

Phys 60441

Techniques of Radio Astronomy

Part 1: Python Programming

LECTURE 5 – Practical Session

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<http://www.jb.man.ac.uk/~tob/python.html>

Requirements for assessment

- Coursework element
 - Limited time i.e. several days
 - Builds on various elements already covered and summarised here in this practical session
- Exam
 - Two compulsory questions, one of which is on Python.
 - Mostly interpreting some simple Python code and writing some very short segments of your own.

You should be able to :

- Edit and run the “Hello world” script ex1.py
- Understand integers, floating point, complex numbers and strings in Python
 - Note integer arithmetic
 - Note accessing parts of strings, arithmetic with strings etc
- Recognise and use “lists”, “tuples” and dictionaries”
- Write a Python script which uses a `while` loop to calculate and display on the screen the factorials of integers from 1 to 5
- Recognise and use “if” statements
- Write a Python program to use a “for” loop and the “range” function to calculate, for the integers 1 to 10, their sum and mean
- Write a script to include a function which returns the mean value of 5 numbers input by the user using the “input” function and prints it to the screen

You should be able to :

- Understand and be able to manipulate “ndarrays” in NumPy
- Write a script which reads data from a text file (using “loadtxt”) into a 1D NumPy array and uses NumPy functions to calculate the min, max, mean, standard deviation, median of its elements.
- Develop the last example to :
 - Prompt the user for the name of a data file
 - Read from the file a list of (x,y,z) groups of real numbers (one group of 3 per line) and stores these in three arrays (try it with 5 rows).
 - Print to the screen the number of lines read from the file.
 - Calculate the minimum, maximum and mean of x and y using your own functions and print these to the screen accurate to 5 decimal places.

You should be able to :

- Develop this script to:
 - Plot y against x using matplotlib
 - Use z as the error bar on y i.e. $y \pm z$.
 - Fit a straight line to the data using the SciPy “leastsq” function with an error function including the uncertainties on y (i.e. a proper chi-squared).
 - Plot the best-fit straight line on the same axes as the data
 - Print out the results to the screen in a tidy format
 - Test your program!
- Write a script which uses PyFITS to:
 - Read in my example fits image and plot an image of it to the screen
 - Find the maximum value in the image (either by inspection of the plotted image) or, better, by using a function
 - Plot the row which runs through the maximum point as a line graph