EE557: Computer Systems Architecture
Units: 4
Spring 2019

EE-557 has two regular lectures of 110 minutes and a 50 minutes discussion session each week, over 15 weeks. The discussion session is an opportunity to discuss the material covered in class, the homework, the simulation assignments and the exams with the TA. As time permits class material may be expounded during the discussion session. Attendance is not taken but attending the class and the discussion session is part of the course requirements.

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Lectures: TTh 9-10:50 in OHE122
Discussion: F 3-3:50 in OHE132

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Course Description
The main objective of EE557 is computer architecture exploration at a more abstract level than in previous courses on architecture. Because architectures are described at a block diagram level a large number of machines, memory structures, and interconnections will be taught. In ee457, we learned how to design a simple five-stage pipeline in great details, down to the circuit level. In ee557, we assume that these implementation details are known. We will learn about computer systems as they are designed today, including processors, memories, interconnects and multiprocessors. The focus of the course is not on research but on actual, commercial, existing machines.

Learning Objectives
At the end of this course students will be ready to work on research in the area of computer architecture. They will have the knowledge to design chip architecture for components of a computer system. Moreover, they will have gained practical experience in using architectural-level design tools, such as architecture simulators, area/complexity estimators and power/energy estimators, to design and evaluate processors and large-scale systems at the architectural level.

Prerequisite(s): EE457: Computer Systems Organization

Course Notes
Communication will be done electronically through DEN's D2L. Copies of lecture slides and other class information will be posted.

Required Readings and Supplementary Materials
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.

Homework:

There will be five homework.

Simulation Assignments:

There will be five simulation assignments. These assignments require to use design tools under Unix. The first and second simulation assignments use a tracing tool called PIN. The goal of the third simulation assignement is to familiarize you with area and performance tools, such as SimpleScalar and Cacti. The fourth assignment is a microarchitecture design project using the tools. The fifth assignment uses GPGPU-Sim to simulate GPU/GPGPU architectures.

Quizzes:

There will be 8-10 quizzes. Quizzes are announced in previous lectures. They are open book/open notes. No electronic device with connection capability is allowed in quizzes (such as smart phone or laptop).

Midterm and Final:

Midterm and final are 110 minutes long. They are open book/open notes. No electronic device with connection capability is allowed.

Grading Breakdown

Homework: 15% (3% per homework); Simulation assignments: 40% (Assignment 0: 2pts; Assignment 1: 8pts; Assignment 2: 10pts; Assignment 3: 10pts; Assignment 4: 10pts); Quizzes: 5%; Midterm: 20%; Final: 20%.

Grading Policy

Letter grades are assigned based on the total numerical scores out of 100. The numerical scores are curved and letter grades are assigned based on relative performance. Here are some guarantees:
If you get more than 80 on the numerical score you will for sure get an A or A-.
If you get more than 60 on the numerical score you will for sure get a B- or better.
If you get more than 50 on the numerical score you will for sure get a passing grade (C) or better.
Below 50: No guarantee.

Assignment Submission Policy

Assignments (homework and simulations) are assigned electronically. We use paperless assignment submission, grading and return. Solutions are submitted electronically online. Your solutions must be in PDF (scan it if you need to). Assignments are graded electronically. Assignments are due at 5pm on the due date. Late assignments will be accepted through electronic submission for two additional days after the due date. The penalty is 25% of the maximum grade if submitted by 5pm the next day after the deadline and 50% of the maximum grade if submitted by 5pm two days after the deadline. No assignment will be accepted after that.

Grading Timeline

Homework and simulation assignments: 2 weeks after due date. Midterm and Final: 2 weeks after date. Quizzes: next class

Course Schedule:

Lecture	Date	Topic--Remarks	Assign date	Due date
Lect 1	1/8	Introduction-Instruction sets		
Lect 2	1/10	Static pipelines	Simulation assignment 0	
Lect 3	1/15	Static pipelines		
Lect 4	1/17	Tomasulo algorithm	Simulation assignment 1	Simulation assignment 0
Lect 5	1/22	Branch prediction	HWK1	
Lect 6	1/24	Speculative execution		
	1/25	**Last day to register/drop**		
Lect 7	1/29	Speculative execution		
Lect 8	1/31	Speculative execution		
Lect 9	2/5	Register renaming/Speculative scheduling	HWK2	HWK1
Lect 10	2/7	Multithreaded cores	Suimulation assignment 2	Simulation assignment 1
Lect 11	2/12	VLIW		
Lect 12	2/14	VLIW/Vector		
Lect 13	2/19	Memory hierarchies/Caches	HWK3	HWK2
Lect 14	2/21	Caches		
Lect 15	2/26	Memory technology		
Lect 16	2/28	DRAM controller micro-architectures	Simulation assignment 3	Simulation assignment 2
Lect 17	3/5	Virtual memory		
Lect 18	3/7	Multiprocessors		HWK3
	3/12	**Spring Break--no class**		
	3/14	**Spring Break--no class**		
Lect 19	3/19	Multiprocessors		
Lect 20	**3/21**	**MIDTERM 9-10:50am**		
Lect 21	3/26	GPUs/GPGPUs	HWK4	
Lect 22	3/28	GPUs/GPGPUs		
Lect 23	4/2	Synchronization	Simulation assignment 4	Simultion assignment 3
Lect 24	4/4	Coherence		
	4/5	**Last day to drop with mark of W**		
Lect 25	4/9	Coherence	HWK5	HWK4
Lect 26	4/11	Consistency		
Lect 27	4/16	Consistency		
Lect 28	4/18	Consistency		

Lect 29	4/23	Chip multiprocessors		
Lect 30	4/25	Transactional memory		HWK5
	4/26	**End of classes**		Simulation assignment 4
	5/7	**FINAL 8-10am**		

Statements on Academic Conduct and Support Systems

Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems:

Student Counseling Services (SCS) – (213) 740-7711 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention. engemannshc.usc.edu/counseling

National Suicide Prevention Lifeline – 1 (800) 273-8255
Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. www.suicidepreventionlifeline.org

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-4900 – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender-based harm. engemannshc.usc.edu/rsvp

Sexual Assault Resource Center
For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: sarc.usc.edu

Office of Equity and Diversity (OED)/Title IX Compliance – (213) 740-5086
Works with faculty, staff, visitors, applicants, and students around issues of protected class. equity.usc.edu

Bias Assessment Response and Support
Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. studentaffairs.usc.edu/bias-assessment-response-support

The Office of Disability Services and Programs
Provides certification for students with disabilities and helps arrange relevant accommodations. dsp.usc.edu

Student Support and Advocacy – (213) 821-4710
Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. studentaffairs.usc.edu/ssa

Diversity at USC
Information on events, programs and training, the Diversity Task Force (including representatives for each school), chronology, participation, and various resources for students. diversity.usc.edu

USC Emergency Information
Provides safety and other updates, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible. emergency.usc.edu

USC Department of Public Safety – UPC: (213) 740-4321 – HSC: (323) 442-1000 – 24-hour emergency or to report a crime.
Provides overall safety to USC community. dps.usc.edu