جامعة الملك سعود
King Saud University

Theory of Computation
CSC 339 – Spring 2021

Syllabus & Course Org.
Week-1

King Saud University

Department of Computer Science

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Contact Information

- **Email:** **azalsudais@ksu.edu.sa**
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- **Information and announcements will be communicated via university email**
  - Enable push notification or check email periodically

Slack

Email me for the link

- **Join the slack group using your KSU email**
- **Utilize slack for all course-related communication**
- **I will be able to respond to questions and provide more clarification as needed**
- **Announcements will be posted on Slack as well, but email remains the main channel to communicate announcements.**

Evaluation

Quizzes (5 + 5 + 5):	**15%**
Assignments (6 + 7 + 7):	**20%**
Midterm exam (in-person):	**25%**
Final exam (in-person):	**40%**

Cheating & plagiarism will NOT be tolerated

You should read, prepare, attend, participate, and ask questions

Attendance

- **Attendance is mandatory for both lecture and tutorial**
- **More than 25% absence results in denial of entry to final exam**
- **Attendance will be taken each lecture**
- **You are encouraged to ask questions during lectures and tutorial sessions**
  - You can either raise a hand, or just speak up.

Overview

- **In this course, we will be studying two main questions:**
  - What problems can a computer solve?
  - How efficiently?
- **Textbook:** Introduction to the Theory of Computation (third edition, 2013) by Michael Sipser.
- **Course assistant: M. Mohammed Khaja**
- **Attending and participating in tutorials is important**

What is Theory of Computation (TOC)?

“Theory of Computation (TOC) is the study of the inherent capabilities and limitations of computers: not just the computers of today, but any computers that could ever be built.”

(CSAIL - MIT)

What is TOC about? - cited from MIT's CSAIL

- **How do resources (time, space, communication, # of processors) scale with the size of the problem?**
- **If a problem is intractable, can we find approximate solutions?**
- **Can we distinguish random numbers from semi-random ones?**
- **What are the capabilities and limits of quantum computers?**

Course Topics

1. Introduction & Languages
2. Finite state machines
3. Non-determinism
4. Regular expressions
5. Context free language
6. Push down automata
7. Turing machine
8. Decidability, Turing recognizability and the halting problem
9. Undecidable problems
10. Time complexity
11. Space complexity

Why study theory of computation?

- Helps you understand how computers really work
- Helps you design/program more efficient models/programs
- Strengthens your problem solving skills
- Provides you with a strong foundation to be a good programmer/developer

Computational Complexity Theory

- **What makes some problems computationally hard?**
- **A problem is difficult/hard if it requires significant resources**
- **Resources such as *time*, *storage*, communication, etc.**

What will we learn?

- **We will cover a few computational models that are used to solve problems**
  - Finite State Machines (FSM)
  - Pushdown automata
  - Random access machines
  - Turing machines

Course Breakdown

- **Chapter-1**
  - Finite automata and regular operations (W1&W2)
  - Non-determinism (W2)
  - Regular expressions (W3)
  - Non-regular languages (W4)
- **Chapter-2**
  - Context-free grammer (W5)
  - Pushdown automata (W6)
  - Non-context free languages (W7)

Course Breakdown

- **Chapter-3**
  - Turing machines (W7)
- **Chapter-4**
  - Decidability, turing recognizability, and the halting problem (W8)
- **Chapter-5**
  - Undecidable problems and reducability (W9)
- **Chapter-6**
  - Turing reducability and definition of information (W10)

Course Breakdown

- **Chapter-7**
  - Time complexity (W11)
- **Chapter-8**
  - Space complexity (W12)
- **Chapter-9**
  - Intractability (W13)
- **Chapter-10**
  - Reviews of advanced topics in TOC (W14)

Reading Assignment

- **Read 0.1 & 0.2 (until page 16)**