UNIVERSIDAD DE CASTILLA - LA MANCHA

GUÍA DOCENTE

1. General information

Course: HIGH PERFORMANCE COMPUTING
Code: 311049
Type: CORE COURSE
ECTS credits: 6
Degree: 2361 - MÁSTER UNIVERSITARIO EN INGENIERÍA INFORMÁTICA (AB) (2020)
Academic year: 2023-24
Center: 604 - SCHOOL OF COMPUTER SCIENCE AND ENGINEERING (AB)
Group(s): 10 11
Year: 1
Duration: C2
Main language: Spanish
Second language: English
Use of additional languages:
English Friendly: Y
Web site:
Bilingual: N

Lecturer: **ENRIQUE ARIAS ANTUNEZ** - Group(s): **10 11**

Building/Office	Department	Phone number	Email	Office hours
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2. Pre-Requisites

Not established

3. Justification in the curriculum, relation to other subjects and to the profession

The field of High Performance Computing (HPC) and its applications has become one of the most dynamic in the world of Computer Science, making it necessary to have a thorough knowledge of this area and its characteristics. Starting from a basic knowledge of the computational infrastructure that supports the HPC, the techniques and methods for the analysis of supercomputers and their comparison, as well as the design and programming of parallel applications, will be studied in depth. The field of supercomputing is involved in many fields of engineering (e.g. simulations of complex physical and chemical processes) and business (e.g. Big Data), making its knowledge indispensable for today's ICT professionals.

4. Degree competences achieved in this course

Course competences

Code	Description
CE09	Ability to design and assess operating systems and servers, plus applications and systems based on distributed computing.
CE10	Ability to understand a apply advanced knowledge on high performance computing and numerical or computational methods to engineering problems.
INS01	Analysis, synthesis and assessment skills.
INS04	Problem solving skills by the application of engineering techniques.
INS05	Argumentative skills to logically justify and explain decisions and opinions.
PER01	Team work abilities.
SIS03	Autonomous learning.

5. Objectives or Learning Outcomes

Course learning outcomes

Description

Manage tasks of all elements involved in the running of a high-performance distributed data processing system

Design and engineer high-performance and high-availability data processing equipment, including hardware, software and human resources

Evaluate and exploit the system, including socio-economic aspects

Additional outcomes

To train students to make professional and business decisions that will enable them to improve the performance and competitiveness of their organisation's ICT infrastructure.

To equip the student with the ability to make professional and business decisions to improve the performance and competitiveness of their organisation's ICT infrastructure.

6. Units / Contents

Unit 1: Introduction to High Performance Computing

Unit 2: Performance analysis and benchmarking

Unit 3: High Performance Programming Models

Unit 4: Models and platforms

Unit 5: Application Deployment

ADDITIONAL COMMENTS, REMARKS

The practical sessions will consist of developing an incremental project in shared memory as well as in distributed and hybrid memory. A brief introduction to quantum computing will also be covered in the form of a seminar.

7. Activities, Units/Modules and Methodology

Training Activity	Methodology	Related Competences (only degrees before RD 822/2021)	ECTS	Hours	As	Com	Description
Class Attendance (theory) [ON-SITE]	Combination of methods	CE09 CE10	1.04	26	N	-	Theory masterclasses
Laboratory practice or sessions [ON-SITE]	Project/Problem Based Learning (PBL)	CE09 CE10 INS04	1.04	26	Y	Y	All students, in groups of maximum 2, have to develop parallel implementations of a problem. Each problem is different per group. Then, the student will learn parallel programming and related libraries by doing.
Workshops or seminars [ON-SITE]	Collaborative on line international learning (COIL)	CE09 CE10 INS04	0.32	8	N	-	Two seminars will be held on advanced aspects of supercomputing.
Individual tutoring sessions [ON-SITE]	Guided or supervised work	INS05	0.16	4	N	-	Tutoring
Study and Exam Preparation [OFF-SITE]	Self-study	SIS03	2.24	56	N	-	Work to be done by the student both for study and test preparation.
Practicum and practical activities report writing or preparation [OFF-SITE]	Self-study	INS01 PER01	1.08	27	Y	Y	The different teams of students have to prepare a report with an hybrid implementation of the problem dealt during the semester. A presentation of this report have to be done.
Final test [ON-SITE]		CE09 CE10 INS01	0.04	1	Y	Y	This final exam will consist of an exam on concepts of the subject developed in a short answer questionnaire in the ordinary exam. This activity will be recovered by taking the exam again in the extraordinary exam.
Project or Topic Presentations [ON-SITE]	Individual presentation of projects and reports	INS01	0.08	2	Y	Y	
		Total:	**6**	**150**			
		Total credits of in-class work: 2.68					**Total class time hours: 67**
		Total credits of out of class work: 3.32					**Total hours of out of class work: 83**

As: Assessable training activity
Com: Training activity of compulsory overcoming (It will be essential to overcome both continuous and non-continuous assessment).

8. Evaluation criteria and Grading System

Evaluation System	Continuous assessment	Non-continuous evaluation*	Description
Practicum and practical activities reports assessment	20.00%	20.00%	(INF) Preparation of a report on the laboratory practicals carried out. The final report containing all the practical exercises will be evaluated. Optionally, and as a formative action, on-site students may submit intermediate reports. In the case of blended learning students, it is compulsory. Esto incluye la evaluación COIL.
Laboratory sessions	30.00%	30.00%	(LAB) Practical work. The laboratory practicals will be assessed by observation for on-site students and by means of the intermediate reports for blended learning students.
Oral presentations assessment	10.00%	10.00%	(PRES) Presentation in class of the final practical report. Esto incluye la evaluación COIL.
Final test	40.00%	40.00%	(ESC) Final written exam. There will be a final short answer exam on the concepts of the subject. Also, 2 points will be achieved by the seminars.
Total:	**100.00%**	**100.00%**	

According to art. 4 of the UCLM Student Evaluation Regulations, it must be provided to students who cannot regularly attend face-to-face training activities the passing of the subject, having the right (art. 12.2) to be globally graded, in 2 annual calls per subject , an ordinary and an extraordinary one (evaluating 100% of the competences).

Evaluation criteria for the final exam:

Continuous assessment:

The course will be passed with a mark equal to or higher than 5. A minimum of 3 points in practicum+ lab+oral must be achieved. Also, in order to validate the final test score, each student has to prepare one question per unit.

If a student has completed 50% of the evaluable activities or, if in any case, the class period has ended, he/she will be considered in continuous evaluation without the possibility of changing the evaluation modality.

Non-continuous evaluation:

The course will be passed with a mark equal to or higher than 5. A minimum of 3 points in practicum+ lab+oral must be achieved. Also, in order to validate the final test score, each student has to prepare one question per unit.

If a student has completed 50% of the evaluable activities or, if in any case, the class period has ended, he/she will be considered in continuous evaluation

without the possibility of changing the evaluation modality.

Specifications for the resit/retake exam:

All grades obtained will be maintained.
The evaluation activities will be the same as in the ordinary exam.

Specifications for the second resit / retake exam:

All grades obtained will be maintained.
The evaluation activities will be the same as in the ordinary exam.

9. Assignments, course calendar and important dates

Not related to the syllabus/contents

Hours	**hours**

General comments about the planning: This course schedule is APPROXIMATE. It could vary throughout the academic course due to teaching needs, bank holidays, etc. A weekly schedule will be properly detailed and updated on the online platform (Virtual Campus). Classes will be scheduled in 2 sessions of two hours per week. Evaluation activities or catch-up classes may exceptionally be scheduled in the morning.

Unit 1 (de 5): Introduction to High Performance Computing

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	6
Laboratory practice or sessions [PRESENCIAL][Project/Problem Based Learning (PBL)]	6
Individual tutoring sessions [PRESENCIAL][Guided or supervised work]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	14
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	7

Unit 2 (de 5): Performance analysis and benchmarking

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	4
Laboratory practice or sessions [PRESENCIAL][Project/Problem Based Learning (PBL)]	2
Individual tutoring sessions [PRESENCIAL][Guided or supervised work]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	14
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	7

Unit 3 (de 5): High Performance Programming Models

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	2

Unit 4 (de 5): Models and platforms

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	4
Laboratory practice or sessions [PRESENCIAL][Project/Problem Based Learning (PBL)]	10
Individual tutoring sessions [PRESENCIAL][Guided or supervised work]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	14
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	7

Unit 5 (de 5): Application Deployment

Activities	**Hours**
Class Attendance (theory) [PRESENCIAL][Combination of methods]	10
Laboratory practice or sessions [PRESENCIAL][Project/Problem Based Learning (PBL)]	8
Workshops or seminars [PRESENCIAL][Collaborative on line international learning (COIL)]	8
Individual tutoring sessions [PRESENCIAL][Guided or supervised work]	1
Study and Exam Preparation [AUTÓNOMA][Self-study]	14
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	6
Final test [PRESENCIAL][]	1
Project or Topic Presentations [PRESENCIAL][Individual presentation of projects and reports]	2

Global activity

Activities	**hours**
Final test [PRESENCIAL][]	1
Project or Topic Presentations [PRESENCIAL][Individual presentation of projects and reports]	2
Individual tutoring sessions [PRESENCIAL][Guided or supervised work]	4
Laboratory practice or sessions [PRESENCIAL][Project/Problem Based Learning (PBL)]	26
Workshops or seminars [PRESENCIAL][Collaborative on line international learning (COIL)]	8
Study and Exam Preparation [AUTÓNOMA][Self-study]	56
Practicum and practical activities report writing or preparation [AUTÓNOMA][Self-study]	27
Class Attendance (theory) [PRESENCIAL][Combination of methods]	26
Total horas:	150

10. Bibliography and Sources

Author(s)	Title/Link	Publishing house	City	ISBN	Year	Description
Rohit Chandra Leonardo Dagum Dave Kohr Dror Maydan Jeff McDonald Ramesh Menon	Parallel Programming in OpenMP	Morgan Kaufmann Publishers		1-55860-671-8	2001	
Peter Pacheco	An Introduction to Parallel Programming	Morgan Kaufmann		978-0-12-374260-5	2011	
	http://proquest.safaribooksonline.com/book/programming/9780123742605					
Ananth Grama, George Karypis,	Introduction to Parallel Computing	Addison Wesley		978-0201648652	2003	Accessd to digital version

Vipin Kumar y Anshul Gupta Thomas Sterling	High Performance Computing: Modern Systems and Practices	Morgan Kauffman		2017	through UCLM library
FRANCISCO CARMELO ALMEIDA RODRÍGUEZ, DOMINGO GIMENEZ CANOVAS, JOSÉ MIGUEL MANTAS RUÍZ, ANTONIO VIDAL MACIA	Introducción a la programación paralela	Paraninfo	9788497326742	2008	
Roman Trobec ¿ Boštjan Slivnik Patricio Buli¿ ¿ Borut Robi¿	Introduction to Parallel Computing From Algorithms to Programming on State-of-the-Art Platforms	Springer	978-3-319-98832-0	2018	
Michael J. Quinn	Parallel Programming in C with MPI and OpenMP	McGraw Hill Higher Education	978-0072822564	2003	