Universidade do Porto
FEUP Faculdade de Engenharia

Doctoral Programme in Electrical and Computer Engineering at FEUP

Course Description

Course

Title	Language	Level	Term
Grid Computing	English	PhD	2S

Course coordinator

Name	Category	Institution
António Miguel Pontes Pimenta Monteiro	Aux. Professor	FEUP

Other lecturers (not TA)	Institution
Jorge Manuel Gomes Barbosa	FEUP

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Pre-requisites (max 600 characters)

The students should have a background in computer science, with emphasis in operating systems and fundamental distributed computing, and be familiar with the Java and C/C++ programming languages.

Objectives (max 600 characters)

The main objectives are to provide the students with a solid knowledge of parallel computing (in clusters) and distributed computing in the Internet infrastructure, mainly Grid Computing and Peer-to-Peer. Also we can enlist as objectives to obtain a solid knowledge on parallel architectures and on developing parallel programs for distributed memory and shared memory architectures. Through assignments and lab projects the students will also obtain experience in the core technologies in the field, including performance analysis and tuning.

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Contents (2500-3000 characters)

1. Parallel Programming (40%)

Introduction to parallel programming, computer architectures, processors, memory organization and interconnection networks.

Parallel Programming Fundamentals: task/channel paradigm, communication patters, synchronization, task granularity and scheduling.

Cluster programming with MPI and OpenMP.

Parallel computing characterization: execution models, programming models, computation models, performance and efficiency measures, scalability analysis.

2. Distributed Computing

a) Peer-to-Peer computing (20 %)

Pure and hybrid p2p networks, taxonomy of p2p systems and objectives of p2p networks.

Applications: communications and collaborations, distributed computing, internet service support, data base applications and content distribution.

P2P Algorithms for content distribution: centralized directory model, flooded request model and document routing model.

b) Grid computing (40%)

Grid computing models: generic grid, utility grid and desktop grid.

Evolution of grid middleware: metacomputing (Condor, LSF), resource-oriented (Globus 1, 2 and 3; LCG) and service-oriented (Globus 4, EGEE).

Grid security: authentication, data integrity and encryption, authorization.

Hands-on Grid technology.

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Main Bibliography (max 1000 characters)

Quinn, Michael J.; "Parallel programming in C with MPI and openMP", McGraw-Hill, 2003, ISBN: 0-07-123265-6.

S. Androutsellis-Theotokis, D. Spinellis; "A survey of Peer-to-Peer Content Distribution Technologies", ACM Computing Surveys, Vol. 36, N. 4, December 2004, pp. 335-371.

Ian Foster, Carl Kesselman; "The Grid 2: Blueprint for a New Computing Infrastructure", Morgan Kaufmann Pub, 2004, ISBN: 1-55860-933-4.

Lisa Childers, Borja Sotomayor; "Globus Toolkit 4: Programming Java Services", Morgan Kaufmann Pub, 2006, ISBN: 0-12-369404-3.

Software (max 600 characters)

C/C++ compiler with MPI and OpenMP libraries

platform with WSRF (Web Services Resource Framework)

Globus Toolkit 4

Teaching (max 600 characters)

In the Classes: Theorethical presentation, complemented by examples, small demonstrations and clues for lab assignements and project. In the Labs: discussions, demonstrantions and problem solving related to assignements and project.

Assignments (max 1200 characters)

1. Analysis of the memory management effect on single processor performance. Sequential implementation of the matrix by matrix algorithm in different versions that result in different memory access patterns

2. Computation of the pi value by numeric integration. Analysis on numeric limitations and techniques to improve accuracy

3. Implementation of the algorithm to compute pi using OpenMP in a shared memory machine (multi-core processor)

4. A project involving the implementation of a grid service using WSRF.

Grading policy (max 400 characters)

The components for student evaluation are:

- Assignments (A)
- Projects (P)
- Final exam (F)

Each component will receive a grading in percentage (100 points).

The final score will be calculated according to the following rule:

Score = 0.15 A + 0.50 P + 0.35 F

Grading will be either PASS or FAIL.

A PASSing grade corresponds to a minimum of 65 points of the maximum score.

Evaluation procedure for students under special legal provisions

These students will be subject to all evaluation procedures of regular students, i.e., they must deliver their assignments specified during the course plus any special works also specified, plus a final exam. The only difference towards regular students being that they are not required to attend classes and deliver assignments in the same dates as regular students, in the cases the law specifically states it.

Improving grades

Not applicable in a PASS/FAIL policy.