ECE 6960 – Datacenter Architecture

Course Number and Title: ECE 6960: Datacenter Architecture
Instructor: Prof. Mohammad Alian (malian@cornell.edu)
Credits and Credit Hour Options: 3 hours, Letter Grade

Lecture Time: MW 2:55 – 4:10 PM
Lecture Location: Bard Hall 140

Instructor Office Hours: MW 4:15 – 4:45 PM

Course Description:
The course will cover the state-of-the-art hardware and software architecture of datacenters that power almost all the cloud services we use today. We will discuss the specific requirements for datacenter hardware and software architecture and how these requirements influence the design of datacenters. We will explore new trends in processor architecture (both general-purpose and domain-specific), memory architecture, storage architecture, network architecture, system software architecture, and software architecture of datacenters.

Prerequisites: ECE 4750 or equivalent course.

Corequisites: None

Textbook(s) and/or Other Required Materials:

- Barroso, Luiz André, Urs Hölzle, and Parthasarathy Ranganathan. The datacenter as a computer: Designing warehouse-scale machines. Springer Nature, 2019.
- Course lectures notes, and assignments will be distributed in the course website

Class schedule:

Lectures: Two 75-min lectures per week

Assignment, Exams, and Attendance:

- Paper reviews: 1 before each class
- In class quizzes and discussion: 1/2 every week
- Exams: 2 midterms, 1 final

Course Grading Scheme (tentative):

- Paper reviews: 5%
- In class quizzes and discussion: 25%
- Homework assignments: 10%
- Midterm 1: 15%
- Midterm 2: 20%
- Final: 25%

Basics of Grade Determination:

- A+:   total >= 96%
- A: 96% > total >= 93%
- A-:   93% > total >= 89%
- B+:   89% > total >= 86%
- B: 86% > total >= 83%
- B-:   83% > total >= 79%
- C: 79% > total >= 69%
- D: 69% > total >= 59%
- F: 59% > total

- The University grading scale can be found on this page:
  https://courses.cornell.edu/content.php?catoid=31&navoid=7933.

Typical Topics Covered:

- Datacenter server hardware architecture (CPU, memory, system interconnect)
- Datacenter network architecture (NIC, Ethernet, RDMA, switches, kernel space and userspace networking)
- Datacenter storage (node local SSDs, disaggregated storage)
- Datacenter software development architecture (monolithic software, micro-services, map-reduce, actor model)
- Hardware acceleration at datacenters (GPUs, TPUs, Domain-Specific Architectures)
- Novel paradigms (memory disaggregation, coherent system interconnects, near-data processing)

Course Outcomes:

- Students will learn the specific requirements of computing at scale

- Students will learn about the state of the art hardware and software architecture of datacenters
- Student will learn about the current challenges in datacenters and future research directions

Academic Integrity:

Each student in this course is expected to abide by the Cornell University Code of Academic Integrity. Any work submitted by a student in this course for academic credit will be the student's own work. The policy can be found on the university's website here:
https://theuniversityfaculty.cornell.edu/academic-integrity/

You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e-mail, an e-mail attachment file, or a hard copy.

Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Code can also be extended to include failure of the course and University disciplinary action.

During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

Optional statement about Academic Misconduct:

A faculty member may impose a grade penalty for any misconduct in the classroom or examination room. Examples of academic misconduct include, but are not limited to, talking during an exam, bringing unauthorized materials into the exam room, and disruptive behavior in the classroom.

Students with Disabilities

Your access in this course is important. Please give the instructor your Student Disability Services (SDS) accommodation letter early in the semester so that we have adequate time to arrange your approved academic accommodations. If you need an immediate accommodation for equal access, please speak with me after class or send an email message to me and/or SDS at sds_cu@cornell.edu. If the need arises for additional accommodations during the semester,

please contact SDS. You may also feel free to speak with Student & Academic Affairs at Cornell Tech who will connect you with the university SDS office.

Religious Observances

Cornell University is committed to supporting students who wish to practice their religious beliefs. Students are advised to discuss religious absences with their instructors well in advance of the religious holiday so that arrangements for making up work can be resolved before the absence.