Northeastern University

CS 6650 Scalable Distributed Systems

Class Times: Monday 4:30 PM PT via Zoom

Instructor: Prasad Saripalli

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Class Session: Monday 4:30 PM via Zoom

Description: Covers techniques and concepts associated with constructing software that is distributed, reliable, efficient, and extensible; programming multi-threaded applications, communication among objects on different computers, creating a server accessed by multiple clients, using common object design patterns, locating and tailoring components.

Prerequisites: OS and Networks

Student Learning Goals: Upon successful completion of the course, students should be able to:

- Devise and argue for the correctness of distributed algorithms that perform computational tasks, using algorithmic building blocks including tokens and logical clocks.
- Construct distributed systems to realize distributed algorithms that perform computational tasks using appropriately chosen models of communication.
- Construct distributed systems with various design patterns (e.g. client-server, peer-to-peer).
- Work within a team to construct the specification for a distributed system and to implement and test one or more parts of the system.

Program Outcomes: This course supports the following MSCSS program outcomes:

- An ability to use current techniques, skills, and tools necessary for computing practice.
- An ability to analyze a problem, to assess an articulate its requirements, to design, to implement, and to evaluate a computer-based system.
- An ability to participate effectively in team projects.
- Recognition of the need for and ability to engage in self-directed learning and continuing professional development.

Student Learning Goals: This course supports the following NEU student learning goals:

- Inquiry and Critical Thinking — Students will acquire skills and familiarity with modes of inquiry and examination from diverse disciplinary perspectives, enabling them to access, interpret, analyze, quantitatively reason, and synthesize information critically.
- Communication/Self-Expression — Students will gain experience with oral, written, symbolic and artistic forms of communication and the ability to communicate with diverse audiences. They will also have the opportunity to increase their understanding of communication through collaboration with others to solve problems or advance knowledge.

Textbook: We will use the following required textbook for this class:

- *Distributed Systems: Concepts and Design. George Coulouris, Jean Dollimore, Tim Kindberg. Addison Wesley. Fifth Edition. http://www.cdk5.net/wp/*

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Other textbooks you may find useful as references for this class are included below.

- *Distributed Systems for System Architects*
  Authors: Paulo Veríssimo, Luís Rodrigues
  https://link.springer.com/book/10.1007/978-1-4615-1663-7
- *Distributed Systems: Principles and Paradigms, Andrew Tanenbaum and Maarten van Steen, Prentice Hall.*
- *Operating Systems, Principles and Practice. Thomas Anderson, Michael Dahlin.*

Topics Covered

- Distributed system basics
- Models of inter process communication
- Representation and correctness of distributed programs
- Time on Distributed Systems – physical and logical time
- Consistency
- Distributed mutual exclusion and tokens
- Distributed snapshots and global state
- Fault tolerance
- Consensus

Please see the Calendar in **Lessons Map Calendar.xls** for an approximate Lecture and assignemnts/exams schedule.

Tentative Schedule - Please note that this schedule may be revised as we progress through the quarter. I will use Canvas to specify the topics for every week, including reading assignments, foils for the week, and projects specifications.

Week	Topic	Exam	Projects
0	***Introduction***		
1	*Introduction, Architecture and Communication Infrastructure Review*		Project #1 Assigned
2	*Processes, Threads, RPC*		
3	*Time & Synchronization*		Project #2 Assigned
4	*Logical Clocks, Group Communication & IP Multicasting*		
5	*Distributed Mutual Exclusion, Network File Systems*	Mid-term Exam	Project #3 Assigned
6	*Distributed File Systems*		
7	*Consensus, Paxos*		Project #4 Assigned
8	*Distributed Parallel Frameworks,*		

		MapReduce, Spark, MPI	
	9	*Byzantine Fault Tolerance, P2P Networks*	
	10	*Distributed Shared Memory*	In---class demos of Final Project
Finals	Week	Final Exam	

Online Materials: Lectures, homework assignments, supplemental materials etc., will be shared via Canvas. Unless otherwise indicated, assignments should be submitted through Canvas. Submission links will be provided as they are assigned. **Grading Criteria:**

Projects (4)	30%
Final Project	10 %
Homeworks 5	20%
Quizzes 4	12%
Midterm exam	13%
Final exam	13%
Attendance	2%

You have 5 days of grace period for late submission of any work (excluding exams and final project). **Additional late submissions will not be graded and are awrded a 0 grade. This is not negotiable.** Overall course grades (decimal) will be calculated from the weighted average of assignment and exam percentage scores using the NEU grading system. The above grading criterion is approximate, and instructor will use a curve to grade for the final grading as needed, adjusting the above % grade credit per how the class performs through the semester. Number of homeworks may vary (+ or – one).
Example grading conversion https://course.ccs.neu.edu/cs5500sp17/grades.html

Teaching Assistants
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There will be weekly sessions by TAs per assignment or project via Zoom to help answer your questions, one session per TA every week.

Practice your Java and Java Networking skills. We mainly use Java for all the work.

You will need to form teams of 3 classmates to work on your Final Projects so reach out and get started. **Welcome to Distributed Systems!**

Please read next page ☞ SUCCESS PATHS 1 pager

SUCCESS PATHS 1 pager

Please note the below guidelines to make sure you learn and do well in this course:

1. **Basics:** Brush up on basic Java skills, basic client server programming and basics of operating systems and networking. These are necessary for a successful completion of this course.
2. **Facetime:** Attend the class if you can or be sure to review the recorded lecture and study the assigned materials.
3. **Study and Project Team:** Form your 3 student study team ASAP, and get started ideating your final project early.
4. **No late work:** Submit work assigned in time, seek help early talking to the TAs and emailing me.
5. **Sending email:** k.saripalli@northeastern.edu please email me directly at and not via Piazza email. Always CC the TAs. Do NOT post your private requests for any help etc. as a Piazza email, use my email ID instead.
6. **Avoid plagiarism**: Do not copy paste any content from any sources including the Web. This has severe penalties as per NEU plagiarism prevention policies.
7. **Piazza**: Monitor Piazza, share any questions or helpful pointers which helped the rest of the class. TAs monitor Piazza and we will answer your questions on Piazza. We don't use Slack or Teams for this.
8. **Timely help:** Attend **TA sessions** and bring up your questions/concerns and seek help early. please do not wait till the last minute. TAs will reinforce key topics/concepts and offer coding help.