# CS 433 / CSE 422 Fall 2025

## *Computer System Organization*


### Instructor

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### Teaching Assistant

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### Course Website

https://courses.grainger.illinois.edu/cs433/fa2025/

### Other Websites Used in This Class

- Ed Discussion *(for announcements and online discussions)*
  https://edstem.org/us/courses/81964/
- Gradescope *(for assignment handouts and submissions)*
  https://www.gradescope.com/courses/1083974/

### Class Times & Location

Tuesdays and Thursdays
12:30 PM – 1:45 PM Central
Urbana: 157 Noyes Lab
Chicago: 200 S. Wacker Dr., 4th Floor, Classroom C

### Sections

- CS 433
  - T3 (3 hr, CRN 36069)
  - T4 (4 hr, CRN 43363)
  - CSP (3 hr, CRN 79901)
  - MCS (4 hr, CRN 36076)
- CSE 422
  - T3 (3 hr, CRN 36083)
  - T4 (4 hr, CRN 43364)

### Course Description

Computer hardware design and analysis and interface with software. Advanced processor design, including superscalar, out-of-order issue, branch prediction, and speculation. Memory hierarchy design, including advanced cache optimizations, main memory, and virtual memory. Principles of multiprocessor design, including shared-memory, cache coherence, synchronization, and consistency. Other advanced topics depending on time; e.g., GPUs and accelerators, warehouse computers and data centers, security.

### Optional Textbook

John L. Hennessy and David A. Patterson. *Computer Architecture: A Quantitative Approach*. 6th edition, Morgan Kaufmann, 2017. *(Note: prior/international editions will work fine.)*

### Prerequisites

CS 233 or equivalent *(must have prior knowledge on sequential logic, CPU pipelines, set-associative caches)*

### Format

- Live in-person lectures (with recordings available)
- Biweekly homework assignments
- Research paper readings (T4/MCS sections only)
- Midterm and final exam

## Topics Covered in This Course

- ***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 Architectures:*** overview of different models, cache coherence with shared-memory systems/multicore (snoopy and directory solutions), synchronization, memory consistency models
- ***Data-Parallel Architectures:*** SIMD, vectors, GPUs
- ***Advanced Architecture Topics:*** systems-on-chip (SoCs), accelerators (time permitting)

## Grading Breakdown

T3/CSP Sections

- 40%: Homework assignments
- 25%: Midterm exam
- 35%: Final exam

T4/MCS Sections

- 40%: Homework assignments (including additional coding labs)
- 10%: Research paper reviews
- 20%: Midterm exam
- 30%: Final exam

## Grading Policies

Research paper reviews and graduate lab exercises need to be completed only by students in the T4 and MCS sections.

Students get a bank of grace days to turn in homework assignments or paper reviews late without penalty. Students in the T3/CSP sections will receive 8 grace days for the semester, while students in the T4/MCS sections will receive 12 grace days (as they have more assignments). Grace days are used automatically on a FIFO basis – they will be applied to the assignments with the earliest deadline first. It is up to the student to keep track of their used grace days. Grace days cannot be used for exams.

Late submissions will be accepted up to 5 days after the original deadline (including grace days used). After grace days run out, a penalty of 8% per day will be assessed on late submissions, rounded to the nearest tenth of a point. Note that for any group assignments, grace days and late penalties will be assessed on an individual basis.

Grace days cover all sorts of issues, from unexpected bugs to homework conflicts with other classes to brief illnesses. For exceptional circumstances, please talk with the course instructor as soon as the circumstances are known, and special arrangements may be made at the discretion of the instructor.

## Collaboration

Homework assignments can optionally be discussed with a *single* partner per assignment (you may switch partners on different assignments) – no other discussion or collaboration on homework is allowed. *You must disclose your partner's name on your submission, and you must write up and submit your own answers,* to avoid an academic integrity violation (see below). Coding labs involve collaboration in small groups, and discussion with your partners is allowed. Paper reviews and exams are expected to be done individually, and should not be discussed with peers at any level.

## Academic Integrity

The University of Illinois Urbana-Champaign Student Code should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: https://studentcode.illinois.edu/

Every student is expected to review and abide by the Academic Integrity Policy as defined in the Student Code (https://studentcode.illinois.edu/article1/part4/1-401/). Academic dishonesty will result in a sanction proportionate to the severity of the infraction, with possible sanctions described in 1-404 of the Student Code (https://studentcode.illinois.edu/article1/part4/1-404/). As a student it is your responsibility to refrain from infractions of academic integrity and from conduct that aids others in such infractions. A short guide to academic integrity issues may be found on the provost's website (https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/). Ignorance of these policies is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

While this is not comprehensive, you may not copy any answers or code from online resources, from ChatGPT, or from other students. If you must include a quote or a figure from an external source (e.g., for a presentation; not allowed for homework or exams), cite the source to avoid plagiarism.

## Mental Health

Diminished mental health, including significant stress, mood changes, excessive worry, substance/alcohol abuse, or problems with eating and/or sleeping can interfere with optimal academic performance, social development, and emotional well-being. The University of Illinois offers a variety of confidential services including individual and group counseling, crisis intervention, psychiatric services, and specialized screenings at no additional cost. If you or someone you know experiences any of the above mental health concerns, it is strongly encouraged to contact or visit any of the university's resources provided below. Getting help is a smart and courageous thing to do – for yourself and for those who care about you.

- Counseling Center: +1 (217) 333-3704, 610 East John Street Champaign, IL 61820
- McKinley Health Center: +1 (217) 333-2700, 1109 South Lincoln Avenue, Urbana, IL 61801
- University Wellness Center: https://wellness.illinois.edu/

## CS CARES, CS Values, and Code of Conduct

All members of the Illinois Computer Science department – faculty, staff, and students – are expected to adhere to the CS Values and Code of Conduct (https://cs.illinois.edu/about/values). The CS CARES Committee (https://cs.illinois.edu/about/cs-cares/) is available to serve as a resource to help people who are concerned about or experience a potential violation of the code. If you experience such issues, please contact the CS CARES Committee (https://cs.illinois.edu/about/cs-cares/contact). The instructor of this course is also available for issues related to this class.

## Anti-Racism and Inclusivity Statement

The Grainger College of Engineering is committed to the creation of an anti-racist, inclusive community that welcomes diversity along a number of dimensions, including, but not limited to, race, ethnicity and national origins, gender and gender identity, sexuality, disability status, class, age, or religious beliefs. The college recognizes that we are learning together in the midst of the Black Lives Matter movement, that Black, Hispanic, and Indigenous voices and contributions have largely either been excluded from, or not recognized in, science and engineering, and that both overt racism and micro-aggressions threaten the well-being of our students and our university community.

The effectiveness of this course is dependent upon each of us to create a safe and encouraging learning environment that allows for the open exchange of ideas while also ensuring equitable opportunities and respect for all of us. Everyone is expected to help establish and maintain an environment where students, staff, and faculty can contribute without fear of personal ridicule, or intolerant or offensive language. If you witness or experience racism, discrimination, micro-aggressions, or other offensive behavior, you are encouraged to bring this to the attention of the course director if you feel comfortable. You can also report these behaviors to the Bias Assessment and Response Team (BART; https://bart.illinois.edu/). Based on your report, BART members will follow up and reach out to students to make sure they have the support they need to be healthy and safe. If the reported behavior also violates university policy, staff in the Office for Student Conflict Resolution may respond as well and will take appropriate action.

## Disability-Related Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call +1 (217) 333-4603, e-mail disability@illinois.edu, or go to https://www.disability.illinois.edu/. If you are concerned you have a disability-related condition that is impacting your academic progress, there are academic screening appointments available that can help diagnosis a previously undiagnosed disability. You may access these by visiting the DRES website and selecting "Request an Academic Screening" at the bottom of the page.

## Family Educational Rights and Privacy Act (FERPA)

Any student who has suppressed their directory information pursuant to the Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the

privacy of their attendance in this course. See https://registrar.illinois.edu/academic-records/ferpa/ for more information on FERPA.

## Religious Observances

Illinois law requires the University to reasonably accommodate its students' religious beliefs, observances, and practices in regard to admissions, class attendance, and the scheduling of examinations and work requirements. You should examine this syllabus at the beginning of the semester for potential conflicts between course deadlines and any of your religious observances. If a conflict exists, you should notify your instructor of the conflict and follow the procedure at https://odos.illinois.edu/community-of-care/resources/students/religious-observances/ to request appropriate accommodations. This should be done in the first two weeks of classes.

## Sexual Misconduct Reporting Obligation

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the university's Title IX Office. In turn, an individual with the Title IX Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated university employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found at https://wecare.illinois.edu/resources/students/#confidential

Other information about resources and reporting is available at https://wecare.illinois.edu/