

Academic Year: (2021 / 2022)

Review date: 09-06-2021

Department assigned to the subject:

Coordinating teacher: GARCIA CARBALLEIRA, FELIX

Type: Electives ECTS Credits : 3.0

Year : 1 Semester : 1

OBJECTIVES

- Modelling, and evaluating distributed systems.
- Ability to design distributed applications.
- To know the main aspect of distributed system design.
- To know and apply simulation techniques in distributed systems.
- Ability to analyze technical documents and scientific papers.
- Ability to transmit the results of a scientific research.

DESCRIPTION OF CONTENTS: PROGRAMME

1. Introduction to distributed systems
 - Types of computing systems
 - Elements of a distributed system
 - Message passing
 - Design of distributed systems
 - The CAP theorem
 - Middlewares
2. Distributed Algorithms
 - Clock synchronization
 - Mutual exclusion
 - Leader election
 - Distributed consensus
 - Group communication
 - Global states
 - Case of study: ZooKeeper
3. Fault tolerant
 - Fault tolerant concepts
 - Replication
4. Simulation of distributed systems
 - Discrete event simulation
 - Generation of random variables
 - Metrics of performance
 - Simulation experiments
 - Error estimation
 - Comparing two alternatives
 - Introduction to SimGrid
5. Scheduling in distributed systems
 - Scheduling
 - Scheduling methods
 - Process migration
 - Scheduling of independent tasks
 - Scheduling of parallel applications
 - Heuristics
 - Load balancing algorithms
 - Assignment of processors
6. Clusters and grid computing

- Architecture of a cluster
- Types of cluster
- Single system image
- Techniques to tolerate latency in large scale systems
- Grid computing
- Globus

7. HPC in distributed environments

- High performance computing
- HW platforms
- MPI

8. Distributed file systems

- Architecture of a distributed storage system
- Network file systems
- Distributed file systems
- Shared disks file systems
- Parallel file systems
- I/O parallel interfaces
- I/O parallel optimizations

9. Large scale distributed systems

- Peer to Peer
- Volunteer computing
- Cloud computing
- Big Data
- Introduction to Apache Hadoop

LEARNING ACTIVITIES AND METHODOLOGY

- Practical and Theoretical lectures
- Student work

ASSESSMENT SYSTEM

The assessment will be based on:

- Reading and description of research papers (30%).
- Experimental simulation project (40%)
- Reading, analysis and public presentations of research papers by students (30%)

% end-of-term-examination:	0
% of continuous assessment (assignments, laboratory, practicals...):	100

BASIC BIBLIOGRAPHY

- G. Coulouris, J. Dollimore, T. Kindberg Distributed Systems, Concepts and Design, 5ª ed., Addison Wesley, 2012
- G. Sukmar Distributed systems: an algorithmic approach, CRC Press, Taylor & Franciss Group, 2015
- K. Hwang, G. C. Fox, J. J. Dongarra Distributed and cloud computing. From parallel processing to the Internet of Things, Morgan Kaufmann, 2012

BASIC ELECTRONIC RESOURCES

- Félix García Carballeira . Material de Diseño de Sistemas Distribuidos: <http://www.arcos.inf.uc3m.es/~dsd>
- INRIA . Simgrid simulator: <http://simgrid.gforge.inria.fr>