BOSTON UNIVERSITY METROPOLITAN COLLEGE COMPUTER SCIENCE DEPARTMENT

MET CS 566 ANALYSIS OF ALGORITHMS

Course Overview

Algorithm design and analysis provide the theoretical background for designing and analyzing algorithms including sorting, searching, dynamic programming, greedy algorithms, graph algorithms (shortest path, spanning trees, tree traversals), etc.

Course Format On Campus
Time and location Monday 6:00 PM – 8:45 PM, Room CAS 322

Prerequisites

MET CS 248 Discrete Mathematics and MET CS 341 or MET CS 342 Data Structures or instructor's consent

Learning Objectives

This course attempts to provide an overview of the theory of algorithm design and analysis, and encourage students to develop and implement algorithms for various practical applications. Topics to be covered include Asymptotic notation; Sums and Recurrences; Divide and Conquer; Dynamic Programming; Greedy Algorithms; Graph Algorithms; Advanced Data Structures; Machine Learning algorithms and NP Completeness for decision problems.

Upon completion of this course, the student should learn:

- Principles of algorithm analysis and design
- Classification of functions by their asymptotic growth rate
- Abstract Data Type (ADT) specification and design techniques
- Elementary ATDs: lists, trees, stacks, queues, and dynamic sets
- Recursive procedures
- Induction proofs
- Principles of proving correctness of procedures
- Sorting algorithms (Insertion Sort; Divide and Conquer; Quicksort; Mergesort; Heapsort; and Radix Sorting)
- Dynamic sets and searching algorithms, including Hashing
- Graphs and Graph Traversals, including Depth-First Search algorithms on directed and undirected graphs
- Graph optimization problems, greedy and Minimum Spanning Tree algorithms; Huffman codes

- All-Pairs Shortest Paths in Graph algorithm
- Principles and techniques of dynamic programming, including the method of constructing optimal binary search trees
- Basic Machine Learning Algorithms
- Overview of NP-complete decision problems and approximation algorithms

Required Textbook

Sara Baase, Allen Van Gelde, "Computer Algorithms", 3rd Ed.,
Addison-Wesley,2000, ISBN-0-201-61244-5

Recommended book T.H. Cormen, C.E. Leiserson,
R.L. Rivest, and C. Stein, "Introduction to Algorithms,"
3rd Ed., MIT Press, 2009, ISBN-13: 9780262033848.

Courseware

Only a part of the lecture notes will be available in traditional digital-file formats (*.doc, *.ppt, and *.pdf) on the Blackboard site related to our course. Some handouts will be distributed in class and some notes will be written on the classroom board. Please, take notes every class and share the notes if someone needs them.

Blackboard Learn, URL: https://learn.bu.edu

Evaluation and Grading

There will be two exams. If any grading criteria event will be missed it will be the responsibility of the student to arrange a mutually agreeable schedule for completion of work.

The grade is made up of your performance on your homeworks, labs, project paper, midterm and final exams. Approximate weightings are as following:

Assignments	Percentage
Six Written Homework Assignments	48%
Midterm Exam	26%
Final Exam (or Project Paper)	26%

Letter Grade:

94 ≤ G:	A,	77 ≤ G < 80:	C+
90 ≤ G < 94:	A-	73 ≤ G < 77:	C
87 ≤ G < 90:	B+	70 ≤ G < 73:	C-
83 ≤ G < 87:	B	60<G<70:	D
77 ≤ G < 80:	C+	G<70 :	F

There will be no make-up exam for the final exam. If a student cannot take the final exam on the designated day, she/he will receive an incomplete grade.

Academic Honesty

The course is governed by the Academic Conduct Committee policies regarding plagiarism (any attempt to represent the work of another person as one's own). This includes copying (even with modifications) of a program or segment of code. You can discuss general ideas with other people, but the work you submit must be your own. Collaboration is not permitted. See link below

http://www.bu.edu/met/metropolitan_college_people/student/resources/conduct/c ode.html.

Instructor Information

Dr. Alexander Belyaev
Computer Science Department,
Metropolitan College Boston
University, 808 Commonwealth
Ave, Room 250 Boston, MA 02215
Office: 617-353-2566,
Email: abelyaev@bu.edu

Office Hours: After each class meeting

Tentative Schedule

- The schedule is subject to change according to the actual progress of the class. Some topics may be skipped and some topics may be added.

- Students are encouraged to review book chapters assigned for each lecture before coming to class.

SESSION	TOPIC	READING	HOMEWORKS
1 (09/10)	Preliminaries (Chapters 1-2): What is an algorithm? Principles of algorithm analysis and design. Classification of functions by their asymptotic growth rate. Big-*O* and similar notations. Abstract Data Type (ADT) specification and design techniques.	Ch. 1, 2	
2 (09/17)	Elementary ATDs: lists, trees, stacks, queues, and dynamic sets. Recurrence equations and their solution. Applications of recurrences. Induction proofs and examples. Principles of proving correctness of procedures. Review of series and sets. A little probability.	Ch. 2, 3	
3 (09/24)	Sorting Algorithms (Heapsort, quicksort, mergesort, and radixsort). Proof that sorting (by comparisons) takes *O*(n log(n)) time. Medians and order statistics. **Homework #1 due**	Ch. 4	**Homework #1 due 09/24**
4 (10/01)	Divide and conquer techniques for mergesort and quicksort. **Homework #2 due**	Ch. 4, 5	**Homework #2 due 10/01**
5 (10/09)	Dynamic Sets: Amortized time analysis;	Ch. 6	
6 (10/15)	Dynamic programming; Examples and principles**; Homework #3 due.** Mid-term Exam Preparation.	Ch. 10	**Homework #3 due 10/15**
7 (10`/22)	**[MID-TERM EXAM] Ch. 1-6, 10**	Ch. 1-6, 10	**MID-TERM EXAM**
8 (10/29)	Graph optimization problems, greedy and Minimum Spanning Tree algorithms; Huffman codes.	Ch. 8	
9 (11/05)	Graph algorithms: Graph representations; Graph traversals. **Homework #4 due**	Ch. 7	**Homework #4 due 11/12**
10 (11/12)	Graph algorithms (continue): Spanning trees or forests; Shortest paths; and Maximum flow.	Ch. 7,9	
11 (11/19)	String matching: Rabin-Karp and Knuth-Morris-Pratt algorithms. **Homework #5 due**	Ch. 11	**Homework #5 due 11/19**
12 (11/26)	NP-complete problems.	Ch. 13	
13 (12/03)	Machine Learning algorithm. **Homework #6 due**	Slide presentation	**Homework #6 due 12/03**
14 (12/10)	Miscellaneous topics and review.	Handouts	
15 (12/17)	**[FINAL EXAM] Ch. 7-8, 11-13, or Project Paper**	Ch. 7-8, 11,13	**[FINAL EXAM] or Project Paper**

Communication

- All official announcements will be made in the class.
- All assignments will be posted on the class web page.
- **Important:** The primary method of communication is through in-class announcements. So, if you miss a class you need to talk to a friend in the class or contact me to find out whether there was any important announcement.