Course Syllabus
COMP 750 – Algorithm Analysis
Fall 2022

Meeting Place: FB007
Meeting Time: 11:00 - 12:15, TuTh
Course Web Page: http://www.cs.unc.edu/∼anderson/teach/comp750. The powerpoint slides and other things can be found here.

Instructor: Prof. Jim Anderson
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Office Hours: 12:30 - 1:30, TuTh

Homework Grader: Shareef Ahmed
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Goal of the Course: To study issues related to the design and analysis of algorithms. This is a graduate course that picks up where most typical undergraduate courses leave off. By the end of the course, you should be able to construct formal proofs (even fairly intense ones) regarding algorithmic correctness and complexity, have an awareness of basic algorithmic techniques and how to apply them, have an awareness of important categories of algorithms, be able to read proof-oriented papers on algorithms without fear, and know what it means for a problem to be intractable, how to show it, and what to do about it if you want to solve the problem anyway.

Text: *Introduction to Algorithms*, Four Edition, Cormen, Leiserson, Rivest, and Stein, McGraw Hill, 2022.

We will also use various other handouts. These handouts can be found on the course web page. **Note:** This edition of CLRS is brand new so **there are going to be typos** (in the powerpoints, homeworks, maybe even this syllabus) — please let me know if you spot any. If you already own an older edition of the book, you can get by without buying the new edition, but one chapter (on ML) is new and some of the exercises and problems have been renumbered. On account of these things, you'll probably want to befriend someone who owns the fourth edition.

Prerequisites: COMP 550 and COMP 455. Material from probability theory and discrete math will be used heavily. You are advised to review this material, because it will not be extensively covered in class. See Chapters 1-5 and the appendices of CLRS.

You should not register for COMP 750 if you do not know the material covered in COMP 550. As for COMP 455, it is required so that you already know how to do proofs and have seen Turing machines before. (See the web for syllabi for these courses.)

Grading:	Homework	30%
	Two Midterm Exams	35%
	Final Exam	35%

Homework assignments will be given approximately every two weeks. Students can expect most homework assignments to be rather time-consuming. Students are encouraged to work together on the problem sets. Note that this says *work together* — copying homework solutions from another student, from the Internet, solution sets of friends who have taken this course or one similar to it previously, or other sources will be considered cheating and referred to the student attorney general. *You must include a signed honor statement with each submission explicitly listing the people you worked with and stating that you completed the assignment in accordance with these rules.* A more comprehensive statement on

allowable collaboration will be distributed with the first homework.

Homework assignments are due *in class* on the due date given. *No late homeworks will be accepted*. However, in calculating your homework average, your lowest score will be dropped.

Each midterm exam will be 1 hour and 15 minutes in duration. The final exam will be 3 hours in duration. The final exam will cover the entire course. Each of these exams will be administered in class.

Note: I do re-use old homeworks and exam questions. Any attempts to access old homeworks and exams from the files of students who have taken this course previously, or from other sources, will be considered an honor code violation. Also, any attempt to upload homework or exam solutions on the Internet will be considered an honor code violation.

Class Etiquette: You are expected to maintain proper etiquette in class. This includes:

- not making a habit of arriving late, or leaving in the midst of class,
- not talking, sleeping, reading newspapers, eating, etc. in class,
- keeping cellphones off,
- and not using your laptop to browse the web.

Note: Posting materials from this class online without prior authorization is an honor code violation.

Class Participation: This class will be far more enjoyable for everyone if all students come to class ready and willing to discuss the material to be covered. I plan to reward those who participate in class by increasing their final grade by up to half a letter grade. I also reserve the right to add a similar negative "reward" for those who do not observe appropriate etiquette in class.

Topics: The list of topics I plan to cover is given below. Chapters 1-17 and 20-22 are considered to be background material. If a few of these topics look unfamiliar, then you should probably review them during the first few weeks of the semester. If more than a few look unfamiliar, then you should probably consider taking COMP 550 before taking COMP 750. (**Note:** I often ask former students who did really well in this class to sub for me when I travel — something you can aspire to! This can result in a slight alteration in the schedule because I tend to give these subs easier material to cover.)

Topics Covered	Classes
Administrivia	1
Introduction to the course	
Bullet-list overview of 550 and 455 material	
RANDOMIZED ALGORITHMS AND PROBABILISTIC ANALYSIS	3
Better brush up on your probability theory!	
Handout -- Skiplists	
Chapter 7 -- Quicksort	
We concentrate on the analysis; you should know how Quicksort works.	
ADVANCED DATA STRUCTURES	5
Handout -- Binomial Heaps	
The handout is Chapter 19 from the 2nd edition of CLRS	
Chapter 19 -- Data Structures for Disjoint Sets	

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Chapter 18 -- B-Trees
Handout    -- Splay Trees

GRAPH ALGORITHMS                                                        3
   Knowledge of Chapters 20-22 is assumed.
Chapter 22 -- Quick review of Dijkstra's Algorithm and
              the Bellman-Ford Algorithm
Chapter 23 -- All-Pairs Shortest Paths
Chapter 24 -- Maximum Flow
Handout    -- Irrational Flows

INTRACTABILITY THEORY                                                   5
Chapter 34 -- NP-Complete and Related Problem Classes
   I will present Turing machine-based proofs from another text,
   rather than the proofs given in Chapter 34.  Knowledge of Turing
   machines is assumed.
Handout    -- Strong NP-Completeness and Pseudo-Polynomial-Time
              Algorithms

MISCELLANEOUS TOPICS
Chapter 35 -- Approximation Algorithms                                  1
Chapter 33 -- Machine-Learning Algorithms                               2
Chapter 31 -- Number-Theoretic Algorithms                               2
Chapter 29 -- Linear Programming                                        2
Chapter 30 -- Polynomials and the FFT                                   1
   If any topic has to be sacrificed because of time constraints, it
   will be Chapter 30, because FFTs are covered in other classes.

TOTAL                                                                  25

We have 28 classes total.  Two will be used for exams.

Note: I will sometimes use chapters from older editions of CLRS in teaching
these topics (I've not always liked the changes they've made).  This material
will be provided to you.
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University Resources:

Accessibility Resources: The University of North Carolina at Chapel Hill facilitates the implementation of reasonable accommodations, including resources and services, for students with disabilities, chronic medical conditions, a temporary disability or pregnancy complications resulting in barriers to fully accessing University courses, programs and activities. Accommodations are determined through the Office of Accessibility Resources and Service (ARS) for individuals with documented qualifying disabilities in accordance with applicable state and federal laws. See the ARS Website for contact information: `https://ars.unc.edu` or email `ars@unc.edu`.

Counseling and Psychological Services (CAPS): CAPS is strongly committed to addressing the mental health needs of a diverse student body through timely access to consultation and connection to clinically appropriate services, whether for short or long-term needs. Go to their website: `https://caps.unc.edu/` or visit their facilities on the third floor of the Campus Health Services building for a walk-in evaluation to learn more.

Title IX Resources: Any student who is impacted by discrimination, harassment, interpersonal (relation-

ship) violence, sexual violence, sexual exploitation, or stalking is encouraged to seek resources on campus or in the community. Please contact the Director of Title IX Compliance (Adrienne Allison Adrienne.allison@unc.edu), Report and Response Coordinators in the Equal Opportunity and Compliance Office (reportandresponse@unc.edu), Counseling and Psychological Services (confidential), or the Gender Violence Services Coordinators (gvsc@unc.edu; confidential) to discuss your specific needs. Additional resources are available at safe.unc.edu.