EE653 -- Advanced Topics in Microarchitecture
Fall 2017
Instructor: Michel Dubois
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Office hours: by appointment only (dubois@usc.edu)
Preliminary Syllabus--subject to change
Final syllabus will depend on the number of students in the class.

1. Overview

This course bridges the gap between EE557 and the current literature on microarchitectures. It covers research in microarchitectures, including microprocessor design (GPs, GPUs, GPGPUs) to speed up the execution of instructions in various contexts, memory controller microarchitectures and Network Processors (NPU) microarchitectures. Emerging memory technologies such as NVMs (Non-Volatile Memory) are changing the trade-offs in the memory hierarchy. Reliability is also a critical issue.

Technological trends favor Chip Multiprocessors and Multithreading (CMP/MT), heterogeneity, and concentrated servers which can execute parallel tasks from large numbers of users. Architectural support (such as Transactional Memory) facilitates the programming problem of vast parallel, heterogeneous systems. Architectural support also contributes to mitigate technological problems, such as power, performance, and reliability. These are the challenges of microarchitecture research today, in the next decade and beyond.

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. Background material (EE557) is in this book. Material not covered in EE557 will be taught from this book. Also some problems and reading assignments will be picked from the book.

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

3. Prerequisite

The prerequisite is EE557: Computer System Architecture.

If you took EE457 and EE560 but not EE557 you can get a waiver for the prerequisite from me. You will need to do some catching up (please review the following material from the textbook: chapters 1, 3, 4, 6, and 7 (pp. 342-379, 388-410)).

4. Venue and time

OHE120--MW 12:30-1:50 pm.

5. TA

TBD

6. Project

The project involves simulation of multiprocessor systems. Each student will briefly report on their research as part of the final exam. At the end of the semester on the date of the final students will have 15 minutes to present their project results.

7. Course Work

The course has three 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). Midterms are take home.
2. An independent research project. More information about the research areas, simulation tools and project descriptions will be made available as we move along through the semester.
3. Individual paper. Each student will also present in class one current microarchitecture paper of his/her choice. I can help select such paper.

8. Grading Policy

Class participation: 10%; Midterm 1: 25%; Midterm 2: 25%; Project: 25%; Paper presentation 15%.

Class attendance is expected.

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. Website for DSP and contact information: (213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) ability@usc.edu.

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 University Student Conduct Code (see University Governance, Section 11.00), while the recommended sanctions are located in Appendix A.

EMERGENCY PREPAREDNESS/COURSE CONTINUITY IN A CRISIS

In case of a declared emergency if travel to campus is not feasible, USC executive leadership will announce an electronic way for instructors to teach students in their residence halls or homes using a combination of Blackboard, teleconferencing, and other technologies. See the university's site on Campus Safety and Emergency Preparedness.

Topics covered (Tentative)

Lecture	Topics
Lect 1	Administration-Introduction
Lect 2	Technological Trends
Lect 3	Technological trends
Lect 3	Review of EE557 material--OoO
Lect 4	Checkpoint-based Microprocessors
Lect 5	Coherence and consistency
Lect 6	Coherence and consistency
Lect 7	CMPs
Lect 8	CMPs
Lect 9	CMPs
Lect 10	Quantitative evaluations
Lect 11	Quantitative evaluations
Lect 12	DRAM Architectures
Lect 13	DRAM Architectures
Lect 14	DRAM caches
Lect 15	Transactional memory
Lect 16	Transactional memory
Lect 17	Bulk-based CMP protocols
Lect 18	GPUs
Lect 19	GPUs
Lect 20	GPUs
Lect 21	Non Volatile Memories (NVMs)
Lect 22	Non Volatile Memories
Lect 23	Network Processors
Lect 24	Power issues
Lect 25	Reliability
Lect 26	Reliability
Lect 27	Data Center and Cloud Computing
Lect 28	Data Centers and Cloud Computing