

# ALGORITHMS -- COS554

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## GOALS

1. To present some of the major strategies for designing and discovering algorithms.
2. To present some key algorithms and data structures.
3. To provide the mathematical background for understanding an algorithm and analyzing its performance.
4. To improve your programming skills.

## PREREQUISITES

COS 250, COS 350 and good programming skills.

## GRADING

Your final average will be computed using the harmonic mean of your homework grade and your exam grade as described below. This method places equal emphasis on homework and exams. If you get a poor grade in either homework or exams it will seriously drag your average down.

There will be a midterm and a final in this course, together with weekly homeworks.

1. I will use +/- grading in the class. The grades will be assigned on the basis of your **final class average** based on the following ranges:

A	-- 90 or above	C	-- 70 to 72
A-	-- 85 to 89	C-	-- 65 to 69
B+	-- 83 or 84	D+	-- 63 or 64
B	-- 80 to 82	D	-- 60 to 62
B-	-- 75 to 79	D-	-- 55 to 59
C+	-- 73 or 74	E	-- 54 or below

2. To encourage improvement, I will replace your midterm score by the final score if it is better. For example, if you get 70 on the midterm and 80 on the final, both scores will be counted as 80. This means that a poor midterm score will not hurt you if you improve.
3. The homework average is the arithmetical average of the homework scores.
4. The exam average is computed as follows:

$$\text{EXAM\_AVG} = \text{ADJ\_MIDTERM}/3 + 2*\text{FINAL}/3$$

where  $\text{ADJ\_MIDTERM} = \text{MAX}(\text{MIDTERM}, \text{FINAL})$ .

The final average is computed by

$$\text{FINAL\_AVG} = \text{HARMONIC\_MEAN}(\text{EXAM\_AVG}, \text{HW\_AVG}).$$

5. All numbers are rounded and the letter grades are assigned according the scale mentioned in 1.

Note, however, it is important that you do and understand the homework, since parts of the exams will be based directly on the homework problems. I will go over the homework problems in class after the HWs have been graded.

### **THE HARMONIC MEAN APPROACH TO GRADING**

In this course, both the homework and exams are very important. The arithmetical mean that is often used to average course grades allows a good performance in one area to offset a poor performance in another. Since I want to emphasize good performance in both homework and exams, I will use the harmonic mean of your homework grade and your exam grade as your final average.

The harmonic mean is very sensitive to extremes in performance. In other words, if your homework and exam grades are close to one another, their harmonic mean is essentially the same as the usual arithmetic mean. If they are far apart, the harmonic mean is pulled sharply down toward the lower grade. Thus, students who copy their homework from others cannot use the good grades they obtain in this manner to offset their poor exam grades. The following table gives you sample values.

				<b>Exam Grade</b>										
		<b>40</b>	<b>45</b>	<b>50</b>	<b>55</b>	<b>60</b>	<b>65</b>	<b>70</b>	<b>75</b>	<b>80</b>	<b>85</b>	<b>90</b>	<b>95</b>	<b>100</b>
	<b>40</b>	40	42	44	46	48	50	51	52	53	54	55	56	57
	<b>45</b>	42	45	47	50	51	53	55	56	58	59	60	61	62
	<b>50</b>	44	47	50	52	55	57	58	60	62	63	64	66	67
<b>HW Grade</b>	<b>55</b>	46	50	52	55	57	60	62	63	65	67	68	70	71
	<b>60</b>	48	51	55	57	60	62	65	67	69	70	72	74	75
	<b>65</b>	50	53	57	60	62	65	67	70	72	74	75	77	79
	<b>70</b>	51	55	58	62	65	67	70	72	75	77	79	81	82
	<b>80</b>	53	58	62	65	69	72	75	77	80	82	85	87	89
	<b>85</b>	54	59	63	67	70	74	77	80	82	85	87	90	92
	<b>90</b>	55	60	64	68	72	75	79	82	85	87	90	92	95
	<b>95</b>	56	61	66	70	74	77	81	84	87	90	92	95	97
	<b>100</b>	57	62	67	71	75	79	82	86	89	92	95	97	100

The exact formula for the harmonic mean is

$$F = 2*E*H/(E+H)$$

Here E is the exam grade and H is the homework grade. Your final grade F will be computed by using this formula exactly and rounding off to the nearest whole number.

## ADDITIONAL NOTES

1. The midterm is listed on the schedule below.
2. The midterm and final are closed book and in class.
3. The midterm and final are cumulative and cover all the material up to the time that they are given.
4. To ensure that you have adequate time on the midterm and final, they will be scheduled at times when ample time will be available. The details on this will be presented in class.
5. Partial credit will be given on exam problems.
6. I want people to work on the homework individually. You can talk to each other and give help, but this help should not take the form of letting other people copy your work. It is important that you understand how to do all the problems on your own. Otherwise you cannot do well on the exams. The harmonic mean grading scheme requires good performance on both the homework and exams in order to get a good grade. **If you need help, please ask questions in class and see me during office hours.**
7. The homework grading will be strict since the goal is to make you more careful. Errors are the source of much mischief, so it is important to reduce them as much as possible. Even minor arithmetical mistakes will result in points being lost, so do your work carefully.
8. If a problem asks you to write a program, a function or a procedure, always submit a printed listing and output, even if the problem does not explicitly ask for these. **Handwritten code is not acceptable.**
9. If your programs have bugs, I expect you to make a reasonable effort to find the bug on your own. I will be happy to help you find problems in your programs, but you must come with evidence that you have tried to find the problem on your own and the program I see should have evidence of your efforts to debug it.
10. If you run out of time and must turn in a program that doesn't run, submit output showing the crash and the error message as well as a listing.
11. be sure that your listings include comments that explain what you are doing if it is not completely obvious. It is up to you to explain what you are doing.
12. If you do not understand a problem get a clarification from me. Do not waste a lot of time working on something that you don't understand.

13. I do not accept late homework except in special circumstances. You must get permission in order to turn your homework in late. Such permission is the exception rather than the rule. Homework turned in late without permission will lose points.

14. Since this is a graduate course, I expect very high quality submissions from you. **Points will be deducted for sloppy or disorganized work.**

15. Programs must be integrated into your homework manuscript. In other words, don't just hand in a program listing stapled to the homework. Place it close to the text giving the answer to that particular problem. It must be clearly labeled and relevant parts highlighted. In particular, I don't want little short paragraphs that say "see PROGRAM..." with a pile of printout attached. The pages of the homework should be consecutively numbered.

16. Any program that you submit must include sample output that adequately tests it. This sample run should not be copied from the screen by hand and should not be a screen dump attached separately. If you want to use a screen dump, put it close to the relevant problem in the homework and give adequate indications of where the output can be found. Alternatively, have the output sent to a file and include the file in your manuscript. You should think carefully about what constitutes an adequate test for each program that you write. You will lose points for inadequate testing.

17. When you write programs, pay attention to the human interface. The requests for data should be reasonable. Ridiculous interfaces will lose points just for being ridiculous.

18. Be sure that you answer the question. If you are asked for an analysis of an algorithm, be sure to supply one. Do not assume that you will receive the bulk of the points simply for coding it. Also, if I ask you to analyze a particular algorithm, analyze the one you are given. Don't analyze some other algorithm. Don't answer questions that are "almost" like the questions you are asked.

19. I expect your algorithms to be reasonably efficient. Just simply whipping something together that gets the job done might not be enough. Also, if you make modifications to algorithms, you will lose points if you make the algorithm perform significantly less efficiently from what was presented.

20. Do not scatter your work all over the place. I will not read through listings to find an analysis of an algorithm. This analysis should be in the text, not in the listing somewhere.

21. Submit all necessary pieces. I don't want to guess what data types you used, etc.

22. You will lose points for submitting poorly organized and unreadable material. **I expect your homework to be stapled together not paper clipped together.**

23. You will lose points for poor programming style. I do not want to see hoards of global variables in your programs. You have been taught how to do things correctly and I want to see you do it.

24. I will post current grades on the web encoded by class ID. This process will be explained in class and you will be able to pick your class ID. You should check this listing regularly to make sure that your grades have been recorded correctly.

**25. I am only interested in grading your original work. I am not interested in grading solutions to the problems that have been posted by other professors on the Web. You can lose many points if you simply copy solutions from other people or other sources.**

## **OFFICE HOURS**

Office : 237 Neville Hall.  
Office Hours : 10:45-12:00 Tuesdays, and Thursdays. Please check website.  
Phone : 581-3940  
E-mail : markov on any system  
Website : [www.cs.umaine.edu/~markov](http://www.cs.umaine.edu/~markov)

Please check <http://www.umcs.maine.edu/~markov/appointments.html> to make sure I will have time to see you. In general, it is best if you make appointments via the website. That way I can notify you in case anything changes.

If you are planning to come to office hours from far away please check with the Computer Science Office (581-3941) to make sure that some event will not prevent me from being at office hours. If you have problems with this course and need help come in to see me immediately. Don't fool around until the end of the semester and then try to learn all the material in a week.

## **TEXT**

The text for the course is *Introduction to Algorithms: 2nd Edition* by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, MIT Press, 2001.

## COS 554 SYLLABUS

The book is too large to cover completely in one semester, but we will cover a good portion of it. See the syllabus below. I reserve the right to modify the syllabus as we go along.

I occasionally have to travel during the semester. If this happens, I will work to reschedule any missed classes to a mutually convenient time.

DATE	EVENT
1/13	Chaps. 1 & 2 Introduction to the Study of Algorithms
1/15	Chaps. 3 & 4 Asymptotic Analysis and Recurrences
1/20	Chap. 5 Probabilistic Analysis
1/22	Chap. 5 Probabilistic Analysis
1/27	Chaps. 6 & 7 Heapsort and Quicksort
1/29	Chap. 8 Sorting in Linear Time
2/03	Chap. 9 Medians and Order Statistics
2/05	Chap. 10 Elementary Data Structures
2/10	Chap. 11 Hash Tables
2/12	Chap. 12 Binary Search Trees
2/17	Chaps. 13 & 14 Red-Black Trees and Augmenting Data Structures
2/19	Chap. 15 Dynamic Programming
2/24	Chap. 16 Greedy Algorithms
2/26	Chap. 16 Greedy Algorithms
3/03	<b>SPRING BREAK</b>
3/05	<b>SPRING BREAK</b>
3/10	<b>SPRING BREAK</b>
3/12	<b>SPRING BREAK</b>
3/17	<b>MIDTERM</b>
3/19	<b>MIDTERM Review</b>
3/24	Chap. 17 Amortized Analysis
3/26	Chap. 18 B-Trees
3/31	Chap. 19 Binomial Heaps
4/02	Chap. 20 Fibonacci Heaps
4/07	Chap. 21 Data Structures for Disjoint Sets
4/09	Chap. 23 Minimum Spanning Tree
4/14	Chap. 29 Linear Programming
4/16	Chap. 29 Linear Programming
4/21	Chap. 34 NP-Completeness
4/23	Chap. 34 NP-Completeness
4/28	Chap. 35 Approximation Algorithms
4/30	Chap. 35 Approximation Algorithms

Typically, homeworks will be due one week after being assigned. If we proceed faster than the proposed syllabus, I will pick some additional topics from the book to cover. As you can see, we are skipping quite a few chapters. The final will be announced as soon as the final exam schedule is published. The final exam will take place the week of May 4, 2009. We will discuss all arrangements in class.