CS3230
DESIGN AND ANALYSIS OF ALGORITHMS (2014/2015, Semester 2)

Module

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CS3230 : DESIGN AND ANALYSIS OF ALGORITHMS

Created: 26-Dec-2014, Updated: 26-Dec-2014

Aims & Objectives | Prerequisites | Schedule | Assessment | Preclusions | Workload | Text & Readings

Module Code	**CS3230**
Module Title	**DESIGN AND ANALYSIS OF ALGORITHMS**
Semester	**Semester 2, 2014/2015**
Modular Credits	4
Faculty	School of Computing (Computer Science)
Timetable	Timetable
Module Facilitators	Click to view who is teaching the module.
Weblinks	Cattywampus! MUST READ. http://www.comp.nus.edu.sg/~leonghw/Courses/cattywampus.html
Tags	--

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Aims & Objectives

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This module introduces different techniques of designing and analysing algorithms. Students will learn about the framework for algorithm analysis, for example, lower bound arguments, average case analysis, and the theory of NP-completeness. In addition, students are exposed to various algorithm design paradigms. The module serves two purposes: to improve the students' ability to design algorithms in different areas, and to prepare students for the study of more advanced algorithms. The module covers lower and upper bounds, recurrences, basic algorithm paradigms (such as prune-and-search, dynamic programming, branch-and-bound, graph traversal, and randomised approaches), amortized analysis, NP-completeness, and some selected advanced topics.

Prerequisites

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(CS2010 or its equivalent) and (CS1231 or MA1100)

Schedule

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Schedule:

The weekly workload of this module (2-1-0-3-3) are mapped into:

(Note: The parts highlighted-in-yellow [like this one] are tentative. Will be updated later.)

Week	**Wed Lecture** (2 hrs/wk) + **Self-Study/Review** (3 hrs/wk)	**Mon/Fri Tutorial** (1 hr/wk)	**HW / Prog** (3 hrs/wk)
Wk-01	**Wed, 14-Jan: L1: Algorithms as a Technology, Motivating Example** a. Admininstrative Trivia, Course Overview b. Algorithms as a Technology c. Stable Marriage Problem (Lecture by: LeongHW)	Not Started	OUT: HW1
Wk-02	**Wed, 21-Jan: L2: Asymptotics & Summations in Analysis of Algorithms** a. Asymptotics and Growth of Functions [CLRS]-Ch3.1 b. Summations, Bounding Summations [CLRS]-App-A c. Use in Analysis of Algorithms [CLRS]-Ch2 (Lecture by: LeongHW)	Not Started	**DUE: HW1 (Thu, 22-Jan, 12nn)** OUT: HW2
Wk-03	**Wed, 28-Jan: L3: D&C Alg, Recurrences and Master Theorem** a. Divide-and-Conquer Algorithm (Quick Review) [CLRS]-Misc b. Recurrences, Recursion Tree [CLRS]-Ch4.1-4.2 c. Master Theorem [CLRS]-Ch4.3 (Lecture by: LeongHW)	T01, Mon/Fri, 26/30 Jan	*Tentative:* OUT: Prog-1(abc)
Wk-04	**Wed, 04-Feb: L4: Sorting, Lower Bounds, Sorting in Linear Time** a. Sorting Problem [CLRS]-Part II b. Quick Review of Quicksort/Mergesort /Heapsort [CLRS]-Ch2,6,7 c. Lower Bound for Sorting [CLRS]-Ch8.1 d. Linear-Time Sorting Algorithms [CLRS]-Ch8.2-8.4 (Lecture by: LeongHW)	T02, Mon/Fri, 02/06-Feb	*Tentative:* DUE: Prog-1(abc) OUT: Prog-1(de(f))
Wk-05	**Wed, 11-Feb: L5: Searching, Median Find, Order Statistics** a. Minimum, Maximum, Simultaneous Min-Max [CLRS]-Ch9.1 b. Selection in Expected Linear Time [CLRS]-Ch9.2 c. Selection in Worst-Case Linear Time [CLRS]-Ch9.3 (Lecture by: LeongHW)	T03, Mon/Fri, 09/13-Feb	*Tentative:* Due: HW2 OUT: HW3
Wk-06	**Wed, 18-Feb: L6: Amortized Analysis** a. Dynamic tables [CLRS]Ch17.4 b. Aggregate method [CLRS]-Ch17.1 c. Accounting method [CLRS]-Ch17.2 d. Potential method [CLRS]-Ch17.3 (Lecture by: LeongHW)	T04, Mon/Fri, 16/20-Feb	DUE: Prog-1(de)

Recess-Wk	No Lecture (RECESS WEEK)	No session	None
Wk-07	**Wed, 04-Mar: L7: Introduction to NP-Completeness** a. Complexity classes [CLRS]Ch34.1-2 b. Polynomial-time reduction [CLRS]Ch34.3 (Lecture by: Ken Sung) **Mid-Term Quiz on Saturday, 07-Mar-2015, 10:00--11:30am, Venue: TBA**	T05, Mon/Fri, 02/06-Mar	*Tentative:* OUT: Prog-2 (abc)
Wk-08	**Wed, 11-Mar, L8: More NP-Completeness** a. Circuit Satisfiability is NPC [CLRS]Ch34.4 b. Proving NP-completeness [CLRS]Ch34.5 c. More NP-complete problems [CLRS]Ch34.5 (Lecture by: Ken Sung)	T06, Mon/Fri, 09/13-Mar	DUE: HW3 OUT: HW4
Wk-09	**Wed, 18-Mar, L9: Graph Algorithms** a. Review on Graph DS, BFS and DFS traversal [CLRS]22.1-3 b. Graph problems that are in NP-Complete versus in P [CLRS]-Ch34 i. Longest versus Shortest path ii. Hamiltonian versus Eulerian cycle iii. 3-CNF-SAT versus 2-CNF-SAT (reduction to SCC) c. Strongly Connected Component [CLRS]-Ch22.5 (Lecture by: Ken Sung)	T07, Mon/Fri, 16/20-Mar	*Tentative:* DUE: Prog-2 (abc) OUT: Prog-2 (def)
Wk-10	**Wed, 25-Mar,L10: Dynamic Programming** a. Steps in dynamic programming: The classic Cutting Rod example b. Pseudo-polynomial DP for 0-1 Knapsack c. TSP (Exponential time DP & polynomial-time Bitonic TSP (Lecture by: Ken Sung)	T08, Mon/Fri, 23/27-Mar	---
Wk-11	**Wed, 01 -Apr, L11: Greedy Algorithms** a. An activity-selection problem [CLRS]-Ch16.1 b. Huffman code [CLRS]-Ch16.3 c. Greedy Nearest Neighbor Heuristic for TSP (Lecture by Ken Sung)	T09, Mon/Fri, 30-Mar / 03-Apr	---
Wk-12	**Wed, 08-Apr, L12: Approximation Algorithms** a. 2-approx Vertex Cover [CLRS]-Ch35.1 b. TSP and Approximation [CLRS]-Ch35.2 c. (lg|X|+1)-approx Set Cover (Lecture by Ken Sung)	T10, Mon/Fri, 06/10-Apr	*Tentative:* DUE: HW4

Wk-13	**Wed, 15-Apr, L13: Other Topics and Semester Wrap Up.** a. Special Topic b. Semester wrap up (Lecture by Ken Sung)	T11, Mon/Fri, 13/17-Apr	*Tentative:* DUE: Prog-2 (def)
	Final Exam: **Saturday, 25-Apr-2015, AM**		

Assessment

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Weightage:

1. 5% Participation -- (inclusive of tutorials, forums, and other class contributions)
2. 20% Homework Assignments -- (VIP of course; HW1-4, written work)
3. 15% Programming Assignments -- 2 programming assignments, each with (very) easy 1st milestone
4. 20% Mid Term Quiz (OPEN BOOK) -- Sat, 07-Mar-2015, (end of Week 07), 10.00-11.30am, venue: TBA
5. 40% Final Exam (OPEN BOOK) -- Sat, 25-Apr-2015, AM, venue TBA

Preclusions

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EEE and CPE students can only take this module as a technical elective to satisfy the program requirements or UEM but not CFM/ULR-Breadth.

Workload

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2-1-0-3-3

Workload Components : A-B-C-D-E
A: no. of lecture hours per week
B: no. of tutorial hours per week
C: no. of lab hours per week
D: no. of hours for projects, assignments, fieldwork etc per week
E: no. of hours for preparatory work by a student per week

Text & Readings

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*If LINC does not return any results, please try alternative searches (e.g title). Any errors encountered, please report to the lecturer and the library.

Total 2 items

Title and Author	Edition/Year	ISBN	Publisher	Type
Introduction to Algorithms **Author: Thomas H. Cormen, Charles E.**	3e / 2009	Search LINC/Libraries	MIT Press	Compulsory Require textbook for CS3230. This book is the best for teaching and learning algorithms properly. Not only does it teaches you algorithm

Leiserson, Ronald L. Rivest, Clifford Stein				design, implementation and analysis, it also does it in a concise, precise and elegant way. And the authors are very generous with adding nice diagrams to illustrate key concepts and steps. If there is ONE book you want to keep for algorithms, THIS is the one. (One of the co-lecturers, LHW, bought a copy of the 1st printing of the 1st edition of the book when it first came out -- he happened to be in the US at the time.) Companion Website
Competitive Programming **Author: Steven Halim, Felix Halim**	3e / 2013	-	Lulu.com	Supplementary Additional Reference: This textbook was written by our very own, Dr. Steven Halim, graduate of SOC, who also runs our ACM-ICPC team (and teaches CS3233) and trains our IOI team too. Use this book as additional reference, esp for code segments for some of the algorithms covered in [CLRS]. See Steve's comments about his book: here (Note: Steven also selling a "no-frill, less-expensive" version of his book.) Companion Website

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