



Shanghai Jiao Tong University

CS249 Algorithms and Analysis (Online)

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| Instructor Information | Professor An Email: xiangdong.an@hotmail.com Office Hour: Determined by Instructor | | |
| Term | June 28, 2021 - July 27, 2021 | Credits | 4 units |
| Course Delivery | The class will be delivered in the format of online. Other than recorded lecture videos, the instructor will arrange 2 hours' real-time interactions with students per week (via discussion forum, zoom meeting, and WeChat). The workload students are expected to complete to properly pass this course is about 15 hours per week. | | |
| Required Texts (with ISBN) | Recommended Texts: T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, 2009, Introduction to Algorithms, 3 rd edition, The MIT Press. ISBN: 978-0-262-03384-8. E. Horowitz, S. Sahni and S. Rajasekaran, 1998, Computer Algorithms, Computer Science Press. ISBN: 0-7167-8316-9. | | |
| Prerequisite | Students are expected to have a good knowledge of basic data structures and algorithms. | | |



Course Overview

Introduction to advanced data structures and algorithms in computer science including key algorithmic design paradigms such as divide and conquer, greedy, dynamic programming. Topics include balanced search trees, heaps, efficient algorithms for sorting, searching and graph problems.

Learning Outcomes

A student who satisfactorily completes this course should be able to accomplish the following:

1. Find and prove runtime bounds for iterative and recursive algorithms;
2. Design efficient algorithms to solve computational problems;
3. Understand and employ algorithmic design paradigms including divide and conquer, dynamic programming, and greedy algorithms in solving varied computational problems;
4. Implement complex algorithms and data structures with a modern high level programming language.

Grading Policy

| Part | Percentage |
|--------------------------|------------|
| Quizzes | 10% |
| Programming projects (3) | 30% |
| Homework assignments (5) | 20% |
| Midterm | 20% |
| Final Exam | 20% |
| Course Total | 100% |

Grading Scale is as follows

| Number grade | Letter grade | GPA |
|--------------|--------------|-----|
| 90-100 | A | 4 |
| 85-89 | A- | 3.7 |
| 80-84 | B+ | 3.3 |
| 75-79 | B | 3 |
| 70-74 | B- | 2.7 |
| 67-69 | C+ | 2.3 |
| 65-66 | C | 2 |
| 62-64 | C- | 1.7 |
| 60-61 | D | 1 |
| ≤59 | F (Failure) | 0 |



Class Schedule

| Date | Lecture | Readings | Online Teaching Arrangement |
|--------|--|-------------------------------------|--|
| Day 1 | Definition of Algorithm, Pseudocode Conventions, Recursive Algorithms, Insertion Sort, Correctness | CLRS: 1.1, 1.2, 2.1-2.3 HSR: 1.2 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 2 | Time and Space Complexities, Common Functions, Mathematical Preliminaries | CLRS: 3.1, 3.2 HSR: 1.3 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 3 | Divide and Conquer - Merge Sort | CLRS: 2.3 HSR 3.4 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 4 | Divide and Conquer – Quicksort | CLRS: 7.1 HSR 3.5 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 5 | Quicksort Analysis, Randomized Quicksort | CLRS: 7.2-7.3 HSR: 3.5 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 6 | Heaps | CLRS: 6.1-6.3 HSR: 2.4.1 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 7 | Heapsort | CLRS: 6.4 HSR: 2.4.2 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 8 | Lower Bounds for Sorting | CLRS: 8.1 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 9 | Counting Sort, Radix Sort | CLRS: 8.2, 8.3 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 10 | Midterm Exam | | |



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| Day 11 | Binary Search, Binary Search Trees | CLRS: 12.3 HSR:2.3.1 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 12 | AVL Trees | CLRS: 12.3 HSR:2.3.1 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 13 | Hashing | CLRS: 11 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 14 | Graphs and Search of Graphs, DFS, BFS | CLRS: 22.1-22.3 HSR: 6.2.1-6.2.2 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 15 | Greedy Algorithms - Minimum Spanning Trees | CLRS: 23.2 HSR: 4.5.1-4.5.2 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 16 | Dynamic Programming – Single Source Shortest Paths | CLRS: 24.3 HSR: 5.1, 5.4 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 17 | Dynamic Programming & Backtracking – Knapsack Problem | HSR: 7.6 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 18 | Greedy algorithms – Huffman Codes | CLRS: 16.3 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 19 | Approximation Algorithms, Local Search, Travelling Salesman Problem Dynamic Programming – All Pairs Shortest Paths | CLRS 25.2, 35.2 HSR: 5.3 | approximately 50 minutes pre-recorded video lectures plus 50 minutes online interaction via Zoom |
| Day 20 | Final Exam | | |