
CS 404-31 - Analysis of Algorithms
Fall 2003, Northeastern Illinois University

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Meeting: TR 5:40-6:55 PM - FA 153

Office hrs: MWTR 4:30-5:30 PM

Description: This course serves as an introduction to different techniques for the design and the analysis of algorithms for selected problems. We will cover techniques such as divide-and-conquer, dynamic programming, greedy approaches, backtracking, and branch-and-bound. We will introduce asymptotic notation to analyze the complexity of algorithms. Students will be expected to understand and apply these techniques into the resolution of sample problems.

Course Prerequisites: CS 201, CS 304

Text: Neapolitan, Richard and Naimipour Kumars. Foundations of Algorithms Using C++ Pseudocode, 3rd Edition. Jones and Bartlett Publishers, 2004.

Course Outline: (subject to change due to time constraints)

1. Review of Mathematical Background

- Notation, functions and related theorems
- The logarithmic function
- Sets, permutations and combinations
- Probability

2. Algorithms: Efficiency, analysis and order

- Efficient algorithms
- Analysis of algorithms
- Order

3. Solving recurrence relations

- Induction, characteristic equations, and substitution methods
- Extending results

4. Divide-and-Conquer

- Definition
- Applications: Binary search, mergesort, quicksort
- More applications: Matrix Multiplication, Arithmetic with large numbers
- Determining thresholds

5. Dynamic programming

- Definition, binomial coefficient
- Applications: Shortest path, optimization problems, matrix multiplication
- More applications: Binary search trees, traveling salesperson problem

6. The greedy approach

- Definition
- Applications: Minimum spanning tree, shortest path, scheduling
- Greedy vs. dynamic programming

7. Backtracking

- Definition
- Applications: the n -queens, sum-of-subsets, graph coloring
- More applications: Hamiltonian circuit, 0-1 knapsack

8. Branch-and-bound

- Definition
- Applications: 0-1 knapsack, TSP, abductive inference
- Design options and examples

9. Computational Complexity

- Introduction, notation, and definitions
- Sorting: Comparison of algorithms, lower bounds, sorting by distribution
- Searching: comparison and interpolation techniques, searching in trees, hashing
- The selection problem

10. Intractability

- Definition
- Three general problems
- NP theory
- Handling NP -Hard problems

Assignments:

- **Homeworks:** Eleven, each due the week after a chapter is finished. Some of the problems will involve programming.
- **Quizzes:** Ten, each on the class following a homework due date
- **Research Project:** A group short research and presentation about one of the main subjects of the course
- **Exams:** A Midterm and a Final

There will be no makeup for missed quizzes, projects, or exams

Grading Policies:

1. The average over the eight best quizzes scores will be worth 10% of your grade. The research project will be worth 25% of your grade. The Midterm will be worth 25% of your grade. The final exam will be worth 40% of your grade. Homework submission is optional, and will be counted as extra credit together with in class participation.
2. Group projects assume collaboration. With the submission of a project students will be required to assess participation in an anonymous way. To preserve the integrity of the process, participation assessment will be applied to the projects score at the end of the semester and will affect directly the research project portion of a students final grade.
3. Regular attendance is expected. Any student who misses more than three class meetings will have her/his final course grade reduced by a letter
4. Cheating on exams, quizzes or homeworks will guarantee the student an F grade, and a report according to school's guidelines
5. No Ws, Is will be granted after the school's withdrawal deadline (Fri, Nov. 7th)

6. Your final grade will be based on the following scale:

- **A** - 90% or above
- **B** - 80 – 90 %
- **C** - 65 – 80 %
- **D** - 50 – 65 %
- **F** - below 50%

If you have a physical, psychological, medical or learning disability that may impact on your ability to carry out assigned course work, I would urge that you contact the staff in the Accessibility Center office, Room A-118 in the A-Wing, exts. 5495, 5496, and 5497. The Accessibility Center will review your concerns and determine with you what accommodations are necessary and appropriate. All information and documentation of disability are confidential.