IS103 – Computational Thinking
AY2011/12, Term 2
COURSE OUTLINE

Instructor: Assoc. Professor LAU Hoong Chuin, 68280229, 97672913, hclau@smu.edu.sg
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Office Hours: by appointment, Lau (SIS Room 5030), Mok (SIS Room 4056), Linda

Class Time: Tue 12nn -3:15pm
Class Venue: SIS Seminar Rm 2-4 (Room 2014)

Course Description:

This course equips students fundamental skills to tackle complex computational problems; it trains students to design solutions to solve those problems using a computer program. It draws upon concepts from mathematics and computer science – more precisely, discrete mathematics, data structures and algorithm design.

This course will hone students' analytical skills as they are challenged to think abstractly and computationally. Their minds will be open to the wonders of computing, as they go behind the scene to unravel the fundamental analytics that empower Twitter, consulting agencies and service companies.

Course Objectives:

By taking this course, the student will:

- discover the science of computing (or *How to think like a Computer Scientist*)
- model problems and learn practical problem-solving techniques to tackle complex computational problems (beyond what a spreadsheet is capable of solving)
- apply problem-solving techniques to develop more elegant and efficient programs
- learn to write programs to represent and manipulate with complex data objects
- understand the challenge of **scale**, not only in dealing with large data sets, but also in appreciating the nature of computing and computability

Course Material:

Course Package (also available in SMU Library Course Reserves) comprising the following textbooks:

a. [SDB] [Stein, Drysdale and Bogart, Discrete Mathematics for Computer Scientists, Pearson, Pearson Custom Publishing, 2011](http://www.pearsonhighered.com) (based on the original text Chapters 1.1-1.4, 3, 4.1-4.3)

   Website: http://www.pearsonhighered.com/educator/product/Discrete-Mathematics-for-Computer-Scientists/9780132122719.page

b. [PC] [Prichard and Carrano, Data Abstraction and Problem Solving with Java: Walls and Mirrors, 3/E, Prentice Hall 2011](http://www.pearsonhighered.com) (Chapters 3-8,10-11,14)

   Website: http://www.pearsonhighered.com/educator/product/Data-Abstraction-and-Problem-Solving-with-Java-Walls-and-Mirrors/9780132122306.page

Additional handouts will be provided during class or downloaded from [SMU eLearn](http://www.smu.edu).

Grading:

(1) Class Participation (10%)

(2) 1 Mid-Term Exam (20%)

(3) 3 Assignments (40%, two individual and one team assignments)

(4) 1 Final Exam (30%)

- All assignments are to be submitted by the day of the class it is due.

Class Schedule (subject to change, depending on class progress):

Wk	Theme	Events
1	What makes a computer scientist different from a biologist, a lawyer, or an economist?	
2	Of pins and balls – counting and computing	
3	The elegance and power of recursion in computing	Release Assignment 1
4	How to search efficiently using a computer?	
5	How does a computer represent lists and sequences?	Due: Assignment 1
6	How does a computer represent hierarchy and structure?	
7	Modeling social and enterprise networks on a computer	Release A1 solution
8	Recess Break	
9	MIDTERM EXAM (2 hours) Introduction to the world of computational complexity	Project briefing Release Assignment 2
10	Exploiting the power of decomposition and parallelism	
11	Reasoning about a highly-connected cyber and physical world	Due: Assignment 2
12	Logic as foundation of thinking and computing	
13	Now let's put everything together	Due: Assignment 3 Release A2 solution
16	FINAL EXAM (3 hours)	

Weekly Plan:

Wk	Date	Topic	Text Reference
1	10/1	Introduction , Abstract Data Types	PC, Chp 4
2	17/1	Discrete Mathematics I (Counting)	SDB, Chp 1.1,-1.2
3	31/1	Discrete Mathematics II (Recursion and Recurrence)	PC, Chp 3.1-3.3
4	4/2* (Sat)	Algorithm Design I (Recursion and Searching)	PC, Chp 3.4-3.5, 6.1 SDB, Chp 3.2
5	7/2	Data Structures I (List, Stack and Queue)	PC, Chp 5, 7, 8
6	14/2	Data Structures II (Trees)	PC, Chp 11
7	21/2	Data Structures III (Graphs and Networks)	PC, Chp 14.1-14.2
8		Recess Break	
9	6/3	MIDTERM EXAM (2 hours) + Introduction to Computational Complexity	PC, Chp 10.1
10	13/3	Algorithm Design II (Sorting, Divide and Conquer)	SDB, Chp 3.3 PC, Chp 10.2
11	20/3	Algorithm Design III (Graph Algorithms)	PC, Chp 14.3-14.4
12	27/3	Discrete Mathematics III (Logic and Proof)	SDB, Chp 2
13	3/4	TOURNAMENT AND PRESENTATION (1.5 hours) Revision for Final Exam	Nil
16	23/4 (Mon)	FINAL EXAM (3 hours)	

*Makeup for Chinese New Year