23MT2014

THEORY OF COMPUTATION

Topic:

INTRODUCTION TO TOC

Session - 1

AIM OF THE SESSION

The aim of studying Automata Theory and Formal Languages is to provide students with a solid theoretical foundation to analyze and design computational systems

INSTRUCTIONAL OBJECTIVES

This Session is designed to:

1. Understand the basic concepts of automata theory, including formal languages, automata, and grammars.
2. Study and analyze different types of automata models, such as finite automata, pushdown automata, and Turing machines.

LEARNING OUTCOMES

At the end of this session, you should be able to:

1. Explain the fundamental concepts and terminologies related to automata theory and formal languages.
2. Identify and analyze different types of automata and their language recognition capabilities.

❖Introduction to THEORY OF COMPUTATION

An Open ended computer science discipline that concerns an abstract device called "automaton", which performs a specific computational or recognition function.

Networks of automata are designed to mimic human behaviour

Automata = abstract computing devices

Turing studied Turing Machines (= computers)

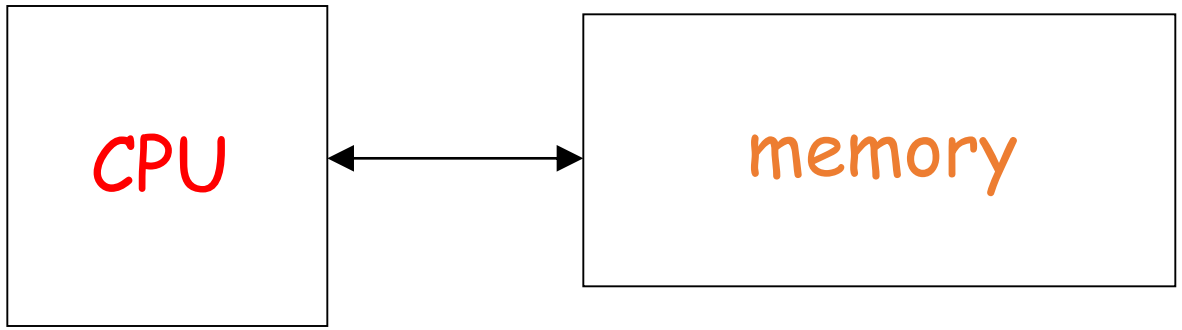
before there were any real computers. We will also look at simpler devices than

Turing machines (Finite State Automata,

Pushdown Automata, . . .), and specification

means, such as grammars and regular expressions.NP-hardness = what cannot be efficiently computed

Computation



temporary memory

$$z = 2 * 2 = 4$$

$$f(x) = z * 2 = 8$$

$$f(x) = x^3$$

input memory

$$x = 2$$

CPU

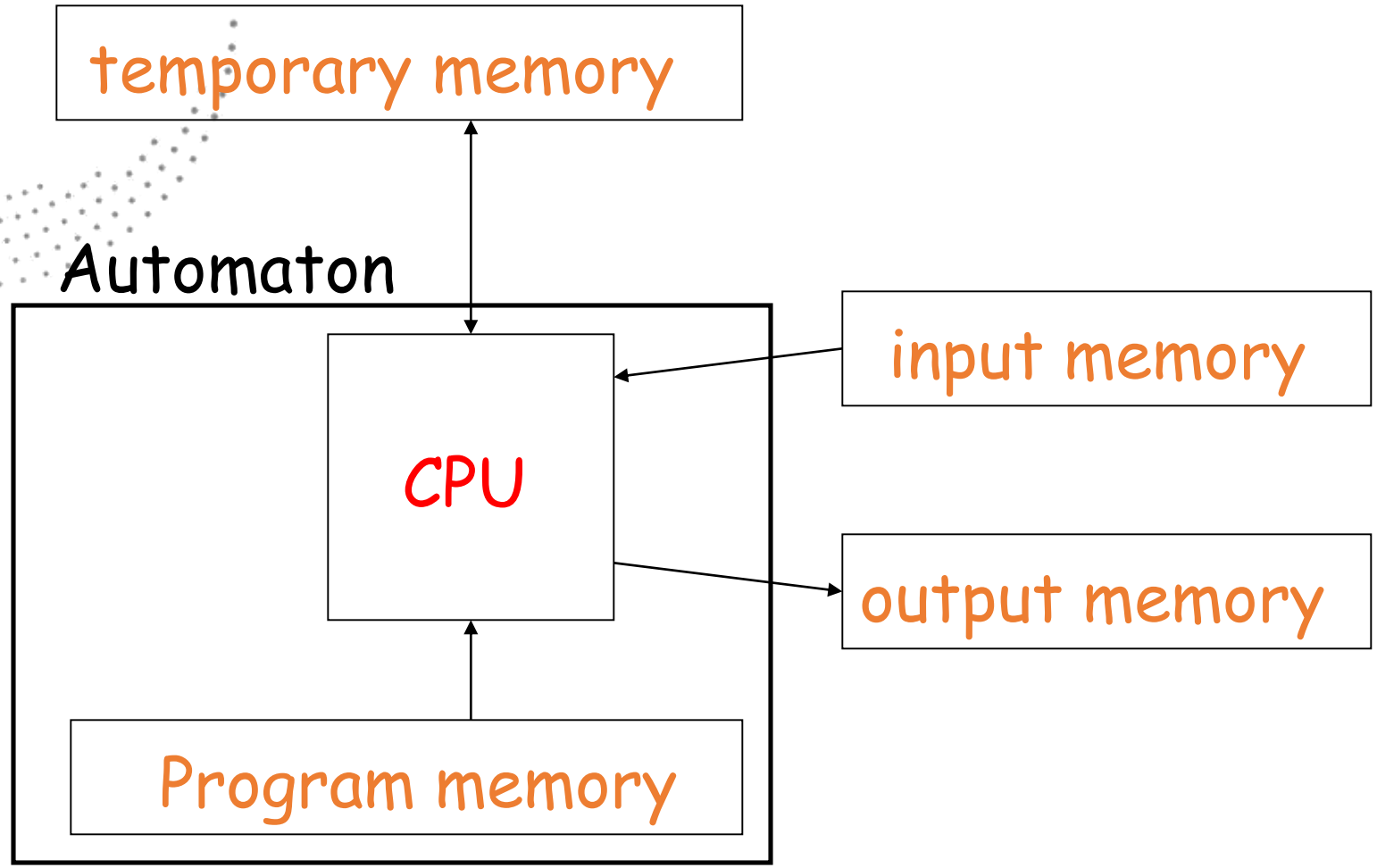
output memory

Program memory

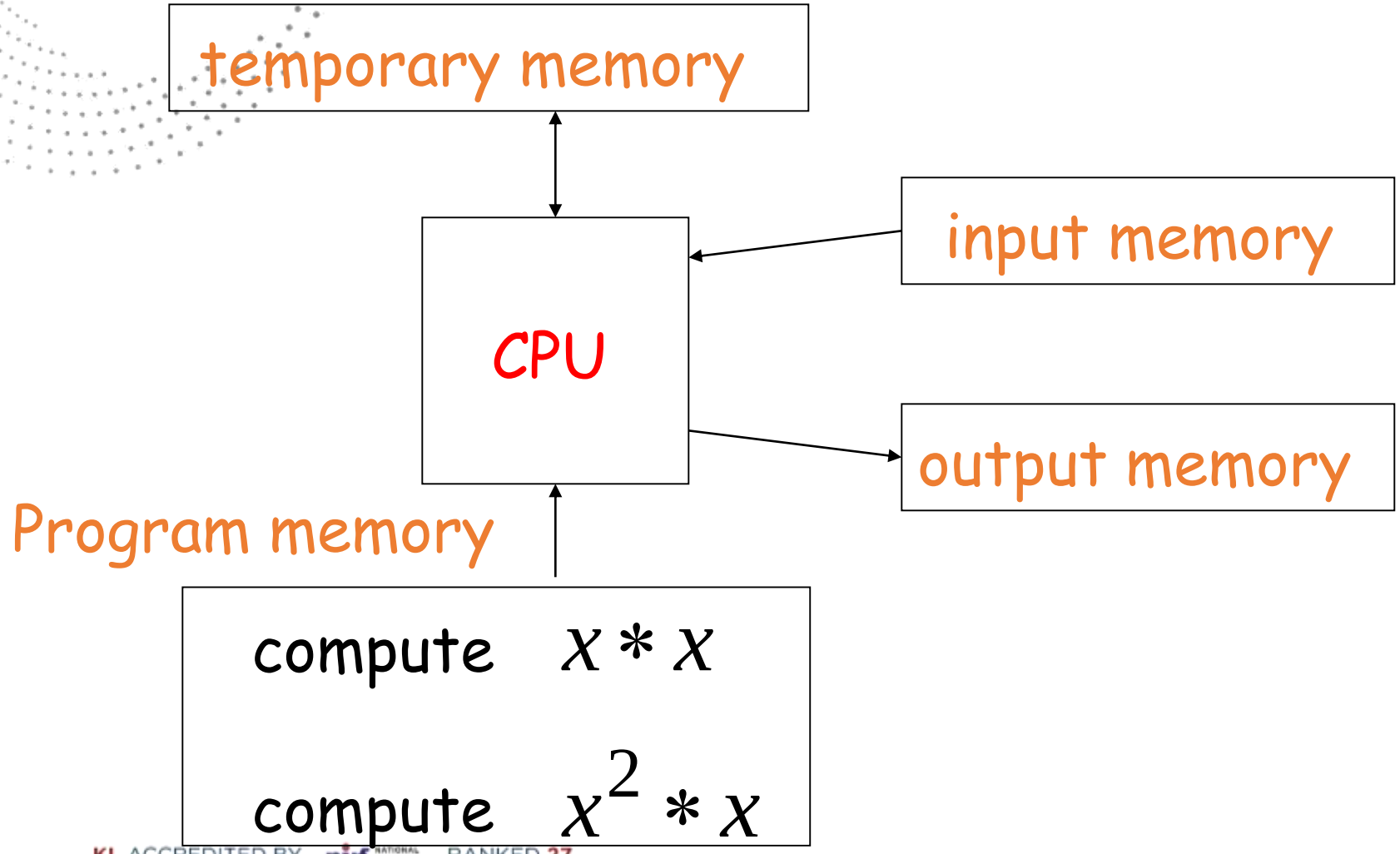
compute $x * x$

compute $x^2 * x$

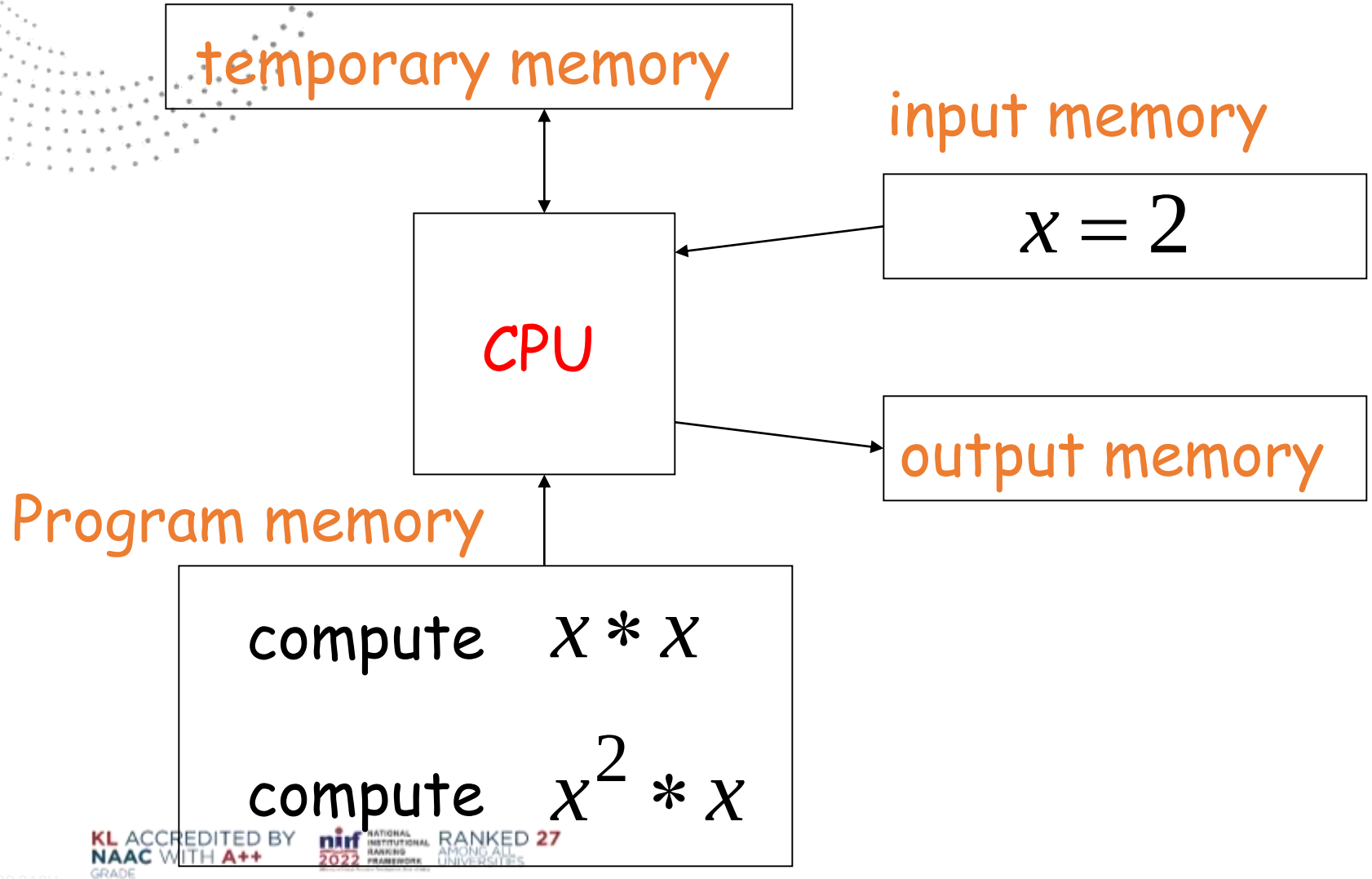
Automaton

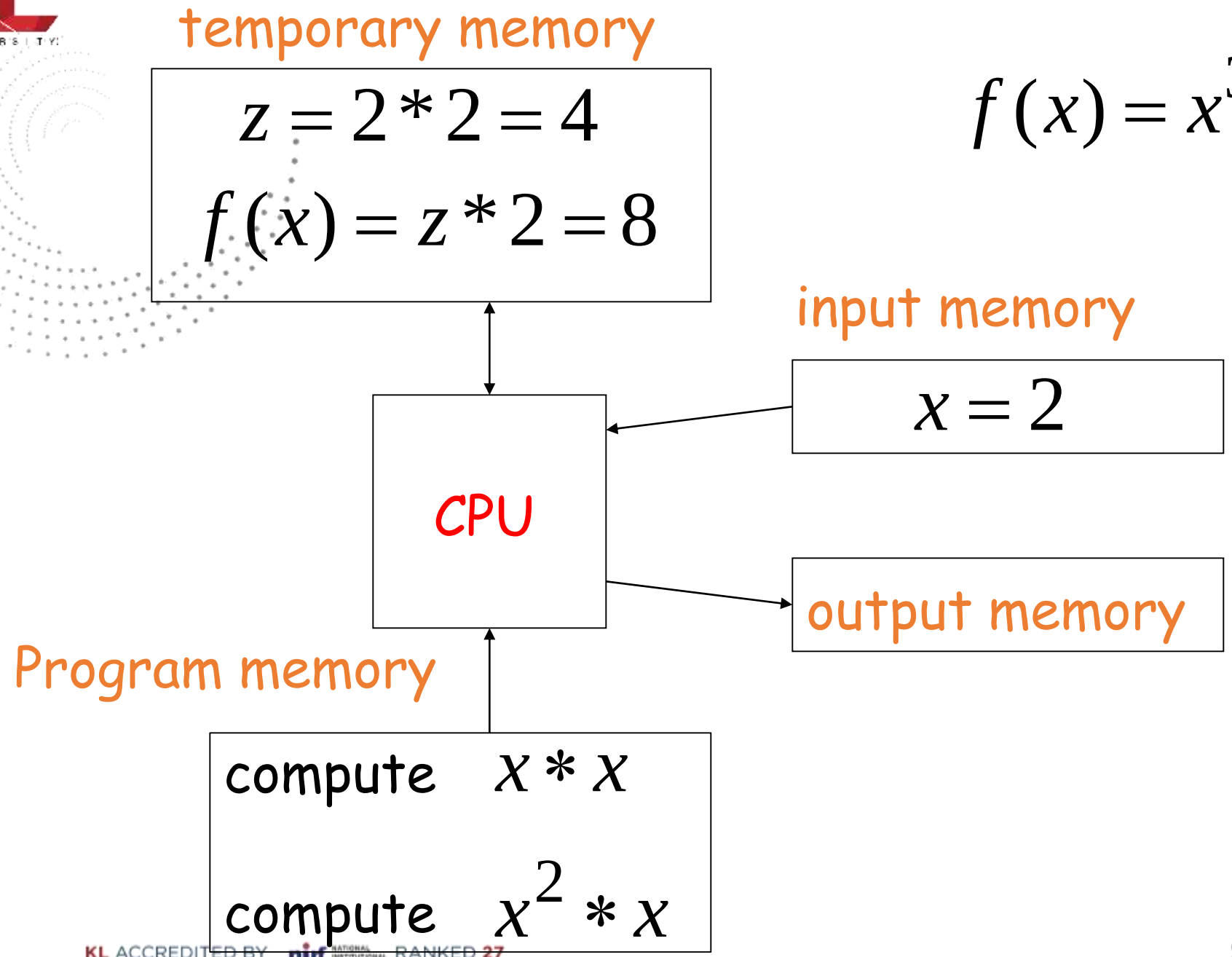

temporary memory
Automaton
CPU
input memory
output memory
Program memory

Example: $f(x) = x^3$



$$f(x) = x^3$$





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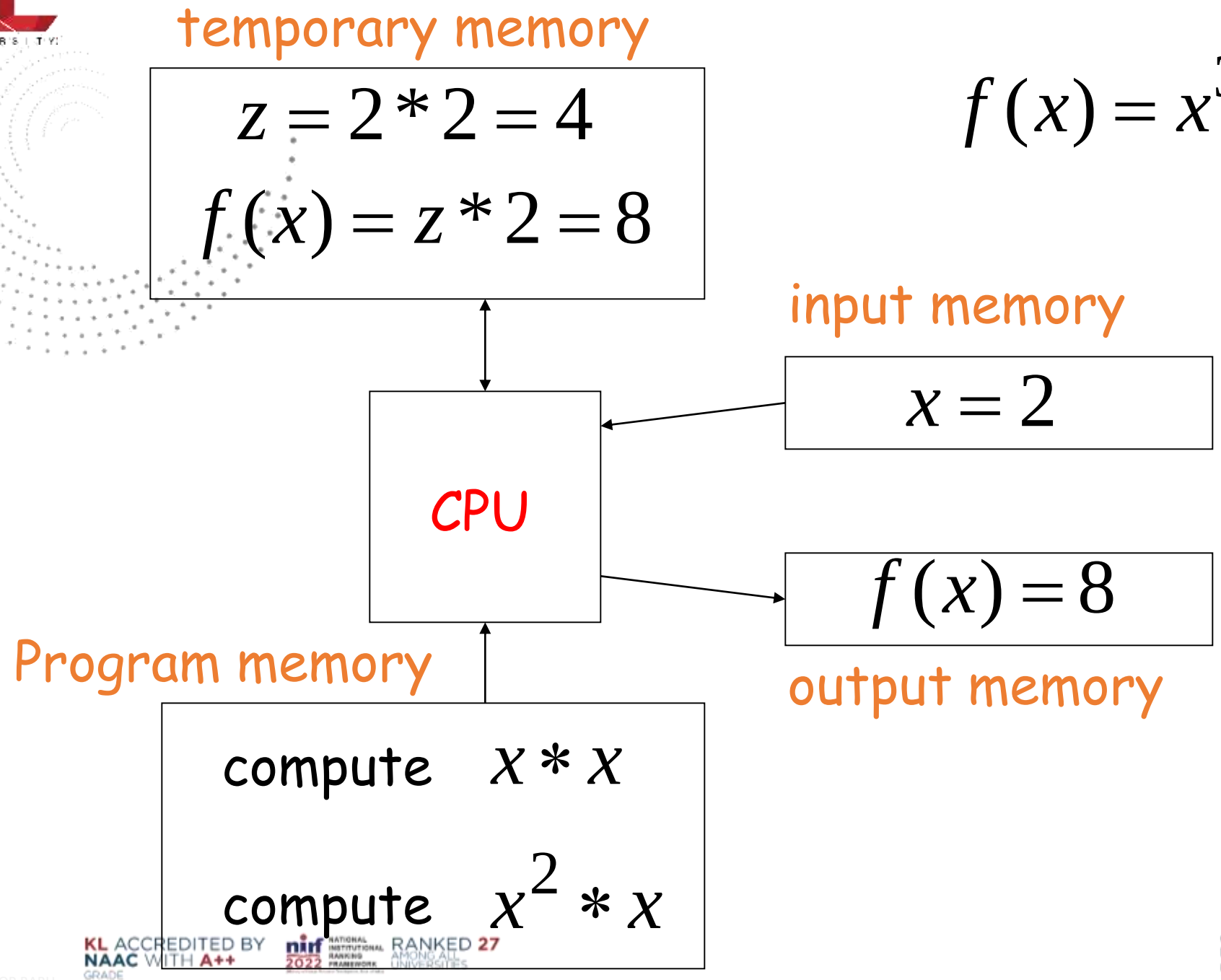
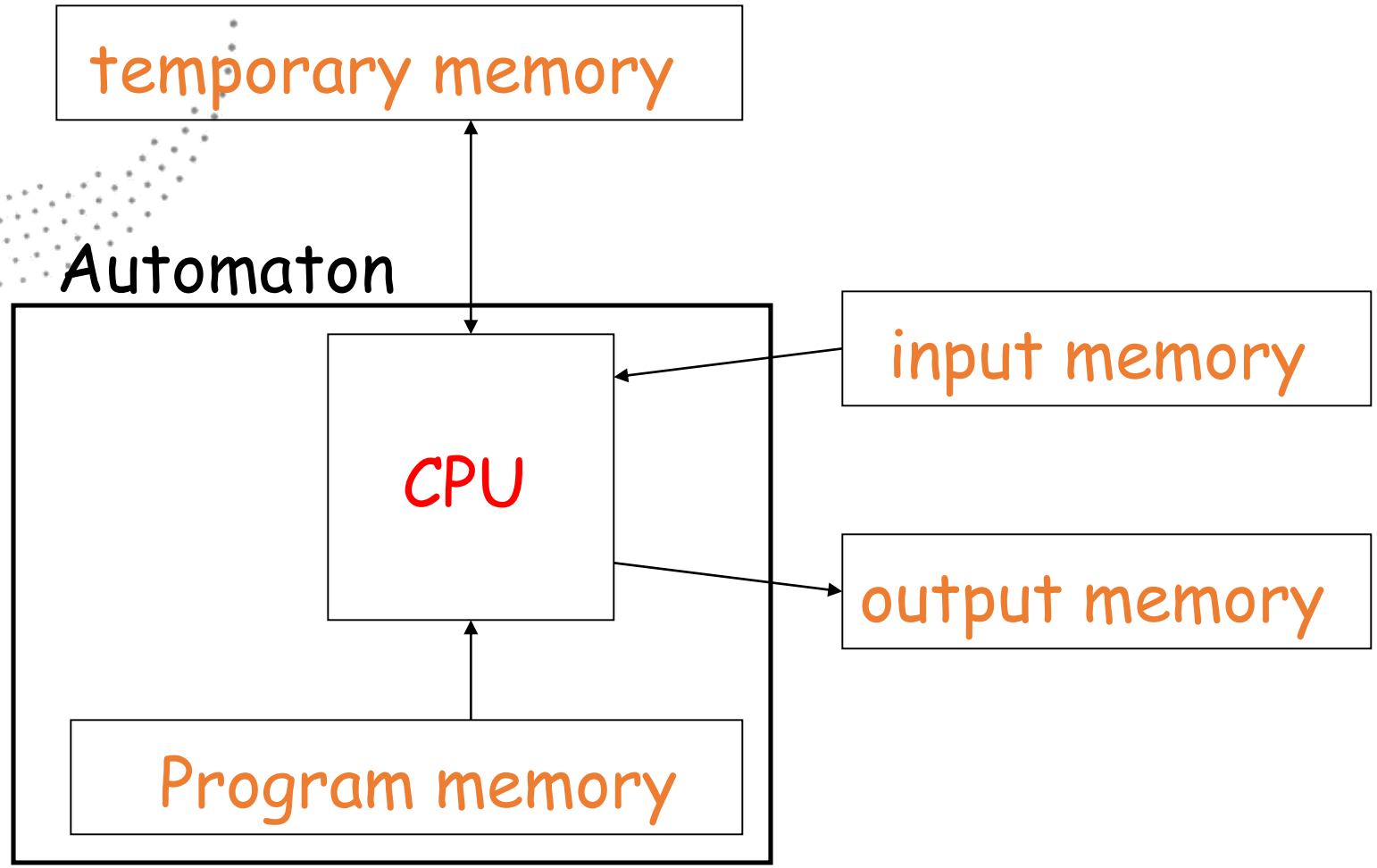


Automaton


temporary memory
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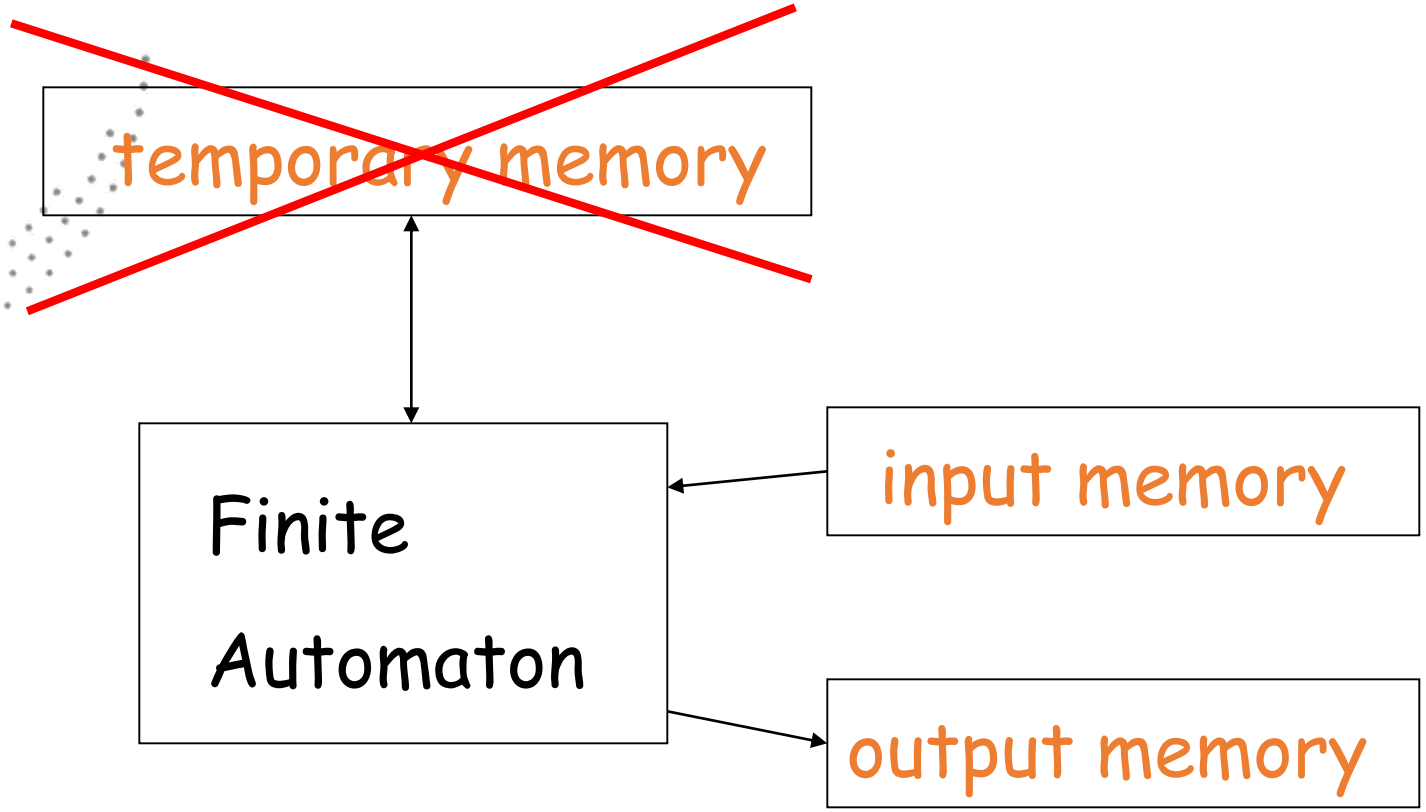
Different Kinds of Automata

Automata are distinguished by the temporary memory

- **Finite Automata:** no temporary memory
- **Pushdown Automata:** stack (LIFO)
- **Turing Machines:** random access memory

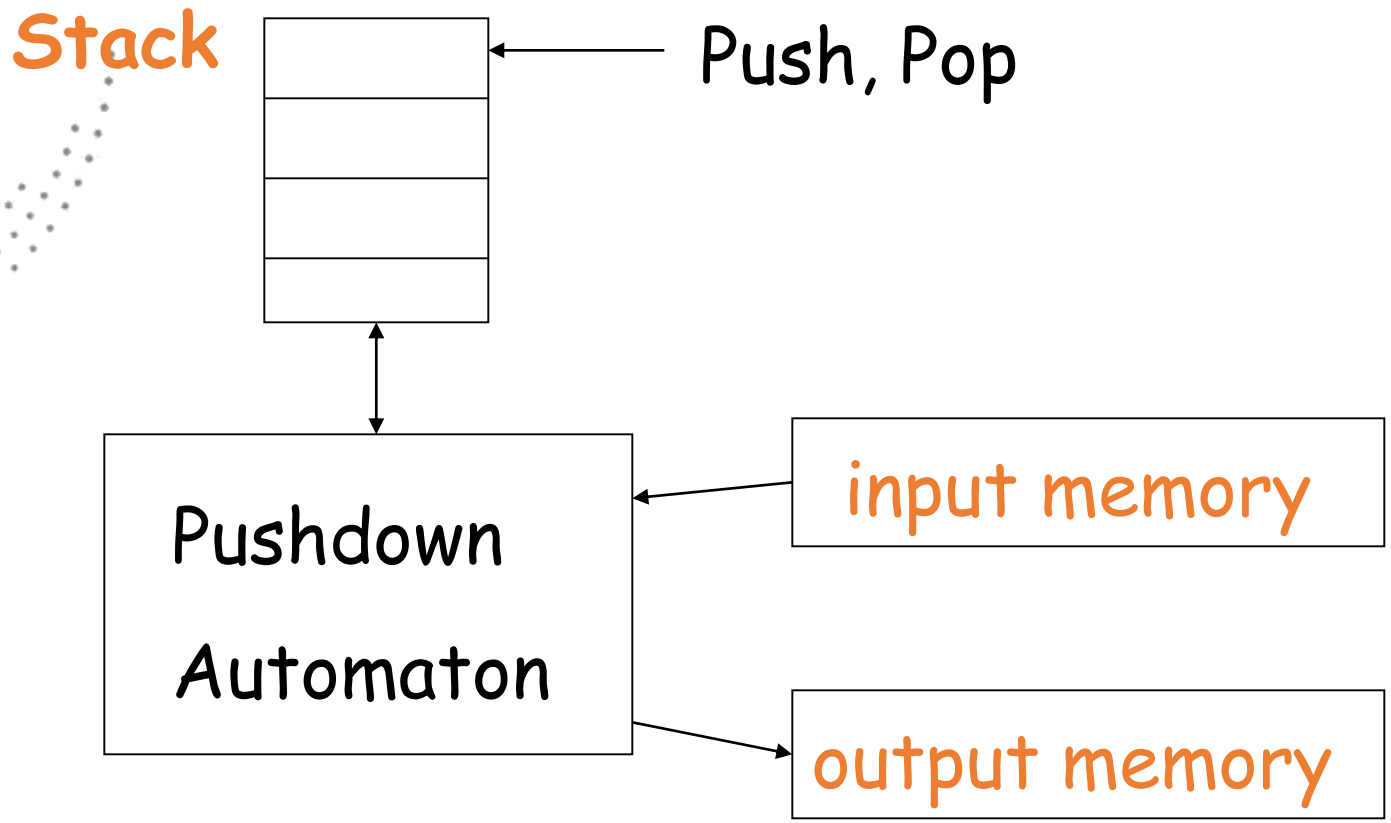
Finite Automaton



Example: Vending Machines

(small computing power)

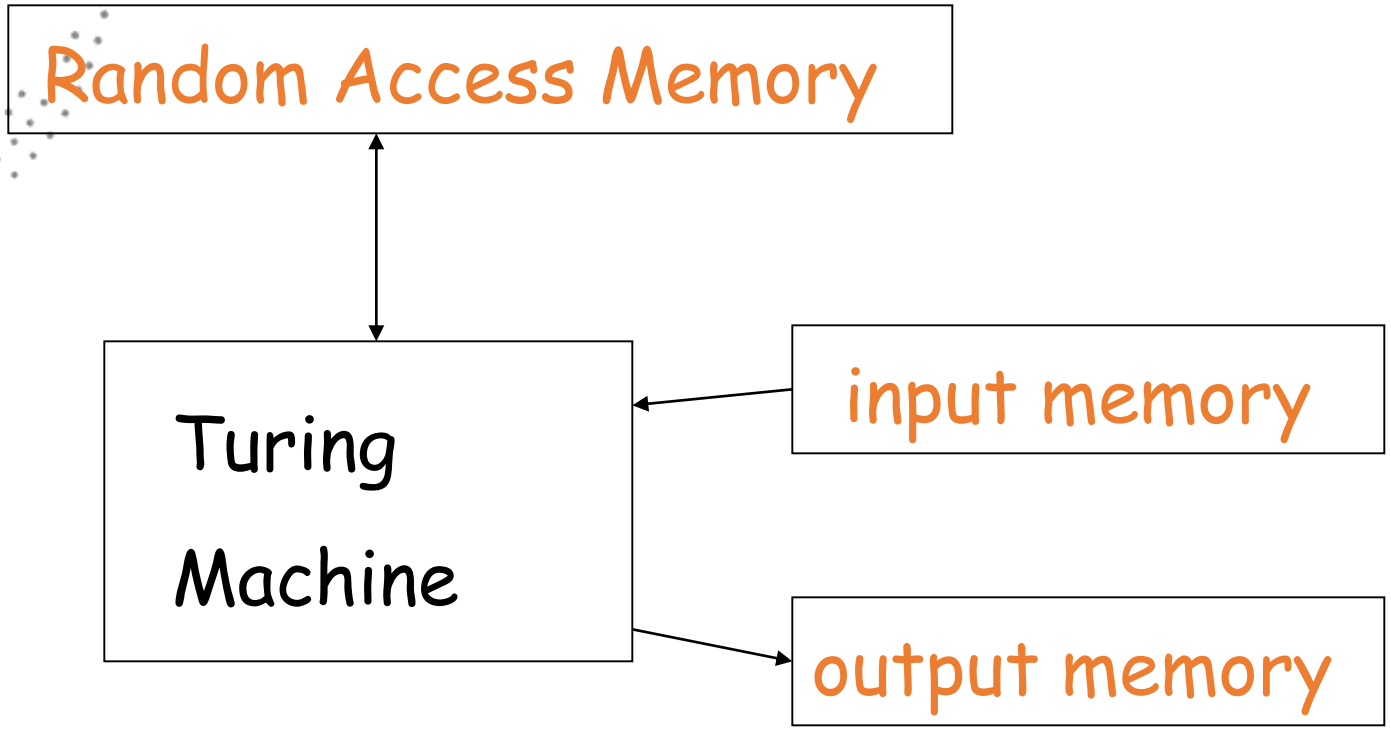
Pushdown Automaton



Example: Compilers for Programming Languages

(medium computing power)

Turing Machine



Examples: Any Algorithm

(highest computing power)

Power of Automata

Finite Automata < Pushdown Automata < Turing Machine

Less power → More power

Solve more computational problems

QUIZ TIME

What is an Automaton?

(a) A calculating device

(b) A computing device

(c) An abstract calculating device

(d) An abstract computing device

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QUIZ TIME

A push down Automaton has:
(a) no temporary memory
(b) access to a stack as temporary memory
(c) access to RAM as temporary memory
(d) access to tape as temporary memory

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When an algorithm is running, which of the following is active?

(a) A finite Automaton
(b) A push down automaton
(c) A Turing Machine
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MCQ

1 What is the primary purpose of automata theory?

a) To study the behavior of autonomous robots

b) To analyze and design computational models for solving problems

c) To investigate the evolution of programming languages

d) To study the structure of natural languages

2. Which of the following is a formal language?

a) English b) Spanish c) Regular expressions d) French

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3 Which type of automaton is characterized by having a finite set of states and the ability to transition between states based on input symbols?

a) Pushdown automaton

b) Turing machine

c) Finite automaton

d) Non-deterministic automaton

4 What is the Chomsky hierarchy used for in formal language theory?

a) Classifying languages based on their complexity and generative power

b) Developing machine learning algorithms

c) Analyzing network protocols

d) Modeling biological systems

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Terminal Questions

1. What is Automata Theory?
2. What is the significance of Automata Theory in computer science?
3. What are the key components of an automaton?
4. What is the difference between a deterministic automaton and a non-deterministic automaton?
5. What is the role of regular languages in Automata Theory?
6. How are formal languages important in Automata Theory?
7. What is the historical background of Automata Theory?
8. What is the difference between an automaton and a Turing machine?
9. How does Automata Theory relate to real-world applications?
10. What are the learning outcomes of studying Automata Theory?

THANK YOU

(DEEMED TO BE UNIVERSITY)

Team - TOC