Computer Science 305
Analysis of Algorithms I
Winter 2015

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Class Time:	MTWF 11:00 - 11:50
Office Hours:	MTF 12:30 - 1:30
	and by appointment

Objectives: Introduce the student to the analysis of algorithms and data structures in a mathematically rigorous fashion. We will cover the necessary mathematical fundamentals and then delve into worst-case, probabilistic and amortized analysis techniques. We will apply these techniques to sorting algorithms and classic data structures.

Course Outcomes: Upon completion of this course students will demonstrate:

- Basic understanding of the mathematical concepts of asymptotic notation, recurrence relations and loop invariants.
- Basic understanding of worst-case, probabilistic and amortized analysis techniques.
- Thorough understanding of the complexity of sorting algorithms and standard operations on common data structures, such as heaps, trees and hash tables.
- Thorough understanding of divide and conquer.
- Basic understanding of the formulation and analysis of probabilistic algorithms.
- The ability to analyze and formulate solutions for abstract problems.
- The ability to derive the time and space complexity of basic algorithms.
- The ability to use mathematical reasoning in correctness proofs of algorithms.

Prerequisites: CSCI 301, 241

Text: *Introduction to Algorithms* third edition by Cormen, Leiserson, Rivest and Stein

Online Resources: All course documents will be posted on Canvas. You will turn in homework using Canvas.

Help: You are welcome to drop by my posted office hours to discuss anything related to class. You can also drop by my office outside of office hours and if my door is open and I'm not talking with someone else I will talk with you. If my door is closed please do not even knock.

Grading:

- **Homework and Final Exam.** Four regularly scheduled homework assignments will be due at the start of class on the specified date. **No late assignments will be accepted**. The value of each homework is: HW1 10%, HW2 12%, HW3 14%, HW4 17%. A take home final exam worth 22% of your grade will have a written component due on March 16 at noon and an oral component that will be held on March 17 or 18. Grades for homework and exams will be based upon the the correctness of your solution as well as the clarity and elegance of your presentation. **I am requiring that all assignments be created in LaTeX and and turned in as a PDF so that I can electronically mark up assignments using Adobe Reader and return them to you via email**.
- **Deep Learning Exercise.** This will be an open-ended group project worth 10% of your grade. Details for this assignment will be presented in a separate handout.
- **Self Assessment Report.** When you turn in your final exam you will also turn in a self assessment report in which you will analyze and demonstrate to me your progress on the assessment items listed below. The report must also contain verbiage that recounts personal experiences, class notes, discussions, etc. that helped you reach these goals. You should be monitoring your progress on these items and be compiling this self-assessment report continuously throughout the quarter. I may ask you to show me your report during the quarter. Your self assessment report will count for 5% of your final grade. Do not take this aspect of the course lightly.
- **Class Participation.** The remaining 10% of your final grade is composed of class participation. Class participation encompasses: (1) attendance, (2) asking and answering questions during lecture, (3) constructively contributing to in-class group exercises.

Schedule: The tentative lecture schedule for the course is as follows. Each bullet point corresponds to about four to six class meetings. I will announce the specific sections of each chapter for which you are responsible in class or via email and possibly assign supplemental reading for some topics.

- Preliminaries, Growth of Functions, Sums, Series, Sets (Chapters 1-3, Appendix A, B)
- Proof Techniques, Loop Invariants, Recurrences (Chapters 1-4)
- Counting and Probability, Probabilistic Analysis, Introduction to Randomized Algorithms (Chap 5, Appendix C)
- Amortized Analysis (Chapter 17)
- Analysis of Hash Tables, Heaps, Trees (Chapters 6, 11, 12)
- Balanced Trees and Augmented Data Structures (Chapters 13, 14)
- Analysis of Sorting Algorithms (Chapters 6, 7, 8)

Assessment Items: I expect students to achieve the following upon completion of this course:

- Engage in class discussions and/or one-on-one discussions relating to course material.
- Understand the mathematical concepts behind asymptotic notation.
- Create and solve recurrences and summations which represent the worst case running time of an algorithm.
- Use a loop invariant to prove the correctness of an algorithm.
- Understand the basics of probability theory, apply it to randomized algorithms, and demonstrate how to use indicator random variables.
- Use worst-cast analysis to quantify the performance of standard operations on common data structures.
- Employ probabilistic analysis to quantify the performance of a randomly created data structure (e.g. hash table) or randomized algorithm.
- Demonstrate the use of amortized analysis techniques.
- Demonstrate the ability to augment a classic data structure to expand its applicability.
- Derive the time and space complexity of classic sorting algorithms.
- Analyze an abstract problem and formulate an efficient solution.
- Write clear and concise proofs.

Academic Honesty

Academic dishonesty is defined in the University Catalog as misrepresentation by deception or by other fraudulent means which compromises an instructor's ability to fairly evaluate a student's work or achievement.

I encourage you to go over lecture notes with classmates and you may work with classmates to solve problems from the text book that are not on homework assignments. However, each homework is to be completed individually. You may **discuss** homework problems with your classmates but no written account (on paper or a whiteboard, etc.) is to be kept or shared. You must independently write up solutions to the homework problems even if you discussed the homework with a classmate. **You may not talk about any aspect of the final exam with anyone other than me**. You may ask for my help on homework or the final via email or during office hours.

Any student who violates the University policy on academic honesty or the specific rules in the paragraph above will receive an F for the course. Please refer to the University catalog for further information and do not hesitate to ask me if you are unsure of anything relating to academic honesty.