Shanghai Jiao Tong University

CS249 Algorithms and Analysis

Instructor Information	Yonghui Wu Home Institution: Fudan University Email: yhwu@fudan.edu.cn Office Hours: Determined by Instructor		
Term	June 28, 2021 - July 23, 2021	**Credits**	4 units
Class Hours	Monday through Friday, 120 mins per teaching day		
Discussion Sessions	2.5 hours each week, conducted by teaching assistant(s)		
Total Contact Hours	66 contact hours (1 contact hour = 45 mins, 3000 mins in total)		
Required Texts (with ISBN)	Recommended Texts: [1] Wu Yonghui, Wang Jiande. Algorithm Design Practice : for Collegiate Programming Contest and Education. (English Version). CRC Press. 2018. ISBN 9781498776639 [2] Wu Yonghui, Wang Jiande. Data Structure Practice : for Collegiate Programming Contest and Education. (English Version). CRC Press. 2016. ISBN 9781482215397 - CAT# K22004 [3] T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, 2009, Introduction to Algorithms, 3rd edition, The MIT Press. ISBN: 978-0-262-03384-8.		
Prerequisite	Students are expected to have a good knowledge of basic data structures and algorithms.		
The course might be moved to online delivery due to COVID-19 pandemic. Students will be notified once the decision is made.			

Course Overview

The course focuses on polishing students' programming skills solving problems by using algorithms. The course introduces algorithms in data structure, Ad Hoc, simulation, greedy, dynamic programming, number theory, combinatorics, and so on. And students practice to solve problems with help of test data, solutions with annotations, and analysis.

The teaching method for the course include:

Lectures: teaching courses; showing related programming contest problems and analyzing solutions to problems;

Experiments: setting mock programming contests to require students solve problems by programming.

Learning Outcomes

Students not only learn algorithm analysis and design, but also practice to solve problems by programming by using algorithms. A student who satisfactorily completes this course should be able to accomplish the following:

1. Set up knowledge system for algorithms; and design efficient algorithms to solve problems;
2. Polish coding ability to solve problems;
3. Understand and employ algorithmic design paradigms including data structure, Ad Hoc, simulation, dynamic programming, greedy, number theory, combinatorics, and so on in solving varied computational problems;
4. Implement complex algorithms and data structures with a modern high level programming language.

Grading Policy

Attendance	10%
Homework (solving problems)	30%
Midterm Examination (a mock programming contest solving problems)	30%
Final Examination (a mock programming contest solving problems)	30%

Grading Scale

Number grade	Letter grade	GPA
90-100	A	4.0
85-89	A-	3.7
80-84	B+	3.3
75-79	B	3.0
70-74	B-	2.7
67-69	C+	2.3
65-66	C	2.0
62-64	C-	1.7
60-61	D	1.0
≤59	F (Failure)	0

Class Schedule

Date	Lecture	Readings
Day 1	Fundamental Programming Skills (I): Simple Computing	Data: Ch. 1
Day 2	Fundamental Programming Skills (II): Recursion	Data: Ch. 3
Day 3	Algorithm for Array and String	Data: Ch. 4
Day 4	Sorting algorithm (including sorting by STL)	Data: Ch. 7
Day 5	Algorithms for Priority Queue and Union-find Set	Data: Ch. 8
Day 6	Algorithms for Binary Tree	Data: Ch. 9 ~10
Day 7	Algorithm for Graphs (I): Graph Traversal	Data: Ch. 11
Day 8	Algorithm for Graphs (II): Best Path	Data: Ch.13
Day 9	Ad Hoc (Solving Problems by Mechanism Analysis, Solving Problems by Statistical Analysis)	Algo. Ch.1
Day 10	**Midterm Examination**	
Day 11	Simulation (Direct Statement, Simulation by Sieve Method, Simulation by Construction)	Data: Ch.2 Algo. Ch.2
Day 12	Greedy Algorithms (I): Greedy Algorithms in Data Structure	Data: Ch 12
Day 13	Greedy Algorithms (II): Practice for Greedy Algorithms, Greedy-Choices Based on Sorted Data	Algo. Ch.5
Day 14	Dynamic Programming: Linear Dynamic Programming (I), Linear Dynamic Programming	Algo. Ch.6
Day 15	Dynamic Programming: Linear Dynamic Programming (II), Tree-Like Dynamic Programming, Dynamic Programming with State Compression	Algo. Ch.6
Day 16	Algorithms for Number Theory, Prime Numbers, Greatest Common Divisors and Indeterminate Equations	Algo. Ch.3
Day 17	Algorithms for Combinatorics: Generating Permutations, Calculating Numbers of Combinations	Algo. Ch.4
Day 18	State Space Search (I), Constructing a State Space Tree, Optimizing State Space Search	Algo. Ch.9
Day 19	State Space Search (II), Two classical problems for State Space Search: Pushing Boxes, The Warehouse	Algo. Ch.9
Day 20	**Final Examination**	