Course Info:

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Class Hours: Tuesdays 5:30 PM - 8:00 PM  
Class Location: DC 116  
Class Webpage: http://cecs.louisville.edu/nihat/teaching/cecs629s20

Overview:

This course covers general concepts in design and implementation of distributed systems, by visiting foundational topics in communication, synchronization, consistency, replication, and fault tolerance. Discussions of research papers will reveal recent advancements in the field and design of modern distributed systems currently used in large-scale companies such as Google, Facebook, Amazon, and Microsoft. The GO programming language and the AWS cloud computing platform will be used in projects.

Textbooks:


Prerequisites:

CECS 420: Design of Operating Systems

Course Content:

This course is composed of the following components (see class web page for a detailed schedule):

- Introduction: GO and AWS review, review of necessary computer networks background for distributed systems, introduction to distributed systems, goals, and architectures.
- Processes: Review of processes and threads in an operating system, roles of processes and threads in a distributed system design, virtualization, and code migration.
- Communication: Socket programming, Remote Procedure Call (RPC), and message passing based distributed communication techniques.
- Synchronization: Clock synchronization, logical lamport and vector clocks, mutual exclusion techniques in a distributed system including centralized, decentralized, distributed, and token-based solutions, and election algorithms.
- Consistency & Replication: Consistent ordering, consistency models including eventual, monotonic read/write, read your writes, and writes follows reads models, replica placement, and consistency protocols including the primary-backup protocol.
- Fault Tolerance: Failure models, paxos, distributed commit techniques including two-phase and three-phase commit, CAP theorem, and recovery from failures via checkpointing and message...
logging.

- **Distributed Computing and Storage:** Google File System and MapReduce programming paradigm.
- **Paper Readings/Discussions:** Selected among Google’s BigTable, Megastore, Chubby, Spanner, Borg; Facebook’s photo storage/caching, existential consistency; Amazon’s Dynamo; Microsoft’s Dyrad, and others including but not limited to Bitcoin, Spark, Ceph, and The Tail at Scale.

**Grading:**

- 30% Test
- 30% Projects (3 programming projects, 10% each)
- 15% Paper Presentation
- 15% Paper Reaction Write-ups (one review for each paper discussed, equally weighted)
- 10% Pop Quizzes (around 10 quizzes, equally weighted, lowest quiz grade will be dropped)

The letter grade is calculated as follows: $100 \geq A^+ \geq 97 > A \geq 94 > A^- \geq 90 > B^+ \geq 87 > B \geq 84 > B^- \geq 80 > C^+ \geq 77 > C \geq 74 > C^- \geq 70 > D^+ \geq 67 > D \geq 64 > D^- \geq 60 > F \geq 0$.

**Policies:**

- Attendance is not graded but pop quizzes may be given at any time. No make-up is provided for missed quizzes; however, **lowest quiz grade will be dropped instead of a make-up.** Exam and due dates will be scheduled in advance, and a grade of zero will be recorded for missed exams unless prior arrangements are made (only allowed in extraordinary circumstances with an official proof).
- All programming assignments will be done in **AWS and the GO programming language only** (not C, C++, Java, or Python). Students are strongly encouraged to collaborate in studying and to learn from each other; however, all submitted assignments should be done individually unless explicitly stated as a group assignment. **Except your group members, if any, you are not allowed to go over your friends’ code, and your friends cannot see your code.** You are only allowed to make a high-level verbal discussion on the project with other students.
- Posting assignments and/or solutions online is not permitted. You cannot publish your code partially (in forums or other sites for asking questions) or completely (in public repos). **For instance, you cannot post your code on your public GitHub account unless you make it private! You are also not allowed to share your code with the future students of this class.** Not complying with these collaboration and code sharing rules will put you under the risk of plagiarism for this semester or the following semesters, including the cases where future students of this class copied your code from online resources (forums, GitHub, etc.).
- **We use advanced copy checkers:** cheating or copying of assignments (including Internet resources) will be reported and a grade of zero will be recorded.
- Students with special needs will be accommodated and all necessary arrangements will be made to facilitate learning the material, doing the assignments, and taking the tests.
- The instructor reserves the right to make changes in the syllabus when necessary.

**Title IX/Clery Act Notification:**

Sexual misconduct (including sexual harassment, sexual assault, and any other nonconsensual behavior of a sexual nature) and sex discrimination violate University policies. Students experiencing such behavior may obtain confidential support from the PEACC Program (852-2663), Counseling Center (852-6585), and Campus Health Services (852-6479). To report sexual misconduct or sex discrimination, contact the Dean of Students (852-5787) or University of Louisville Police (852-6111).

**Disclosure to University faculty or instructors** of sexual misconduct, domestic violence, dating violence, or sex discrimination occurring on campus, in a University-sponsored program, or involving a campus visitor or University student or employee (whether current or former) is **not confidential** under Title IX. Faculty and instructors must forward such reports, including names and circumstances, to the
University’s Title IX officer.
For more information, see http://louisville.edu/hr/employeerelations/sexual-misconduct-brochure.