Course Description

Grid Computing, NGSSC, 2p

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August 19, 2004

General information

This course is designed to give a broad overview of the concept of grid computing and state-of-the-art grid software, understanding and practical experience of how computational grids can be used to further research in science and technology, and to review some current and future directions of grid computing research and development.

Prerequisites

The prerequisities are extensive programming experience (e.g., in C/C++ and Java) and completion of the following courses (or similar knowledge and experience): Object-oriented scientific programming NGSSC, 3p, Introduction to High Performance Computing NGSSC, 4p, Parallel algorithms with applications to scientific computing, 3p, Scientific visualization NGSSC, 3p.

Course contents

Topics covered in the course include the following:

- Introduction to grid computing ($\sim$ 10% of lectures):
  - Overview: Fundamental concepts, grid architecture models, grid middleware functionalities, etc.
  - International overview: Application projects, software development projects, political and administrative aspects on grids, emerging grid standards (OGSA/OGSI), etc.
  - Foundations in algorithm and software development for grids.
- Grid computing middleware and tools ($\sim$ 40% of lectures):

  - Globus: Overview and some specific components, including resource specification language, security, scheduling, file transfer, information services, etc.
  - Grid security: Grid security demands and solutions for, e.g., authentication, authority, assurance, accounting, trust, group communication, for large-scale, dynamic, multi-organization environments.
  - Resource management and scheduling: Characterization of resource management problems based on job requirements, characteristics, and availability of resources. Algorithms, tools and sample resource management systems.
  - Grid portals: Convenient access to grid environments. Functionality and underlying infrastructure for sample general and application specific portals.
  - Data management: Key issues for data management in grids, including file transfer, data replication, data caching issues, catalog issues.
  - Sample grid middleware packages, software tools, and problem solving environments for grids.

- Applications, algorithms, and sample projects ($\sim$ 40% of lectures):
  - Swegrid and NorduGrid ARC: Introduction to the Swegrid resources and the NorduGrid software package. Introduction to hands-on tutorial.
  - Swegrid applications: Overview of planned and ongoing projects, in e.g., high-energy physics, biomedical sciences, earth sciences, space and astro sciences etc. Key issues for their successful use of Swegrid and the grid's implications on future research in these projects.
  - Algorithm development for grids, and e.g., the GrADS project. Focus on the special requirements that grid environments put on algorithm development, e.g., heterogeneity in computers and networks, fault tolerance, possibilities to access special instruments and equipment, etc.
  - Environments for visualization, interactivity and collaboration on the grid: Overview and examples from computational steering, data mining, virtual reality.

- Sample grid research projects ($\sim$ 10% of lectures):
  - One or two invited presentations on current grid research topics.

- Computer projects (preliminary):
  - Hands-on grid introduction. Sample small ready-to-run exercises.
  - Basic resource brokering.
  - Hands-on introduction to OGSA/WSRF programming.
  - Project.

Literature

The course literature will be based on a collection of articles from journals, conference proceedings and books, and material available via WWW.
Lecture notes including exercises, projects etc will be produced for the course and made available via WWW.

Examination

A number of carefully documented computer assignments.

Preliminary dates

The course 2005 is planned to be given at NSC, Linköping University, January 10-18, including scheduled and unscheduled work during the weekend, January 15-16. As a guideline, the 80 hours of the two credit points course will roughly be spent on 20 hours with lectures, 45 hours scheduled computer assignments (including introductions and summaries) 15 hours homework (literature studies, unscheduled work on computer assignments).

The following years the course is planned to alternate between HPC2N (Umeå University), NSC (Linköping University), and PDC (KTH).