Computability and Complexity
COSC 4200

Welcome and Syllabus

Main Questions of the Course

What problems can be solved on a computer?

What is a computer?

What is an algorithm?

Which problems can be solved on a computer?
What is a computer?

Four types of algorithms – models of computation:

1. **Finite-State Automata**: algorithms with extremely limited memory
2. **Pushdown Automata**: algorithms that have a stack data structure
3. **Turing Machines**: any algorithm can be implemented on a Turing machine according to the *Church-Turing thesis*
4. **Polynomial-Time Algorithms**: efficient computation

Which problems can be solved on a computer? What is a computer?

Four types of algorithms – models of computation:

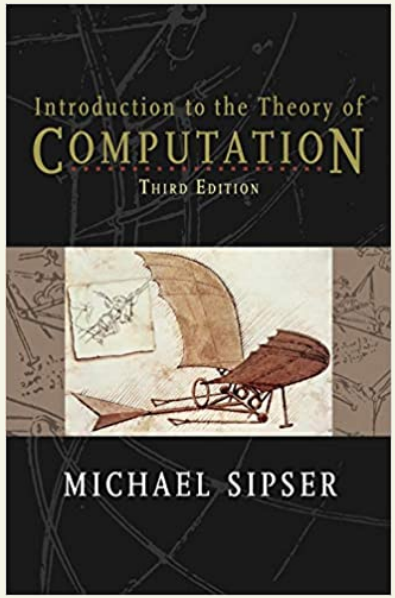
1. **Finite-State Automata**: algorithms with extremely limited memory
   equivalent in power to **regular expressions**
2. **Pushdown Automata**: algorithms that have a stack data structure
   equivalent in power to **context-free grammars**
3. **Turing Machines**: any algorithm can be implemented on a Turing machine according to the *Church-Turing thesis*
   We will study the **halting problem** *and* **undecidability***: many fundamental problems cannot be solved by any algorithm.*
4. **Polynomial-Time Algorithms**: efficient computation
   We will study **computational complexity** *and* **NP-completeness***. Many optimization problems are (probably) impossible to solve efficiently on a computer.*

Course Staff

Professor:
John Hitchcock
jhitchco@cs.uwyo.edu
Office: 4075 Engineering Hall
Office hours: TBA

Teaching Assistant:
Kegan McIlwaine
kmcilwai@uwyo.edu
Office hours: MWF 2-3pm on Zoom
https://uwyo.zoom.us/j/96989604782

Required Textbook



Required textbook: *Introduction to the Theory of Computation* by Michael Sipser.
Third edition. Cengage Learning, 2012. ISBN-10: 113318779X. ISBN-13: 9781133187790.

Textbook updates and errata are available at the author's website:
`http://www-math.mit.edu/~sipser/book.html`

Recommended Optional Books:

- *Mathematics for Computer Science* by Eric Lehman, F. Thomason Leighton, and Albert R. Meyer. eng.libretexts.org
- *Automata and Computability* by Dexter Kozen. Springer, 1997.
- *The Golden Ticket: P, NP, and the Search for the Impossible* by Lance Fortnow. Princeton University Press, 2013.
- *P, NP, and NP-Completeness: The Basics of Computational Complexity* by Oded Goldreich. Cambridge University Press, 2010.
- *Introduction to Theoretical Computer Science* by Boaz Barak. www.introtcs.org

Homework, Exams, and Grades

1. Homework will be assigned weekly. (Typically due on Friday.)
2. Midterm exam after we finish Chapter 2.
3. Comprehensive final exam during finals week.

Course grade contributions:

Homework Assignments:	50%
Midterm Exam:	20%
Final Exam:	30%

Grading scale:

A	90%
B	80%
C	70%
D	60%

Course Policies - Homework Expectations

- The homework assignments are designed to help you learn the material and prepare for the exams.
- The homework will be challenging and you should expect that some problems will require extensive thought before you arrive at the solution.
- Start early and allow yourself plenty of time.
- It is highly recommended that you work on the problems throughout the week rather than trying to solve them all at once close to the deadline.

Course Policies - Homework Collaboration and Academic Honesty

- You should solve each of the problems on your own in order to receive the maximum benefit.
- Discussion of the problems with your classmates is permitted and encouraged, but all solutions must be written individually.
- Homework papers must include acknowledgements citing all discussions and any other sources (such as books, websites, online forums, videos, etc.) that helped you when solving the problems.
- Do not copy from your classmates or any source.
- Copying or any other form of academic dishonesty will be handled **strictly** according to university policies.

Course Policies - Homework Submission

- All homework must be submitted through WyoCourses as pdf files.
- Please type your assignments. I recommend LaTeX.
  - You may find it helpful to use supplemental software for constructing diagrams.
- Organize your solutions in a clear way.
- Turn in only one solution per problem.
- Papers deviating substantially from these guidelines will not be graded.

Course Policies - Deadlines

- Homework deadlines are strict.
- Late papers will receive reduced credit with a 20% penalty per day late (including weekends).
- An extension to a homework deadline will be granted only if there is a legitimate reason, for example, a University Excused Absence.
- There are no other exceptions to the late paper policy.

Classroom Behavior Policy

Excerpt from syllabus:

At all times, treat your presence in the classroom and your enrollment in this course as you would a job. . . . You will be respectful towards you classmates and instructor. . . . As the instructor, I have the right to dismiss you from the classroom, study sessions, electronic forums, and other areas where disruptive behavior occurs.

Classroom Statement on Diversity

The University of Wyoming values an educational environment that is diverse, equitable, and inclusive. The diversity that students and faculty bring to class, including age, country of origin, culture, disability, economic class, ethnicity, gender identity, immigration status, linguistic, political affiliation, race, religion, sexual orientation, veteran status, worldview, and other social and cultural diversity is valued, respected, and considered a resource for learning.

Disability Accomodations

If you have a physical, learning, sensory or psychological disability and require accommodations, please let me know as soon as possible, and register and provide documentation of your disability to Disability Support Services (DSS), room 109 Knight Hall. You may also contact DSS at (307) 766-3073 or udss@uwyo.edu. Visit their website for more information: www.uwyo.edu/udss.

Academic Dishonesty Policy

Academic dishonesty will not be tolerated in this class. Cases of academic dishonesty will be treated in accordance with UW Regulation 2-114. The penalties for academic dishonesty can include, at my discretion, an "F" on an assigment and/or an "F" in the entire course. Academic dishonesty means anything that represents someone else's ideas as your own without attribution. It is intellectual theft – stealing - and includes (but is not limited to) unapproved assistance, plagiarism (use of any amount of another person's writings, blog posts, publications, and other materials without attributing that material to that person with citations), or fabrication of referenced information. Facilitation of another person's academic dishonesty is also considered academic dishonesty and will be treated identically.

Duty to Report

UW faculty are committed to supporting students and upholding the University's non-discrimination policy. Under Title IX, discrimination based upon sex and gender is prohibited. If you experience an incident of sex- or gender-based discrimination, we encourage you to report it. While you may talk to a faculty member, understand that as a "Responsible Employee" of the University, the faculty member MUST report information you share about the incident to the university's Title IX Coordinator (you may choose whether you or anyone involved is identified by name). If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are people who can meet with you. Faculty can help direct you or you may find info about UW policy and resources at http://www.uwyo.edu/reportit

COVID-19 Policies

During this pandemic, you must abide by all UW policies and public health rules put forward by the City of Laramie, the University of Wyoming, and the State of Wyoming to promote the health and well-being of fellow students and your own personal self-care. Please review our current policy.

As with other disruptive behaviors, we have the right to dismiss you from the classroom (Zoom and physical), or other class activities if you fail to abide by these COVID-19 policies. These behaviors will be referred to the Dean of Students Office using the UWYO Cares Reporting Form for Student Code of Conduct processes.

Syllabus Changes: I will alert you to any possible course format changes in response to UW decisions about community safety during the semester.