ECE/CS 757: Advanced Computer Architecture II

Spring Semester 2009, MWF 11:00-12:15 EH 3418

Instructor: Prof. Mikko Lipasti, mikko@engr.wisc.edu, EH4613

http://ece757.ece.wisc.edu

Course Description

This course covers parallelism and the design of parallel computers. Historically, parallel computers have been designed for the sole purpose of quickly solving large-scale computational problems like weather forecasting or molecular modeling (to name just two examples). These problems are usually expressed as a series of floating-point computations of large data sets stored in multidimensional arrays, and can usually be partitioned across multiple processors to achieve large-scale parallelism. However, within the last fifteen years, new applications for parallel computers have eclipsed these traditional numeric codes, and are the driving force behind the tremendous volume and revenue growth in the marketplace for parallel computers. These applications span all the way from commercial server workloads that run in managed datacenters, to heavily-threaded games and web browsers running on PCs and laptops, to massively data-parallel applications like graphics rendering. In other words, parallelism in applications and in hardware has become pervasive in our industry.

This course will study the nature of parallelism across these application domains, as well as the hardware required to support parallel execution. We will investigate techniques for detecting, increasing, and exploiting parallelism across this spectrum of workloads, and will study in detail the design of various components of parallel computer systems. The discussion will rely heavily on examples of real or proposed parallel designs.Prerequisites: ECE 552 (or equivalent) and CS 537 (not strictly enforced). **NOTE: ECE 752 is not a prerequisite for this course.**

Course Textbook

For reference only: David Culler and J. P. Singh with Anoop Gupta. Parallel Computer Architecture: A Hardware/ Software Approach. Morgan Kauffman Publishers, 1998.

The course will rely on several beta chapters written by Jim Smith and a large number of additional readings from the literature, as posted to the class web page.

Lectures & Readings

It is very important that you attend lecture faithfully. Much of the material will be covered only in lecture, as the beta book chapters are incomplete and the readings are by definition out of date. Lecture slots are overscheduled; we are likely to meet more often than necessary in the first half of the semester to free up time in the second half for project work. Many lecture times will be devoted to discussing the readings in detail. You are expected to be prepared to present detailed summaries, views, and opinions on the assigned readings (refer to course schedule and check website for updates).

Homework & Paper Reviews

There will be several assignments. Some assignments will require the review of material that is touched upon, but not covered in depth in class, and will require C/unix programming skills. Assignments may not all be weighted equally. Assignments will be due in class on the due date. No late homework will be accepted.You must submit reviews for a subset of the papers on the reading list using the learn@uw dropbox. The detailed course schedule (on the web) indicates which ones and when they are due.

Project

The default course project is to do some original research in a group of three to four students. Some alternatives for original research are: you could examine a modest extension to a paper studied in class or simply revalidate the data in some paper by writing your own simulator. Projects will include a written report. Project work will be presented orally to the rest of the class at the end of the semester.

Examinations

There will be two midterms; the second midterm is scheduled in the final exam timeslot. The second midterm will not be comprehensive.

Grading

Homework & Readings	20%
Midterm 1	25%
Midterm 2	25%
Project	30%

Communications Channels

I strongly encourage you to meet with me during my office hours, or call me or send e-mail. Introducing yourself to me, expressing concerns, offering suggestions, and seeking advice are among the welcome topics. Make sure you monitor the web site for this course which contains course information, lecture notes, pointers to project resources, and the latest announcements.

Office Hours

Prof. Lipasti: EH4613, M1-4, R9-11, or by appointment

Tentative Course Outline

Week	Dates	Assignments	Topics	Readings
1	1/21, 1/23	HW 0 due 1/23	Introduction	Ch. 1 of Smith beta
2	1/26, 1/28, 1/30		MP Software and ISA	Ch. 2 of Smith beta Papers (see web)
3	2/2, 2/4, 2/6		More MP Software 2/6: 752 review (optional)	Ch. 2 of Smith beta Papers (see web)
4	2/9, 2/11, 2/13		Cores, multithreading, multicore	Ch. 3 of Smith beta Papers (see web)
5	2/16, 2/18, 2/20	HW 1 due 2/18	Cores, multithreading, multicore	Ch. 3 of Smith beta Papers (see web)
6	2/23, 2/25, 2/27		MP Memory Systems	Ch.4 of Smith beta Papers (see web)
7	3/2, 3/4, 3/6	HW2 due 3/6	More memory, case studies	Papers
8	3/9, 3/11		Midterm 1 review Midterm 1 in-class on 3/11	
N/A	Spring break			
9	3/23, 3/25, 3/27	Project proposals due 3/27	Interconnects	Papers (see web)
10	4/3 (Fri only)		SIMD	Papers (see web)
11	4/6, 4/8, 4/10	HW 3 due 4/8	Dataflow	Papers (see web)
12	4/13,4/15,4/17	Project progress report due 4/17	Clusters	Papers (see web)
13	4/20, 4/22, 4/24	HW 4 due 4/23	MPP Systems	Papers (see web)
14	4/27, 4/29, 5/1		Schedule slack	Papers (see web)
15	5/4, 5/6, 5/8	Final project reports due 5/8	Project talks Course Evaluation Midterm 2 Review	--
16	5/12 Tuesday		Midterm 2 10:05am	