

## SUBJECT TEACHING GUIDE

### 319 - Parallel Programming

#### Master's Degree in computing engineering

Academic year 2024-2025

1. IDENTIFYING DATA					
Degree	Master's Degree in computing engineering			Type and Year	Optional. Year 1
Faculty	Faculty of Sciences				
Discipline	Optional Subjects				
Course unit title and code	319 - Parallel Programming				
Number of ECTS credits allocated	3	Term	Semester based (2)		
Web					
Language of instruction	Spanish	English Friendly	No	Mode of delivery	Face-to-face

Department	DPTO. INGENIERÍA INFORMÁTICA Y ELECTRÓNICA				
Name of lecturer	JOSÉ LUIS BOSQUE ORERO				
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Other lecturers					

3.1 LEARNING OUTCOMES
- Know and understand the models of parallel and vector architectures.
- Being able to analyze, design and implement efficient algorithms and parallel applications on different parallel architectures.
- Knowing how to evaluate the performance of a parallel algorithm, identifying design and implementation factors that most impact on performance, and be able to solve them using parallel computing techniques.
- Know and use the most common algorithmic schemes and patterns in the development of parallel software.

**4. OBJECTIVES**

The objectives of this subject focus on training students in the programming of parallel architectures, specifically systems based on multiprocessor clusters. The student must be able to carry out a complete parallelisation of an application in this type of architecture, tackling problems such as performance analysis, workload balancing and energy consumption analysis.

**6. SUBJECT PROGRAM**

**CONTENTS**

1	Lesson 1. Models of Parallel Programming
2	Lesson 2: Desing of Parallel Programs 2.1 Design Features 2.2 Workload Balacing.
3	Lesson 3: Parallel Message Passing Programming: MPI 3.1 MPI: Message Passing Interface 3.2 Point-to-Point Communication Functions 3.3 Collective Functions 3.4 Non-Blocking Communication 3.5 Communicators 3.6Derived and Packet Data Types
4	Lesson 4: SLURM Workload manager
5	Lesson 5: Analysis of Parallel Algorithms

**7. ASSESSMENT METHODS AND CRITERIA**

Description	Type	Final Eval.	Reassessn	%
There will be a laboratory practice that will include hybrid parallel programming (OpenMP+MPI), performance and scalability analysis and workload balancing algorithms.	Laboratory evaluation	Yes	Yes	100,00
<b>TOTAL</b>				<b>100,00</b>
<b>Observations</b>				
Both sides will be recoverable. There is a unique annual call.				
<b>Observations for part-time students</b>				
Part-time students can chosee between the ordinary continuous assessment or a single test that will include an examination of theory plus practical examination in the laboratory. It is essential to pass the course deliver all exercises held throughout the course condition.				

**8. BIBLIOGRAPHY AND TEACHING MATERIALS**

**BASIC**

Francisco Almeida, Domingo Giménez, José Miguel Mantas, Antonio M. Vidal: "Introducción a la Programación Paralela". Editorial Paraninfo. 2008

Michael J. Quinn. "Parallel Programming in C with MPI and OpenMP". McGraw-Hill, 2003

Peter Pacheco, Matthew Malensek. An Introduction to Parallel Programming  
2nd Edition, 2021

