Module 4 Overview

Turing Machines (Chapter 3)

Module Intro

So far in our development of the theory of computation, we have presented several models of computing devices. Finite automata are good models for devices that have a small amount of memory. Pushdown automata are good models for devices that have an unlimited memory that is usable only in the last in, first out manner of a stack. We have shown that some very simple tasks are beyond the capabilities of these models. Hence they are too restricted to serve as models of general purpose computers.

We turn now to a much more powerful model, first proposed by Alan Turing in 1936, called the Turing machine. Similar to a finite automaton but with an unlimited and unrestricted memory, a Turing machine is a much more accurate model of a general purpose computer. A Turing machine can do everything that a real computer can do. Nonetheless, even a Turing machine cannot solve certain problems. In a very real sense, these problems are beyond the theoretical limits of computation.

Objectives

Upon completion of this module, students will be able to:

1. Discuss who Alan Turing was
2. Define a Turing machine and how it works
3. Define configurations of a Turing Machine
4. Define the tape alphabet for a Turing Machine
5. Define a computational step within a traditional Turing Machine

6. Define the difference between a Turing decidable language and a Turing recognizable language
7. Define the universal Turing Machine and why it is important to computing
8. Define the Church-Turing thesis and explain why it is important
9. Define what it means for a language to be undecidable
10. Define what it means for a Turing Machine to be robust
11. Define what a language is, and how that relates to the number of possible strings from a given alphabet
12. Define variants of Turing Machines and how they determine to accept a given input string
13. Demonstrate the ability to walk through a Turing machine with a given string
14. Demonstrate the ability to define an implementation-level description of a Turing Machine

Readings and Resources

You can explore this module's information in multiple ways:

- View slides
- Access this information from the textbook (**Chapter 3)** **Course Textbook (https://virginiacommonwealth.instructure.com/courses/119232/pages/course-textbook)**
- Solve practice activities

Module at a Glance

Below is an overview of this module. Pay particular attention to items with **points values** and **due dates,** as these are graded assignments. (Note: module overview will not display if you are accessing Canvas on a mobile device.)

Module 4: Turing Machines (Chapter 3)

- **Module 4 Overview: Turing Machines (Chapter 3)**
- **M4 Chapter 3: Notes - Turing Machines 3.1**
  - **M4: 3.1 Practice**

0 pts

M4 Chapter 3: Notes - Variants of Turing Machines 3.2

M4: 3.2 Practice
0 pts

M4 Chapter 3 Turing Machine Review Key

M4 Chapter 3: Notes - Universal Turing Machine 3.3

M4: Challenge Problem Set
0 pts

M4 Chapter 3 Review

Reflection 4 - Exam 3
Nov 2, 2025, 11:59 PM 10 pts This assignment was locked Nov 3 at 11:59pm.

Will unlock Sep 15 at 12:00AM