



Python for Science, Engineering, and Astrophysics

Actividades Transversales de Doctorado
Universidad Politécnica de Cartagena
Curso 2020/21

1. Información general de la actividad /General course information					
Nombre/ Name	Python for Science, Engineering, and Astrophysics				
Nivel /Level	Doctorado				
Modalidad de impartición / Teaching mode	Online				
Lengua impartición/ Language	English				
ECTS	1	hours / ECTS	30	Total hours	30

2. Datos del profesorado / Lecture data	
Profesor /Lecturer in charge	Anastasio Díaz Sánchez
Departamento o Servicio/ Department/Service	Departamento de Física Aplicada y Tecnología Naval
Area de conocimiento /Knowledge area	Física Aplicada
Despacho /Office location	Antiguo Hospital de Marina. Despacho nº 3016 (3ª planta)

Teléfono /Telephone	968325331	email	Anastasio.diaz@upct.es
URL / WEB	www.upct.es		
Horario de Atención /Office hours	Aula virtual UPCT		

3. Fechas por edición / Dates	
1ª edición / 1st edition-	From November to September
Fecha/Date	Online
Horario/Hours	30

4. Objetivos del curso/Course objectives

Python is becoming one the most used interpreted languages for data analysis, competing directly with well-established commercial solutions as Matlab or IDL. Apart from its simple syntax and very smooth learning curve, the main advantage of Python is that you can use it virtually for everything, having modules for database interaction, web development, parallel computing and a long etcetera. Of course, there are mature scientific and mathematical libraries.

In this course, we will give a short introduction to the Python language and to the main packages used in science, engineering, and astrophysics. Mainly we will study the “Numpy” package (arrays manipulation library), the “Matplotlib” package (2D & 3D plotting library), the “Scipy” package (main scientific library) and the core package for Astronomy “Astropy”. We will study the central tools and techniques needed for performing science, engineering, and astrophysics with Python.

5. Contenidos teóricos / Theory programme

1. Python scientific computing ecosystem
 - Why Python
 - The Scientific Python
 - Starting
 - The workflow
2. The Python language
 - First steps
 - Basic types
 - Control Flow
 - Defining functions
 - Scripts & modules
 - Input & output
 - Standard Library
 - Object-oriented programming
3. NumPy: creating and manipulating numerical data
 - Array object
 - Numerical operations on arrays
 - More elaborate arrays
 - Advanced operations

- Some exercises
- 4. Matplotlib: plotting
 - Introduction
 - Simple plot
 - Figures, subplots, axes and ticks
 - Other types of plots
 - References & code examples
- 5. Scipy : high-level scientific computing
 - File input/output
 - Special functions
 - Linear algebra operations
 - Interpolation
 - Optimization and fit
 - Statistics and random numbers
 - Numerical integration
 - Fast Fourier transforms
 - Signal processing
 - Image manipulation
 - Exercises on scientific computing
- 6. Getting help and finding documentation
- 7. Astropy: astronomy and astrophysics with Python
 - Data structure
 - Transformation
 - Files input/output
 - Communication
 - Computations
 - Utilities

6. Contenidos prácticos / Practical programme

All the theoretical units come with a lot of examples and exercises. The knowledge is acquired interactively through these examples and exercises, the course is mainly practical. The student will have to download and install the Python interface and the scientific packages and go through the units next to the computer, working with the examples and exercises.

7. Sistema de evaluación/ Sistem of evaluation

The student has to resolve at home a final practice exercise related with Science, Engineering or Astrophysics from the proposed by the teacher.

8. Distribución horaria de los contenidos, incluyendo las tareas de los alumnos / Hours distribution

Activity	Location	Hours
Theory programme	online	10
Examples and exercises	online	10
Study of the theory contents	online	6
Practice exercise	online	4
		30