جامعة الملك عبدالله
للعلوم والتقنية
King Abdullah University of
Science and Technology

Course Syllabus: Computing Systems and Concurrency - CS 240

Division	Computer, Electrical and Mathematical Sciences & Engineering
Course Number	CS 240
Course Title	Computing Systems and Concurrency
Academic Semester	Fall
Academic Year	2018/2019
Semester Start Date	08/26/2018
Semester End Date	12/11/2018
Class Schedule (Days & Time)	02:30 PM - 04:00 PM | Sun Wed

Instructor(s)

Name	Email	Phone	Office Location	Office Hours
Marco Canini	marco@kaust.edu.sa	+966128080489	0144, 1, Al-Khawarizmi (bldg. 1)	By appointment only.

Teaching Assistant(s)

Name	Email
TBA	TBA

Course Information

Comprehensive Course Description	CS 240 is a core class as part of the curriculum of the computer science program at KAUST. This course covers introductory material on the design and implementation of computer-based systems, with an emphasis on distributed systems. Students will gain an understanding of the principles and techniques behind the design of modern, reliable, and high-performance systems. Topics include server design, network programming, naming, transactions, concurrency and locking, consistency models and techniques, security, data-intensive computing and fault tolerance. Modern techniques and systems employed at some of the largest Internet sites (e.g., Google, Facebook, Amazon) will also be covered. Through programming assignments, students will gain practical experience in designing, implementing, and debugging real distributed systems.
Course Description from Program Guide	Operating systems design and implementation. Basic structure; synchronization and communication mechanisms; implementation of processes, process management, scheduling and protection; memory organization and management, including virtual memory; I/O device management, secondary storage and file systems. Concurrency at the hardware, programming language, and operating system level.
Goals and Objectives	-To give a sound foundation in fundamentals of computing systems › Theory › Practice -To be exposed to the latest research results -To put into practice what has been learned › As we believe the best way to learn the material is to build it, there will be a series of hands-on programming projects

Required Knowledge	The equivalent of: - An undergraduate course in computer system architecture. - An undergraduate course in operating systems. - An undergraduate course in concurrency control. - Good programming skills. - Knowledge and comfort with systems programming. - Some knowledge of how computer networks function (TCP/IP) and experience with socket programming.
Reference Texts	No textbook is required for this class. We will make course material (slides, notes, readings) available from the course website and point out relevant references widely available. The following textbooks may be used for supplementary course material or as references for optional reading. Textbooks 1. Distributed Systems: Principles and Paradigms by Andrew S. Tanenbaum and Maarten Van Steen, Second Edition, Prentice Hall 2. Guide to Reliable Distributed Systems by Kenneth P. Birman, Springer 3. Distributed Systems: Concepts and Design by George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair, Fifth Edition, Addison Wesley 4. Introduction to Reliable and Secure Distributed Programming by Christian Cachin, Rachid Guerraoui, Luís Rodrigues, Springer 5. Principles of Computer System Design, by J.H. Saltzer and M.F. Kaashoek, ISBN 978-0-12-374957-4.
Method of evaluation	**35.00**% - Final exam **15.00**% - Midterm exam **50.00**% - Course Project(s)
Nature of the assignments	Each student will perform: - Four projects. - Two examinations. The weights of the individual projects will vary slightly by the difficulty of the project. The midterms will be in-class, open-notes exams. You can consult the following course materials: *slides, handouts (including labs and assigned readings), lecture notes*. Anything else is not allowed (except linguistic dictionaries). The final exam will be a open-notes exam, covering material from the whole semester, with slight emphasis on material covered since the last midterm.
Course Policies	- Cheating: Zero tolerance. If you cheat you will face severe sanctions, the least of which is an automatic F in the course and the strong possibility of dismissal from the university. Cheating includes but is not limited to: 1. Copying code from the Internet or other sources without instructor's prior knowledge and authorization. 2. Copy and paste from papers. 3. Not using the appropriate reference for one's. When in doubt, ask the instructor and remain on the safe side. - Lectures: You are expected to attend all lectures. If you will be absent, please inform the instructor. You are responsible for covering the material. I will not give additional lecture simply because you chose to miss class. During lectures, you need to turn off your phone and your laptops. You are required to abstain from eating or bringing food with you (water or other drinks are OK). You are expected to refrain from side discussions. - Preparation: Certain lectures require a preparatory reading to be made prior to the lecture. You are expected to have done so. - Late work: You should submit your work on an assignment (electronically) before its due time. All assignments will be due at 11:59pm on their selected days. You have a total of 72 late hours to use throughout the semester (but not beyond December 6). After you have used up your late hours, each additional day late will incur a 10% lateness penalty (1 minute late counts as 1 day late). Submissions late by 3 days or more will no longer be accepted. Friday and Saturday both count as days. (Late days are tracked automatically, so you don't need to email before using one.) We will grant no-penalty extensions only in the case of illness (with a doctor's note) or extraordinary circumstances (with the involvement of the dean of student affairs). If illness or an extraordinary circumstance will cause you to submit an assignment late, then you should discuss the matter with your instructor as soon as possible. Please plan your work on the assignments so that travel, interviews, athletics, touring, student clubs, extracurricular activities, holidays, etc. do not cause you to submit it late. None of the above reasons nor a heavy academic workload constitute an extraordinary circumstance.
Additional Information	For a more up to date version of this syllabus, you are required to see the version of the syllabus on the class's web page. The class Web page will be announced on the first lecture. The class online discussion forum will be offered on the Piazza system. This instructor does not use Blackboard.

Tentative Course Schedule

(Time, topic/emphasis & resources)

Week	Lectures	Topic
1	Sun 08/26/2018 Wed 08/29/2018	Course overview, principles, MapReduce Network communication and Remote Procedure Calls
2	Sun 09/02/2018 Wed 09/05/2018	Virtualization and Cloud computing Network file systems
3	Sun 09/09/2018 Wed 09/12/2018	GFS Time synchronization and logical clocks
4	Sun 09/16/2018 Wed 09/19/2018	Global state Primary-backup replication
5	Sun 09/23/2018 Wed 09/26/2018	Two-phase commit, introducing safety and liveness Consensus I: FLP Impossibility, Paxos
6	Sun 09/30/2018 Wed 10/03/2018	Consensus II: Replicated State Machines, Raft Byzantine Fault Tolerance
7	Sun 10/07/2018 Wed 10/10/2018	No class
8	Sun 10/14/2018 Wed 10/17/2018	Midterm review Midterm
9	Sun 10/21/2018 Wed 10/24/2018	Peer-to-Peer Systems and Distributed Hash Tables Eventual consistency
10	Sun 10/28/2018 Wed 10/31/2018	Scaling Services: Key-Value Storage Strong consistency and CAP Theorem
11	Sun 11/04/2018 Wed 11/07/2018	Causal consistency
12	Sun 11/11/2018 Wed 11/14/2018	Concurrency Control, Locking, and Recovery Concurrency Control 2 and Distributed Transactions
13	Sun 11/18/2018 Wed 11/21/2018	Security Blockchain
14	Sun 11/25/2018 Wed 11/28/2018	Performance evaluation Data-intensive computing I: graph processing, distributed ML
15	Sun 12/02/2018 Wed 12/05/2018	Data-intensive computing II: stream processing, coordination Final review
16	Sun 12/09/2018	Exam week
17		
18		

Note

The instructor reserves the right to make changes to this syllabus as necessary.