CSE 4/586 Distributed Systems

Murat Demirbas

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Distributed Systems

Distributed systems need radically different software than centralized systems do.
A. Tannenbaum
http://www.youtube.com/watch?v=eakKfY5aHmY
Distributed Systems

A collection of autonomous nodes

- communicating over a network to address a problem collectively
- with no shared memory
- with no common physical clock
Distribution goals

- Scalability
- Reliability
- Accommodating geographic separation
Distribution challenges

- Coordination despite lack of global view (lack of global state/time)
- Handling failures of the nodes and communication
- Reasoning about nondeterminism due to concurrency
- Scalability
Distributed systems examples

- Cloud computing
- Grid computing
- Client-server systems
- Peer-to-peer systems
- Network protocols
- Wireless sensor networks
- Ad hoc and mobile networks
Our course

Our course covers principles for design & analysis of distributed systems

- reasoning about distributed programs
- handling the lack of global state and global time
- achieving distributed consensus in the presence of faults
- designing fault-tolerance for distributed systems

The course also reviews state-of-the-art distributed systems, particularly cloud computing systems
Topics

- Introduction, 2 phase-commit
- Safety/progress properties and proving program properties
- Consensus, Paxos
- Failure detectors, Faults and fault-tolerance
- Time: logical clocks, State: distributed snapshots

- Datacenter computing, Cloud computing
- NoSQL databases, CAP theorem, Distributed databases
- Big data, Big data analytics
- Decentralized ledgers and blockchains
Non-topics

- Internet protocols
- Security
- Parallel computing
- Web services
Logistics

- Class location: 201 Natural Sciences
- Mon/Wed 5:00pm-6:20pm
- Office hours: Mon/Wed 4pm-5pm, Davis 313

We will use Piazza as a social Q&A web service for classrooms. Piazza is a mixture between a wiki and a forum.
No required textbook

If you like to use a reference book, you can consider:


Grading

- %24 Assignments (8 will be assigned)
- %16 TLA+ project
- %25 Midterm (closed book)
- %35 Final (closed book, final will be inclusive of the midterm content)
My expectations

- Review the assigned reading/slides
- Work independently and ethically on the assignments
- Ask questions

All assignments are due on the day and time posted

Extra work will **NOT** be given to improve your grade
Academic Integrity

Zero tolerance on cheating!

- 0 in the particular assignment/exam for first attempt
- Fail the course on the second attempt
- Students who do share their work with others are as responsible for academic dishonesty as the student receiving the material
- Consult the University Statements on Academic Integrity: http://www.cse.buffalo.edu/shared/policies/academic.php.
About Me

- background in distributed systems (OSU, MIT)
- worked on wireless sensor networks for 8 years (OSU, UB)
- cloud computing for the past 9 years
- sabbatical at Microsoft Azure Cosmos DB in 2018/19
- http://muratbuffalo.blogspot.com/
Questions ?