



Universidad
Politécnica
de Cartagena

Campus
de Excelencia
Internacional

Python for Science, Engineering, and Astrophysics

**Actividades Transversales de Doctorado
Universidad Politécnica de Cartagena
Curso 2024/25**

1. Información general de la actividad /General course information					
Nombre/ Name		Python for Science, Engineering, and Astrophysics			
Nivel /Level		Doctorado			
Modaliad 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. Departamento de Física Aplicada (1ª 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 September to July
Fecha/Date	Online
Horario/Hours	30
2ª edición / 2nd edition	
Fecha/Date	
Horario/Hours	
3ª edición / 3rd edition-	
Fecha/Date	
Horario/Hours	

(añadir o eliminar tantas ediciones se haga. Si la docencia es continua a lo largo del curso se indicará solo en la 1ª edición)

4. Objetivos del curso/Course objectives
Python is becoming one the most used interpreted languages for data analysis, competing directly with well-stablish 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
- Python scientific computing ecosystem - Why Python - The Scientific Python - Starting - The workflow - 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 students may 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