Multicore and GPU Programming

Programme course

6 credits

Multicore- och GPU-Programmering

TDDD56

Valid from: 2017 Spring semester

Determined by
Board of Studies for Computer Science
and Media Technology

Date determined
2017-01-25

Main field of study

Information Technology, Computer Science and Engineering, Computer Science, Media Technology and Engineering

Course level

Second cycle

Advancement level

A1X

Course offered for

- Computer Science and Engineering, M Sc in Engineering
- Industrial Engineering and Management - International, M Sc in Engineering
- Media Technology and Engineering, M Sc in Engineering
- Applied Physics and Electrical Engineering, M Sc in Engineering
- Computer Science, Master's programme
- Electronics Engineering, Master's programme
- Information Technology, M Sc in Engineering
- Industrial Engineering and Management, M Sc in Engineering
- Applied Physics and Electrical Engineering - International, M Sc in Engineering
- Mathematics, Master's programme
- Computer Science and Software Engineering, M Sc in Engineering

Entry requirements

Note: Admission requirements for non-programme students usually also include admission requirements for the programme and threshold requirements for progression within the programme, or corresponding.

Prerequisites

Computer engineering. Data structures and algorithms. Concurrent programming and operating systems. Programming skills in C. Some basic familiarity with C++ is useful.

Intended learning outcomes

Modern computers feature processors with multiple cores and powerful many-core based hardware accelerators such as graphics processing units (GPUs) that can be used for general-purpose computations (GPGPU or GPU Computing). The performance potential of such architectures can only be leveraged for speeding up applications if the code is properly parallelized and (re)written to exploit the specific architectural features.
After this course, the student will:

- be able to write code and re-write code for multicore and GPGPU architectures
- understand parallel algorithms and data structures, and be able to analyze them
- know general principles for parallel computing and techniques for parallelization.

Course content

Introduction to multi-core, many-core and GPU architecture concepts. Theory of parallel computing. Theory of parallelization. Design and analysis of parallel algorithms. Survey of parallel programming language concepts. Thread programming for multicore computing. SIMD-programming and data-parallel programming. GPU-programming with OpenCL and/or CUDA. Non-blocking synchronization and transactional memory. Scheduling for multicore and operating system issues. Introduction to heterogeneous multicore and parallel DSP architecture concepts and programming.

Teaching and working methods

A lecture series introduces the theory and gives an overview of architectural concepts and programming techniques. A lab series contains programming assignments in multi-core thread programming and GPU programming. Lessons introduce the technical programming platforms used for the labs.

Examination

LAB1	Laboratory work	3 credits	U, G
TEN1	Written examination	3 credits	U, 3, 4, 5

The questions in the written exam check how well the student has fulfilled the learning goals of the course. For passing the exam, deficits in fulfilling certain partial goals can be balanced by a better fulfilling of other partial goals.

Grades

Four-grade scale, LiU, U, 3, 4, 5

Other information

Supplementary courses: Programming of parallel computers - methods and tools is complementary to this course. Both address parallel computing, where this course emphasizes thread programming and GPU programming while TDDC78 focuses on OpenMP and message passing as required for programming larger clusters.

Department

Institutionen för datavetenskap

Director of Studies or equivalent

Ahmed Rezine

Examiner

Christoph W. Kessler

Course website and other links

http://www.ida.liu.se/~TDDD56

Education components

Preliminary scheduled hours: 60 h
Recommended self-study hours: 100 h

Course literature

Additional literature

Other

Common rules

Regulations (apply to LiU in its entirety)

The university is a government agency whose operations are regulated by legislation and ordinances, which include the Higher Education Act and the Higher Education Ordinance. In addition to legislation and ordinances, operations are subject to several policy documents. The Linköping University rule book collects currently valid decisions of a regulatory nature taken by the university board, the vice-chancellor and faculty/department boards.

LiU's rule book for education at first-cycle and second-cycle levels is available at http://styrdokument.liu.se/Regelsamling/Innehall/Utbildning_pa_grund-_och_avancerad_niva.