SPEC
(31)

THE UNIVERSITY OF THE WEST INDIES
ST. AUGUSTINE

EXAMINATIONS OF APRIL/MAY 2011

Code and Name of Course: **COMP 2000 – Data Structures** Paper:

Date and Time: Monday 9th May 2011 9 am. Duration: **2 hours**

INSTRUCTIONS TO CANDIDATES: This paper has **4** pages and **5** questions

Answer ALL questions

Questions are not equally weighted

If parts of questions are done out of order, then they must be properly numbered and the order in which the parts were done must be entered in the space provided for this purpose at the bottom of the answer booklet.

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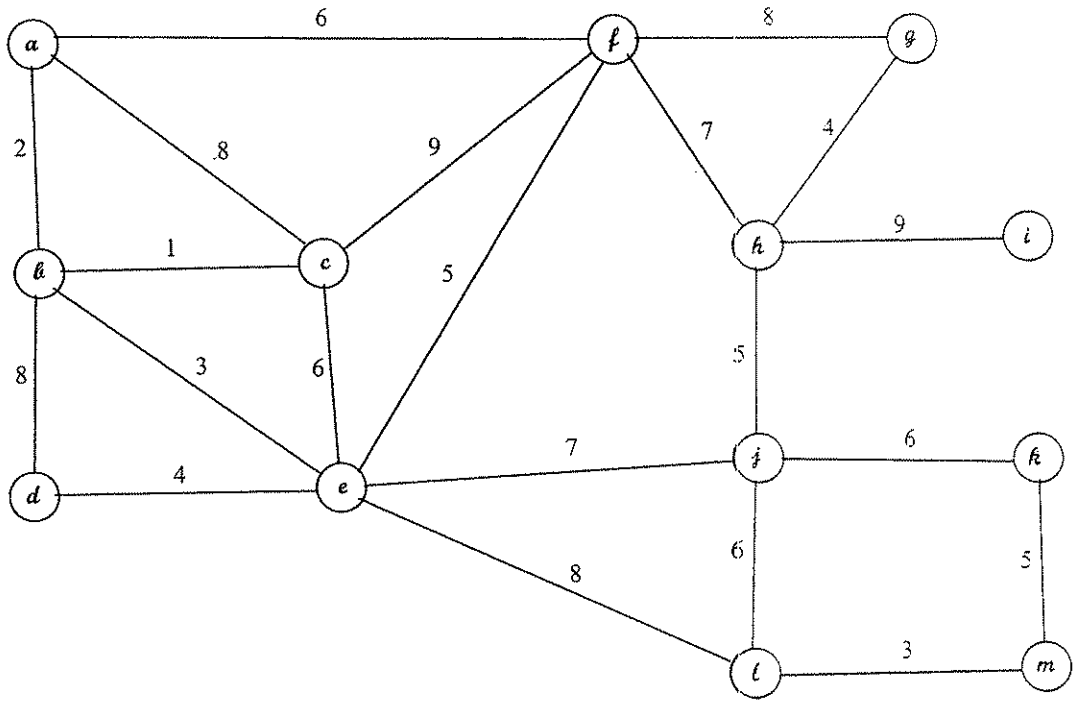
Question 1: Graphs and Matrices

For the following graph:



(a)

Show the C data declarations necessary for implementing this graph using adjacency lists (you are not required to write any access procedures). **[2]**

(b) If a node label may be stored as an ASCII character, an integer is four bytes in size and a pointer is four bytes in size:

(i) What would be the size in bytes of the adjacency list representation of the above graph?

[2]

(ii) What would be the size in bytes of an adjacency matrix representation of the above graph (assume no matrix compression technique is applied)? **[2]**

Question 1: Graphs and Matrices (cont'd)

(c)

(i) Since the graph is an undirected graph, its adjacency matrix will be symmetric, and lower-packed storage can be used to reduce the size of the stored matrix. Given that an integer is four bytes in size, what would be the size in bytes of the compressed matrix?

[4]

(ii) How much memory will be used to store the sparse array using compressed row storage?

[10]

[Total 20]

Question 2: Trees

(a) Without assuming any particular storage method for a tree, write algorithms in pseudocode for doing:

(i) a pre-order traversal of a tree; **[1]**

(ii) an in-order traversal of a tree; **[1]**

(iii) a post-order traversal of a tree. **[1]**

(b) Without assuming any particular storage method for a **binary search tree**, write in pseudocode, algorithms for the following, such that the tree remains a binary search tree:

(i) finding a node; **[2]**

(ii) inserting a node; **[2]**

(iii) deleting a node. **[3]**

[Total 10]

Question 3: Hash Tables

Show the resulting contents of a hash table of size 10 after the elements

6, 36, 28, 27, 65

are inserted in the order given, using the primary hash function, $h_1(k) = k \% 10$, and:

(a) linear probing. **[2]**

(b) double hashing with the secondary hash function, $h_2(k) = (1+k \% 3)$. **[3]**

[Total 5]

Question 4: Heaps

With reference to the following array of integers:

8	12	32	36	72	23	25	60	97	65

(a) Draw the nearly complete binary tree represented by this array. **[2]**

(b)

(i) Write a function in pseudocode that rearranges the elements of the nearly complete binary tree into a min-heap. **[2]**

(ii) Show by a series of drawings of the array contents how the array is rearranged by the algorithm in part (b)(i). **[3]**

(c) Explain with the aid of a series of drawings of the array contents how the function in part (b)(i) can be used to perform a heapsort on the array elements to sort them in descending order. **[3]**

[Total 10]

Question 5: Sorting and Searching

(a) Write an algorithm in pseudocode for each of the following sorting techniques:

(i) quicksort; **[2]**

(ii) mergesort; **[2]**

(iii) shellsort. **[2]**

(b) Using the algorithms specified in part (a) of this question, show by means of a series of drawings of the array contents, how the array

8	12	32	36	72	23	25	60	97	65

will change as it goes through a

(i) quicksort; **[3]**

(ii) mergesort; **[3]**

(iii) shellsort using increments of 1, 3 and 5. **[3]**

[Total 15]

End of Question Paper