CS 534 ME / MCS   Spring 2024
Architectures for Mobile and Edge Computing

Instructor
Prof. Saugata Ghose
ghose@illinois.edu
4120 Siebel Center

Teaching Assistant
Sudhanshu Agarwal
sa86@illinois.edu

Course Website
https://courses.grainger.illinois.edu/cs534/sp2024/

Other Websites Used in This Class
- Ed Discussion *(for announcements and online discussions)*
  https://edstem.org/us/courses/53413/
- Gradescope *(for assignment handouts, submissions, and quizzes)*
  https://www.gradescope.com/courses/708399/

Class Times & Location
Tuesdays and Thursdays
12:30 PM – 1:45 PM Central
Urbana: 3018 CIF (Campus Instructional Facility)
Chicago: 200 S. Wacker Dr., Room 702

Sections
- ME (4 hr, CRN 74420)
- MCS (4 hr, CRN 76091)

Course Description
Mobile computing platforms (e.g., smartphones, tablets, wearables, processors in autonomous vehicles) have enabled a revolutionary change in society over the last two decades. Much of this success is a result of a fundamental shift in architectural design, with new architectures focusing on lowering energy consumption, improving the handling of data, and specializing for target platforms. These architectures are continuing to transform, as the relationship between data centers, networks, and mobile platforms changes, and as applications continue to deal with increasing amounts of data. This course will cover key enabling technologies and current research challenges for mobile computer architectures. Topics include smartphone architectures and hardware components, memory and storage systems for mobile platforms, system-on-chip integration, emerging applications, and edge computing platforms. The course will be taught using a combination of lectures and paper readings, and students will be expected to present research papers and complete a substantial final project.

Textbooks
None

Prerequisites
CS 433, ECE 411, or equivalent
You must have prior knowledge about out-of-order CPUs, set-associative caches, virtual memory, and exception handling.

Format
- Live lectures and paper discussions (in-person with available hybrid participation)
- Short take-home quizzes
- Semester-long course project

Topics Covered in This Course
- *Systems-on-chip:* design principles, typical hardware components in smartphones, interconnects, interactions between hardware components
- *Thread-level parallelism and data-level parallelism:* GPUs, vector processors, dataflow processors, systolic arrays
- *Modern memory hierarchy:* advanced cache design, detailed DRAM operation, solid-state drive design and operation
- *Hardware and SoC design metrics:* performance, energy, fairness, EPI
- *Application-specific accelerators:* machine learning, video encoding/decoding, image processing
- *Edge computing:* impact of network latency, data-centric computing, changing data center hardware, data analytics, edge applications

Grading Breakdown
- 20%: Quizzes
- 20%: Paper reviews
- 10%: Paper discussion presentation
- 10%: Paper discussion participation
- 40%: Final course project

Grading Policies

Quizzes are expected to sum up to 135 points (approximately 5 points per class). Up to 15 points will be dropped. In other words, while the total possible quiz points will add up to 135, a student needs to earn only 120 points to get full credit for quizzes.

There will be approximately 7 paper reviews due for the course. You should not submit a paper review for the paper you sign up to lead a discussion on. In addition, only the 5 highest grades will count.

Students receive a bank of grace days to turn in assignments late without penalty. Each student will receive 10 grace days for the semester, which can be applied only to quizzes, paper reviews, and written project milestones. Grace days are applied 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.

Late submissions will be accepted up to 7 days after the original deadline (including grace days used). After grace days run out, a penalty of 6% per day will be assessed on late submissions. 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. Attendance is not graded in this class, and while participation is graded, you do not need to attend or take part in every class to get full credit.

Collaboration

Quizzes and paper reviews are expected to be done individually, and should not be discussed with peers at any level. The paper discussions and the course project involve collaboration in small groups, and discussion with your partners is allowed for these assignments.

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: http://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/