Arquitectura i Computadors Paral·lels 2012/2013

Code: 42233
ECTS Credits: 6

Degree	Syllabus	Type	Year	Semester
4313133 Còmput d'Altes Prestacions, Teoria de la Informació i Seguretat / High Performance Computing, Information Theory and Security	1094 Còmput d'Altes Prestacions, Teoria de la Informació i Seguretat / High Performance Computing, Information Theory and Security	P	1	0

Contact

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Use of languages

Principal working language: anglès (eng)

Prerequisites

There are no requirements.

Objectives and Contextualisation

1. Analyze the structure and operation of current computers (workstations, network servers, computing nodes).
2. Acquire criteria for selecting indicators and metrics to evaluate performance adequately high performance computers
3. Identify bottlenecks in the system (computer, communications, input / output) and analyze / propose solutions.
4. Designing appropriate strategies for performance assessment, using the current tools of performance evaluation, benchmarks, ...
5. Evaluate the performance of computer systems and features that affect performance and propose strategies to improve performance

Skills

- Analyse and evaluate parallel and distributed computing architectures, as well as develop and optimise advanced software for them.
- Analyse, synthesise, organise and plan projects related to information theory, security and high performance computing.
- Assure, guarantee, manage, certify and investigate the quality of advanced computing developments, processes, systems and products.
- Direct innovation and research projects and work teams in the area of information theory, security and high performance computing.
- Recognise the human, economic, legal and ethical dimensions of professional exercise.
- Show responsibility in the handling of information and knowledge, and in the management of multidisciplinary groups and/or projects.

Learning outcomes

1. Analyse and evaluate computer architectures, including parallel platforms, and develop and optimise software for the same
2. Analyse, design, evaluate, select and configure hardware platforms for the development and running of

computer applications and services from the hardware description level of systems
3. Analyse, synthesise, organise and plan projects related with information theory, security and high performance computing
4. Interpret the information provided by performance analysis tools and transform it into actions that improve advanced computer systems
5. Plan and develop innovation and research projects with content related to the architectures of parallel computers
6. Recognise the human, economic, legal and ethical dimensions of professional exercise
7. Show responsibility in the handling of information and knowledge, and in the management of multidisciplinary groups and/or projects
8. Use the adequate tools for the analysis of the performance of an advanced computer system

Content

Block 1: Parallel Computers

Parallel Systems: Types of parallelism. Classification of parallel computers. Benefits.

Shared Memory Parallel Computer: Organization of memory. The role of Cache

Parallel computing Message Passing: Cluster and Grid

Block 2: Interconnection Networks:

Types of networks, configuration and topology. Routing information. Simulation and modeling of interconnection networks. Simulation tools.

Block 3: Performance Evaluation

Performance: Indexes / Benchmarks. Simulation Tools for Research in Computer Architecture and Parallel computers. Tools for measuring performance architecture.

Block 4: Computer Architecture and Design

Design principles of current processors

Block 5: Parallelism in the compute node:

Multithreading and Multicore

Block 6: Input / Output:

Problems of E / S in today's computers. Connection. Management.

Block 7: Availability. Fault Tolerance:

Fault Tolerance in Parallel Computers. Metrics. Measures of reliability. Prevention Techniques and Redundancy. Protocols "Rollback-recovery" based on Checkpoint and Log.

Block 8: Computer Systems:

Hierarchical Organization of memory. Interconnection inside the computer. System Input / Output

Methodology

The methodology applied to the student work will combine master classes, laboratories, independent and assisted work of the students, and the presentation of group small project where students apply the received knowledge.

Distribution of the tasks:

Attending lectures and activities: 20%

Guided learning activities (outside classroom): 20%

Learning self-activities (outside classroom): 60% presented/displayed.

Activities

Title	Hours	ECTS	Learning outcomes
Type: Directed			
Attending lectures and activities	30	1.2	1, 2, 4, 5, 8
Learning self-activities	90	3.6	1, 2, 3, 4, 5, 6, 7, 8
Type: Supervised			
Guided learning activities	30	1.2	1, 2, 3, 4, 5, 6, 7, 8

Evaluation

- Work done by students individually or in groups 10%
- Class presentation of the proposed work 10%
- Practical lab and presentation and analysis of results 25%
- Attendance (minimum 80% of classes) and active participation in class 5%
- Attendance at tutorials. 5%
- Attendance at conferences and seminars recommended. 5%
- Participation in evaluation sessions. 40%.

Evaluation activities

Title	Weighting	Hours	ECTS	Learning outcomes
Attendance (minimum 80% of classes) and active participation in class	5%	0	0	1, 2, 4, 5, 6, 8
Attendance at conferences and seminars recommended	5%	0	0	1, 2, 3, 4, 5, 6, 7, 8
Attendance at tutorials	5%	0	0	1, 2, 3, 4, 5, 6, 7, 8
Class presentation of the proposed work	10%	0	0	1, 2, 3, 4, 5, 6, 7, 8
Participation in evaluation sessions.	40%	0	0	1, 2, 4, 6, 7, 8
Practical lab and presentation and analysis of results	25%	0	0	1, 2, 3, 4, 5, 6, 7, 8
Work done by students individually or in groups	10%	0	0	1, 2, 3, 4, 5, 6, 7, 8

Bibliography

References:

BOOKS

- Parallel Computers:

Culler, D.E. (1999). Parallel Computer Architecture. A Hardware / Software Approach. Morgan Kaufmann Publishers.

Henessy, J.L. Patterson, D.A. (2006). Computer Architecture A Quantitative Approach. Morgan Kaufmann Publihers, 4ª edition. Chapter 6

Grama A., Gupta A., Karypis G., Kumar V. (2003). Introduction to Parallel Computing (2nd Edition). Pearson Addison Wesley

J.A.Fisher, P. Faraboschi, C. Young "Embedded Computing - A VLIW Approach to Architecture, Compilers and Tools". Elsevier 2005.

- Interconnection Networks:

Dally, W.J., Towles, B. (2004) Principles and Practices of Interconnection Networks, Morgan Kaufmann Publishers

Duato, J, Yalamanchili, S., Ni, L (2002) Interconnection Networks, Morgan Kaufmann Publishers.

- Input/Output System:

May, J.M. (2001). Parallel I/O for High Performance Computing. Morgan Kaufmann Publishers.

- Fault Tolerance:

Elnozahy, E.N.; Alvisi, L.; Wang, Y. & Johnson, D.B. (2002)A Survey of Rollback-recovery Protocols in Message-passing Systems. ACM Computing Surveys, ACM Press, 34, 375-408.

Jalote, P. (1994) Fault Tolerance in Distributed Systems. Prentice Hall

Koren I,, Mani Krishna C. (2007). Fautl Tolerant System, Morgan Kaufmann. Elsevier.

- Computer Architecture and Design:

Henessy, J.L. Patterson, D.A. (2006). Computer Architecture A Quantitative Approach. Morgan Kaufmann Publihers, 4ª edition.

- Performance Evaluation:

Lilja, David J. (2005). Measuring Computer Performance : A Practitioner's Guide. Cambridge University Press

Raj Jain (1991). Art of Computer Systems Performance Analysis Techniques For Experimental Design Measurements Simulation And Modeling. Wiley Computer Publishing, John Wiley & Sons, Inc.