Introduction to Python Programming for Astronomers

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1 Course Description

This course is aimed primarily at astronomy and physics majors interested in learning programming in the context of research. The course is taught in Python, a programming language becoming widespread in the astronomy community and currently used in the undergraduate astronomy laboratory courses. The course assumes no knowledge of computer programming, while being beneficial to those who already have working knowledge of programming. The first half of the course focuses on teaching the building blocks of using a programming language while the second shows the wide variety of applications it has in astronomy. The course also covers the basics of UNIX and \LaTeX.

2 Course Objectives

By the end of the semester, students will be able to write programs in Python to manipulate data, process images, and generate plots. Students will also be comfortable working in a UNIX/Linux operating system and will be proficient at \LaTeX. Such skills will greatly ease the transition into the astronomy lab courses and will be useful in research.

3 Required Texts

No texts will be needed, as all resources will be available on ugastro.berkeley.edu/~parriaga/python/

4 Grading

Grading for this class will be P/NP. Grades will be based on the following:
Participation and Attendance: 20%
Homework: 30%
In-class Lab Assignments: 30%
Final project/presentation: 20%
The assignments will not be submitted, but saved onto the uga stro server where they will be viewed and graded for achievement of initial objectives and completeness.

5 Schedule:

This is a rough guide of what will be covered during the semester, though it is subject to change according to class progress and the availability of guest speakers. Tuesday classes will take place in B1 of Hearst Field Annex and Thursday classes will be in the undergrad lab.

5.1 Week 1: Basics

• Why use UNIX?
• Navigating UNIX
• Manipulating files
• Emacs

Week 2: Starting Python

• Basic math in Python
• Variables and data types
• Basic arrays
• Basic strings
• Importing packages and using functions
• Writing basic programs

Week 3: Basic Programming

• Writing functions
• Modular programming
• Positional and keyword parameters
• Loops and conditionals
• Good programming practices
• Error handling and exceptions

Week 4: Advanced Arrays

• Vectors and array generators
• Accessing array elements
• Array concatenation
• Using arrays with loops
• Basic lambda functions
• Tuples and Dictionaries

Week 5: Plotting and Figures

• Basic matplotlib
• Plotting functions
• Representing data
• Customizing good plots

Week 6: Applications

• Reading and writing data
• CSV, TSV files
• Application: Linear regressions
• Application: 1-D centroids
Week 7: Images
  • Introduction to FITS files
  • Displaying and representing image data
  • FITS header files
  • Advanced string operations

Week 8: More Object Oriented
  • Application: Monte-Carlo Markov Algorithm
  • Application: Analyzing Series of Images
  • Application: Modeling Images
  • Dictionaries

Week 9: \LaTeX
  • What is \LaTeX
  • Creating and customizing documents
  • Equations, Figures, Tables

Week 10: Final Presentations