EE653 -- Advanced Topics in Microarchitecture

Fall 2012

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Preliminary Syllabus--subject to change

Warning: Final syllabus will depend on the number of students in the class and the availability of a TA.

1. Overview

This course bridges the gap between EE557 and the current literature on microarchitecture. It focusses on research in microprocessor design to speed up the execution of instructions in various contexts and under power, complexity and cost constraints. Reliability is also a critical issue. Current research in microarchitecture targets improvements to classical dynamically-scheduled processors, including scheduling, memory wall, multithreading, speculative execution, heterogeneity, and branch prediction and recovery. Furthermore technological trends favor Chip Multiprocessors and Multithreading (CMP/MT).

Besides performance this course explores novel architectural techniques to improve power dissipation, temperature control, noise and reliability, and to deal with the impact of wire delays. In future Moore's law as it applies to computing power may continue to hold valid by increasing the number of threads executing in parallel in a CMP/MT micro-architecture. Exploiting this ever-increasing concurrency together with architectural support to solve technological problems (e.g., power, reliability, wire delays) and to help the programming problem are the challenges of micro-architecture research in the next decade.

2. Textbooks

Dubois, Annavaram and Stenström: "Parallel Comupter Organization and Design" Cambridge University Press, 2012. ISBN: 978-0-521-88675-8. Purchase from the USC bookstore or from Amazon.com. REQUIRED. material not covered in EE557 will be taught from this book. Also problems and reading assignments will be pciked from the book.

A list of required readings and notes will be posted on the blackboard, from which copies can be downloaded.

3. Prerequisite

EE557. Computer System Architecture.

If you did not take EE557 with me or Professor Annavaram, please review the following material from the book:chapters 1, 3, 4, 6, and 7 (pp. 342-379, 388-410) and don't hesitate to ask questions if you ave any.

4. Venue and time

VHE 206--MW 2-3:20.

5. TA

Not known at this point. At least there will be help with simulations.

6. Project

Right now registration shows 8 students. Thus we will form 4 teams of 2 students. Each team will pick a research topic and will review the literature on that topic. The team will then propose a project proposal on that topic. The project will involve simulation.

Each team will report on their research as part of the final exam. At the end of the semester on the date of the final each team will have 30 minutes to present its project results.

7. Course Work

The course has two major components.

1. Regular lectures at first on material from the book (basics) and then on research papers (advanced topics). There are two midterms about the material covered in lectures: midterm 1 (on basic material) and midterm 2 (on advanced material)
2. An independent research project. We will form teams of 2 students. Each team will pick a research topic and will thoroughly review the literature on that topic. The team will then propose a project proposal on that topic. The project will involve simulation and should lead to quality research report. Each team will submit a project report on their research at the end of the semester. More information about the research areas, simulation tools and project descriptions will be made available as we move through the semester. The grade on the project will be shared by the 2 students in each team. We will have short by-weekly meeting to discuss progress after the project officially starts.

8. Grading Policy

Class participation: 10%; Midterm 1: 20%; Midterm 2: 20%; Project: 50% (10% for progress reports; 15% for experimental; 25% for final project report and presentation).

Class attendance is expected.

9. Statement for Students with Disabilities

Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.-5:00 p.m., Monday through Friday. The phone number for DSP is (213) 740-0776.

10. Statement on Academic Integrity

USC seeks to maintain an optimal learning environment. General principles of academic honesty include the concept of respect for the intellectual property of others, the expectation that individual work will be submitted unless otherwise allowed by an instructor, and the obligations both to protect one's own academic work from misuse by others as well as to avoid using another's work as one's own. All students are expected to understand and abide by these principles. Scampus, the Student Guidebook, contains the Student Conduct Code in Section 11.00, while the recommended sanctions are located in Appendix A: http://www.usc.edu/dept/publications/SCAMPUS/gov/. Students will be referred to the Office of Student Judicial Affairs and Community Standards for further review, should there be any suspicion of academic dishonesty. The Review process can be found at: http://www.usc.edu/student-affairs/SJACS/.

11. Web Resources[please help add to the list!]

http://www.princeton.edu/~jdonald/research/cmp/ :links to publications on CMPs

http://www.princeton.edu/~jdonald/research/hyperthreading/ :publications on CMTs

http://www.cs.wisc.edu/arch/www/ : tools, people, resources

http://www.itrs.net/Links/2005ITRS/ExecSum2005.pdf : the road map for semi-conductors.

http://www.cs.wisc.edu/~markhill/conference-talk.html : how to prepare a talk.

12. Tentative Course Schedule:

Lecture	Date	Topics	MILESTONES/REMARKS
Lect 1	8/27	Administration-Introduction/Technological trends	Read Chapter 2
Lect 2	8/29	Technological Trends	
	9/3	No class	LABOR DAY
Lect 3	9/5	Review of EE557 material--OoO	
Lect 4	9/10	Review of EE557 material--Multiprocessors	Read parts of Chapter 7. List of papers available--start reading
Lect 5	9/12	Coherence and consistency	9/14: Last day to drop w/o W
Lect 6	9/17	Coherence and consistency	Select topic area; start of bi-weekly meetings
Lect 7	9/19	CMPs	Read Chapter 8
Lect 8	9/24	CMPs	
Lect 9	9/26	CMPs	
Lect 10	10/1	Quantitative Evaluations	Read Chapter 9
Lect 11	10/3	Quantitative Evaluations	END OF COVERAGE FROM BOOK
Lect 12	10/8	Cache architectures in CMPs	Project proposal due; 1page proposal report due
Lect 13	10/10	Cache architectures in CMPs	
Lect 14	10/15	Transactional memory	
Lect 15	10/17	Transactional memory	
Lect 16	10/22	MIDTERM 1 2-3:20	On material up to lect 11 (from book)
Lect 17	10/24	Thread-level speculation	
Lect 18	10/29	Commercial processors	
Lect 19	10/31	Commercial processors	
Lect 20	11/5	GPGPUs	
Lect 21	11/7	Research processors	Midterm project status report due(3-5 pages)
Lect 22	11/12	Reasearch processors	
Lect 23	11/14	Power issues	11/16: Last day to drop with W
Lect 24	11/19	Power issues	
	11/21	No class	THANKSGIVING RECESS
Lect 25	11/26	Reliability	
Lect 26	11/28	Reliability	
Lect 27	12/3	3-D stacking technology	Project status report (2 pages)
Lect 28	12/5	MIDTERM 2 2-3:20	On material since Lect 11
	12/7	END OF CLASSES	
	12/14	FINAL Friday 12/14, 2-4pm	Final project reports due; project presentations