CS 433: Computer System Organization

Course Information for Fall 2020

Instructor: Sarita Adve

All online lectures are recorded

You can join an online lecture anonymously. Please get in touch with Prof. Adve in that case. Instructions for joining a meeting anonymously are here: https://wiki.illinois.edu/wiki/display/CSID/Attending+Sessions+Anonymously

Introduction to Prof. Adve

PhD from Wisconsin in 1993, at Illinois since 1999

Main research area – architecture

−Cross-disciplinary work: languages, OS, applications, …

Research interests and major projects

− Scalable specialization (Emphasis on Augmented and Virtual reality)

− Coherence and Consistency

− Heterogeneous memory systems

− Software-driven hardware reliability

− Approximate computing

− Cross-layer power management

Your introduction?

Course Staff

- Instructor: Sarita Adve
  - sadve@illinois.edu
  - 217-333-8461
  - Office hours: Tues and Thurs 12:30-1:00 pm Illinois time & by appointment
    - Via zoom: Meeting ID: 992 3823 2258 Password: archiscool
    - See piazza for more details
- Teaching Assistant: Antonio Franques
  - franque2@illinois.edu
  - Office hours: Mondays and Wednesdays 3:00-4:00 pm
  - Zoom information will be posted on piazza
- Administrative Assistant: Kim Baker
  - kabaker@illinois.edu
  - 217-300-6504

Website and Online Discussion

- Course home page: http://courses.grainger.illinois.edu/cs433/
  - For lecture notes, homeworks, solutions sets, and other handouts

- Piazza: https://piazza.com/illinois/fall2020/cs433
  - For all course announcements from course staff
  - For online discussion, clarifications, etc. between staff and students
  - This is the primary medium of communication between staff and students. It is your responsibility to check this site regularly.

Lectures

- Lectures will be online, via Zoom
  - Tuesdays and Thursdays, 11:00-12:15 pm Illinois time
  - Meeting ID: 979 2200 3672
  - Password: archiscool
  - See piazza for more details on zoom

Pre-requisites

- CS 233 or equivalent
- You should be familiar with Chapters 1-5 and parts of Chapter 6 of "*Computer Organization and Design: The Hardware Software Interface*", by Patterson and Hennessy, 5th edition, with specific emphasis on the topics on the next slide

Pre-requisites: Specific 233 topics (see previous slide)

- Instruction sets
  - Familiarity with at least one RISC instruction set (e.g. MIPS, ARM, RISC V, Alpha, SPARC, ...)
  - Addressing modes, arithmetic instructions, control instructions (jump, conditional branch), procedure calls and returns
- Basics of computer arithmetic
- Basic understanding for assessing performance
- Basic pipelined implementation
  - Hazards (structural, data, control)
- Memory hierarchies - caches and virtual memory
  - Concepts of ocality, miss vs. hit, miss and hit ratios, block/line, page, page fault, address translation, purpose of a TLB, associativity, block replacement policies (LRU, random, etc.), block finding (index, tag, etc.), write-through vs. write-back
- Basics of I/O - disks and buses
- Basic familiarity with shared memory and snooping based cache coherence and the SIMD model of computation

Course Material, Lecture Notes, Recordings

- John L. Hennessy and David Patterson, "*Computer Architecture: A Quantitative Approach*", Elsevier, sixth edition
  - The text will be supplemented with some additional material that will be provided in the lectures
- Most lecture notes will be available from the course web site the day before they are used in class
- Lecture recordings will be available from the web site, but these are intended for supplementary purposes
- If you are unable to attend synchronous lectures for a good reason (e.g., time zone issues), please get in touch with me (see HW 0 later). Wanting to take a class that conflicts with this one is not a good reason - I cannot provide overrides for such conflicts

Course Topics

- Introduction – review of fundamental performance issues, power and reliability, cost vs. price, basic pipeline structure
- Instruction level parallelism – hardware and software techniques (e.g., dynamic scheduling, superscalar, static and dynamic branch prediction, VLIW, loop unrolling)
- Memory hierarchy – advanced concepts in caches, main memory, and virtual memory
- Multiprocessors/multicore – overview of different models, cache coherence with shared-memory systems/multicore (snoopy and directory solutions), synchronization, memory consistency models
- Data parallel architectures (e.g., SIMD, vectors, GPUs)
- Domain-specific architectures – *depending on available time*
- Storage systems, I/O – *depending on available time*
- Recent advances in architecture and future challenges – *depending on available time*

Assignments

- There will be several written assignments
  - Usually due at 10pm Illinois time on due date
  - An automatic extension of 10 minutes (i.e., until 10:10 p.m. Illinois time) is given without any further request. **No further extensions for late submissions will be given except in the following cases:**
  - For exceptional reasons, an agreement to submit an assignment late may be reached with Professor Adve. Except for unforeseen medical or other emergencies, the agreement must be made within 48 hours after the assignment is handed out to the class. **In all cases, you must get an email confirmation of the agreement.** I am liberal with granting exceptions when requested in advance and responsibly (e.g., “excessive work this week due to a research deadline or three midterms” is a fine reason)
- Submit pdf through Illinois Compass 2g (https://compass2g.illinois.edu/)
  - Preferably write in latex, word, etc., but pdf scans of hand-written solutions will be accepted

Exams

- One midterm exam:
  - Date (in October), time, and logistics will be announced shortly
  - Will include material covered until and including the last class before the midterm
- Final exam:
  - Date will be announced by the campus office
  - Logistics will be announced shortly
  - Will include material covered after the midterm and until last lecture

Mini-projects

- Graduate students:
  - Research how concepts presented in class are applied in a real system
  - Present findings to class (towards end of semester)
  - Work in small groups
- All students (grad and undergrad):
  - All students are required to attend the mini-project presentations
  - Brief questions from presentations will appear on the exam
- More details will be announced shortly (after we have covered some more material in the lectures)

Grading

- Undergraduate students: assignments 25%, midterm: 37%, final: 38%
- Graduate students: assignments: 20%, mini-projects: 14%, midterm: 33%, final: 33%
- Absolute scale. Minimum score for guaranteeing a grade:
  - Undergrads: A+: 95%, A: 90%, A-: 85%, B+: 78%, B: 70%, B-: 65%, C+: 58%, C: 52%, C-: 45%, D: 35%, F: 0%
  - Grads: A+: 97%, A: 92%, A-: 87%, B+: 80%, B: 75%, B-: 70%, C+: 62%, C: 55%, C-: 48%, D: 35%, F: 0%
  - No D- and D+ grades will be alloted. Under exceptional circumstances, the minimum scores on some grades may be reduced, but they will not be increased

Regrade Requests

- If you think you have been unfairly graded on a homework or exam, you should petition the TA or Prof. Adve **in writing within a week of distribution of the graded work.** After a week, no regrade requests will be entertained

Honor Code (1 of 3)

- You may work with one partner for each assignment (different partners for different assignments are encouraged)
- You may discuss the problem and solution at length with your partner, but each partner must finally write up her or his own solution independently (on your own, with no more input from your partner) and submit an individual assignment
- Write the name of your partner clearly on the submitted work
- The partner will not get any credit for your submission
- Both partners must actively participate in the development of all solutions
- You may seek clarifications on the assignment *problems* from other students in the class as well, but you may not discuss the *solutions* with anyone other than your partner
- Exams are to be done individually. No books, notes, electronic devices, handouts, etc. may be used during the exams.

Honor Code (2 of 3)

Unless made available by the course staff, assignments, exams, and solution sets from previous offerings of the course or from other universities may not be used for this course. If you use such material, it is likely you will find the solutions to the problems in the assignments and the exams – we spend much time formulating the best possible set of problems and it is not possible to invent all new assignments for each course offering. Your use of such solutions will entirely defeat the goal of helping you learn the material and violate our honor code principles.

Honor Code (3 of 3)

I call the policies on the previous two slides and this slide the honor code because I would like to largely rely on your honor to enforce them – you are the only one to lose when you cheat. I consider both giving and receiving help beyond that allowed by the honor code policies to be forms of cheating, and take a violation of the honor code very seriously. **My default is to give anyone found violating the above policies a zero on the entire section of the course where the policy is violated (where a section is *all* homeworks, the midterm, or the final); further, after the student's scores are adjusted as above, the resulting grade will be reduced by a whole letter grade to determine the final grade. For example, if a student cheats on one homework problem, a zero score will be assigned on *all* homeworks. If this adjustment results in a total course score that would normally give a B- grade, then the final grade will be a C-. All cheating cases will be handled through the College of Engineering reporting system and will become part of the students' permanent academic record. So please read these policies very carefully.**

Homework 0 [1 point]

Due date: 8/27 (or within two days of registering if registered after 8/25)

Send a private, introductory message (to instructors only) on piazza with the following information:

- City/country from where you attend lectures, your time zone, how many hours ahead or behind you are from the central daylight time zone.
- If you are unable to attend synchronous lectures for a good reason (e.g., time zone issues), please explain. Wanting to take a class that conflicts with this one is not a good reason - we cannot provide overrides for such conflicts.
- If you have any other concerns about being able to fully participate in the online lectures (e.g., technology issues), please explain.
- If you have any other concerns or input for the class, please add.
- I always love to learn more about my students, so please feel free to add anything you like about yourself.
- Please provide your full name and email address in this message.