# **COMP 550.** Algorithms and Analysis

### **Bulletin Description**

Formal specification and verification of programs. Techniques of algorithm analysis. Problem-solving paradigms. Survey of selected algorithms.

General Course Info	
Term:	Fall 2023
Department:	СОМР
Course Number:	550
Section Number:	002
Time:	MW, 04:00pm – 05:15pm
Location:	Davie 112
Website:	https://www.cs.unc.edu/~shareef/teaching/comp550/
Instructor Info	
Name:	Shareef Ahmed, Graduate Student Instructor
Office:	SN324
Email:	<pre>shareef@cs.unc.edu (Please use [COMP550] in your</pre>
	email subject to receive timely response)
Phone:	336-567-2015
Web:	<u>http://www.cs.unc.edu/~shareef</u>
Canvas:	https://uncch.instructure.com/courses/34716
Office Hours:	(Tentative) M 2:00pm-3:30pm (in person),
	Th 10:00am – 12:00pm (zoom)
7	

Zoom:

https://unc.zoom.us/j/8689310417?pwd=UnZTN3lqcnRTUVhrMWVGUCtyY TN6QT09

Meeting ID: 868 931 0417 Passcode: unc-cs

Learning Assistants Oliver Chen Zhehao Wang

Textbooks and Resources

# Introduction to Algorithms, 4<sup>th</sup> Edition.

Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein. MIT Press. If you already own a copy of the 3<sup>rd</sup> edition, you may not need to buy a new copy. However, you may need to befriend someone who owns a 4<sup>th</sup> edition copy. I will try to mention key differences for each topic during the lectures.

#### **Course Description**

An algorithm is a set of well-defined computational steps to solve a problem. The course emphasizes developing skills to devise algorithms for solving real-world problems. Additionally, emphasis is given on analysis of algorithms that includes proving correctness via sound mathematical techniques and measuring efficiency using time and space complexity.

#### **Target Audience**

The major target audience are undergraduate students with computer science major. Undergraduate students who intend to learn problem solving techniques using a computer program can take the class given they have met prerequisites.

Knowledge of the material of this course will be required to take courses and understand parallel and distributed computing, computer security, data mining, computer vision, robotics, etc.

### Prerequisites

COMP 211 (Systems Fundamentals) and 301 (Foundation of Programming); or COMP 410 (Data Structures); a grade of C or better is required in all prerequisite courses.

This course builds on data structures introduced in COMP 410. To implement algorithms, knowledge of programming at the level of COMP 410 or 211 is required. In addition, proof techniques introduced in COMP 283 or MATH 381 will also be heavily utilized.

Goals and Key Learning Objectives

- i. Develop skills to devise algorithms using appropriate data structures for real-life problems using common algorithmic paradigms.
- ii. Develop skills to analyze time and space complexity of an algorithm.
- iii. Develop the ability to compare different algorithmic solutions of a problem and determine their trade-offs.
- iv. Develop the ability to anticipate and determine tractability of a problem.
- v. Develop skills to deal with intractability using common techniques.

## **Course Requirements**

Instruction will be primarily through in-class lectures. In case of emergency (e.g., Covid), instruction may be provided via zoom.

Homework will be assigned approximately bi-weekly. Homework assignments will contain a written component focusing on algorithm design, correctness, and complexity analysis. Some assignments may have a programming component. Written component will enhance students' theoretical understanding of the material and the programming component will develop their ability to implement and understand nuances of different implementations.

There will be two midterm exams and a final exam, which will be closed book. Exams will be heavily drawn from class lectures and homework. Students are expected to demonstrate the skills they attained as given in goals and learning objectives.

In class quizzes will typically cover recent lectures.

Key Dates

Class start: Aug 21, 2023 Class end: Dec 6, 2023 Assignments will be due biweekly starting from week 3 or 4. Tentative dates for midterms are **Oct 4, 2023** and **Nov 8, 2023**. No classes: Sep 4 (Labor Day), Sep 25 (Well-being Day), Nov 22 (Thanksgiving) Final exam will be held according to the university calendar: Dec 14, 2023, 4:00pm-7:00pm

Course Schedule (Tentative)

Week no	Topics
1	Course introduction, what are algorithms, correctness
2	Condition 3: No class
3	Labor day, Correctness and runtime (cont'd)
4	Correctness and runtime (cont'd) , Condition 3
5	Asymptotic analysis
6	Well-being day, Asymptotic analysis (cont'd), Divide and
	Conquer
7	Divide and Conquer (cont'd), Recurrence relations
8	Recurrence relations, Midterm 1
9	Sorting algorithms

10	Greedy algorithms
11	Greedy algorithms (cont'd), Dynamic programming
12	Dynamic programming, Graph algorithms
13	Midterm 2, Graph algorithms (cont'd)
14	Graph algorithms (cont'd), Thanksgiving
15	Graph algorithms (cont'd)
16	NP-completeness, approximation algorithms, miscellaneous
	(if time allows)

Grading Criteria

Quizzes: 5% Assignments: 30% Midterm 1: 15% Midterm 2: 15% Final: 35%

Assignments will be graded both for correctness and style. For written component, good style implies that you give enough information to complete the questions but are not excessively verbose. For programming components, this means having well-documented (through comments and/or good variable/function names). Your lowest scoring assignment will be excluded when calculating your final assignment score.

There will be some in-class quizzes. Your two lowest scoring quizzes will be excluded when calculating your final quiz score.

# Attendance and Participation

Attendance will not be recorded. However, you are expected to attend all lectures. Participation in class and online discussions will be rewarded by increasing final grade by up to half a letter grade.

### **Course Policies**

**Assignments**: Written assignments are due by the class start time on the due date. As an example, if a written assignment is due on Sep 6, then it must be turned in before Sep 6 04:00pm. Written assignments can be turned in either in-class by a hard copy or via Canvas. Electronic submissions of written assignments MUST consist of one PDF. If multiple PDFs are submitted for a single assignment (e.g., each page as a separate file), only one will be graded. You are responsible for the readability of your homework. If some portions of an answer are difficult to understand due to clumsy handwriting or poor scan quality, you will receive a zero for that answer. One suggested approach

is to typeset written assignments using LaTeX. A convenient way to work using LaTeX is via overleaf.com.

Programming assignments are due by 11:59pm on the due date. As an example, if a programming assignment is due on Sep 6, then it must be turned in before Sep 6 11:59pm. Programming assignments must be turned via Canvas. Assignment grades will be posted within a week of submission.

Written assignment questions will be marked as "collaborative" or "individual." Collaborative written questions may be discussed with a group of up to four students including yourself. Final answers should be your own, and everyone must turn in their own assignment. If you are having difficulties forming a group, please email me.

For programming questions, whether you can collaborate or not, how many students can form a group, what sort of collaboration is allowed, will be mentioned in the assignment documents.

Each assignment has two late days. A late assignment must be turned in within 48 hours of the original submission deadline. A late assignment will receive 80% of the received total point. No assignment will be accepted 48 hours after the due date. Late assignments must be submitted via Canvas.

For assignments, you can use any non-human, non-AI based resources without the ones that give you exact answers (e.g., CLRS manual, Stack Overflow, etc.). Using AI-based text generator (e.g., ChatGPT) is prohibited. When you take help from a resource, you must acknowledge it in your answer by citing it (book/paper title, URL of online resources, etc.). Failing to do so is an honor code violation. If you are unsure about whether a resource is acceptable, please ask me.

The course final is given in compliance with UNC final exam regulations and according to the UNC Final Exam calendar.

**Quizzes**: In-class quizzes will be based on recent lectures. These quizzes can both be pre-declared or unannounced. Some quizzes may be anonymous and will not be counted towards final grade.

**Exams**: Exams are closed-book, closed-note. You will be allowed "cheat sheets" for the exams: 1 for each midterm and 3 sheets for the final. Your cheat sheets can be hand-written or typed on 8.5"x11" paper, double-sided, and you must create your own.

In case of an unavoidable conflict with any exam dates, it is your responsibility to notify me as early as possible so that a make-up exam can be arranged. If you have an unanticipated emergency, such as illness, I reserve the right to require evidence, such as a Doctor's note, to take a make-up exam.

## Honor Code

The Honor Code applies to all assignments. If you have questions about the Honor Code, please ask me. If I find you are cheating, I will refer you to the honor council. Quizzes and exams are entirely individual grades. Any giving or receiving of aid on quizzes and exams is considered an honor code violation. Making a collaborative effort on individual homework problems, or failing to cite all resources on homework, is also an honor code violation.

## Disclaimer

The instructor reserves the right to make changes to the syllabus, including due dates and test dates. These changes will be announced as early as possible. It is your responsibility to regularly check the course webpage to keep track of important dates (e.g., midterms).

## Services & Student Support Policies

## Accessibility Resources & Services (ARS)

<u>Accessibility Resources and Service</u> (ARS – <u>ars@unc.edu</u>) receives requests for accommodations, and through the Student and Applicant Accommodations Policy determines eligibility and identifies reasonable accommodations for students with disabilities and/or chronic medical conditions to mitigate or remove the barriers experienced in accessing University courses, programs and activities. ARS also offers its Testing Center resources to students and instructors to facilitate the implementation of testing accommodations. Faculty and instructors with any concerns or questions about accommodations and/or their implementation, are invited to <u>reach out to ARS</u> to discuss.

# Counseling & Psychological Services (CAPS)

UNC-Chapel Hill is strongly committed to addressing the mental health needs of a diverse student body. The <u>Heels Care Network</u> website is a place to access the many mental health resources at Carolina. CAPS is the primary mental health provider for students, offering timely access to consultation and connection to clinically appropriate services. Go to their website <u>https://caps.unc.edu/</u> or visit their facilities on the third floor of the Campus Health building for an initial evaluation to learn more. Students can also call CAPS 24/7 at 919-966-3658 for immediate assistance.

### **Title IX Resources**

Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitation, or stalking is

encouraged to seek resources on campus or in the community. Reports can be made online to the EOC at <u>https://eoc.unc.edu/report-an-incident/</u> or by contacting the University's Title IX Coordinator (Elizabeth Hall, <u>titleixcoordinator@unc.edu</u>) or the Report and Response Coordinators in the

Equal Opportunity and Compliance Office

(<u>reportandresponse@unc.edu</u>). Confidential resources include Counseling and Psychological Services and the Gender Violence Services Coordinators (<u>gvsc@unc.edu</u>). Additional resources are available at <u>safe.unc.edu</u>.