

ECE 1755: Parallel Computer Architecture and Programming

Instructor

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- Office: EA321 (Engineering Annex)
- Meetings anytime (by appointment is best for longer discussions)

Admin Assistant

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- EA317 (Engineering Annex)

Summary

With the advent of multicore processors, we are faced with the challenge of exploiting this ubiquitous multi-threaded hardware. This course explores the evolution of modern parallel architectures and programming models, and is divided into two phases. In the first phase we will investigate in detail the design and operation of modern parallel architectures, with a brief look at how they are programmed. This phase will include several homeworks which provide hands-on experience with real parallel machines.

The second phase of the course will switch gears: we will study current research and development of emerging parallel architectures including multicore processors, helper threads, and speculative multithreading; in this phase we will read research papers, and through the class project implement and evaluate new ideas. Students are welcome to suggest topics for class discussion and/or projects.

Topics Covered

1. Past, Present, and Future of Computing
2. Background
 - Basic compiler concepts
 - Performance Analysis
3. Parallel Programming
 - Basics
 - Abstractions
 - Synchronization
 - Programming for performance
4. Conventional Parallel Architectures
 - Interconnection networks
 - Coherence and consistency
5. Emerging Parallel Architectures (potential research readings)
 - Simultaneous multithreading
 - Chip-Multiprocessors (homogeneous & heterogeneous)
 - Helper threads and precomputation
 - Thread-level speculation
 - Transactional Memory

Administrivia

- Course web page: <http://www.eecg.toronto.edu/~steffan/teaching/ece1755F>

Prerequisites/Conditions

- Basic knowledge of computer architecture and organization is required
- Solid experience in C/unix programming required, experience with C++, perl, RCS/CVS, is an asset
- It is highly recommended that students have taken ECE243/341/352/385 (basic computer organization) or equivalent
- ECE552 (computer architecture) is an asset but not required.

Materials

- Recommended textbook (not required): *Parallel Computer Architecture, A Hardware/Software Approach* David Culler, J.P. Singh, Anoop Gupta; Morgan Kaufmann Publishers.
- The second phase of the course will consist of several readings of current research in computer architecture.
- See the course web page for more information.

Homeworks

There will be homeworks (during the first phase of the course) which provide hands-on experience with the mechanisms described in class, as well as preparation for the project.

Project

Implement and evaluate new ideas or compose a survey based on topics suggested by student or the instructor. Grading will be based on a brief proposal, interim and final reports, and a short presentation at the end of the semester.

Grading

- Homework: 30%
- Project: 40%
- Reviews: 10%
- Lecture: 10%
- Class participation: 10%