High Performance Computing

Academic Year: (2023 / 2024) **Review date: 16-05-2023**

Department assigned to the subject: Computer Science and Engineering Department

Coordinating teacher: GARCIA BLAS, FRANCISCO JAVIER

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 1

DESCRIPTION OF CONTENTS: PROGRAMME

1. Principles of high-performance computing
1.1 Definition of high-performance systems
1.2 Definition of a computation cluster

2. Design and analysis of high performance applications.
2.1 Modeling of parallel applications
2.2 Application parallelization methodology

3. Parallel Programming Paradigms: Message Passage, Shared Memory, Data Parallelism
3.1 Message Passing (MPI)
3.2 Programming in shared memory systems (OpenMP)
3.3 Parallelism in Heterogeneous GPGPU Systems (CUDA)

4. Data parallelism using Big Data techniques
4.1 Map-Reduce Programming Paradigm
4.2 Storage systems for data intensive systems (HDFS and HBASE)
4.3 Hadoop Apache
4.4 Apache Spark

5. Performance analysis, evaluation and optimization of applications.
5.1 Performance metrics
5.2 Amdahl's Law

LEARNING ACTIVITIES AND METHODOLOGY

LEARNING ACTIVITIES

AF1 - Theoretical class [23.33 hours with 100% attendance, 0.77 ECTS]
AF2 - Practical classes [11.90 hours with 100% attendance, 0.50 ECTS].
AF4 - Laboratory exercises [10 hours with 100% attendance, 0.33 ECTS]
AF5 - Tutorials [2 hours with 25% attendance, 0.03 ECTS].
AF6 - Group work [24 hours with 0% attendance, 1.70 ECTS].
AF7 - Individual student work [76.70 hours with 0% attendance, 2.55 ECTS].
AF8 - Partial and final exams [2 hours with 100% attendance, 0.06 ECTS].

METHODOLOGY

MD1 - Class lectures by the professor with the support of computer and audiovisual media, in which the main concepts are developed.
and audio-visual means, in which the main concepts of the subject are developed
the subject and the bibliography is provided to complement the students' learning.
students' learning.
MD2 - Critical reading of texts recommended by the professor of the subject: press articles
subject: Press articles, reports, manuals and/or academic articles,
either for later discussion in class, or to expand and consolidate the knowledge of the subject.
consolidate the knowledge of the subject.
MD3 - Resolution of practical cases, problems, etc. .... posed by the teacher individually or in groups.
teacher individually or in groups.
MD4 - Presentation and discussion in class, under the moderation of the teacher of
topics related to the content of the subject, as well as case studies.

case studies.
MD5 - Preparation of papers and reports individually or in groups.

ASSESSMENT SYSTEM

The evaluation has the mission to know the degree of fulfillment of the learning objectives, therefore all the student's work will be evaluated, individually or collectively, through the continuous evaluation of their activities through exercises and exams, projects, and other academic formative activities described above.

A continuous evaluation will be carried out. The 60% of the grade will be obtained through continuous evaluation and the remaining 40% through a final exam. The continuous evaluation process consists of:

SE2: Assignments 60%.
- Practicals and laboratory projects, which will count 60% of the overall mark.

SE3: Final exam 40%.
- The final exam will cover all the contents of the course. The minimum grade to pass the final exam is a score of 5 on a scale of 0 to 10.

% end-of-term-examination:	40
% of continuous assessment (assigments, laboratory, practicals…):	60

BASIC BIBLIOGRAPHY

- D. Kirk, W. Hwo. Programming Massively Parallel Processors: A Hands-on Approach, Morgan Kaufmann, 2010

- D.E. Culler, J.P. Singh, with A. Gupta. Parallel Computer Architectures: a Hardware/Software Approach, Morgan Kaufmann Pub, 1999
- Holden Karau, Andy Konwinski, Patrick Wendell & Matei Zaharia Learning Spark, O Reilly, 2015
- Martin Odersky, Lex Spoon, Bil Venners Programming in Scala, Artima.