



Universidad  
Politécnica  
de Cartagena | Campus  
de Excelencia  
Internacional

# COMPUTATION FOR RESEARCH

**Transversal Activities of Doctorate**

**Universidad Politécnica de Cartagena**

1. General course information					
Name	COMPUTATION FOR RESEARCH				
Level	Doctorate				
Code	300001005				
University	Universidad Politécnica de Cartagena				
Language	ENGLISH				
ECTS	1	hours / ECTS	10	Total hours	30

2. Lecture data		
Lecturer in charge	JUAN JOSE ALCARAZ ESPÍN	
Department	TECNOLOGÍAS DE LA INFORMACIÓN Y LAS COMUNICACIONES	
Knowledge area	INGENIERÍA TELEMÁTICA (DATA NETWORKS)	
Office location	OFFICE 14, ANTIGONES BUILDING	
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Office hours	Mondays 17:00 – 19:00, Thursdays 16:00-18:00	

3. Course objectives
<ul style="list-style-type: none"> <li>- To acquire an operative command of a general-purpose state-of-the-art computing language: Python.</li> <li>- To use the essential tools and libraries available for scientific computing.</li> <li>- To acquire hands-on experience with practical scientific computing algorithms.</li> </ul>

4. Theory programme
<ul style="list-style-type: none"> <li>- Unit 1: Introduction to Python (2h) <ul style="list-style-type: none"> <li>○ Installation</li> <li>○ Python Scripting</li> <li>○ Files and Functions</li> <li>○ Control Structures</li> <li>○ Types of Variables</li> <li>○ IPython</li> </ul> </li> </ul>

- Unit 2: Numerical Computing with Python (4 h)
  - Vectorized computation
  - Random Numbers
  - Linear Algebra
  - Input and Output
  - Automating Numerical Experiments
  - Computing over Multiple Machines
- Unit 3: Survey of Advanced Numerical Techniques (4 h)
  - Monte Carlo Methods
  - Importance Sampling
  - Estimation of Derivatives
  - Stochastic Optimization

### 5. Practical programme

1. Introduction to Python (3h). Downloading and installing Python, and the development environment. Solving exercises of increasing difficulty for acquiring command on the Python syntax and scientific libraries and functions.
2. Programming Numerical Algorithms in Python (7h). The students should complete a set of exercises about the algorithms covered in Unit 3, or complete a smaller set of exercises and develop a programming project related to their research interests.

### 6. Hours distribution

Activity	Location	Student work	Hours
<b>Theory programme</b>	Online (Aula Virtual UPCT)	Read materials and watch videos	<b>10</b>
		Homework: study of the theory contents	<b>10</b>
<b>Practice 1 (P1)</b>	Online (Aula Virtual UPCT)	Install the Anaconda distribution, implement basic scripts, and run IPython to execute the commands seen in theory	<b>3</b>
<b>Practice 2 (P2)</b>	Online (Aula Virtual UPCT)	Complete the basic exercise set	<b>3</b>
<b>Practice 3 (P3)</b>	Online (Aula Virtual UPCT)	Complete the set of exercises or develop a programming project based on his/her own research interest.	<b>4</b>
			<b>30</b>