Concurrent and Distributed Systems
Spring 2017

Course Outline

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Objective of the Course

This course mainly aims to build the following capabilities in you.

- This course covers a broad range of topics related to parallel and distributed computing, including parallel and distributed architectures and programming paradigms of parallel and distributed systems. Basic goal of this course is to understand the fundamental concepts of parallel and distributed computing

- You should be able to understand the basic principles of distributed systems and to comprehend the problems associated with building applications for distributed systems

- You should be able to analyse an existing distributed systems with respect to the principles of distributed systems and compare different computing systems according to these principles.

- You should be able to write distributed applications using existing paradigms like MPI, RPC, RMI, etc.

The course assumes knowledge of computer networks and operating systems. This course does not deal with the details of computer networking (e.g., details of different routing protocols in the Internet), except as applied to topics listed.

Text Book

Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore and Tim Kindberg, 5th Ed.
Research papers, provided during the course

Reference Book

Ref 1:Distributed System: Principles and Paradigms by Andrew S. Tenenbaum and Maarten van Steen, 2nd Ed.

Ref 2:Introduction to Parallel Computing by Ananth Grama and Anshul Gupta

Course Contents

Week	Lecture #	Topics Covered	Book/Reference
1	1	Introduction to concurrent and distributed systems Goals Examples of distributed systems Trends in distributed systems Challenges	Text Book: Ch.1, Ref Book 1: Ch.1
1	2	Scalability Issues, Amdahl's law Flynn's Taxonomy	Text Book: Ch.1, Ref Book 1: Ch.1 Research Papers
2	3	Shared memory systems Introduction Multi-threading, superscalar processors, Intel's hyper-threading	Ref book 2
2	4	Shared Memory architecture Processor to memory connection strategies	Ref book 2
3	5	Multiprocessors, Homogeneous and Heterogeneous Multicomputer systems	Ref book 2
3	6	Network Operating Systems	Ref book 2
4	7	Middleware	Text Book: Ch.1

4	8	Brief Overview of Computer Networks. Layered architecture and Protocols	Text Book: Ch.1
5	9	Application layer and Transport Layer Protocols	
5	10	Review	
Mid I			
6	11	Operating system support Introduction The operating system layer Protection	Text Book: Ch.7
6	12	Processes and threads Communication and invocation Virtualization at the operating system level	Text Book: Ch.7
7	13	Remote Invocation Introduction Request- Reply protocols	Text Book: Ch.5
7	14	RPC Remote Method Invocation JavaRMI: Introduction and Implementation details	Text Book: Ch.5
8	15	Distributed File System File service architecture Case study: Sun Network File System	Text Book: Ch.12
8	16	Synchronization and Coordination Distributed mutual exclusion Elections	Text Book: Ch.15
9	17	Coordination and agreement in group communication Consensus and related problems	Text Book: Ch.15
9	18	Review	
Mid II			
10	19	Transactions and concurrency Control Concurrency control in distributed transactions	Text Book: Ch.16
10	20	Fault tolerance Basic Concepts Failure Models Failure Masking by Redundancy	Ref Book 1: Ch.7
11	21	Process Resilience Design Issues Failure Masking and Replication Agreement in Faulty Systems Failure Detection	Ref Book 1: Ch.7
11	22	Reliable client-server communication Point-to-Point Communication RPC Semantics in the Presence of Failures	Ref Book 1: Ch.7
12	23	Introduction to Cluster and Grid Computing Introduction Cluster classification and their applications Grid Components	Research/Survey Papers
12	24	Cloud Computing at a Glance The Vision of Cloud Computing Defining a Cloud Cloud Computing Reference Model Characteristics and Benefits Challenges Ahead	**Reference Text** Mastering Cloud Computing by Rajkumar Buyya
13	25	Software defined networking Introduction Control and data forwarding plane	Research/Survey Papers
13	26	Controller scalability	Research/Survey

		Distributed Network/Controller Operating Systems	Papers
14	27	Emulation and Simulation Environments SDN applications Research Challenges	Research/Survey Papers
14	28	Review	
Final			

Evaluation

Assignments	10%
Quizzes	10%
Mid Exams	30% (15% + 15%)
Final Exam	50%
Total:	**100 %**

Course Policies

- There will be <u>no retake</u> of quizzes or exams. Special consideration may be given only for mid or final exam for an emergency on per case basis. In approved circumstances, percentage of mid will be awarded for final or vice versa.
- Integrity in the assignments/quizzes is expected; otherwise result would be an F grade in the course or may be the case is forwarded to Disciplinary committee.
- Attendance MUST be ensured according to the University policy to avoid disqualification.