Analysis of Algorithms (COSC 302) — Spring 2018 — Syllabus

Professor: Darren Strash
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Location: 315 McGregory Hall
Time:

- Section A: T 8:30am–11:10am (Lecture), R 9:20am–11:10am (Lab)
- Section B: T 1:20pm–4:00pm (Lecture), R 1:20pm–3:10pm (Lab)

Course Website: http://cs.colgate.edu/~dstrash/cosc302
Office Hours: T 4:10pm–5:10pm, W 8am–10am, R 3:20pm–4:20pm, and by appointment. There will be exceptions: consult http://cs.colgate.edu/~dstrash/cosc302/calendar for current office hours.

Course Textbook: *Introduction to Algorithms*, MIT Press, 3rd Edition (preferred).
by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein
The book is available as an e-book through Colgate University's library here.

Other Sources: I will potentially draw from *many* sources, including research papers, discrete math and algorithms textbooks, and lecture notes from other institutions. If supplementary reading is essential to understanding, it will be posted on the course website.

Course Summary and Goals

Efficient algorithms and data structures play a critical role in making modern applications not only *fast* but, in many cases, *possible*. GPS navigation and word processing, for example, would be much slower and much more frustrating without efficient routing and text searching algorithms, and Internet searching, DNA sequencing and VLSI manufacturing may not exist as we know it today.

In this course you will learn how to analyze, design, and implement efficient (generally non-numerical) algorithms to solve problems in diverse application areas. At the end of the course you will be *fluent* in the language of algorithms: you will be able to prove their correctness, analyze their properties, and apply algorithmic techniques to solve new problems efficiently.

Planned Topics

Mathematical writing; proof structure and techniques; proving algorithm correctness; asymptotic analysis; recurrences; the master method; tree data structures; hashing; worst-case and average-case analysis; sorting; searching; selection; lower bounds and optimality; algorithm paradigms: greedy, divide-and-conquer, and dynamic programming; graphs; graph traversals; shortest path algorithms; minimum spanning trees; network flow; geometric algorithms; linear programming; NP-completeness; approximation algorithms; parameterized algorithms

Lecture: Philosophy, Expectations & Grading

Active Participation and Collaborative Learning

The classroom should be a vibrant atmosphere that is safe and conducive to learning. One my goals for this course to create an atmosphere of acceptance that encourages everyone to openly ask and answer questions. Making this a reality requires everyone's persistent and diligent participation. You must be *present* & *ready* for discussions, *tolerant* and *respectful* of others, and the classroom must be free of distractions.

Recitations will be *dynamic* and include many components: group discussions, worksheets, visualizations, games, board work and slides. *Every student will be called on to participate at some point during the course.* It is therefore important to be ready to discuss the day's topic.

Weekly Reading, Video Lectures, and Classroom Participation

This course is different from any other computer science course at Colgate. Lectures are in the style of a *recitation*—which consists of solving many practice problems at all levels of collaboration: individual, group-based, and as a class; students are expected to have an intermediate understanding of course material through readings and lecture videos before coming to recitation. This understanding is then refined and strengthened during recitation. Recitations should be viewed as an opportunity to clarify and expand on the material from the reading, not replace it. *Actively* and *judiciously* reading the material (by weaving together repeated reading, solving practice problems, annotating, and thoroughly questioning of your understanding) and watching lecture videos is highly recommended.

Come to class prepared to actively discuss the reading, ask questions, apply principles to new problems, and to exercise your creative problem solving skills. Active and enthusiastic participation in discussions is *highly* encouraged and incentivized through the *donut tracker*: participation from every student is rewarded with donuts.

Check-ins

Part of being an active participant in the class is attending class regularly and on time to contribute to discussions and classroom dynamic. Arriving on time is especially important, given that late arrivals are distracting. To encourage attendance and on-time arrival, weekly "check-in" worksheets will be given, to be completed at the beginning of class. Only those present and arriving on time will receive points for these check-ins. They are designed to gauge the current depth of understanding of a topic and will be used as a catalyst for discussion.

Missed check-ins due to illness and athletic competitions are always excused, but to be excused the student must notify the instructor that this is the case. For athletic competitions, notification must be given in advance of the absence.

Homework

Assignments must be legibly written (or typed, preferably in LaTeX) on paper free from perforations, and fixed with a staple in the upper left corner. You are expected to show your work and explain your logic both precisely and succinctly. Each homework problem is graded on the following 5-point scale:

Points	Description	
5	*Mastered:*	Fully correct or contains a minor error
4	*Sufficient:*	Contains a serious error, but overall idea is correct
3	*Borderline:*	Contains correct work, but only half of problem solved
2	*Understood:*	An incorrect answer that shows understanding
1	*Attempted:*	An attempt was made
0	*Unattempted:*	No response or answer disjoint from problem

There will be 8 homework assignments, each worth 5 percent of the total grade. Students are strongly encouraged to typeset homework assignments using LaTeX, as it is the standard tool for typesetting mathematical formulae in books and professional publications. Any student who uses LaTeX for *all* homework assignments will be given a 5% bonus on the final exam. LaTeX files of all homeworks and notes will be made available as a reference.

Assignments will not be accepted late except under extenuating circumstances, such as serious illness or a death in the family. Accommodations must be arranged **well in advance** for athletic competitions, religious celebrations, and the like.

Algorithm Write-Up

Each student is expected to complete a 1 to 2 page **algorithm write-up** on a topic not covered in class. A list of available topics will be posted mid-semester, and will be assigned to students on a first-come first-served basis. Students may also propose a topic, but the topic must be approved by the instructor. The write-up must written in LaTeX, using an instructor-provided template. The template will be single-spaced,

written with 11 point font, the paper should be 1-2 pages in length, excluding references. The write-up will be graded on mastery of the topic, precision in writing, and succinctness. Formatting and text-length will be strictly enforced. Students should avoid the "standard" 5-paragraph format, which is rarely used in real-world writing. Every sentence should have a clear purpose. Points will be removed for "filler" text—text that simply exists without a meaningful purpose.

Exams

Exams will measure depth of understanding and mastery of the material. In line with this, only a small portion of any exam will be devoted to *recalling* material (such as definitions, algorithm running time, and other facts). The vast majority of questions (and points) are instead devoted to *creatively* applying algorithmic principles to solve new problems. Exams are *cumulative*. **Midterm exams** are closed book and closed notes; however, a formula sheet will be provided. The **final exam** is closed book and *open notes*; however, no digital materials are allowed. It is therefore strongly recommended that each student take extensive notes on a physical medium. **To pass the class, you must pass the final exam.**

Lecture Grade Breakdown

Grading will take place on the standard scale—however, the performance of the class as a whole will be taken into consideration. If adjusted, class performance will only be used to increase grades. Grades will *not* be curved—which unfairly disadvantages some students. The lecture's grade breakdown will be as follows:

Category	Percentage
Check-ins	5%
Homework	40%
Algorithm write-up	5%
Midterm exam I	15%
Midterm exam II	15%
Final exam	20%

Lab: Philosophy, Expectations & Grading

This lab puts algorithmic principles into practice. The lab will consist of weekly projects that complement the current topic and generally consist of implementing efficient algorithms and conducting experiments.

Projects. The lab will consist of 15 projects of varying complexity. The expectation is that the projects can be completed during lab time. However, work may occasionally spill over the allotted time. Instructions will be clearly given for each project. Projects will include a coding portion, a write-up, and in some cases a code review. Projects will not be accepted late except under extenuating circumstances, such as serious illness or a death in the family. Accommodations must be arranged **well in advance** for athletic competitions, religious celebrations, and the like.

Lab Grade Breakdown

Grading will take place on the standard scale. The lab's grade breakdown will be as follows:

Category	Percentage	Grading method
Participation	25%	Attendance and completing work
Projects	75%	Rubric for project outcomes

Participation is difficult to make up. Each lab missed without notice will result in a loss of 5% from the participation portion of your grade. Let me know **well in advance** if you cannot attend a lab: this will be handled on a case by case basis.

Important Dates

Date	Event
January 31	End of add/drop
February 27	Midterm exam I
March 13 & 15	No class (Midterm recess)
March 28	Deadline for S/U option & withdrawal without WF
April 3	Midterm exam II
May 8	Final exam: 9am–11am (Section B)
May 10	Final exam: 3pm–5pm (Section A)

Other Important Information

Academic Honesty

You are expected to abide by Colgate's academic honor code (which you can find at http://www.colgate.edu/offices-and-services/deanofthecollege/academichonorcode). Collaboration (such as discussing problems and brainstorming ideas for solving them) is highly encouraged, but the work you submit must be your own. Unless work is explicitly to be done in groups, give only information as a tutor would: ask questions so that your classmate is able to figure out the answer for themselves. It is unacceptable to share any artifacts, such as code and/or write-ups, unless explicitly allowed by the assignment. If you do collaborate, you must clearly state with whom you collaborated on any submitted work. Failing to acknowledge your collaborators can be considered a violation of the honor code.

Seeking Help

Position yourself for success: Form study groups as soon as possible and actively read, study for exams, and work on homework assignments together. Come to my office hours regularly, even if you aren't struggling. If you start to struggle, come see me right away (even outside of office hours).

Contact the Counseling Center: College life can sometimes get bumpy; if you are experiencing emotional or personal difficulties, seek help right away. The counseling center offers completely confidential and highly professional services, and can be contacted at 315-228-7385. If this seems like a difficult step, come find me. We can talk and call or walk to the Counseling Center together.

Contact Academic Support and Disabilities Services: If you believe you may need accommodation for a disability, contact me privately to discuss your specific needs. If you have not already done so, please contact Lynn Waldman, Director of Academic Support and Disability Services at 315-228-7375, or via e-mail at lwaldman@colgate.edu, in the Center for Learning, Teaching, and Research. She is responsible for determining reasonable and appropriate accommodations for students with disabilities on a case-by-case basis, and more generally, for ensuring that members of the community with disabilities have access to Colgate's programs and services. She also assists students in identifying and managing the factors that may interfere with learning and in developing strategies to enhance learning.