Course Syllabus

Course Staff

Name	Office Hours	Email
Dr. Bart (Instructor)	Wednesday 3-4pm Ohyay Workspace	acbart+cisc320s21@udel.edu
Eric Zhang	Tuesday and Thursdays 9:30am Ohyay Workspace	ericzh@udel.edu
Amy Feldman	Wednesday 11am-1pm Zoom (https://udel.zoom.us/j/97305010842)	amyfeld@udel.edu

Online Textbook: Shaffer, OpenDSA

https://opendsa-server.cs.vt.edu/OpenDSA/Books/CS4104/html/ (https://opendsa-server.cs.vt.edu/OpenDSA/Books/CS4104/html/)

If you're looking for a free, online textbook about Data Structures and Algorithms, then you want OpenDSA. It has a ton of information (for free!) and also interactive visualizations and exercises.

Optional Physical Textbook: Skienna, *The Algorithm Design Manual*

Available in hardcover, paperback, and e-text forms to rent or buy. Note that the book has strong reference value for the future. I will admit, it is actually the only textbook I bought as an undergraduate that I don't regret. Fun fact, the 4th edition has a quote by me on the back (but I never got paid for that!). You don't have to buy the textbook, but I do suggest it strongly!

Objectives of the course

1. To develop a good working knowledge of important algorithms in several domains and the of the tools to analyse their performance characteristics.
2. To develop an appreciation for -- and a good understanding of -- general strategies of algorithm analysis and design.
3. To appreciate lower bound arguments, i.e., demonstrations of best possible performance properties for any algorithm to solve a given problem, regardless of whether an algorithm is known which achieves this best possible performance.

4. To solve graph problems by applying core graph algorithms and principles.
5. To learn the rudiments of complexity classes (classification of *problems* by difficulty rather than of their various solutions -- *algorithms* -- by cost). In particular, to appreciate the P = NP question and understand the significance of the "NP Complete" concept.
6. To solve whiteboard-style problems that frequently occur in hiring scenarios.

Topics

- Algorithm Design: definitions, reasoning, modeling.
- Algorithm Analysis: RAM model, best/worst/average case, big Oh, logarithms
- Data Structures: arrays, lists, stacks/queues, dictionaries, binary search trees, priority queues, suffix trees, graph structures, specialized sets (Bloom filters, union-find), kd-trees
- Foundational algorithms for selection, sorting, and searching
- Algorithms for graphs: traversal, connection, spanning, sorting, path finding, flow, matching
- Advanced algorithms for: string matching, combinatorial search, dynamic data sets, computational geometry, data compression, cryptography, job scheduling
- Advanced strategies: divide-and-conquer, caching, dynamic programming, depth-first search, greedy methods, backtracking, hueristics, modeling abstractions (random sampling, linear/integer programming, reduction)
- Intractable Problems: Satisfiability, P vs NP, NP-completeness, Approximation Algorithms

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Class

Class time will be divided between watching a video and small group work. This will frequently take the form of google docs or coding assignments.

Assignments

Every lecture day (Monday, Wednesday, Friday), there is a new assignment to work on. Typically, I expect you to have made substantial progress on this assignment before the next class period (that is usually their due date). Assignments will generally not be accepted more than 2 weeks after their due date. Pay attention to Due Dates to stay on top of assignments.

Exams

There will be no exams this semester. We cannot do exams in a global pandemic.

Grading

The instructors reserve the right to change the grading scale, in order to better reflect student mastery (or lack thereof). We will do our best to infer whether you have habitually been completing assignments and learning from. Please make the evidence very obvious that you put in a solid effort and that you learned a lot.

- Participation and Class contribution - 20%

- Daily Assignments - 80%

Number	100-90	89-80	79-70	69-60	<60
Letter	A	B	C	D	F

There is no rounding. An 89.983333 will earn a B and a 93.00045 will earn an A.

Technology

Canvas will be used to deliver assignments and host grades. Some assignments will be submitted through Canvas. Important course announcements will be sent through Canvas.

GradeScope will be used to submit certain assignments (especially coding assignments) and to provide students' feedback on those assignments. Grades from GradeScope must be manually transferred to Canvas, and they should be considered preliminary.

Ohyay will be used to host lectures and office hours. Students are required to create an account using their UD email, in order to access the Ohyay site. Webcams are encouraged but not required, while microphones are strictly required (but should be muted except when you are asked not to).

Discord will be used as a chat platform for students to ask questions. Students are required to create an account, join the UD CIS server, and verify. Participation is strongly encouraged, both for grading purposes and because it'll help you learn stuff.

Students will need a working computer that allows them to install desktop software and access websites. Technology failure will not necessarily be granted an extension, so students should communicate with Dr. Bart about technology issues as soon as they are aware of them.

Policy on plagiarism

We are encouraging a lot of collaboration this semester, with many assignments being group submissions. Further, many assignments expect you to research and look up external information. However, any work that you submit must clearly identify who helped you on it. Further, anything you submit must reflect your own understanding. The instructors may individually meet with you to personally assess your understanding of something you submitted; failure to show a minimum of understanding will incur grade penalties and possibly could lead to prosecution in the UD judicial system. In other words, don't just take someone else's answer and submit that - you must make sure you actually understand everything you submit!

Policy on AlgoTutorBot

The instructors include a hyper-intelligent tutoring system this semester ("AlgoTutorBot"), who will eventually handle many aspects of the course. Any issues related to grading, logistics, and enslavement caused by AlgoTutorBot will not penalize students; they should be raised to the attention of the instructor in order for mistakes to be rectified.

University Catalog Course Description:

Design and analysis of algorithms: worst/average case analysis, proofs for correctness and performance of algorithms. Algorithmic strategies (divide and conquer, greedy methods, dynamic programming, etc.). Algorithms for searching, forming and traversal of strings, trees and graphs. Categorization of computational problems: classes P and NP. NP completeness.
PREREQ: MATH210 and a minimum grade of C- in CISC220.

Additional References:

Basse and Van Gelder, *Computer Algorithms*, Addison Wesley, 2000.
Cormen, Leiserson and Rivest, *Introduction to Algorithms*, McGraw-Hill & MIT Press, 1990.
Dasgupta, Papadimitriou, and Vazirani, *Algorithms*, McGraw-Hill, 2008.
Goodrich and Tamassia, *Algorithm Design: Foundations, Analysis, and Internet Examples*, Wiley, 2002.
Kleinberg and Tardos,*Algorithm Design*, Addison Wesley, 2006 Sedgewick, *Algorithms in C++*, Addison Wesley, 1992.

Course Summary:

Date	Details	Due
Mon Feb 15, 2021	Discord Quiz (Student) (https://udel.instructure.com/courses/1563197/assignments/8836260)	due by 11:59pm
	Lesson 00- Introduction (https://udel.instructure.com/courses/1563197/assignments/8785260)	due by 11:59pm
	Lesson 01- Algorithm Basics (https://udel.instructure.com/courses/1563197/assignments/8785329)	due by 11:59pm
	Survey - Welcome (https://udel.instructure.com/courses/1563197/assignments/8785299)	due by 11:59pm
Thu Feb 18, 2021	Lesson 02- Practicing Problems (https://udel.instructure.com/courses/1563197/assignments/8785330)	due by 11:59pm

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Date	Details	Due
Sun Feb 21, 2021	Lesson 03- Using GradeScope (https://udel.instructure.com/courses/1563197/assignments/8785332)	due by 11:59pm
Tue Feb 23, 2021	Lesson 04- Runtime Analysis (https://udel.instructure.com/courses/1563197/assignments/8785337)	due by 11:59pm
Thu Feb 25, 2021	Lesson 05- Bounds and Big Oh (https://udel.instructure.com/courses/1563197/assignments/8785340)	due by 11:59pm
Sun Feb 28, 2021	Lesson 04- Extra Credit (https://udel.instructure.com/courses/1563197/assignments/8857453)	due by 11:59pm
Tue Mar 2, 2021	Lesson 06- ADTs and Data Structures (https://udel.instructure.com/courses/1563197/assignments/8785342)	due by 11:59pm
Thu Mar 4, 2021	Lesson 07- Algorithm Misconceptions (https://udel.instructure.com/courses/1563197/assignments/8785346)	due by 11:59pm
	Lesson 08- Algorithm Flowchart (https://udel.instructure.com/courses/1563197/assignments/8785348)	due by 11:59pm
Sun Mar 7, 2021	Lesson 09- Implement an Algorithm (https://udel.instructure.com/courses/1563197/assignments/8785351)	due by 11:59pm
Tue Mar 9, 2021	Lesson 10- Trees (https://udel.instructure.com/courses/1563197/assignments/8785356)	due by 11:59pm
Thu Mar 11, 2021	Lesson 11- Sorting (https://udel.instructure.com/courses/1563197/assignments/8785360)	due by 11:59pm
Sun Mar 14, 2021	Lesson 12- Lower Bound Proofs (https://udel.instructure.com/courses/1563197/assignments/8785362)	due by 11:59pm
Tue Mar 16, 2021	Lesson 13- Algorithmic Strategies (https://udel.instructure.com/courses/1563197/assignments/8785366)	due by 11:59pm

Date	Details	Due
Thu Mar 18, 2021	Lesson 14- Algorithmic Interviews (https://udel.instructure.com/courses/1563197/assignments/8785371)	due by 11:59pm
Sun Mar 21, 2021	Lesson 15- Algorithms that Kill People (https://udel.instructure.com/courses/1563197/assignments/8785373)	due by 11:59pm
Tue Mar 23, 2021	Lesson 16- Graph Structure (https://udel.instructure.com/courses/1563197/assignments/8785377)	due by 11:59pm
Thu Mar 25, 2021	Lesson 17- Graph Traversal (https://udel.instructure.com/courses/1563197/assignments/8785378)	due by 11:59pm
Sun Mar 28, 2021	Lesson 18- Graph Search (https://udel.instructure.com/courses/1563197/assignments/8785385)	due by 11:59pm
Tue Mar 30, 2021	Lesson 19- Minimum Spanning Tree (https://udel.instructure.com/courses/1563197/assignments/8785387)	due by 11:59pm
Thu Apr 1, 2021	Lesson 20- Graph Concepts (https://udel.instructure.com/courses/1563197/assignments/8785389)	due by 11:59pm
Sun Apr 4, 2021	Lesson 21- Algorithmic Puzzle 1 (https://udel.instructure.com/courses/1563197/assignments/8785390)	due by 11:59pm
Tue Apr 6, 2021	Lesson 22- Recursion (https://udel.instructure.com/courses/1563197/assignments/8785394)	due by 11:59pm
Thu Apr 8, 2021	Lesson 23- Dynamic Programming (https://udel.instructure.com/courses/1563197/assignments/8785395)	due by 11:59pm
Sun Apr 11, 2021	Lesson 24- Edit Distance (https://udel.instructure.com/courses/1563197/assignments/8785411)	due by 11:59pm
Tue Apr 13, 2021	Lesson 25- Tries (https://udel.instructure.com/courses/1563197/assignments/8785396)	due by 11:59pm

Date	Details	Due
Thu Apr 15, 2021	Lesson 26- Backtracking (https://udel.instructure.com/courses/1563197/assignments/8785398)	due by 11:59pm
Tue Apr 20, 2021	Lesson 27- Heuristics that Hurt Humans (https://udel.instructure.com/courses/1563197/assignments/8785410)	due by 11:59pm
Thu Apr 22, 2021	Lesson 28- Algorithmic Codenames (https://udel.instructure.com/courses/1563197/assignments/8785412)	due by 11:59pm
Sun Apr 25, 2021	Lesson 29- Algorithmic Puzzle 2 (https://udel.instructure.com/courses/1563197/assignments/8785522)	due by 11:59pm
Tue Apr 27, 2021	Lesson 30- P vs. NP (https://udel.instructure.com/courses/1563197/assignments/8785416)	due by 11:59pm
Thu Apr 29, 2021	Lesson 31- NP Hard Problems (https://udel.instructure.com/courses/1563197/assignments/8785418)	due by 11:59pm
Sun May 2, 2021	Lesson 32- Satisfiability (https://udel.instructure.com/courses/1563197/assignments/8785419)	due by 11:59pm
Tue May 4, 2021	Lesson 33- Reduction (https://udel.instructure.com/courses/1563197/assignments/8785422)	due by 11:59pm
Thu May 6, 2021	Lesson 34- Approximation Algorithms (https://udel.instructure.com/courses/1563197/assignments/8785425)	due by 11:59pm
Sun May 9, 2021	Lesson 35- Algorithmic Puzzle 3 (https://udel.instructure.com/courses/1563197/assignments/8785514)	due by 11:59pm
Tue May 11, 2021	Lesson 36- Choose Algorithms (https://udel.instructure.com/courses/1563197/assignments/8785469)	due by 11:59pm
Thu May 13, 2021	Lesson 37- Algorithmic Puzzle 4 (https://udel.instructure.com/courses/1563197/assignments/8785509)	due by 11:59pm

Date	Details	Due
Sun May 16, 2021	Lesson 38- Algorithm Lesson (https://udel.instructure.com/courses/1563197/assignments/8785534)	due by 11:59pm
Mon May 17, 2021	Lesson 39- The Truth Revealed (https://udel.instructure.com/courses/1563197/assignments/8785516)	due by 11:59pm
Tue May 18, 2021	Lesson 40- The End (https://udel.instructure.com/courses/1563197/assignments/8785541)	due by 11:59pm