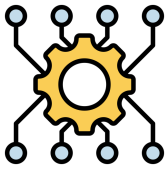

DATS 6001 – Algorithm Design for Data Science

"Everyday life is like programming, I guess. If you love something you can put beauty into it."
– Donald Knuth

Course and Contact Information

Term		**Spring 2026**
Section(s)	10 (CRN: 46379)	
Time	Tuesdays (6:10–8:40 pm)	
Location	DUQUES 360	

Instructor

Name: Dr. Sushovan Majhi
Office: Samson Hall 313 (easier to enter from Corcoran 2nd floor, through the end-of-hallway stairs)
Email: s.majhi@gwu.edu
Office hours: Mondays 1–2 pm (Samson Hall 313)
Teaching Assistant: Siddhant Saxena (siddhant.saxena@gwu.edu)
TA Office Hours: TBD (Samson Hall 311)

Course Description

First of all, **this is NOT a programming course**! The course covers algorithm design and selected data structures. Unlike the ones offered in most CS departments, this course is particularly tailored for non-CS major students. Specifically, we will only focus on (the theory and implementation of) the most critical problems in algorithm design.

A significant learning objective of this course is to teach students how to write bug-free code with the lowest time complexity (i.e., uses the minimum time) and space complexity (uses the minimum space). This is a key skill often tested in the "Whiteboard Coding" interviews for Data Scientist / Software Engineer positions.

This course will cover Algorithms (Search, Sorting, and Dynamic Programming) and Data Structures (e.g., Arrays, Stacks, Queues, Trees, and Heaps). See the tentative schedule for more details.

This course will use **Python** exclusively. We assume that students have previously used Python extensively. If that is not the case, I **strongly** recommend completing one of the following before the instruction begins:

- (**Trinket Tutorials**) https://hourofpython.com/#tutorials
- (**Official Tutorials**) https://docs.python.org/3/tutorial/index.html
- (**Book**) John Zelle, Python Programming: An Introduction to Computer Science (3rd Edition). Franklin, Beedle. 2017 ISBN: 978-1590282755

Learning Outcomes

By the end of the course, students will learn the following:

- understand the theory and implementation of the data structures and algorithms covered in the course
- use appropriate data structures and algorithms to design solutions that have the lowest time and space complexity
- crack coding interviews for competitive industry jobs, e.g., software engineers, data engineers, etc
- write bug-free code to implement the solutions to complex problems

Course Prerequisite

An undergraduate-level mathematical maturity is a prerequisite. The course assumes prior experience with Python programming. The course is intended for motivated students seeking to deepen their understanding of computational approaches to problem-solving. Although we go over the basics of Python programming in the first week, you will find the class more rewarding if you have prior programming experience. Below are optional, but strongly recommended:

1. I use Visual Studio Code for all my programming projects.
2. If you use VS Code or another IDE, ensure you install and enable additional useful extensions to support Python and Jupyter Notebooks.

Course Format and Labs

The primary format of this course is a lecture followed by a computer lab. In general**, lectures with computer labs** are the main learning tools. These labs are an essential part of the course. It is the student's responsibility to complete the in-class lab, which will be graded.

Course Website

The course will very closely follow the course website (https://6001-majhi.datasci.land/).

Textbook

The course will loosely follow the following book:

1. (ITA) Introduction to Algorithms (Fourth edition) by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. ISBN: 978-0-262-04630-5

Course Schedule

Date	Topics	Reading (hrs)	Assignment(s) Due
Jan 13	Getting to know each other introduction to computers and programs Algorithms and their roles in computing Lab: Solving the Strand puzzle	Intro (0.5) Appendix (2)	
Jan 20	Time and Space complexities Analyzing algorithms Lab: Analyzing the time complexity of algorithms	Chapter 2 (3)	HW 0
Jan 27	Introduction to Complexity Classes The big-O notation Analyzing insertion sort and Merge Lab: Proving complexities using limits	Chapter 3 (3)	HW 1
Feb 3	Divide-and-Conquer Recursive algorithms: sorting and searching Lab: writing recursive algorithms, implementation in Python	Chapter 4 (3) Up to 4.4	HW 2
Feb 10	Analyzing the running time of recursive algorithms Recursion trees and the Master Theorem Lab: Applying the Master Theorem	Chapter 4 (3) From 4.5	HW 3
Feb 17	Big-Ω notation Max-heaps Lab: implementation in Python	Chapter 5 (3) Up to 5.2	HW 4
Feb 24	Heapsort and its complexities Problem-solving using heaps	Chapter 5 (3) 5.3	
Mar 3	**Exam 1** (proctored by TA)		HW 5
Mar 10	**Spring Break (No class)**		
Mar 17	Basic Data Structures: arrays, stacks Lab: Implementing Stacks	Chapter 6 (3)	
Mar 24	Queues and Priority Queues Lab: Implementing Priority Queues Using Heaps		

Mar 31	Graph data structure Graph Traversal Lab: Implement graphs and BFS	Chapter 7 (4)	HW 6
Apr 7	Shortest Paths Belman-Ford Algorithm Dijkstra's algorithm Lab: Implementation	Chapter 8 (4)	
Apr 14	Dynamic Programming: concepts Motivating examples Lab: implement the examples	Chapter 9 (3)	HW 7
Apr 21	Dynamic Programming: problem-solving Lab: Ground-up implementation	ITA: Ch 14	
Apr 28	**Makeup session**		
Apr 30	**Exam 2 / LeetCode**		HW 8

Independent or Out-of-Class Learning

The average minimum amount of out-of-class or independent learning expected per week is 5 hours, for our 2.5 hours of classroom meetings. You are strongly encouraged to make use of our office hours, the TA's help, as well as other resources, including but not limited to those offered by the library service, to help you learn. Do not wait until it is too late to get help.

Exams

There will be two in-class written exams in this course on the following dates:

- **Exam 1**: Mar 3
- **Exam 2**: Apr 30

Assignments

Assignments will be due weekly and will be either individual or group. More details will be posted on Blackboard.

Participation

Student participation in the course is essential to fully grasp the course material. The following factors will be taken into account when calculating participation grade:

- Being present in class
- Asking questions
- Making contributions to class discussions and when called upon
- Staying on task during lab exercises

Readings
Most class days have a corresponding reading assigned, which is indicated within the class syllabus. It is the student's responsibility to complete these readings **before** class on the date they appear on the schedule.

Labs
Students are expected to be present during labs and to complete all labs during class lectures. Labs will be due at the end of class and will be submitted on Blackboard. Labs will be graded and will constitute 30% of the overall grade.

Grading
Your final grade will be determined by:

- ✔ Assignments (30%)
- ✔ Labs (30%) [Interview-style]
- ✔ Exams 1 and 2 (30%)
- ✔ Participation (10%)

Letter Grades

A	A–	B+	B	B–	C+	C	C–	F
≥ 93	90–92	87–89	83–86	80–82	77–79	73–76	70–72	< 70

Generative Artificial Intelligence (GAI) In Our Course
I agree that the use of GAI is inevitable and is how modern programmers work. However, the goal of this course is to learn to code from scratch, **without** any AI assistance.

I simply ask for two things when you do use GAI:

1. Cite it as you would for other references. Indicate where you used GAI for your code. Sample citation: "Create a script in Python to web scrape NBA.com season data" prompt. ChatGPT-4, OpenAI, 14 Mar. 2023, chat.openai.com/chat.
2. Thoroughly understand the code you use in your work. Rewrite/restructure it so that it makes sense to you. Seek help from yourself or others if you do not understand the code you are using. I will ask you what your codes mean and why.

Maintaining academic honesty is a challenging skill to learn. There are also some University-wide guidelines you need to be aware of:

- GW Office of the Provost - Generative Artificial Intelligence guidelines
- An aggregated source for GAI classroom policies
- Responding to AI tools when designing activities

That said, you should also be aware of the limitations and ethical issues associated with AI tools. These tools are based on training data that is likely biased, incomplete, and outdated, among other obvious deficiencies. If we base our everyday decisions on all the books and articles that were written hundreds of years ago, for example, there would be no women's rights, and no ethnic equality in our decisions. I am confident you will delve further into these questions in another data science and ethics course in the future.

UNIVERSITY POLICIES

Observance of Religious Holidays
Students must notify faculty during the first week of the semester in which they are enrolled in the course, or as early as possible, but no later than three weeks prior to the absence, of their intention to be absent from class on their day(s) of religious observance.

If the holiday falls within the first three weeks of class, the student must inform the faculty in the first week of the semester. For details and policy, see "Religious Holidays" at provost.gwu.edu/policies-procedures-and-guidelines.

Academic Integrity Code

Academic integrity is an essential part of the educational process, and all members of the GW community take these matters very seriously. As the instructor of record for this course, my role is to provide clear expectations and uphold them in all assessments. Violations of academic integrity occur when students fail to cite research sources properly, engage in unauthorized collaboration, falsify data, and otherwise violate the Code of Academic Integrity. If you have any questions about whether or not particular academic practices or resources are permitted, you should ask me for clarification. If you are reported for an academic integrity violation, you should contact the Office of Student Rights and Responsibilities (SRR) to learn more about your rights and options in the process. Consequences can range from failure of the assignment to expulsion from the university and may include a transcript notation. For more information, please refer to the SRR website (https://studentconduct.gwu.edu/academic-integrity), email rights@gwu.edu, or call 202-994-6757.

Use of Electronic Course Materials and Class Recordings

Students are encouraged to use electronic course materials, including recorded class sessions, for private personal use in connection with their academic program of study. Electronic course materials and recorded class sessions should not be shared or used for non-course-related purposes unless express permission has been granted by the instructor. Students who impermissibly share any electronic course materials are subject to discipline under the Student Code of Conduct. Please contact the instructor if you have questions regarding what constitutes permissible or impermissible use of electronic course materials and/or recorded class sessions. Please contact Disability Support Services at disabilitysupport.gwu.edu if you have questions or need assistance in accessing electronic course materials.

ACADEMIC SUPPORT

Writing Center

GW's Writing Center cultivates confident writers in the University community by facilitating collaborative, critical, and inclusive conversations at all stages of the writing process. Working alongside peer mentors, writers develop strategies to write independently in academic and public settings. Appointments can be booked online at gwu.mywconline.com.

Academic Commons

Academic Commons provides tutoring and other academic support resources to students in many courses. Students can schedule virtual one-on-one appointments or attend virtual drop-in sessions.

Students may schedule an appointment, review the tutoring schedule, access other academic support resources, or obtain assistance at academiccommons.gwu.edu.

SUPPORT FOR STUDENTS OUTSIDE THE CLASSROOM

Disability Support Services (DSS) 202-994-8250

Any student who may need an accommodation based on the potential impact of a disability should contact Disability Support Services at disabilitysupport.gwu.edu to establish eligibility and coordinate reasonable accommodations

Counseling and Psychological Services 202-994-5300

GW's Colonial Health Center offers counseling and psychological services, supporting mental health and personal development by collaborating directly with students to overcome challenges and difficulties that may interfere with academic, emotional, and personal success. healthcenter.gwu.edu/counseling-and-psychological-services.

Safety and Security

- In an emergency: call GWPD at 202-994-6111 or 911
- For situation-specific actions: review the Emergency Response Handbook at: safety.gwu.edu/emergency-response-handbook
- In an active violence situation: Get Out, Hide Out, or Take Out. See go.gwu.edu/shooterprep
- Stay informed: safety.gwu.edu/stay-inform