
CSC301 Algorithms and Data Structures

Professor. Leon Tabak

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Calendar

	MON	TUE	WED	THU	FRI
Week 1	16	17	18	19	20
Week 2	23	24	25	26	27
Week 3	30	31	01	02	03
Week 4	06	07	08	09	10

Our meeting times and places

My office is in Law 206C.

You may call me in my office at (319) 895 4294.

You may send me electronic mail at <1.tabak@ieee.org>.

I will be in my office and available to meet with you Monday through Friday from 3:00 p.m. until 3:30 p.m.

We will all meet together in the classroom in the mornings and in the laboratory in the afternoons.

	Where	When
Classroom	Law Hall 113	9 a.m. to 11 a.m.
Laboratory	Law Hall 109	1 p.m. to 3 p.m.

Textbooks

Algorithms (Fourth Edition) [<http://algs4.cs.princeton.edu>] . Robert Sedgwick and Kevin Wayne. Addison-Wesley.
Copyright © 2011. 978-0-321-57351-3.

Etiquette for the Classroom

Please show respect to your classmates, to me, and to the seriousness of our enterprise by exercising the following courtesies:

- Please give your attention to whomever is speaking. That'll be me some of the time, but it will be you some of the time too.

Did you bring a computer to class? Good. We will find ways to use your computer to accomplish the goals that we have set for ourselves in this course.

Now, please turn off the games. Close windows that are displaying news, electronic mail, and scores from the world of sports. Put the earbuds away.

- Please do not interrupt and distract the class by late entries, early departures, or by coming less than fully prepared to make your contribution to the class. If you anticipate a need to be absent or late, please notify me in advance of your anticipated absence. With all due respect to Admiral Grace Murray Hopper, excuses after the fact will not succeed.
- Tastes in music vary. Some people need more quiet than others in order to concentrate. I and your classmates would like to know that we, and not an MP3 player, have your attention when we speak to you. Keep these things in mind.
- Please refrain from bringing food or drink into the classroom or laboratory.
- Please refrain from the use of vulgar language.
- Please do not wear clothing or buttons that bear vulgar messages or images. Indeed, it is best to avoid wearing messages of any kind. Outside of the classroom, I will be happy to discuss with you any issue of the day. Inside of the classroom, it is rude to broadcast opinions unrelated to our subject because our work there does not allow anyone else to respond to your challenge (or to decline your invitation to debate).

- Please keep shoes on and hats off in the classroom. Leave your pajamas and bathrobe at home. Test the limits of social conventions if you must during the more than 80% of the week during which we shall be apart.
- Please demonstrate your love for your fellow man or woman with kind words and gracious gestures but delay other physical expressions of tenderness until our work is done and you have found a more private setting.

Policies

Cornell College is committed to providing equal educational opportunities to all students. If you have a documented learning disability and will need any accommodation in this course, you *must* request the accommodation(s) from the instructor of the course and no later than the third day of the term. Additional information about the policies and procedures for accommodation of learning disabilities is available on Cornell College's Web site [<http://www.cornellcollege.edu/academic-support-and-advising/disabilities/academic-accommodation/index.shtml>].

Please also familiarize yourself with the college's statement on academic honesty [<http://www.cornellcollege.edu/registrar/pdf/Academic%20Honesty.pdf>] and its policies for dropping courses [<http://www.cornellcollege.edu/registrar/gb-resources-student/add-drop.shtml>]

Description of the course

Measurements of complexity. Comparison of methods for searching and sorting data. Alternative ways of organizing data in lists, tables, and trees. Prerequisites: CSC 140, 144, 151, and MAT 120 or 121.

Goals

We will give special attention to three of Cornell College's Educational Priorities and Outcomes: [<http://www.cornellcollege.edu/catalogue/introducing-cornell-college/educational-objectives.shtml>]

- Reasoning—you will learn how to divide a big problem into a set of smaller problems and how to compose sequences of logical and arithmetic operations that produce solutions.
- Communication—you will practice describing your solutions in spoken and written words
- Vocation—you will gain a familiarity with people who have contributed to the development of computer science and with important applications of computer science. You might discover in these examples models and inspirations for your own careers.

Objectives of the course

Upon the successful completion of this course, students will be able to:

- Identify important uses of stacks, queues, trees, sets, and maps.
- Design, write, and test programs that make use of classes in Java's Collections framework.
- Design, write, and test classes that model lists and binary search trees.
- Analytically and experimentally measure the time and space required to solve a problem using given algorithms and data structures.

- Present programs that they have written to their peers using Javadoc documentation, UML class diagrams, UML use cases, and the JUnit testing framework.
- Describe the attitudes and habits that define professional practice in software engineering.

Grades

Written work will be due on each day of the term except for the first day and the last day. Printed copies and electronic copies of your papers will be due at 9 a.m.

Experience presenting work to peers will be a central part of the course. Practice asking your teammates questions during their presentations, critiquing their decisions, and suggesting improvements to their code will also be an important part of your education during this term. We will schedule one day in each week of the term for you to present your work.

	Activity	Points
	Daily work	10
	Examination 1 (Wednesday, March 25)	20
	Examination 2 (Tuesday, March 31)	20
	Examination 3 (Wednesday, April 08)	20
+	Code reviews (3 presentations)	30
		100

Daily schedule

Monday, March 16

Read.

Read Section 1.5 (pages 216–240).

Discuss.

Reasons for analyzing algorithms, application of the scientific method, the development of successively better solutions.

The dynamic connectivity problem and its application in modeling computer networks, social networks, mathematical sets, and the equivalence of variable names in computer programs.

Equivalences sets, trees, and inductive reasoning.

Write.

Write solutions to Problems 1.5.1, 1.5.2, 1.5.3, 1.5.4, 1.5.5, and 1.5.6 on page 235 in *Algorithms*.

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Tuesday, March 17

Read.

Read Section 1.4 (pages 172–215).

Discuss.

A closer look at the use of the scientific methods in computer science. The roles of experimentation and mathematical models. Useful mathematical functions, approximations, and commonly encountered orders of growth. Common misunderstandings and false assumptions. Reasons for not giving performance the highest priority.

Write.

Write solutions to Problems 1.4.37, 1.4.38, 1.4.39, and 1.4.44 on pages 214–215 in *Algorithms*.

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Wednesday, March 18

Read.

Read Section 1.3 (pages 120–171).

Discuss.

Abstract data types to represent bags, queues, and stacks. Linked data structures. Generic and iterable collections. The FIFO and LIFO disciplines.

Write.

Write solutions to Problems 1.3.42 and 1.3.43 on page 170 in *Algorithms*.

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Thursday, March 19

Read.

Read Section 2.1 (pages 243–269).

Discuss.

Reasons for studying sorting algorithms. Methods for analyzing and comparing algorithms. Criteria for evaluating algorithms. Selection sort, insertion sort, and shell sort.

Write.

Write solutions to Problems 2.1.24, 2.1.25, and 2.1.26 on page 267 in *Algorithms*.

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Friday, March 20

Read.

Read Section 2.2 (pages 270–287).

Discuss.

Mergesort. Divide and conquer strategy for solving problems. Top-down and bottom-up approaches. Advantages of combining the mergesort and insertion sort algorithms. Trade-offs in the use of space and time.

Write.

Write solutions to Problems 2.2.1, 2.2.2., and 2.2.3 on page 284 in *Algorithms*.

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Monday, March 23

Read.

Read Section 2.3 (pages 288–307).

Discuss.

Tony Hoare's Quicksort algorithm. Complementary relationship between quicksort and mergesort algorithms. Methods for partitioning the array to be sorted. Errors that can reduce efficiency of algorithm. Improvements upon the original algorithm.

Write.

Write a solution to Problem 2.3.16 on page 305 in *Algorithms*.

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Tuesday, March 24

Read.

Read Section 2.4 (pages 308–335).

Discuss.

A abstract data type to model priority queues. Binary heaps, their properties, operations on binary heaps, and the use of binary heaps to model priority queues. The heapsort algorithm, its optimal use of space and time, and its poor cache performance.

Write.

Write solutions to Problems 2.4.1, 2.4.6, and 2.4.9 on page 329 in *Algorithms*.

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Wednesday, March 25

Read.

There is no reading assigned for today.

Discuss.

Ask your classmates questions about their projects. Offer your classmates suggestions for the improvement of their projects.

Write.

Examination 1 and presentations of projects.

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Thursday, March 26

Read.

Read Section 3.2 (pages 396–423).

Discuss.

Binary search trees. Properties of binary search trees. Operations on binary search trees. Simplicity vs. costs of operations in the worst case.

Write.

Write solutions to Problems 3.2.6 and 3.2.7 on page 416 in *Algorithms*.

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Friday, March 27

Read.

Read Section 3.3 (pages 424–456).

Discuss.

Ways of maintaining balance in search trees (and thereby keeping costs of operations low). Red-black and 2-3 trees. Local transformations and global properties. Application of balanced search trees in symbol tables.

Write.

Write solutions to Problems 3.3.1, 3.3.2, 3.3.10, and 3.3.11 on page 449 in *Algorithms*.

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Monday, March 30

Read.

Read Section 3.4 (pages 458–485).

Discuss.

Hash tables. Hash functions. Characteristics of a good hash function. Methods for resolving collisions: separate chaining and linear probing. The tradeoff between space and time. Amortized analysis.

Write.

Write solutions to Problems 3.4.4, 3.4.5, 3.4.6, and 3.4.7 on page 480 in *Algorithms*.

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Tuesday, March 31

Read.

There is no reading assigned for today.

Discuss.

Ask your classmates questions about their projects. Offer your classmates suggestions for the improvement of their projects.

Write.

Examination 2 and presentations of projects.

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Wednesday, April 01

Read.

Read Section 4.1 (pages 515–565).

Discuss.

Graphs and their applications. Methods of representing graphs. Depth-first and breadth-first searches. Degrees of separation and Bacon numbers.

Write.

Write solutions to Problems 4.1.1., 4.1.2, 4.1.3, 4.1.4, and 4.1.5 on page 558 in *Algorithms*.

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Thursday, April 02

Read.

Read Section 4.2 (pages 566–602).

Discuss.

Directed graphs. Cycles. Topological sorts. Connectivity and reachability.

Write.

Write solutions to Problems 4.2.1, 4.2.2, 4.2.3, 4.2.4, and 4.2.5 on page 596 in *Algorithms*.

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Friday, March 03

Read.

Read Section 4.3 (pages 604–636).

Discuss.

Minimum spanning trees. Greedy algorithms. Prim's and Kruskal's algorithms.

Write.

Write a solution to Problem 4.3.10 on page 631 in *Algorithms*.

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Monday, April 06

Read.

Read Section 4.4 (pages 638–693).

Discuss.

Shortest paths. Dijkstra's algorithm. The Bellman-Ford algorithm. The Critical Path Method for scheduling parallel tasks.

Write.

Write solutions to Problems 4.4.2 and 4.4.6 on page 685 in *Algorithms*.

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Tuesday, April 07

Read.

There is no reading assigned for today.

Discuss.

Review the course. Ask your classmates questions about their projects. Offer your classmates suggestions for the improvement of their projects.

Write.

Present reports on projects.

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Wednesday, April 08

Read.

There is no reading assigned for today.

Discuss.

There is no discussion scheduled for today.

Write.

Final examination.

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Thursday, April 09

Read.

There is no reading scheduled for today.

Discuss.

We will not meet today.

Write.

There is no writing assigned for today.

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Friday, April 10

Read.

There is no reading assigned for today.

Discuss.

We will not meet today.

Write.

There is no writing assigned for today.

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