UNIVERSITY OF LONDON

GOLDSMITHS COLLEGE

B. Sc. Examination 2008

COMPUTING AND INFORMATION SYSTEMS

IS52017A Data Communication and Algorithms

Duration: 3 hours

Date and time: May 2008

Answer FOUR questions ONLY.

Full marks will be awarded for complete answers to FOUR questions.

You must answer TWO *questions from section A and* TWO *questions from section B.*

There are 100 marks available on this paper

THIS EXAMINATION PAPER MUST NOT BE REMOVED FROM THE EXAMINATION ROOM

Section B

Question 4

(a) Describe three standard operations of an abstract data type *linked list*. You should include necessary parameters and other details. [5]

(b) Explain, with an example, what is meant by the term *linear probing* in the context of hashing. [5]

(c) Consider the task of maintaining a million-record list of supermarket customers.

(i) Propose a suitable data structure for the task. Justify your choice and add assumptions if necessary. [3]

(ii) Discuss the suitability of using two standard methods *size* and *isEmpty* in terms of efficiency. [4]

(iii) Suppose that we need to keep track of the total number of the customers. How would you implement the two methods? [3]

(d) Explain, with an example, how to distinguish a *binary search tree* and a *binary heap*. Draw both types of data structures for (5, 7, 10, 6, 1, 14, 11, 2) in your example. [5]

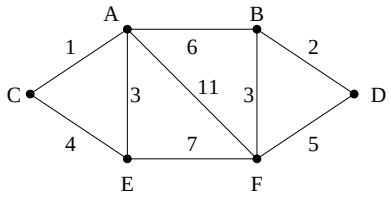
Question 5

(a) Explain briefly what a *stack* is. Describe briefly *three* standard operations on stacks. Demonstrate one example of stack application. [5]

(b) Derive the compressed trie that stores the following names: (code, abstract, call, access, and, an, clone, class, cat). [5]

(c) Explain what is meant by *dynamic programming*. Demonstrate, with the example of *Fibonacci* algorithm, when *dynamic programming* is useful. [5]

(d) Draw a minimum weight spanning tree of the simple graph below and demonstrate an *inorder traversal* of the tree by writing down the vertex labels in the order of being visited, starting from vertex E. [5]



(e) Design an algorithm to allow 4 people to cross a river within 17 minutes as described below. Discuss whether or not this is a 'problem' in the context of algorithm design. Justify your conclusion. [5]

> Four people need to cross a bridge at a dark night within 17 minutes. With a single torch, they begin from the same side of the river. A maximum of two people can cross the river at a time and they must take the torch with them. The torch must be walked and cannot be thrown. Person 1, 2, 3 and 4, if alone, takes 1, 2, 5, and 10 minutes respectively to cross the river, but two people, if together, must walk at the rate of the slower person's pace.

Question 6

(a) Explain what an *optimisation* problem is in the context of algorithm design. [2]

(b) Describe the *coin-change* problem. [2]

(c) Write two different instances of the coin-change problem including one *special case* and propose a data structure for solving the coin-change problem. [4]
Hint: A special case can be a situation where a special solution is required. Specify your assumptions if necessary.

(d) Design and outline an algorithm for the coin-change problem. Explain the data structure used and the input and output expected. Let the coins be of values 200p, 100p, 50p, 20p, 10p, 5p, 2p and 1p. What is the minimum number of coins needed to make Xp of change? [12]

(e) Analyse the time complexity of your algorithm for the coin-change problem. [5]