Teaching Guide				
Identifying Data				2023/24
Subject (*)	Parallel Programming		Code	614973102
Study programme	Mestrado Universitario en Computación de Altas Prestacións / High Performance Computing (Mod. Virtual)			
Descriptors				
Cycle	Period	Year	Type	Credits
Official Master's Degree	1st four-month period	First	Obligatory	6
Language	SpanishEnglish			
Teaching method	Non-attendance			
Prerequisites				
Department	Departamento profesorado másterEnxeñaría de Computadores			
Coordinador	Martin Santamaria, Maria Jose	E-mail	maria.martin.santamaria@udc.es	
Lecturers	Martin Santamaria, Maria Jose Touriño Dominguez, Juan	E-mail	maria.martin.santamaria@udc.es juan.tourino@udc.es	
Web	aula.cesga.es			
General description	The global objectives of this subject are: to train the student in the different programming paradigms of parallel computers; to teach software techniques for the design and implementation of algorithms and efficient parallel applications; and apply these techniques in a practical way for the programming of parallel computers with different architectures, using supercomputing resources such as those available at the Galicia Supercomputing Center (CESGA).			

Study programme competences / results	
Code	Study programme competences / results
A1	CE1 - Define, evaluate and select the most appropriate architecture and software to solve a problem
A2	CE2 - Analyze and improve the performance of a given architecture or software
A3	CE3 - Know the high performance computing basic concepts
A4	CE4 - Deepen in the knowledge of different programming tools and programming languages in the field of the high performance computing
A5	CE5 - Analyze, design and implement efficient parallel algorithms and applications
B1	CB6 - Possess and understand the knowledge that give a baseline or opportunity to be original in the development and/or application of ideas, often in a research environment
B2	CB7 - The students have to know how to apply the acquired knowledge and their capacity to solve problems in new or hardly explored environment inside wider contexts (or multidiscipinary) related to its area of development
B5	CB10 - The students have to possess learning skills that allows them to continue to study in a mainly self-driven or autonomous manner
B6	CG1 - Be able to search and select useful information to solve complex problems, using the bibliographic sources of the field
B10	CG5 - Be able to work in teams, specially multidisciplinary, and do a proper time and people management and decision taking
C1	CT1 - Use the basic technologies of the information and computing technology field required for the professional development and the long-life learning

Learning outcomes			
Learning outcomes	Study programme competences / results		
Understand the main organizational differences in parallel architectures	AJ1 AJ3	BJ1 BJ5	
Understand the main programming models	AJ1 AJ3 AJ4		
Apply the knowledge acquired to the efficient implementation of parallel applications using different programming models	AJ2 AJ5	BJ2 BJ6 BJ10	CJ1

Contents	
Topic	Sub-topic
Parallel programming	Introduction Parallel programming paradigms Parallel programs using shared memory directives Parallel programs using message-passing libraries

Planning				
Methodologies / tests	Competencies / Results	Teaching hours (in-person & virtual)	Student?s personal work hours	Total hours
Laboratory practice	A1 A2 A3 A4 A5 B1 B2 B5 B10 C1	18	54	72
Supervised projects	A1 A2 A3 A4 A5 B1 B2 B5 B6 C1	0	54	54
Objective test	A1 A2 A3 A4 A5 B1 B2	2	0	2
Guest lecture / keynote speech	A1 A2 A3 A4 A5 B1	21	0	21
Personalized attention		1	0	1
(*)The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.				

Methodologies	
Methodologies	Description
Laboratory practice	Practical classes in the laboratory to familiarize the students, from a practical point of view, with the contents seen in the theoretical classes.
Supervised projects	Realization of works in which the student has to use the acquired knowledge to solve different problems in an autonomous way.
Objective test	At the end of the term there will be a written exam on the subject matter covered during the course.
Guest lecture / keynote speech	Theoretical classes in which the content of each subject is exposed.

Personalized attention	
Methodologies	Description
Supervised projects Laboratory practice	The personalized attention in the accomplishment of the laboratory practices and the supervised projects is indispensable to direct to the students in the development of the work. It is recommended that students use the personalized attention to validate the work they are doing.

Assessment			
Methodologies	Competencies / Results	Description	**Qualification**
Supervised projects	A1 A2 A3 A4 A5 B1 B2 B5 B6 C1	Evaluación dos traballos académicamente dirixidos	50
Objective test	A1 A2 A3 A4 A5 B1 B2	Exame final	50

Assessment comments

The course is divided into two parts (directive-based and message-passing programming). Each part represents 50% of the final grade of the course. In order to pass the course, the student must obtain a minimum grade of 4 out of 10 in each of the parts, and a minimum of 5 out of 10 in the overall grade.

In the second opportunity only the grades of the final exam can be improved. The marks of the supervised projects will be those obtained during the course.
Fraudulent conduct in the assessments will directly involve a grade of '0'.

Sources of information	
Basic	- W.P. Petersen, P. Arbenz (2001). Introduction to Paralell Computing. Oxford University Press - F. Almeida, D. Giménez, J.M. Manta, A.M. Vidal (2008). Introducción a la programación paralela. Paraninfo - P. Pacheco (2011). An Introduction to Parallel Programming. Morgan Kaufmann Publishers - W. Gropp, E. Lusk and R. Thakur (1999). Using MPI-2. The MIT Press - P.S. Pacheco (1997). Parallel Programming with MPI. Morgan Kaufmann Publishers - T.G. Mattson, Y (Hellen) He, A.E. Koniges (2019). The OpenMP Common Core: Making OpenMP Simple Again. The MIT Press
Complementary	

Recommendations
Subjects that it is recommended to have taken before
Subjects that are recommended to be taken simultaneously
Subjects that continue the syllabus
Advanced Parallel Programming/614473107
Other comments

(*)The teaching guide is the document in which the URV publishes the information about all its courses. It is a public document and cannot be modified. Only in exceptional cases can it be revised by the competent agent or duly revised so that it is in line with current legislation.