COMP 4581—Algorithms for Data Science

Course Overview

This course provides an introduction to the design and analysis of algorithms for the data science student. Topics covered include asymptotic complexity and algorithm design techniques such as incremental, divide-and-conquer, dynamic programming, greedy algorithms, and backtracking. Additionally, fundamental data structures such as stack, queues, heaps, trees, and hashing are covered, as well as their role in the design of efficient algorithms. Although the Python programming language is extensively used in examples and assignments, this class is not about Python. Rather, we will emphasize computational solutions to problems and the role of efficient algorithms as a tool for exploring and processing large data sets.

Objectives

Students will be able to estimate the efficiency of algorithms and predict running times. Students will be able to select the appropriate data structure and algorithm paradigm for a given problem. They will be able to turn the design of their solution into efficient code using the paradigms and data structures covered in class. Finally, by the end of this course, students will better appreciate the importance of careful algorithm design when processing large data sets.

Textbooks and Materials

Although a textbook is not required for this class, the following book is highly recommended: Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). *Introduction to algorithms* (3rd ed.). MIT Press. Additional reading materials such as class slides and handouts will be provided.

Grading

Assignment/Assessment	Points	Weight on Final Grade
Lab 1	5	4%
Lab 2	5	4%
Lab 3	5	4%
Lab 4	5	4%
Lab 5	5	4%
Lab 6	5	4%
Lab 7	5	4%
Lab 8	5	4%
Lab 9	5	4%
Lab10	5	4%
Assignment 1	20	10%
Assignment 2	20	10%
Assignment 3	20	10%
Final	100	30%

Grading Scale

A: 93–100
A–: 90–92.99
B+: 86–89.99
B: 83–85.99
B–: 80–82.99
C+: 76–79.99
C: 73–75.99
C–: 70–72.99
D+: 66–69.99
D: 63–65.99
D–: 60–62.99
F: < 60

Assignment and Assessment Information

There will be 10 weekly programming labs, three larger programming assignments, and a final exam. The labs/assignments will all require you to write Python code on your own machine and upload the .py file for grading. The details of each lab/assignment are provided in their own PDF files. No late submissions are allowed without previous permission for special circumstances.

Weekly Schedule

Each week there will be asynchronous videos/PowerPoint slideshows and integrated knowledge-check questions to watch and complete. Although there are no points assigned for watching videos or doing the knowledge-check questions, they are very important for learning the material. Please try to complete these videos early in the week.

Each week there will also be a lab due 12 hours before the live session. These labs are all programming based and focus on the content in the videos for the week. The labs will be discussed during the live session. All 10 labs make up 40% of your grade.

There will be three larger programming assignments given throughout the quarter. They will be discussed when given out during a live session and be due approximately 2.5 weeks later. All three assignments make up 30% of your grade.

There will be a final exam after the 10 weeks are completed. The final exam makes up 30% of your grade.

Week 1: Introduction to Algorithms

Videos/knowledge-check questions
Lab 1 due 12 hours before the live session

Week 2: Introduction to Paradigms

Videos/knowledge-check questions
Lab 2 due 12 hours before the live session
Assignment 1 assigned (due in Week 4)

Week 3: Asymptotics

Videos/knowledge-check questions
Lab 3 due 12 hours before the live session

Week 4: Divide-and-Conquer

Videos/knowledge-check questions
Lab 4 due 12 hours before the live session
Assignment 1 due 72 hours after the start of the live session

Week 5: Data Structures

Videos/knowledge-check questions
Lab 5 due 12 hours before the live session
Assignment 2 assigned (due in Week 7)

Week 6: Data Structures 2

Videos/knowledge-check questions
Lab 6 due 12 hours before the live session

Week 7: Optimization

Videos/knowledge-check questions
Lab 7 due 12 hours before the live session
Assignment 2 due 72 hours after the start of the live session

Week 8: Dynamic Programming

Videos/knowledge-check questions
Lab 8 due 12 hours before the live session
Assignment 3 assigned (due in Week 10)

Week 9: Greedy

Videos/knowledge-check questions
Lab 9 due 12 hours before the live session

Week 10: Backtracking

Videos/knowledge-check questions
Lab 10 due 12 hours before the live session
Assignment 3 due 72 hours after the start of the live session

Attendance Policy

Attendance at all live session meetings is mandatory.

Program Mission

Our MS in Data Science provides students with a broad course of study in programming, algorithms, statistics, and data management, as well as a depth of understanding in specific fields such as data mining, machine learning, and parallel systems. Graduates of the data science program go on to work in a wide variety of careers, including business, government, education, and the natural sciences.

Honor Code and Academic Integrity

All students are expected to abide by the University of Denver Honor Code. These expectations include the application of academic integrity and honesty in your class participation and assignments. Violations of these policies include but are not limited to

- Plagiarism, including any representation of another's work or ideas as one's own in academic and educational submissions
- Cheating, including any actual or attempted use of resources not authorized by the instructor(s) for academic submissions
- Fabrication, including any falsification or creation of data, research, or resources to support academic submissions

Violations of the Honor Code may have serious consequences including, but not limited to, a zero for an assignment or exam, a failing grade in the course, and reporting of violations to the Office of Student Conduct.

Diversity, Inclusiveness, Respect

DU has a core commitment to fostering a diverse learning community that is inclusive and respectful. Our diversity is reflected by differences in race, culture, age, religion, sexual orientation, socioeconomic background, and myriad other social identities and life experiences. The goal of inclusiveness, in a diverse community, encourages and appreciates expressions of different ideas, opinions, and beliefs, so that conversations and interactions that could potentially be divisive turn instead into opportunities for intellectual and personal enrichment.

A dedication to inclusiveness requires respecting what others say, their right to say it, and the thoughtful consideration of others' communication. Both speaking up *and* listening are valuable tools for furthering thoughtful, enlightening dialogue. Respecting one another's individual differences is critical in transforming a collection of diverse individuals into an inclusive, collaborative, and excellent learning community. Our core commitment shapes our core expectation for behavior inside and outside of the classroom.