A27544 *No calculator permitted in this examination*

UNIVERSITY OF BIRMINGHAM

School of Computer Science

Degree of MSc

Computer Science

06 21921

Fundamentals: Data Structures & Algorithms

Summer Examinations 2011

Time allowed: 1 ½ hours

[Answer THREE out of Four Questions]

[Marks indicated on this paper add up to 102%.
The final mark will be capped at 100%.]

No calculator

[Answer THREE out of Four Questions]

1. (a) Suppose that Composite data types are constructed from combinations of the four following fundamentals data types: sets, lists, trees and graphs; e.g. a box containing several bags of nuts and bolts would be an example of a of set of set data type components Give two real-life examples for each of the following:

(i) A list with list components.
(ii) A list with set components.
(iii) A set with tree components.
(iv) A tree with nodes which are lists.
(v) A graph with list component nodes.

[26%]

(b) A list data type may be represented and implemented in Java using an array data type or using object references to create a linked list structure. State one advantage and one disadvantage for each of these features in Java for implementing a list data type. [8%]

2. (a) Briefly outline the Hash Table methods referred to as –

Open Hashing and **External Hashing**.

[8%]

(b) A particular External Hash Table organisation is to use a second Hash Table - Open Hash - as the external list. The Hash function for the first table uses the position of the **first** letter of the key in the alphabet: a=1, b=2 . . . and the second Hash Table will use a Hash Function based on the position of the **second** letter of the key in the alphabet.

Illustrate the use of the above organisation to store the following list of key words (in the order given) -

image, graph, pixel, point, resolution, palette, scope, question, position, reflection, feature, texture, font, recognition, imitate, median, mode, query, test.

[20%]

(c) Comment on the relative efficiency of the organisation described above and that of a conventional External Hash Table [6%]

3. (a) Highlight the differences between the abstract data types referred to as a **List** and an **Index List**. [6%]

(b) Briefly define **three** distinct classes of Index List data types. [12%]

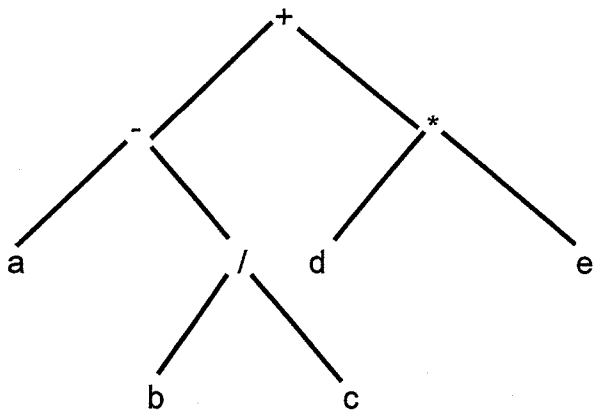
(c) A large university needs to produce its Staff Handbook in order of seniority of staff i.e. grouped, by title in each Department, in the order Head of Department, professors, readers, senior lecturers, lecturers, technicians, administrators, secretaries and clerks. In the current computer system, the university already records the title of each member of staff and the department in which they work.

Describe, using diagrams and/or a suitable notation, how an Index List may be used to solve the above requirements.

[16%]

4. (a) A Binary Search Tree (BST) abstract data type can also be represented by a Sequential Enumerated List ADT (created by traversing the BST). Explain the properties that permit the generation of such a list from a BST. [6%]

(b) Construct the Sequential Enumerated List representation for the following Binary Search Tree:



[8%]

(c) Give one advantage and one disadvantage of a Sequential Enumerated List representation for a Binary Search Tree. [6%]

(d) A binary search tree T has eight nodes. The symmetric order and pre-order traversals of T yield the following sequence of nodes:

symmetric order traversal: C B D A F E H G
pre-order traversal: A B C D E F G H

Draw the tree T and indicate very briefly your approach to its construction. [14%]