Lecture 0 – Course Overview

COSE215: Theory of Computation

Jihyeok Park

2023 Spring

Course Information

- **Instructor:** Jihyeok Park (박지혁)
  - **Position:** Assistant Professor in CS, Korea University
  - **Expertise:** Programming Languages, Software Analysis
  - **Office hours:** 14:00–16:00, Tuesdays (by appointment)
  - **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

Schedule

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

Weak	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
12	Extensions of Turing Machines
13	Undecidability
14	P, NP, and NP-Completeness
15	**Final Exam (Jun. 14 - Wed.)**

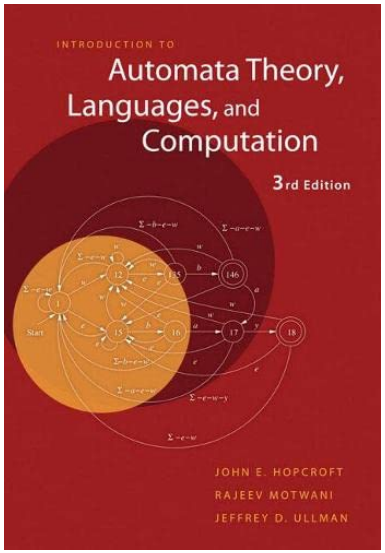
Grading

PLRG

- **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.

Course Materials

- 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.

Goal of This Course

PLRG

- What is the *mathematical model* of computers?

Turing Machine!

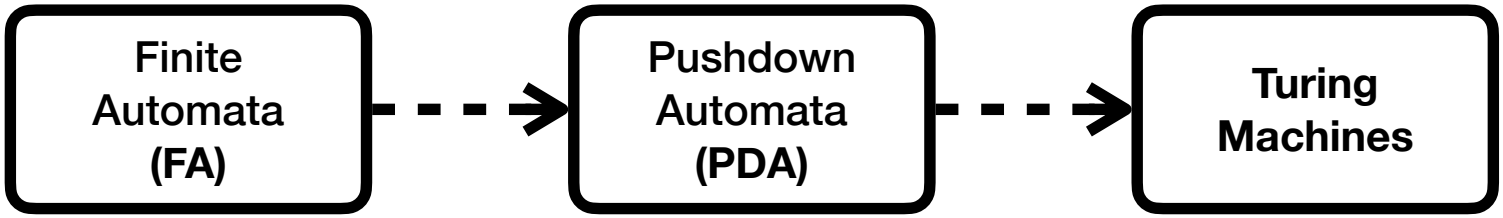
Let's learn **Turing Machine**

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

No!

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

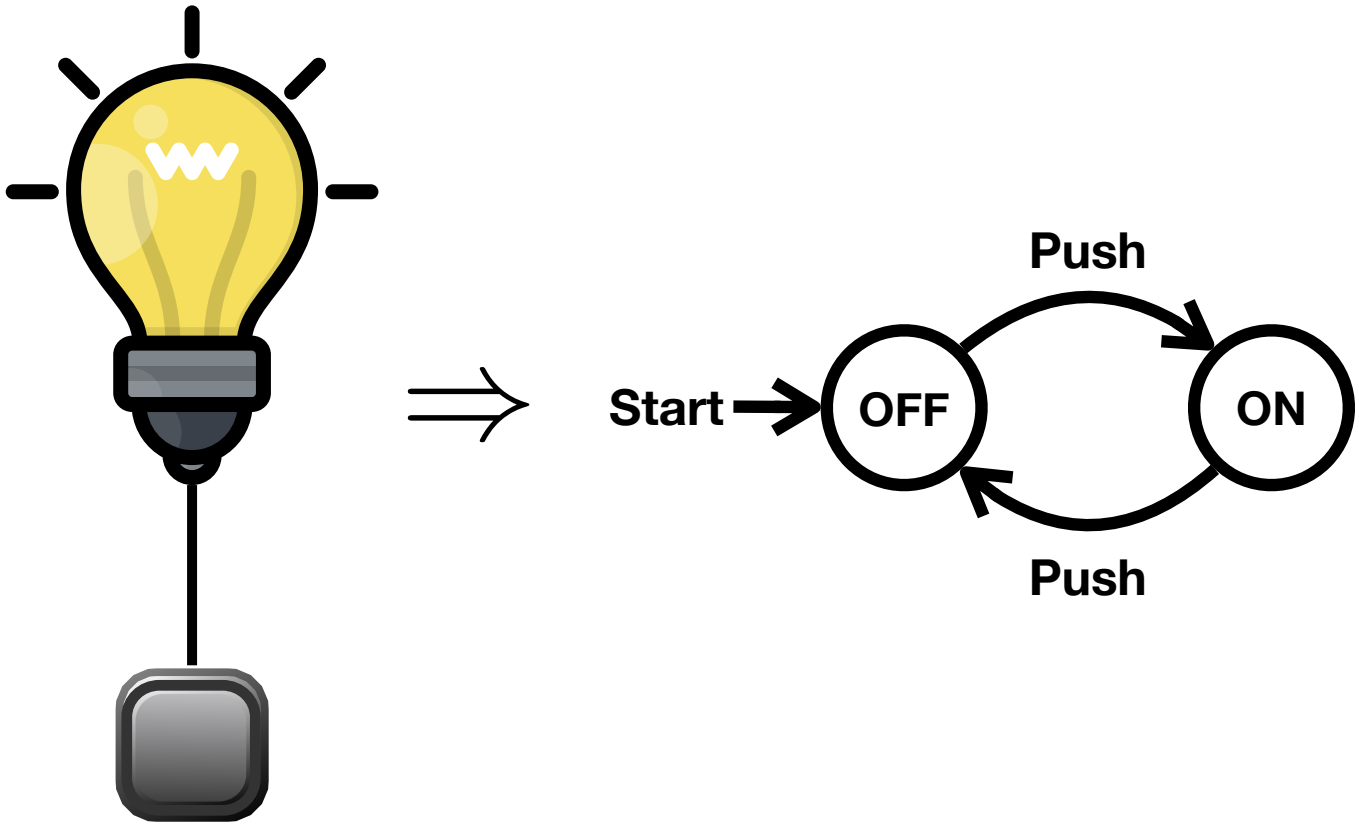
Roadmap: Towards Turing Machine



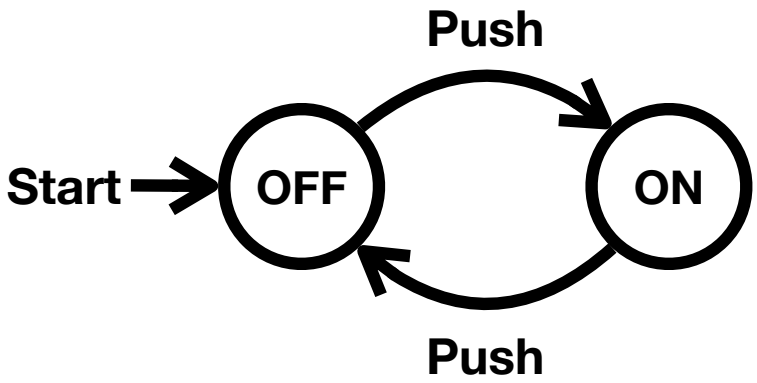
- **Finite Automata (FA)**
  - Regular Expressions and Languages
  - Applications: text search, etc.
- **Pushdown Automata (PDA)**
  - Context-Free Grammars (CFGs) and Languages (CFLs)
  - Applications: programming languages, natural language processing, etc.
- **Turing Machines**
  - Universal Turing Machine
  - Undecidability and Intractability

Introduction of Automata

- A Turing machine is a specific kind of **abstract machine**.
- Then, what is an **abstract machine**?
  - **Example)**



Introduction of Automata



Theorem

The current state is OFF *if and only if the button is pushed even times.*

- Is it possible to prove it?

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

- Is it possible to implement the abstract machine?

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

Next Lecture

- Mathematical backgrounds and notation
- Basic introduction of Scala

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