New York University Tandon School of Engineering
Department of Computer Science & Engineering

CS 9223 Fall 2020
Distributed Systems Prof. Gustavo Sandoval

Large-scale distributed systems are the core software infrastructure underlying cloud computing. These systems consist of tens of thousands of networked computers working together to provide unprecedented performance and fault-tolerance. Examples include distributed databases (e.g. Google's Spanner, Amazon's S3 and Dynamo), distributed computation frameworks (e.g. Hadoop/Spark and TensorFlow) or even decentralized currency systems (e.g. BitCoin). This class teaches the abstractions, design and implementation techniques that allow you to understand and build such distributed systems.

It will present abstractions and implementation techniques for engineering distributed systems. Major topics include multithreading, network programming, **fault tolerance, replication, and consistency**. We will also spend a lot of time studying several case studies of distributed systems.

Contact

Email: gustavo.sandoval@nyu.edu
370 Jay office 846
Office hours: Wed: 2:30 – 4:00

Prerequisites:

CS 6233 – Intro to Operating Systems.
Expertise in C/C++ programming.

Course requirements

- This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. Here's the link for our class: https://piazza.com/nyu/fall2018/cs9223/home
- In class quizzes and participation in Piazza will count towards 10% of your grade. So Participate!!
-

Course schedule (Tentative and subject to change)

Week	Date	Topic	Reading
1	**Jan 29**	Introduction to Distributed Systems and : MapReduce	MapReduce
2	**Feb 5**	Go Intro. Web Architectures and Cloud Computing	Online go Tutorial
3	**Feb 12**	Distributed Communication: Sockets and RPC	Online go Tutorial
4	**Feb 19**	Time, Clocks and Distributed Systems	Logical Clocks
5	**Feb 26**	Fault Tolerance: Primary/backup Replication	GFS VR Revisited
6	**Mar 4**	CAP Theorem Consistency Models	Perspectives on the CAP Theorem
7	**Mar 11**	Consensus: Paxos	Paxos Made Simple
8	**Mar 18**	**Spring Break**	
9	**Mar 25**	Consensus: Raft	Raft
10	**Apr 1**	Consensus in Practice**:** Chubby, and BigTable	Special Guests from Google to talk about: Chubby, BigTable
11	**Apr 8**	Relaxed Consistency	Dynamo Bayou
12	**Apr 15**	Distributed Transactions	Spanner
13	**Apr 22**	Peer to peer: Bitcoin	Bitcoin Summary
14	**Apr 29**	Project Presentations	
15	**May 6**	Project Presentations	

Textbook: None. We will be reading conference papers.

Useful Reference Books:

- Designing Data Intensive Applications (Kleppmann)
- Distributed Systems (Colouris, et al)
- Distributed Systems (Tanenbaum and Steen)
- Distributed Systems for Fun and Profit

Reading

We will be reading published papers and discussing them in class. The papers will also be covered in the exams.

Acknowledgements

This course builds upon several existing distributed systems courses from other universities:

MIT Distributed Systems course by Robert Morris.

NYU Distributed Systems course by Jinyang Li

Columbia Distributed Systems course by Roxana Geambasu

Grading

Grading will be based on the following weights.

30 % Assignments
30 % Quizzes
40 % Project

Assignments:

There will be several assignments involving programming projects. Every assignment has to be done individually by each student. Discussions between students and help in using the programming environment are permitted and encouraged, however no code or solutions may be copied. The assignments must be in Completed in **Go**. There is no late policy for assignments; any absence notifications should be communicated via http://engineering.nyu.edu/life/student-affairs/advocacy-privacy-and-compliance.

Project:

The goal of this project is for the student to gain experience in implementing a Distributed System different to what we see in class. The project will be performed in teams, details to be announced. Students will be responsible for selecting a domain area problem (some example problems will be suggested). The grade for the project will be divided between: problem and background research, proposed solutions (short presentation), and implementation. More details will be provided in class.

Quizzes:

There will be a series of very short quizzes at the beginning of selected classes covering material to date. The lowest quiz mark will be dropped. Quiz marks will not be excused.

Other Grading notes:

Please take the following into consideration during and after the semester and save yourself one or many emails.

1) **I must grade every student EXACTLY the same way.** To this end, I cannot give you special consideration as a result of your academic status (probation or otherwise), scholarships, work status, family situation, visa status, race, color, creed, religious beliefs, past alien abductions, current moon cycle, location of the sun in the sky or anything other than your academic performance. **Your grade must be based on your academic performance in my class**.
2) **I cannot change your grade simply because you ask me to.** Your grade is calculated based on your performance from the first day of class to moment you turn in the final exam.
3) **I will not give you additional work.** Please remember that I must treat all students the same, so if I give you additional work, I would have to give it to the entire class. This is unfair to the students who complete their work on time.
4) **Your grade is a measure of your performance in my class.** If you receive an "F" it is because you have demonstrated that you do not understand the material in the course; if you receive an "A" it is because you have demonstrated that you fully understand the material covered in the course. Other grades are assigned accordingly.

Moses Center Statement of Disability

If you are student with a disability who is requesting accommodations, please contact New York University's Moses Center for Students with Disabilities (CSD) at 212-998-4980 or mosescsd@nyu.edu. You must be registered with CSD to receive accommodations. Information about the Moses Center can be found at www.nyu.edu/csd. The Moses Center is located at 726 Broadway on the 3rd floor.

NYU School of Engineering Policies and Procedures on Academic Misconduct – complete Student Code of Conduct here

A. Introduction: The School of Engineering encourages academic excellence in an environment that promotes honesty, integrity, and fairness, and students at the School of Engineering are expected to exhibit those qualities in their academic work. It is through the process of submitting their own work and receiving honest feedback on that work that students may progress

academically. Any act of academic dishonesty is seen as an attack upon the School and will not be tolerated. Furthermore, those who breach the School's rules on academic integrity will be sanctioned under this Policy. Students are responsible for familiarizing themselves with the School's Policy on Academic Misconduct.

B. Definition: Academic dishonesty may include misrepresentation, deception, dishonesty, or any act of falsification committed by a student to influence a grade or other academic evaluation. Academic dishonesty also includes intentionally damaging the academic work of others or assisting other students in acts of dishonesty. Common examples of academically dishonest behavior include, but are not limited to, the following:

1. Cheating: intentionally using or attempting to use unauthorized notes, books, electronic media, or electronic communications in an exam; talking with fellow students or looking at another person's work during an exam; submitting work prepared in advance for an in-class examination; having someone take an exam for you or taking an exam for someone else; violating other rules governing the administration of examinations.
2. Fabrication: including but not limited to, falsifying experimental data and/or citations.
3. Plagiarism: intentionally or knowingly representing the words or ideas of another as one's own in any academic exercise; failure to attribute direct quotations, paraphrases, or borrowed facts or information.
4. Unauthorized collaboration: working together on work meant to be done individually.
5. Duplicating work: presenting for grading the same work for more than one project or in more than one class, unless express and prior permission has been received from the course instructor(s) or research adviser involved.
6. Forgery: altering any academic document, including, but not limited to, academic records, admissions materials, or medical excuses.

NYU School of Engineering Policies and Procedures on Excused Absences – complete policy here

A. Introduction: An absence can be excused if you have missed no more than **10 days of school**. If an illness or special circumstance has caused you to miss

more than two weeks of school, please refer to the section labeled Medical Leave of Absence.

B. Students may request special accommodations for an absence to be excused in the following cases:

1. Medical reasons
2. Death in immediate family
3. Personal qualified emergencies (documentation must be provided)
4. Religious Expression or Practice

Deanna Rayment, deanna.rayment@nyu.edu, is the *Coordinator of Student Advocacy, Compliance and Student Affairs* and handles excused absences. She is located in 5 MTC, LC240C and can assist you should it become necessary.

NYU School of Engineering Academic Calendar – complete list here.

Final exams for graduate courses will be held on the last day of class during the week of _____. If you have two final exams at the same time, report the conflict to your professors as soon as possible. Do not make any travel plans until the exam schedule is finalized.

Also, please pay attention to notable dates such as Add/Drop, Withdrawal, etc. For confirmation of dates or further information, please contact Susana: sgarcia@nyu.edu