BASIC DETAILS:

Subject:	COMPUTACIÓN DE ALTO RENDIMIENTO		
Id.:	33306		
Programme:	GRADUADO EN BIOINFORMÁTICA. PLAN 2019 (BOE 06/02/2019)		
Module:	INFORMÁTICA		
Subject type:	OBLIGATORIA		
Year:	3	**Teaching period:**	Segundo Cuatrimestre
Credits:	3	**Total hours:**	75
Classroom activities:	34	**Individual study:**	41
Main teaching language:	Inglés	**Secondary teaching language:**	Castellano
Lecturer:		**Email:**	

PRESENTATION:

In this subject, the students will learn complex computational systems and how they work. When the clock frequency of a processor can not be increased it is necessary to look for other ways to increase the computational capacity. Throught this subject ,the students will learn how this can be solved using parallelization in the same computer, with more than one computer or using other parts of the computer as the GPU.

PROFESSIONAL COMPETENCES ACQUIRED IN THE SUBJECT:

General programme competences	G01	Use learning strategies autonomously for their application in the continuous improvement of professional practice.
	G02	Perform the analysis and synthesis of problems of their professional activity and apply them in similar environments.
	G05	Communicate professional topics in Spanish and / or English both orally and in writing.
	G06	Solve complex or unforeseen problems that arise during the professional activity within any type of organisation and adapt to the needs and demands of their professional environment.
	G07	Choose between different complex models of knowledge to solve problems.
	G09	Apply information and communication technologies in the professional field.
	G10	Apply creativity, independence of thought, self-criticism and autonomy in the professional practice.
Specific programme competences	E02	Develop the use and programming of computers, databases and computer programs and their application in bioinformatics.
	E04	Program applications in a robust, correct, and efficient way, choosing the paradigm and the most appropriate programming languages, applying knowledge about basic algorithmic procedures and using the most appropriate types and data structures.
	E09	Develop and maintain descriptive documentation of the genesis, production and operation of computer systems.
	E11	Apply the principles and techniques of concurrent or parallel computing for the creation and simulation of bio-inspired processes.
Learning outcomes	R01	Conocer los diferentes retos que se abordan en la computación de alto rendimiento.
	R02	Identificar el paralelismo en las aplicaciones.
	R03	Comprender el paradigma de la computación en paralelo.
	R04	Desarrollar programas que exploten la paralelización de diferentes algoritmos.
	R05	Analizar el rendimiento y el consumo de energía de las aplicaciones paralelas.

PRE-REQUISITES:

SUBJECT PROGRAMME:

Subject contents:

1 - Introduction
1.1 - The need for computing

1.2 - Moore's Law
1.3 - Pipelining
1.4 - Parallel programming
2 - Multiprocessors
2.1 - Introduction
2.2 - Shared memory
2.3 - Multithreading hardware
2.4 - Multicore processors
2.5 - OpenMP
3 - Grid Computing
3.1 - Introduction
3.2 - Classification
3.3 - Cluster Architecture
3.4 - MPI
3.5 - Volunteer computing
4 - GPGPU
4.1 - Introduction to heterogeneous computing
4.2 - OpenCL
4.3 - CUDA

Subject planning could be modified due unforeseen circumstances (group performance, availability of resources, changes to academic calendar etc.) and should not, therefore, be considered to be definitive.

TEACHING AND LEARNING METHODOLOGIES AND ACTIVITIES:

Teaching and learning methodologies and activities applied:

Classes are conducted exclusively through English using CLIL. Students are expected to participate in class and in all class-related activities in English. Classes are practical and communicative. Many class activities will be conducted in pairs and groups in the format of information gaps, debates, project preparation, problem solving, simulations, presentations etc.

This methodology enables maximum student participation and talking time in class. It also encourages cooperate learning and meaningful interaction between students and the development of professional competences.

Students are expected to complete all independent study tasks, which will be uploaded on the PDU.

Theory Sessions: Lectures will be used to explain the basis of the different chapters. Wherever possible, explanations will be acompained by images, text or sounds to be used as practical examples and discussion topics. During the sessions, the lecturer will propose activities or to look for information out of the class and he will resolve doubts.

Practical Sessions: There are individual labs. During practice, students will use problem-based learning methodological strategy

Problem based learning: At the end of the subject, the students will work in a project of HPC for Bioinformatics. They will use all the tools learned through the subject to reduce the amount of time that is necessary to complete the task.

Student work load:

Teaching mode	Teaching methods	Estimated hours
Classroom activities	Master classes	11
	Practical work, exercises, problem-solving etc.	5
	Laboratory practice	2
	Assessment activities	2

	Video class/Webinar/Videolesson/Podcast	2
	Collaborative activities	2
	Individual activities	6
	Online tests	4
Individual study	Tutorials	3
	Individual study	12
	Individual coursework preparation	21
	Recommended reading	5
	Total hours:	75

ASSESSMENT SCHEME:

Calculation of final mark:

Written tests:	30	%
Online tests:	10	%
Laboratories:	35	%
Final project:	25	%
TOTAL	100	%

*Las observaciones específicas sobre el sistema de evaluación serán comunicadas por escrito a los alumnos al inicio de la materia.

BIBLIOGRAPHY AND DOCUMENTATION:

Basic bibliography:

HENNESSY, John L. and PATTERSON, David A. Computer Architecture: A Quantitative Approach. Morgan Kaufmann, 3a Edición, 2003.

SANDERS, Jason and Kandrot, Edward. CUDA by example: an introduction to general-purpose GPU programming. Addison-Wesley, 2011.

Recommended bibliography:

BUYYA, R. Hig Performance Cluster Computing: Architectures and Systems. Upper Saddle River, NJ. Pretince Hall, 1999

BUYYA, R. Hig Performance Cluster Computing: Programming and Applications. Upper Saddle River, NJ. Pretince Hall, 1999

HWANG, K. Advanced Computer ARchitectura. New York: McGraw-Hill, 1993.

STALLINGS, William. Organización y arquitectura de computadores. Pretince Hall, 2006.

Recommended websites:

BOINC	http://boinc.berkeley.edu/
CUDA	https://developer.nvidia.com/cuda-zone
HTCondor	https://research.cs.wisc.edu/htcondor/

* Guía Docente sujeta a modificaciones