

## Syllabus CMSC 452: Elementary Theory of Computation

This document has three parts with three very different functions.

1. **CONTENT:** What is the content of the course.
2. **POLICY:** How the course is run (office hours, tests, HW, etc). This will be particular to this course.
3. **GENERAL INFO:** This information is helpful for any course you take at UMCP.

## CONTENT

### 1 Content of the Course

**THEME:** In CMSC 351, and other courses, you wanted to solve problems *fast*. This is all well and good! But how do you show that a problem *can't* be solved fast? Or that the problem requires a lot of space? This course looks at *models of computation* that allow us to show **lower bounds** on how well we can solve a problem.

The following number-of-weeks is approximate. Getting it exact is NP-complete.

1. Regular Languages: DFA's, NFA's, Regular expressions. Showing that some languages *are regular*. Showing that some regular languages *require* a lot of states for their DFA. Showing that some language are *not regular* (pumping Lemma).
2. Context Free Languages. Chomsky Normal Form. Showing that some languages *are CFL*. Showing that some CFLs *require* a lot of rules in their Chomsky Normal Form Grammar. Showing that some language are *not CFL* (pumping Lemma).
3. P and NP: Turing Machines, Cook-Levin Theorem (SAT is NP-complete). Reductions. Some Complexity Theory. Showing that some languages *are P*. Showing that some languages *are likely to not be in P*. Showing that some problems *are likely to hard to approximate*.
4. Decidable and enumerable Languages: Turing Machines and the HALTING problem. Showing that some languages *are Decidable*. Showing that some languages *are Undecidable*. We will emphasize natural problems such as Hilbert's 10th problem, Godel's theorem, WS1S.
5. Depending on Time: Primitive Recursive Hierarchy, Kolmogorov complexity, bounded queries, quantum computing.

**REQUIRED TEXT** There is no text. There will be notes online and slides online.

**PREREQUISITES** CMSC 351.

## POLICY

### 1 Basic Information

**Course title and Number** CMSC 452. Elementary Theory of Computation.

**Term: Spring 2025**

**Credits: 3**

**Course Dates** Jan 28-May 13. No class March 17-21 for Spring Break.

**Lecture Time and Place** Tu and Th 11:00-12:15. Room IRB 1116.

**Course Website** <http://www.cs.umd.edu/~gasarch/COURSES/452/S25/index.html>

This will contain slides, notes, and HWs.

**ELMS** ELMS will have the recordings of the lectures. However, you are advised to go to class.

**Gradescope** You will submit HW on Gradescope and this is where you can see your grades and make regrade requests. Such requests must be made within a week of the HW being graded.

**Piazza** We will be using Piazza as a forum to ask questions and get answers, in addition to office hours.

### 2 Course Guidelines

#### Academic Integrity

1. **Homework** You may talk to your fellow students about the problems, however you must hand in your own work and you must understand your own work. You may use ChatGPT however (1) you need to tell us that you did, (2) for your own benefit you should read it and rewrite it, and (3) warning: it may do well on standard problems that you can do yourself but it has done **terribly** on harder problems. My advice: don't use it.
2. **Exams** These must be solely your own work.

**Communication from you to the instructor or TA** You should feel free to email us or post things on Piazza or meet us in office hours. You can also request a zoom meeting if that makes more sense.

**Communication from us to you** We will email you (1) when HWs are posted, (2) when HW solutions are posted, and (3) other things you need to know. We will respond to your Piazza posts promptly.

### 3 Homework, Exams, Mandatory Project, Optional Project, and Grading

For all of the below see the Academic Integrity section above for guidance on how much help you can get on the Homework and Exams.

1. **Homework** There will be problems based on the material. They will be roughly once a week. The Homework will be posted on the course website (NOT on ELMS) in three forms. We do an example with hw00.

hw00.pdf

hw00st.txt- this is plaintext

hw00st.tex- this is LaTeX

You may use the .txt or .tex to help you typeset your homework.

After the Dead-Cat day has passed (see later for what that means) I will post hw00sol.pdf- Solutions to some of the problems.

**Typed** Homework must be typed and submitted on Gradescope. We strongly recommend that you use LaTeX (if you don't know it, learn it). If diagrams are needed to be drawn they can be handwritten.

**Dead Cat Policy** HW is posted on Tuesday and due the following Tuesday at 11:00AM (before class). But *everyone* gets an extension to Thursday at 11:00AM. *Do not think the real deadline is Thursday.* I have already given you an extension to Thursday hence I am not going to give you another one. I use the phrase **Morally due Tuesday Feb 4 11:00AM** to indicate that you have an automatic no-penalty extension to Thursday Feb61, **BUT DO NOT ABUSE THAT PRIVILEGE!**

2. **Midterm** The midterm will be on April 1 at 11:00AM-12:15PM in class. You may bring a sheet of notes to the exam with anything on it.
3. **Final** The final is TO BE ANNOUNCED. It will be in our classroom. You may bring a sheet of notes to the exam with anything on it.
4. **One Mandatory Programming Projects** This will be MORALLY DUE March 11 (SEE dead-cat policy for what *MORALLY DUE* means).
5. **Optional Project** After the Midterm I will give out an OPTIONAL project. It is MORALLY DUE May 6.

If you get a C- or higher *we will not look at your optional final*

If you get a D of any sort then *we will look at your optional final and if it is good then we will bump you to a C-*

If you get an F of any sort then *we will look at your optional final and if it is good then we will bump you to a D*

## 4 Grading Structure

We will make each HW worth 2.5% of the grade. We intend to have 10 HWs. That leads to the following table; however, if we have a different number of HWs this will change slightly.

Homework	25%
Midterms	20%
Project	20%
Final	35%

**Grades Cutoffs:** ROUGHLY

- 90-100 is an A
- 75-89 is a B
- 60-74 is a C
- 50-59 is a D
- 0-49 is an F.

Notice that (1) this is ROUGH- there may be some adjustments in any direction, and (2) this will be further refined with + and - after the final.

**Academic Dishonesty:** This will be dealt with harshly.

### **Staff, Office Hours, email addresses**

- Prof William Gasarch [gasarch@umd.edu](mailto:gasarch@umd.edu) Office Hours Tu 12:30-3:15 In his office, IRB 2242. You can also email for an appointment which might be on zoom.  
<https://umd.zoom.us/my/gasarch>
- TA's Office Hours. All of the TA office hours are in FILL IN LATER
  1. Cheng-Lee Yuan (goes by Sam) [c1571128@terpmail.umd.edu](mailto:c1571128@terpmail.umd.edu) Office Hours: FILL IN LATER.
  2. Danesh Sivakumar [dsivakum@terpmail.umd.edu](mailto:dsivakum@terpmail.umd.edu) Office Hours: FILL IN LATER

**Note on Location of TA office hours for CS TAs** These are set by the dept and are here:

<http://www.cs.umd.edu/class/resources/cstarooms/fallspring/>

## **GENERAL INFO**

### **1 Course Evaluations**

**COURSE EVALUATIONS** In May you will be asked to fill out course evals. I will urge you to fill out, not just the eval for me, but the eval for ALL of your courses. I have been on the committees that reads these evals and hence I can assure you that they are important.

### **2 UMD Policies and Resources for Undergraduate Courses**

It is our shared responsibility to know and abide by the UMD policies that relate to all courses, which include topics like

- Academic Integrity

- Student and Instructor Conduct
- Accessibility and Accommodations
- Attendance and Excused Absences
- Grades and Appeals
- Copyright and Intellectual Property.

Please visit

<https://www.ugst.umd.edu/courserelatedpolicies.html>  
for the UMCP policy on these issues.

### 3 Resources and Accommodations

#### 3.1 Accessibility and Disability Services

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The Accessibility & Disability Service (ADS) (see here:)

<https://www.counseling.umd.edu/ads/>

provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact me as soon as possible so that I have sufficient time to make arrangements. For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at [adsfront-desk@umd.edu](mailto:adsfront-desk@umd.edu). Information about sharing your accommodations with instructors, note taking assistance and more is available from the Counseling Center.

#### 3.2 Student Resources and Services

If you are not doing well in the course and want to do better feel free to talk to me so we can see what we can do. There are also campus services that might be helpful:

**Tutoring and Academic Success**

<https://tutoring.umd.edu/>

**UMD Writing Center**

<https://english.umd.edu/writing-programs/writing-center>

**Health Services Website**

<https://sph.umd.edu/academics/advising-resources/undergraduate-center-academic-success-and-a-casa-student-resources-and-information>

### **3.3 Basic Needs Security**

If you have difficulty affording groceries or accessing sufficient food to eat every day or lack a safe and stable place to live, please visit

**UMD Division of Student Affairs website**

<https://studentaffairs.umd.edu/basic-needs-security>

for information about resources the campus offers you.