



Syllabus for CS584 (Subject to change)

Course Information

Theory Of Computation And Computational Complexity - 10775 - CS 58400 - LE1

Meeting day(s) and time(s). Tuesday/Thursday 12-1:15 pm

Location: Wilmeth Active Learning Center 3132

Prerequisites: Mathematical maturity: familiarity with proofs, discrete math and undergraduate algorithms. (Eg., equivalent of CS381)

Instructor(s) Contact Information

- **Instructor:** [Elena Grigorescu](mailto:elena-g@purdue.edu) (elena-g@purdue.edu); **TA:** Maoyuan Raymond Song (song683@purdue.edu)
- **Office Location** LWSN 1209
- **Instructor's Office Phone Number** 765 496 1185
- **Instructor/TA Office Hours: TBD (on Zoom)**

Course Description

This is an introductory graduate level course on the theory of computation. We will focus on the fundamental mathematical model of a Turing Machine, discuss its powers and limitations, discuss computational resources that a TM might use (time, space, randomness) and the complexity classes associated with them (P, NP, PSPACE, BPP, RP, etc). In the latter part of the course we'll cover more advanced topics, possibly including Interactive Proofs (IP, PCP).

Learning Resources, Technology & Texts

- **Informed Learning resources**
 - **Required text:** Introduction to the Theory of Computation by Michael Sipser, 3rd edition, Cengage Learning.
 - **Recommended:** Computational Complexity: A Modern Approach, by Sanjeev Arora and Boaz Barak, Cambridge University Press
- **Software/web resources:** Brightspace. Gradescope. Zoom.

Learning Outcomes

By the end of the course, you will be able to:

1. Identify: classes of problems that are computable by a Turing Machine; the time/space complexity of classical problems and of new problems.
1. Demonstrate ability to write clear and correct mathematical proofs using techniques learnt in the prerequisites (deduction, induction, contradiction) and new specific proof strategies learnt in this class (eg, diagonalization, computational method)
2. Develop skills to read and understand technical papers in the field: eg., from conferences such as Computational Complexity, FOCS, STOC, APPROX/RANDOM, ICALP)
3. Critique papers in the field and proof strategies and present them in front of the peers

4. Begin research in theoretical computer science.

Assignments (Read very carefully!!)

Homework Expectations

There will biweekly graded homework assignments. Homework must be uploaded to Gradescope by the stated deadline. Assignments will be generally due at 11:59 PM on the posted deadline. You are responsible to complete the entire homework assignment. The assignments will be posted on the course web page on Brightspace. You must turn in a digital copy of your homework assignment on Gradescope.

Homework **should be typed** using Latex, MS Word, or any text editor of comparable quality. Only PDFs are accepted on Gradescope. You are expected to select the correct problem under which you are uploading your solution. Figures, diagrams, and complex** mathematical notations can be handwritten and included in the PDF as an image, but **illegible*** solutions will receive no credit.**

*The definitions of “complex” and “illegible” are at the discretion of the grader.

Submission on Gradescope:

- Gradescope will ask you to highlight the appropriate region of the PDF document for each question. It is your responsibility to highlight the correct region for each question (Failure to comply may result in a penalty).
- We recommend submitting 15 minutes before the deadline to avoid late penalties.

Homework will be graded both for completion and for accuracy.

Some assignments might have an optional problem. The optional problem does not count towards your score, unless your grade will be a borderline case.

If you don't know the answer to a question you will receive 15% of the grade for the problem if you admit it upfront by writing “I don't know how to solve this problem” and nothing else. If your solution is wrong, you get a score of 0 for that problem. This option does not apply to optional homework problems or exam problems.

Collaboration Policy: You may collaborate on your homework with your colleagues *from the class*, however you *must* write down the solutions *yourself*, and you must *completely understand* any solutions you submit. *No other sources are allowed and violations will be penalized according to Purdue's integrity policies.* Do not copy another student's homework and do not allow another student copy your homework. Turning in a solution that you could not explain to the instructor is considered cheating.

Discussions with other students should be appropriately acknowledged as follows. Every problem on an assignment must include a Collaborators and Resources (CR) statement: This means every problem on every assignment includes information on collaboration and the use of on-line material. Help from a TA or course instructor does not count as collaboration. The CR statement for each problem should include the following

- Names of students enrolled in the course who collaborated on the problem: Name1,Name2,...
- Names of students not enrolled who provided help: Name1, Name2
- Name of tutor (if applicable):
- On-Line resources consulted and used: URLs (one per line).
- State “none” if there are no resources to cite.
- Problems that do NOT include a CR statement will not be graded.

We expand on homework submission guidelines and grading:

- Assignments are graded for correctness, clarity, conciseness, rigor and efficiency.
- Please use pseudocode to describe an algorithm instead of code from a programming language. Remember: The target audience (grader/TA) is a human and not a compiler!
- Describe your solution in steps. When appropriate include an example to help describe your algorithm.
- Start by describing your main idea and the intuition for your solution.
- When using theorems presented in class describe differences and any adjustments to be done (if any). There is no need to reproduce material seen in class.
- When using material from other sources you must use your own words; **DO NOT COPY AND PASTE**; clearly cite every source you use.
- Formatting Guidelines: submissions should use a font size of at least 11 points.

Missing or Late Work: Homework is due at 11:59PM on the given due date. The late policy for homework is described above (0 to 23.99 hours late = 10 point penalty; 24 to 48 hours late = 25 point penalty; >48 hours late = no credit).

Grading:

Your learning will be assessed through a combination of participation, projects, a reflection paper, and a final exam spread throughout the academic period. Details on these assignments and exams, including a schedule of due dates, rubrics to guide evaluation, and guidelines on discussion participation and evaluation will be posted on the course website.

Assignments	Due	Percentage
Homework	Throughout the semester	20
Midterm	TBD	30
Final exam	TBD	35
Project	TBD	10
Participation/Quizzes	Throughout the semester	5
		Total: 100

Quizzes Expectations

There will be some short quizzes through the semester. Taking them will count towards involvement and participation.

Exam Expectations

There will be one midterm and a final exam. All exams may be cumulative (i.e. they may cover any material covered in class up to that point in the session), and all exams are closed-book, closed-note, etc. You may not use calculators, cell phones, smart watches, computers, cameras, radios, televisions, books, Morse code, signals or sign language during exams. Do not look at other student’s exams or let others see your exam while the exam is in progress. Communicate only with the instructor (or TA) during an exam.

The midterm exam will be offered in-person, unless a student needs to quarantine. In that case they will be permitted to take the exam online.

Project Expectations

The project will consist of a short presentation of a paper from a theoretical CS conference on a topic in complexity theory (eg. FOCS/STOC/SODA/RANDOM/CCC/ICALP) and scribe notes for this paper. Collaborate in teams of 2 or 3.

Optional: The project may consist in a research topic of your choice, and may include original work in theory of computation performed for this course that could have potential for publication. Please discuss this option with the instructor.

Grade Distribution

The exact grading scale will be determined at the end of the semester.

Regrade Requests

For a re-grade on homework or an exam you may submit a regrade request on Gradescope. The request will be automatically directed to the TA (or instructor) who graded that question. You must submit the re-grade request 14 days from the date when the assignment was returned. There will be no re-grading after this period.

- Re-grade requests should only be submitted when you are confident that the grader made a mistake misunderstood your solution. Regrade requests deemed to be excessive/frivolous may result in a one-point penalty.
 - When making a regrade request you should clearly explain what you think the grader missed (the explanation is *not* an opportunity to expand upon the answer you already submitted).
 - We generally recommend that you talk with a TA or with a classmate before submitting a regrade request.
- A re-grade request may mean that the entire assignment/exam may be re-evaluated. Scores may go up or down.
- Please be patient while waiting for a TA to re-grade an assignment.
- If you disagree with the result of a re-grade request you may appeal to the course instructor.
 - If the instructor agrees with you then you will automatically receive a 2-point bonus for your trouble.
 - If the instructor agrees with the TA (the most common outcome) then you will automatically receive a 2-point penalty.

Attendance Policy

General Attendance Considerations

This course follows Purdue's academic regulations regarding attendance, which states that students are expected to be present for every meeting of the classes in which they are enrolled. Attendance will be taken at the beginning of each class and lateness will be noted. When conflicts or absences can be anticipated, such as for many University-sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to the instructor is not possible, the student should contact the instructor as soon as possible by email or phone. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases falling under excused absence regulations, the student or the student's representative should contact or go to the [Office of the Dean of Students website](#) to complete appropriate forms for instructor notification. Under academic regulations, excused absences may be granted for cases of grief/bereavement, military service, jury duty, and parenting leave. For details, see the [Academic Regulations & Student Conduct section](#) of the University Catalog website.

Guidance on class attendance related to COVID-19 are outlined in the [Protect Purdue Pledge for Fall 2021](#) on the Protect Purdue website.

Academic Guidance in the Event a Student is Quarantined/Isolated

If you must miss class at any point in time during the semester, please reach out to me via email so that we can communicate about how you can maintain your academic progress. If you find yourself too sick to progress in the course, notify your adviser and notify me via email or Brightspace. We will make arrangements based on your particular situation. Please note that, according to [Details for Students on Normal Operations for Fall 2021](#) announced on the Protect Purdue website, “individuals who test positive for COVID-19 are not guaranteed remote access to all course activities, materials, and assignments.”

Classroom Guidance Regarding Protect Purdue

Any student who has substantial reason to believe that another person is threatening the safety of others by not complying with Protect Purdue protocols is encouraged to report the behavior to and discuss the next steps with their instructor. Students also have the option of reporting the behavior to the [Office of the Student Rights and Responsibilities](#). See also [Purdue University Bill of Student Rights](#) and the Violent Behavior Policy under University Resources in Brightspace.

Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing integrity@purdue.edu or by calling 765-494-8778. While information may be submitted anonymously, the more information is submitted the greater the opportunity for the university to investigate the concern. More details are available on our course Brightspace table of contents, under University Policies.

Academic Integrity is a critical foundation for any form of higher education, and Purdue University takes this concept seriously. All submitted assignments will automatically be checked for plagiarism. Any student found guilty of plagiarism and/or other forms of academic dishonesty will automatically FAIL this course, and face any additional consequences that the University deems necessary. To know and understand what is academic integrity, what is expected from you, and what you should NOT do, read carefully this document: [Academic Integrity](#). **Posting homework questions (or any other part of an assignment) online is NOT ALLOWED.** **Examples of Academic Dishonesty:** Examples of academic dishonesty include (but are not limited to):

- Failing to acknowledge a resource/collaborator on a homework assignment.
- Submitting a homework solution which you do not understand (could not explain to a TA/Professor) or which is not written entirely in your own words
- Copying another homework solution or allowing another student to copy your solution
- During an Exam:
 - Looking at other student’s exam or letting another student look at your test
 - Using any electronics (laptops, phone, smart watch, calculator etc...)
- Sharing the answer to quiz questions with another student
- Posting exam/quiz questions online or discussing exam/quiz questions with classmates who have not completed the exam/quiz.

Accessibility

“Purdue University is committed to making learning experiences accessible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.”

Suggestions & tips:

1. *Purdue also offers resources to help you make learning materials accessible. Some examples include:*

- Information from Innovative Learning on [Universal Design for Learning](#)
- Guidance from Innovative Learning on [creating accessible documents](#)
- Contact innovativelearningteam@purdue.edu with questions.

Mental Health/Wellness Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try [WellTrack](#). Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the [Office of the Dean of Students](#). Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a [Purdue Wellness Coach at RecWell](#). Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact [Counseling and Psychological Services \(CAPS\)](#) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.-5 p.m. Monday through Friday. Considering the significant disruptions caused by the current global crisis as it related to COVID-19, students may submit requests for emergency assistance from the [Critical Needs Fund](#)

Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted onto the course website or can be obtained by contacting the instructors or TAs via email or phone. You are expected to read your @purdue.edu email on a frequent basis.

Nondiscrimination Statement

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. [Link to Purdue's nondiscrimination policy statement.](#)