

Lecture 0 – Course Overview

COSE215: Theory of Computation

Jihyeok Park



2023 Spring

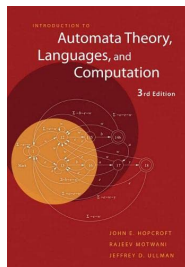
- **Instructor:** Jihyeok Park (박지혁)
 - **Position:** Assistant Professor in CS, Korea University
 - **Expertise:** Programming Languages, Software Analysis
 - **Office hours:** 14:00–16:00, Tuesdays (appointment by e-mail)
 - **Office:** 609A, Science Library Bldg
 - **Email:** jihyeok_park@korea.ac.kr
- **Class:** COSE215 - 02 (English) - **Only for CS students**
- **Lectures** 14:00–15:15, Mondays and Wednesdays @ 302 Aegineung
- **Homepage:** <https://plrg.korea.ac.kr/courses/cose215/>
- Please use **blackboard** when asking questions

- There is a **lecture on Apr. 26 (Wed.)**
- **No lecture in the final exam week (Jun. 15–Jun. 21).**

| Week | Contents |
|------|--|
| 1 | Basic Concepts |
| 2 | Deterministic Finite Automata (DFA) |
| 3 | Nondeterministic Finite Automata (NFA) |
| 4 | Regular Expressions and Languages |
| 5 | Properties of Regular Languages |
| 6 | Context-Free Grammars and Languages |
| 7 | Parse Trees and Ambiguity |
| 8 | Midterm Exam (Apr. 24 - Mon.) |
| 9 | Pushdown Automata |
| 10 | Deterministic Pushdown Automata |
| 11 | Properties of Context-Free Languages |
| 11 | Turing Machines (TMs) |
| 12 | Extensions of Turing Machines |
| 13 | Undecidability |
| 14 | P, NP, and NP-Completeness |
| 15 | Final Exam (Jun. 14 - Wed.) |

- **5–7 Homework Assignments: 20%**
 - Handwritten assignments (submission in class)
 - Programming assignments in Scala (submission in blackboard)
 - You can utilize or refer to any other materials (e.g., ChatGPT), but you **MUST** write your **OWN** solution.
 - **Cheating is strictly prohibited. Cheating will get you an F.**
- **Midterm exam: 30%**
 - April 24 (Mon.) 14:00 – 15:15 (in class, 75 min.)
- **Final exam: 40%**
 - June 14 (Wed.) 14:00 – 15:15 (in class, 75 min.)
- **Attendance and Participation: 10%**
 - Please use **blackboard** to attend the class.

- Self-contained lecture notes.
 - <https://plrg.korea.ac.kr/courses/cose215/>
- Reference:



John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman. Introduction to automata theory, languages, and computation. Third edition.

- What is the *mathematical model* of computers?

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Turing Machine!

Let's learn **Turing Machine**

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- Is it possible to solve *every problem* using computers?

- What is the *mathematical model* of computers?

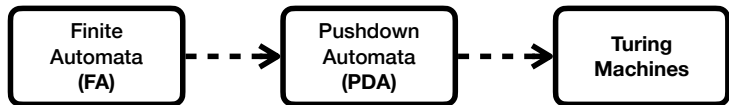
Turing Machine!

Let's learn **Turing Machine**

- Is it possible to solve *every problem* using computers?

No!

Let's learn **Undecidability** and **Intractability**



- **Finite Automata (FA)**

- Regular Expressions and Languages
- Applications: text search, etc.

- **Pushdown Automata (PDA)**

- Context-Free Grammars (CFGs) and Languages (CFLs)
- Applications: programming languages, natural language processing, etc.

- **Turing Machines (TMs)**

- Extensions of Turing Machines
- Undecidability and Intractability

- A Turing machine is a specific kind of **automaton**.

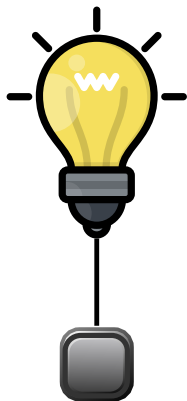
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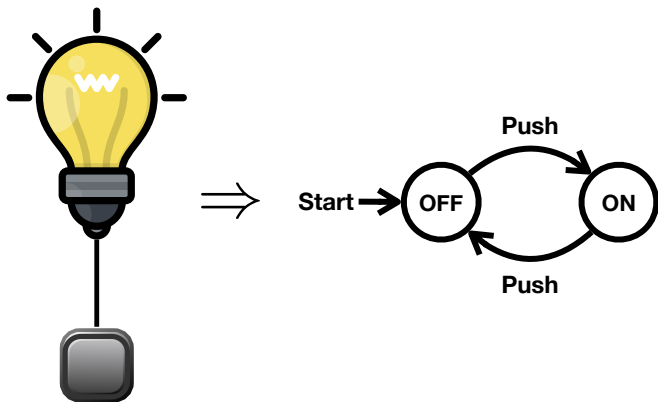
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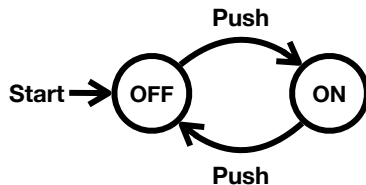


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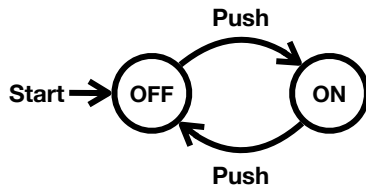
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Theorem

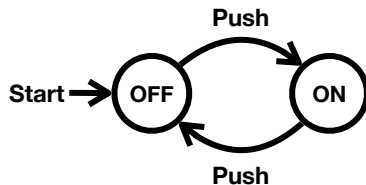
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Theorem

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- Is it possible to prove it?

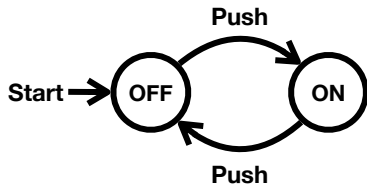


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Let's learn **mathematical background and notation**.



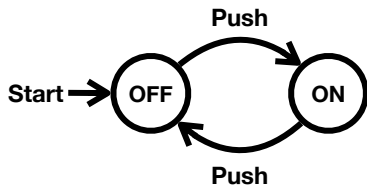
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- Is it possible to implement the automaton?



Theorem

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- Is it possible to implement the automaton?

Let's learn **Scala** as an implementation language.

- Mathematical Preliminaries

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