ADA University, School of IT and Engineering

CSCI 2407 – Theory of Computation

Instructor:	**Samir T. Mammadov**
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Office:	**B315**
Office hours:	**Tuesday/Thursday, 16:00-18:00**
Schedule:	**Tuesday, 13:00-14:15, B103 (20324)**
	Thursday, 13:00-14:15, D208 (20324)
	Tuesday/Thursday, 14:30-15:45, B102 (20323)

Synopsis

Content of the course includes definition of Turing machines and basic time and space complexity classes, finite automata, regular expressions, context-free languages, probabilistic computation.
The learning objectives of this course are to:

1. introduce students to the mathematical foundations of computation including automata theory; the theory of formal languages and grammars; the notions of algorithm, decidability, complexity, and computability.
2. enhance/develop students' ability to understand and conduct mathematical proofs for computation and algorithms.

Outcomes

After completing this course, students will be able to:

1. analyze and design finite automata, pushdown automata, Turing machines, formal languages, and grammars.
2. demonstrate their understanding of key notions, such as algorithm, computability, decidability, and complexity through problem solving.
3. prove the basic results of the Theory of Computation.
4. state and explain the relevance of the Church-Turing thesis.

Prerequisites

- CSCI 2304 – Data Structures & Algorithms
- MATH 1101 – Discrete Structures

Reading

Primary sources:

- Sipser, M. *Introduction to the theory of computation, 3rd edition.* 2012.

Supplementary sources:

- Moore, C., Mertens, S. *The Nature of Computation.* 2011.

Grading

- **Assignments** **40%**
- **Midterm** **25%**
- **Final** **35%**

Topics

The following list gives an overview of the topics intended to cover during the semester. This list is not absolute and due to changes, by adding or removing some topics, as instructor considers necessary.

- **Foundations**
  - **Definitions**
  - **Proof Techniques**
- **Automata and Languages**
  - **Regular Languages**
  - **Finite Automata**
  - **DFA and NFA**
  - **Regular Expressions**
  - **Pumping Lemma**
  - **Context-free Languages**
  - **Chomsky Normal Form**
  - **Context-free Grammars**
  - **Pushdown Automata**
- **Computability Theory**
  - **Turing Machines**
  - **Church-Turing Thesis**
  - **TM Variants**
  - **Decidability**
  - **Halting Problem**
  - **Reducibility**
- **Complexity Theory**
  - **Time Complexity**
  - **Complexity Classes P and NP**
  - **NP-completeness**
  - **Cook-Levin Theorem**
  - **Space Complexity**
  - **Class PSPACE**
  - **PSPACE-completeness**