CSCI 256: Algorithm Design and Analysis (Fall 2026)

Instructor: Shikha Singh **Email:** ss32@williams.edu
Time: MWF 11-11:50 am (01), 12–12:50 pm (02) **Room:** TBL 202

Course Overview and Resources: This course is about mathematical modeling of computational problems, developing common algorithmic techniques to solve them, and about analyzing the correctness and running time of the algorithms. By clearly formulating and carefully analyzing the structure of a problem, it is often possible to dramatically decrease the computational resources needed to solve it. In addition, by analyzing algorithms you can provide provable guarantees of their performance. We will study several algorithm design strategies that build on data structures and programming techniques introduced in CS 136 and mathematical tools introduced in MATH 200. The course will roughly cover the following topics in order: graph algorithms, greedy algorithms, divide-and-conquer, dynamic programming, network flows, NP completeness and problem reductions. At the end of the course, the students should be able to:

- Analyze worst-case running time and space usage of algorithms using asymptotic analysis.
- Formulate real-world optimization problems mathematically (using concepts like sets and graphs) and apply algorithmic paradigms such as divide-and-conquer and dynamic programming to solve them.
- Identify and prove that certain computational problems are NP-hard or NP-complete, that is, show that they are unlikely to admit an efficient solution.

Prerequisites: CSCI 136 and the Discrete Math Proficiency Requirement
Course Webpage: https://williams-cs.github.io/cs256-f26/index.html

Textbooks: The primary text for the course is *Algorithm Design* by Jon Kleinberg and Éva Tardos, Addison-Wesley 2006. This will be supplemented by readings from the *Algorithms* textbook by Jeff Erickson available at http://jeffe.cs.illinois.edu/teaching/algorithms/book/Algorithms-JeffE.pdf

Grading Policy: The final grade will be calculated based on the following breakdown:

- Homeworks (20%): Daily Exercises (10%), Weekly Problem Sets (10%)
- Attendance and class participation (±5%)
- Three in-class tests (10+20+20%)
- Final exam (30%)

The exams will be slightly reweighted based on performance: the lowest score will be worth 5% less, and the highest will be worth 5% more.

Attendance and Class Participation: Learning is a collaborative endeavor and lectures will include in-class discussions and activities to practice the concepts in the course. Student are encouraged to ask and answer questions in class, and collaborate with their peers in classroom activities. The final grade may be adjusted by ±5% to reflect postive or negative participation in the course.

Attendance is mandatory in this course. Each student is allowed three unexcused absences. For an excused absence, students must inform me of their absence ahead of time. If a student has more than three unexcused absences, they will be sent a formal warning. Further absences may result in a letter grade penalty.

Daily Exercises: Most lectures will be accompanied by a daily exercise, each due at the beginning of the next lecture. Students must handwrite answers and resubmit the exercise sheet. These exercises will consist of short procedural problems that are meant to reinforce algorithms and definitions. They must be done individually—no collaboration is allowed. Daily exercises will be graded coarsely: a check mark for full credit, a check minus if significant parts are mising, or no credit for a missing or nearly blank submission.

Problem Sets: This course will have weekly problem sets. Problem sets will be done in pairs; the pairs will be randomly assigned for each problem set on GLOW. Problem sets are intended to be challenging and will

and explore the material more deeply. Students are particularly encouraged to get help from the instructor and TAs if they find themselves stuck on a problem set.

Students are required to typeset their problem set solutions in LaTeX using the template provided. LaTeX is free and available on all lab computers; it can also be installed on your personal computer, or accessed via a web interface (Overleaf). LaTeX is the standard tool for typesetting mathematical notations, academic manuscripts, resumes, books, etc. For example, this syllabus was typeset using LaTeX. A (small) portion of the grade for each problem set will be based on correctly using LaTeX.

Problem sets will be graded largely on completion: while a correct answer is required to get full credit, there will be considerable partial credit given for an attempt at a solution.

Academic Honesty: For a full description of the Computer Science Honor Code, please see: https://csci.williams.edu/the-cs-honor-code-and-computer-usage-policy/. If you have any doubt about what is appropriate, please email me at ss32@williams.edu. Specific rules are outlined below.

- Problem sets and daily exercises are meant to provide practice with the concepts covered in class. Looking up complete or partial solutions by using problem-specific prompts on the internet or AI tools is not permitted. If you need guidance on the problem sets, please seek help from the course staff.
- Students must only use definitions and concepts that have been covered in class. Any solution that uses concepts not covered in class will not receive credit.
- Daily exercises, in-class tests and the final exam are to be the sole work of each student. No collaboration or discussion is allowed. For problem sets, each student may collaborate fully with their partner (including joint writing). Student may only discuss problem set questions with other classmates at a high level, and may not engage in any joint writing or step-by-step problem solving. Refrain from crafting your response to the problems in the presence of other students who are not your partner.
- When attempting your exercises or problem sets, you may only refer to the materials provided by the instructor. You are not allowed to reference or cite external online resources.
- You should never turn in a solution that you do not understand. If an honor-code violation is suspected, you will be asked to explain your solution orally to determine if you came up with it on your own.

Grading and Late Policy: All problem sets will be weighted equally toward the final grade unless otherwise stated. Each student's lowest problem set grade will be dropped. Late problem sets will have a penalty of 10% per day late.

Late daily exercises will not be accepted; however, the lowest 4 daily exercise grades will be dropped.

Exams: We will have three 50 minute in-class tests, tentatively on October 2, October 30 and November 20. We will have a 2.5 hour scheduled exam during the finals period.

Health and Accessibility Resources: Students with disabilities or disabling conditions who experience barriers in this course are encouraged to contact me to discuss options for access and full course participation. The Office of Accessible Education is also available to facilitate the removal of barriers and to ensure access and reasonable accommodations. Students with documented disabilities or disabling conditions of any kind who may need accommodations for this course or who have questions about appropriate resources are encouraged to contact the Office of Accessible Education at oaestaff@williams.edu.

Inclusion and Classroom Culture: The Williams community embraces diversity of age, background, beliefs, ethnicity, gender, gender identity, gender expression, national origin, religious affiliation, sexual orientation, and other visible and non-visible categories. I welcome all students in this course and expect that all students contribute to a respectful, welcoming and inclusive environment. If you have any concerns about classroom climate, please come to me to share your concern.

A note on preferred names/pronouns: In this class, we use the name and gender pronouns that individuals ask us to use as a sign of mutual respect. Please ensure that your preferred pronouns are up to date on GLOW. That said, everyone makes mistakes—in general, should you use an incorrect pronoun or name, the best course of action is to make a quick correction and move on, rather than dwelling on it.