October 8th, 2018 | Sandra Diaz
Working with examples in this course

• Git repository
  - Work: Exercises we will be interactively working on
  - Slides
Starting with Python

- IDEs: Pyzo, PyCharm, Spyder, Wing
- [https://www.python.org/](https://www.python.org/)
- [https://docs.python.org/3/](https://docs.python.org/3/)
- [https://www.scipy.org/](https://www.scipy.org/)
- [https://matplotlib.org/](https://matplotlib.org/)
Executing code in python

• The python interpreter
  - $ python my-program.py

• Ipython
  - Interactive shell for the python interpreter

• Jupyter notebooks
  - HTML-based notebook environment for Python, similar to the Matlab frontend
Running Python

• Versions 2 and 3 are commonly found

• In this course we focus on Python 3
  - $ python --version
Introduction to Python

• Modules
  - import math
  - from math import *
  - from math import cos
  - print(dir(math))
  - help(math.cos) or help(math)
Introduction to Python

- Indentation is very important!
  - Do not use tabs
- Variable names
- Variable types
  - Fundamental types: int, float, bool, complex
  - Type casting
- Operators
  - All works the same as Matlab but:
    - `/` is always a floating point division in Python 3 (Python 2: from __future__ import division)
    - `//` integer division
    - `**` power
    - Booleans: and, not, or
    - `=` identical (objects or fundamental types)
Introduction to Python

• List of equivalent operations:
Introduction to Python

• Indexing
  - In Python indexing starts at 0
  - In Python, indexing is done with [] not ()
  - Use one [] for each dimension to index.
  - [start:stop] extract a portion of an indexable object from start until stop-1
  - [start:end:step] also works
    • Omitting one gives defaults
  - Index -1 is the last element, -2 the second last and so on so forth
Introduction to Python

- Indexable objects and basic data structures
  - Strings are arrays of characters
  - Lists are arrays of any type and do not have to be all of the same type: `x = [5, 'h', 2.0]`
  - Numerical arrays:
    - `range(start, stop, step)`
    - `drange`
  - Dictionaries: `{‘key1’: ‘value’, ‘key2’: 3}`
Introduction to Python

• Sending output to the screen: unlike Matlab, in Python we use the print command to send variable values and text to the screen
  - print (variable)
  - print ("Hello Python!")
  - print('{} {} {}'.format(2, 2*2, 2*2*2))
  - print('Port your code from {} to {}'.format('Matlab', 'Python'))
Introduction to Python

• Open a file
  - file = fopen(‘myfile.dat’, ‘w’) → file = open(‘myfile.dat’, ‘w’)

• Output to a file
  - fprintf(file,’From Matlab’) → file.write(“To Python”)
  - Variables must be converted to a string:
    file.write('{} {} {}\'.format(2, 2*2, 2*2*2))

• Read from a file
  - content = fread(file) → content = file.read()
  - line = file.readline()

• Close a file
  - fclose(file) → file.close()
Introduction to Python

• Flow control
  - Important that the scope of the flow control structure is defined by the indentation. There is no ‘end’ statement like in Matlab
  - Loops
    • for x in range(10):
    • while x<10:
      • parfor can be implemented in many ways in python: MPI or OpenMP
        - http://www.reddit.com/r/Python/comments/j3qjb/parformatlabpool_replacement/
  - Control
    • if, elif, else
    • no real switch statement but can use a dictionary
Introduction to Python

• Tip: Code in Python is not checked for syntax errors before execution because it is an interpreted language
• Code that is not executed is not verified
• Test your code for all cases (unit testing)
Introduction to Python

• Functions
  - Use the `def` keyword to identify a function
  - Be careful, the extent of the function is defined by indentation
  - Use the return statement to send back one or more values from your function
  - Lambda functions are special functions without a name
Virtual environments

- Enclosed spaces with an independent Python installation in a self-contained directory
- Allow the installation of packages without administrator permissions
- Flexibility and portability
- Several independent Python spaces in the same computer
- `source env_path/bin/activate`
- https://docs.python.org/3/tutorial/venv.html
References

(1) Based on the work by J.R. Johansson http://jrjohansson.github.io