Universidad Zaragoza

Academic Year/course: 2023/24

62222 - High Performance Computing

Syllabus Information

Academic year: 2023/24
Subject: 62222 - High Performance Computing
Faculty / School: 110 - Escuela de Ingeniería y Arquitectura
Degree: 534 - Master's Degree in Informatics Engineering
ECTS: 6.0
Year: 1
Semester: First semester
Subject type: Compulsory
Module:

1. General information

Each student must have achieved the following objectives:

- Master the concepts and tools that allow them to acquire training as a professional, technologist and researcher in the field of high-performance computing.
- Have the necessary basic knowledge to use the large facilities and supercomputers resources to solve real-world problems, as well as to perform the analysis and evaluation of the results obtained.
- To be adequately prepared (having the necessary skills) to join innovation, research and development centres, technology parks, industrial parks, and high-tech centres, which use high-performance computing.

These approaches and objectives are not specifically aligned with the Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda (https://www.un.org/sustainabledevelopment/es/).

2. Learning results

Upon completion of the subject, the student will be able to:

1. Analyse, compare and evaluate different architectures for supercomputing.

2. Define, evaluate and select the most suitable architecture and parallel programming paradigm for the execution of a scientific problem.

3. Compare and evaluate alternatives for the design and implementation of applications for parallel computers with different architectures.

4. Facing emerging architectures

5. Use the appropriate tools for the performance analysis of a supercomputer.

6. Interpret the information provided by the performance analysis tools in supercomputers and infer actions to improve their performance.

7. Know and use fundamental numerical methods for the approximation of solutions to problems in engineering.

8. Develop parallel implementations of the most well-known numerical approximation methods for supercomputing systems.

3. Syllabus

Block 1: Numerical Simulation

- Numerical simulation of continuous phenomena
- Numerical simulation of discrete phenomena
- Approximations and numerical techniques

Block 2: Architecture and technology of supercomputers

- Shared memory multiprocessor systems. Coherence, consistency.
- Distributed memory multiprocessor systems. Interconnection networks
- Specific architectures for high performance. Multimedia extensions, GPGPUs

Block 3: Paradigms of parallel programming

- Shared memory
    - Automatic parallelization. Help the compiler
    - Manual parallelization: OpenMP
    - Vectorization
- Distributed Memory: MPI

Block 4: optimization of parallel programs

- Optimization techniques
- Metrics and performance analysis tools in supercomputers

4. Academic activities

The subject consists of 6 ECTS which correspond to around 150 hours of student work distributed as follows:

- Face-to-face activities: 50 h (master class, problem and case solving, laboratory practices and special practices)
- Completion of practical application or research work: 45 h
- Theory study: 50 h
- Assessment tests: 5 h

5. Assessment system

In order to pass the subject, the student must demonstrate they has acquired the foreseen learning results by the following assessment activities:

Final written open-response test. (45 %). Learning results: 2, 3, 4, 6, 7 and 8

Delivery of results of the subject practices. (45%). Learning results: 2, 3, 4, 6, 7 and 8

Oral presentations and debates (10%). Learning results: 1, 2, 3, 4, 6 and 8

The student who does not opt for the evaluation procedure described above , does not pass these tests during the teaching period or who would like to improve their grade will be entitled to a global test that will be scheduled within the exam period corresponding to the first or second call.