SF2568 Parallel Computations for Large- Scale Problems 7.5 credits

Parallella beräkningar för storskaliga problem

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for SF2568 valid from Spring 2018

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Mathematics,Technology

Specific prerequisites

Single course students: 90 university credits including 45 university credits in Mathematics or Information Technology. English B, or equivalent.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

The overall goal of the course is to provide a basic understanding of how to develop algorithms and how to implement them in distributed memory computers using the message-passing paradigm.

This understanding means that after the course you are able to

- explain parallelization strategies;
- find properties of a given problem which may be used for potential parallelization;
- select and/or develop an algorithm for solving a given problem which has the potential for an efficient parallelization;
- select and/or develop data structures for implementing parallel computations;
- theoretically analyze a given parallel algorithm with respect to efficiency;
- implement a given algorithm on a distributed-memory computer using the message passing library MPI;
- understand the message flow and avoid unwanted situations (e.g. deadlock, synchronization delays);
- modify and adapt a set of basic routines to special situations;
- experimentally evaluate the performance of a parallel program;
- explain differences between the theoretically expected performance and the practically observed performance;
- independently solve a more complex problem and present your results in a report;
- are able to run programs on high-performance computers;
- understand challenges of Green Computing in HPC.

Course contents

- Basic ideas including hardware architectures, memory hierarchies, communications, parallelization strategies, measures of efficiency;
- HPC and Green Computing;
- Introduction to MPI, the Message Passing Interface;
- Simple numerical algorithms including matrix operations, Gaussian elimination;
- Algorithms on graphs including graph partitioning problems;
- Parallel sorting;
- More advanced parallel algorithms;
- Standard libraries;

Course literature

Barry Wilkinson, Michael Allen: Parallel Programming, 2nd ed., Pearson Education International 2005, ISBN 0-13-191865-6.
Peter S. Pacheco: A Users Guide to MPI, downloadable from internet.
Michael Hanke: Lecture Notes.

Examination

- HEMA - Assignment, 4.5 credits, grading scale: A, B, C, D, E, FX, F
- PROA - Project, 3.0 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Other requirements for final grade

- Homework and a mid-term quiz (HEMA; 4,5 credits)
- Project report and oral presentation (PROA; 3.0 credits)

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.