San José State University
Department of Computer Science
Fall 2025
CS 249 – Distributed Systems

Course and Contact Information

Instructor:	Ramin Moazeni, PhD
Class Hours:	TTh: 4:30PM - 5:45PM
Office Hours:	Fri: 12:30PM – 1:00PM over Zoom or after class
Email:	Ramin.Moazeni@sjsu.edu
Classroom:	DH 450
Prerequisites:	CS149 and Graduate standing

Catalog Description

Current issues in operating systems, including multiprocessor systems and distributed computing, networks, security and performance. Case studies of current operating systems.

Course Overview

The objective of this course is to give students a basic grounding in designing and implementing distributed and cloud systems. This course covers common problems in distributed systems and the algorithms to solve them. Distributed filesystem; process synchronization; leader election and mutual exclusion; distributed transactions and concurrency control; data consistency and replication; fault tolerance in distributed systems.

Learning Outcomes

By the end of this course, a student should be able to:

- Explain the fundamental challenges of distributed systems, including coordination, scalability, performance, and security.
- Analyze and apply algorithms for process synchronization, leader election, mutual exclusion, and consensus.
- Demonstrate understanding of distributed transactions, concurrency control, recovery, and their role in ensuring correctness.
- Evaluate data consistency models, replication strategies, and fault-tolerance mechanisms in distributed and cloud environments.
- Gain hands-on experience with distributed file systems and storage architectures, including performance considerations.
- Critically assess design trade-offs and emerging research trends in distributed and cloud computing.

Required Texts

Distributed Systems, Concepts and Design, 5th edition by Coulouris, Dollimore, Kindberg, Blair; Addison Wesley

Important Dates:

- Class Begins: Thursday, Aug 21
- Midterm: Tuesday, Oct 14 (4:30-5:45pm) - DH450
- Academic Holiday
  - Veterans Day -- Nov 11 **(No Class)**
  - Fall Recess -- Nov 27-28 **(No Class)**
- Class Ends: Thursday, Dec 4
- Final: Tuesday, Dec 16 (3:15-5:15pm) - DH450

Course Requirements and Assignments

SJSU classes are designed such that in order to be successful, it is expected that students will spend a minimum of forty-five hours for each unit of credit (normally three hours per unit per week), including preparing for class, participating in course activities, completing assignments, and so on. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf. Note that University policy F15-12 at http://www.sjsu.edu/senate/docs/F15-12.pdf states that "Attendance shall not be used as a criterion for grading."… "Students are expected to attend all meetings for the courses in which they are enrolled as they are responsible for material discussed therein, and active participation is frequently essential to ensure maximum benefit to all class members. In some cases, attendance is fundamental to course objectives; for example, students may be required to interact with others in the class. Attendance is the responsibility of the student."… "Participation may be used as a criterion for grading when the parameters and their evaluation are clearly defined in the course syllabus and the percentage of the overall grade is stated."

Assignments

The submissions are due at midnight on the due date. The assignments are to be submitted on time. A penalty of 10% per day is applied to late submissions. No assignments will be accepted after a week past its due date.

Course Project:

A programming group project of your choice related to the course. Detailed guidelines including milestones for the project will be posted on Canvas in the second week of the semester.

Absolutely NO late submission for the course project.

Exams

- Absolutely NO items may be shared during the exams, including books, notes, and calculators.
- Absolutely NO usage of cell phones during exams. Cell Phones must in off or silent mode and not within your reach.

Makeup exams will only be granted in case of documented medical emergency with an advanced notice to the instructor.

No students are allowed to miss either exam. Failure to take an exam during its scheduled time will result in a grade of zero on that exam.

Grading Policy

Your individual class grade will be weighted as follows:

Assignments	20%
Course Project	20%
Exams (Midterm and Final)	60% (each exam 30%)
Total	100%

The final "letter" grade will be determined by a curve based on class average at the end of the semester.

University Policies

Per University Policy S16-9, university-wide policy information relevant to all courses, such as academic integrity, accommodations, etc. will be available on Office of Graduate and Undergraduate Programs' Syllabus Information web page at http://www.sjsu.edu/gup/syllabusinfo/

CS 249, Distributed Systems, Topics (Tentative)

Topic	Description
Introduction and Overview	Overview of distributed systems concepts; motivation for distribution (scalability, availability, performance); real-world applications such as cloud services, microservices, and large-scale data processing.
System Architectures, Processes and Threads in Distributed Systems	Architectural models (client-server, peer-to-peer, hybrid, cloud-based); design trade-offs; process and thread models for concurrency; challenges of process management in distributed environments.
Inter-Process Communications: Sockets, Remote Procedure Calls, Messages, Streams, Multicast	Mechanisms for communication between distributed components; sockets programming basics; Remote Procedure Calls (RPC) and Remote Method Invocation (RMI); message queues and publish-subscribe systems; streaming data; multicast protocols.
Name Services: DNS and Directory Services	Role of naming and directory services in distributed systems; hierarchical naming (DNS); distributed directory structures; challenges with naming in large-scale systems; case studies of DNS and enterprise directory services.
Distributed Synchronization, Coordination, Time and Ordering, Global Snapshots	Clock synchronization techniques (NTP, logical clocks, vector clocks); distributed mutual exclusion; consensus and coordination algorithms (Paxos, Raft, Zookeeper); snapshot algorithms (Chandy-Lamport) and system monitoring.
Replication and Consistency	Replication strategies for fault tolerance and performance; strong vs. eventual consistency; CAP theorem; quorum systems; case studies in databases and cloud systems (e.g., Dynamo, Cassandra, Spanner).
Distributed File Systems: NFS, GFS, etc.	Design and implementation of distributed file systems; comparison of NFS, AFS, HDFS, and Google File System (GFS); performance, reliability, and scalability issues; use in modern big data frameworks.
Transactions and Concurrency Control	Distributed transaction models (2PC, 3PC); concurrency control techniques (locking, timestamp ordering, optimistic concurrency); deadlock handling; recovery and fault tolerance in transactional systems.