PHYS4038/MLiS and AS1/MPAGS

Scientific Programming in

python™

mpags-python.github.io

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ASI/MPAGS

Course Introduction

Course prerequisites

- To make the most of this course, you should have:
  - Some programming experience (in any language)
  - Access to a computer with Python installed
    - Anaconda recommended – see course webpage

- Ideally you should also have:
  - Some current or upcoming need of a scripting language
  - A piece of real or toy analysis on which you can try out using Python

Course aims

- To give you…
  - experience of using a modern scripting language
  - introduction to all essential Python syntax
  - practical advice about scientific programming
  - knowledge of the main scientific modules for Python
  - the ability to do basic data analysis tasks in Python
    (e.g. data manipulation, plotting, …)
  - knowledge of some specific tools for scientific computing
    (e.g. signal processing, optimisation, …)
  - an overview of Python's full capabilities
- Not to…
  - teach programming in general (but I will try to help!)
  - cover every aspect of Python

Course structure

- Ten weeks
- About one hour of recorded lecture videos each week
- Watch at your own pace, try out examples
- Work on exercises and coursework
- Synchronous online session via MS Teams – **Fridays at 10am**
  - Ask any questions
  - Exercise solutions
  - Help with debugging
- Talk to me:
  - During synchronous Teams sessions *(preferred)*
  - Via Slack channel (you will receive an invitation)
  - Email: steven.bamford@nottingham.ac.uk

Outline

- **Session 1**: Introduction to Python
  - Why Python is (mostly) awesome
  - Writing and running Python
  - Language basics
- **Session 2**: Introduction to Python, continued
  - More language basics
  - Good programming practice
- **Session 3**: Staying organised
  - Managing your environment with conda and pip
  - Version control with GitHub
- **Session 4**: Numerical Python and Plotting
  - Numpy
  - Using arrays wisely
  - Matplotlib (and others)
- **Session 5**: Scientific Python
  - Scipy and other tools
  - Filtering, interpolation, optimisation

Outline

- **Session 6**: Data handling
  - Efficiently storing and processing large amounts of data
    - PyTables, Pandas, Dask
    - Multiprocessing
- **Session 7**: Python for specialists
  - Python for astronomers
    - Astropy
  - Python for theorists
    - Symbolic algebra
- **Session 8**: MSc presentations (no lecture / no PhD students)
- **Session 9**: Bayesian inference and Deep Learning in Python
  - MCMC with emcee
  - ANNs with keras
- **Session 10**: Robust, fast & friendly code
  - Testing and timing
  - Wrapping external libraries and creating the fastest code
    - cython, numba, etc.
  - Web applications

Assessment

For those taking this module for MPAGS credits

- Assessed by development of a Python program relevant to your interests
  - put course material into practice
  - opportunity to become familiar with Python
  - get feedback on your coding
- Your code should…
  - be written as an executable module (.py file) or Jupyter notebook (.ipynb)
  - do something meaningful: analyse real data or perform a simulation
  - define at least two user functions (but typically more)
  - make use of appropriate specialist modules
  - produce at least one informative plot
  - comprise >~ 50 lines of actual code
    - excluding comments, imports and other 'boilerplate'
  - contain no more than 1000 lines in total
    - if you have written more, please isolate an individual element

Code development

- Three stages (first two optional for MPAGS students)

1. hand-in by **28th October** (optional for feedback)
   - README describing what you intend your code to do
   - Rough outline of the code (classes, functions, snippets, comments, pseudocode)

2. hand-in by **18th November** (optional for feedback)
   - Rough version of your code, may be incomplete, have bugs, although try to make it reasonable and easy to understand!

3. hand-in by **16th December** (required for MPAGS credits)
   - Complete working version of your code

Deadlines are 3pm on Wednesdays.

That's it for today!

Next up:

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