CptS 317:
Automata and Formal Languages

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About me

- **Name**: Assefaw Gebremedhin

    (pronounced "Asse-faw" "Geb-re-me-d-hin")

- **Email**: assefaw.gebremedhin@wsu.edu

- **Webpage**: www.eecs.wsu.edu/~assefaw

- **Research interests**: Data science, graph algorithms, high performance computing, health informatics, cybersecurity

- **Lab:** Scalable Algorithms for Data Science (SCADS) Laboratory (https://scads.eecs.wsu.edu)

- **Teaching at WSU:**
    - CptS 475/575: Data Science (Fa. 2015--2021)
    - CptS 591: Elements of Network Science (Sp. 2015–2022)
    - CptS 317: Automata and Formal Languages (Sp. 2020, 2021)
    - DATA 424: Data Analytics Capstone (Sp. 2019)

- **CptS 317 Spring 2022**:
    - **Lectures:** MWF, 10:10--11
    - **Instructor Office Hour**: Wed. 1-2pm (or by appointment).

    - **Graduate Teaching Assistant 1:** James Halvorsen
    - **Email:** james.halvorsen@wsu.edu
    - **Office Hour**: TBD

    - **Graduate Teaching Assistant 2**: Olufunso Oje
    - **Email:** olufunso.oje@wsu.edu
    - **Office Hour**: TBD

    - **UG Teaching Assistant:** Nathan Waltz
    - **Email:** nathan.waltz@wsu.edu
    - **Office Hour:** TBD

    - All TAs Office: Dana 115

What I know (so far) about the class

- Enrolled: 115, Waitlisted: 7

- Majors:
  - BS in Computer Science
  - BS in Software Engineering
  - BA in Computer Science
  - BS in Data Analytics
  - BS in Electrical Engineering
  - BS in Computer Engineering
  - BA in Business

Course management system

- Everything will be done on Canvas
  - Syllabus
  - Lecture notes/slides
  - Panopto Recordings
  - Homework posting
  - Homework submission
  - Announcements
  - Messages (emails)
- Make sure to work on your Canvas setting
  - Time zone
  - Notification frequency

Course Objectives

- Introduce concepts in automata theory and theory of computation

- Identify different formal language classes and their relationships

- Design grammars and recognizers for different formal languages

- Prove theorems in automata theory using its properties

- Determine the decidability and intractability of computational problems

Major Course Topics (Modules)

1. Introduction
2. Regular Languages
3. Context-free Languages
4. Church-Turing Thesis
5. Decidability
6. Reducibility
7. Time Complexity

Why study theory of computation?

- *Theory is relevant to practice*

- *Theory is relevant to you*

- *Theory is good for you*

Why study theory of computation?

- *1) Theory is relevant to practice*
  - Designing a new programming language for a specialized application
    - Grammars
  - String searching and pattern matching
    - Automata and regular expressions
  - Intractable problems
    - NP-completeness

Why study theory of computation?

- *2) Theory is relevant to you*
  - It shows you a new, simpler, and more elegant side of computers
  - A theoretical course can heighten your aesthetic sense and help you build more beautiful systems

- *3) Theory is good for you*
  - Studying it expands your mind

Pre-requisites

- CptS 122/132: Data Structures
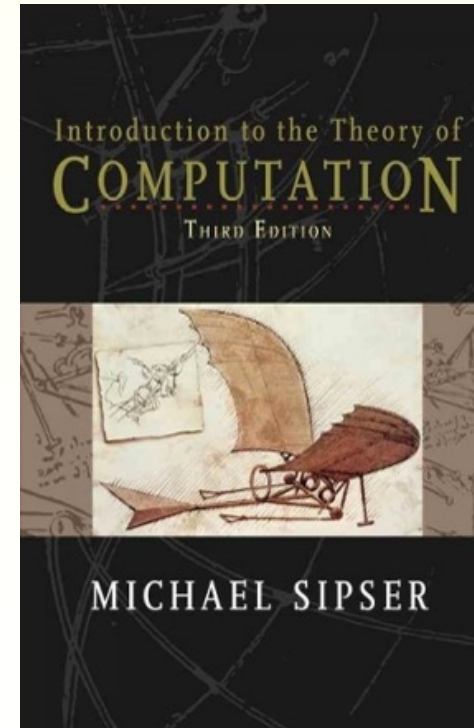
- Math 216: Discrete Structures
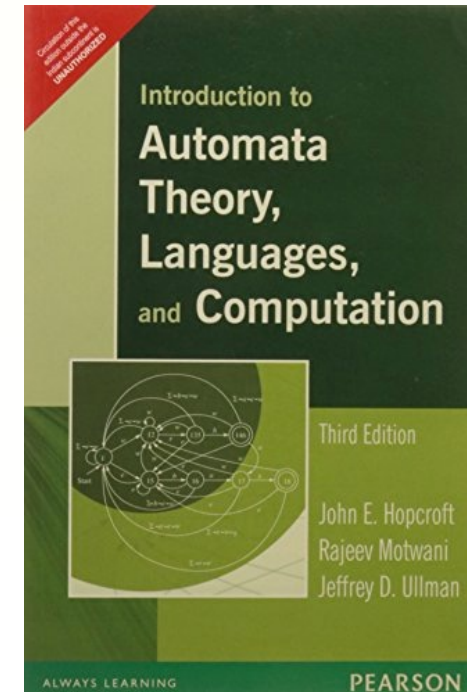
Textbook

Textbook (required):

- Introduction to the Theory of Computation, 3rd Edition
  - By Michael Sipser

(Optional reference):

- Introduction to Automata Theory, Languages and Computation, 3rd Ed.
  - By J.E. Hopcroft, R. Motwani, J.D. Ullman

Optional reference:

Coursework and grading

- 7 homeworks (58%) – best 6 out of 7 will be used toward final grade

- 2 midterms (20%)

- 1 final exam (20%)

- Class participation (2%)

- Exam formats not decided yet

- Final letter grade based on ranges (see syllabus)

Homework submission policy

- Solutions submitted electronically on Canvas
    - Type up and generate PDF, or
    - Scan hand-written solution

- No late submissions allowed (unless there was prior permission)
    - Permission is given only under extraordinary circumstances

- Homeworks will be posted on Canvas.

- A HW will be posted a week before it is due, typically on a Wed

Homework policy

- All homework must be done individually

- Cheating:
  - Helping others, getting help, looking up website for solution, etc
  - Students caught cheating will be awarded an F grade, and will be subjected to the WSU academic dishonesty policy
  - If something is not clear, on what constitutes cheating and what does not, please consult the instructor in advance

Exam policy

- 2 midterms and 1 final exam

- Format not decided yet (could be take-home)

- Will certainly be creative, will require reflection, challenging, fun

- Make-ups happen only under **extraordinary** circumstances

- Seek prior permission from instructor (at least two weeks in advance)

Weekly schedule

Week	Topics	Assignments/comments
01 (Jan 12)	Intro to course	HW0 (survey) out
02 (Jan 17)	Intro to automata theory	HW0 in, HW1 out
03 (Jan 24)	Finite Automata	HW1 in, HW2 out
04 (Jan 31)	Regular Expressions	HW2 in
05 (Feb 7)	Nonreguar Languages	HW3 out
06 (Feb 14)	Context-free Languages	HW3 in
07 (Feb 21)	Context-free Grammars	Mid-Term 1, HW4 out
08 (Feb 28)	Pushdown Automata	HW4 in, HW5 out
09 (Mar 7)	CFG and PDA equivalence, DFA minimization	HW5 in;
10 (Mar 14)	**Spring Break**	
11 (Mar 21)	Deterministic CFL, non-context free Languages	Review for MT2
12 (Mar 28)	Turing Machines	Mid-Term 2; HW 6 Out
13 (Apr 4)	Decidable languages	HW6 in; HW 7 out
14 (Apr 11)	Reducibility	HW 7 in
15 (Apr 18)	Time Complexity	Practice
16 (Apr 25)	NP-Completness, Review	
17 (May 2)	Finals Week	Final Exam

Lecture basics

- Classes will mostly be based on Slides but occasionally may involve "Board" writing

- Lecture slides will be posted on Canvas immediately after class

- Take your own notes in class (can't stress this enough), even if slides are posted afterwards

In conclusion…

- Welcome to this course again
- This is going to be a fun semester
- Put in your best effort
- You will be rewarded
- Class begins sharp at 10:10, be in class at least a few minutes early
- Thanks for today and see you in class on Friday!