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12

THE UNIVERSITY OF THE WEST INDIES
ST. AUGUSTINE

EXAMINATIONS OF April/May 2013

Code and Name of Course: COMP2000 – Data Structures

Date and Time: Monday 29th April 2013 1 pm. Duration: 2 Hours

INSTRUCTIONS TO CANDIDATES: This paper has 4 pages and 3 questions

**Answer ALL Questions**

1. (a) Write a function countLeaves which given a pointer to the root of a binary tree, returns the number of leaves in the tree. [2]

   (b) Write a function interchange which, given a pointer to the root of a binary tree, interchanges **all** left and right sub-trees in the binary tree. [3]

   (c) Write functions to perform the following operations on a binary search tree (BST):

   (i) insert a key into the BST. [3]

   (ii) find and return a pointer to the node containing a key value; return NULL if the key is absent in the tree. [2]

   (d) (i) Write a function deleteMin which, given a pointer to the root of a **non-empty** binary search tree, deletes the node with the smallest value from the tree and returns the value in the node. [3]

   (ii) Write a function delete which deletes a node from a binary search tree which contains a given key value. The function delete should use the function deleteMin. [3]

   (e) Each node of a binary search tree has fields, left, right, data (an integer) and parent, with the usual meanings. Write a function which, given the pointer to the root of the tree and an integer key, inserts the key in the binary search tree. [4]

   finds or

[TOTAL: 20 marks]

2. (a) Give definitions for (i) primary clustering and (ii) secondary clustering. [2]

(b) Integers are inserted in an integer hash table **list**[1] to **list**[**n**] using " linear probing". You may assume that the function **h1** produces the initial hash location. An available location has the value **Empty** and a deleted location has the value **Deleted**, where **Empty** and **Deleted** are symbolic constants.

Write a function to search for a given **key** value. If found, your function must return the location containing the key. If not found, you function must insert the **key** in the first deleted location encountered (if there is one) in searching for the **key**, or an **Empty** location, and returns the location in which **key** was inserted. You may assume that list contains room for a new integer. [4]

(c) A function makeHeap is passed an integer array **A**. If **A**[0] contains n, then **A**[1] to **A**[**n**] contains numbers in arbitrary order.

(i) Write a function makeHeap such that **A**[1] to **A** [**n**] contain a max-heap. [6]

(ii) If the array **A** contains the following values initially:

8 25 42 14 36 50 21 63 48

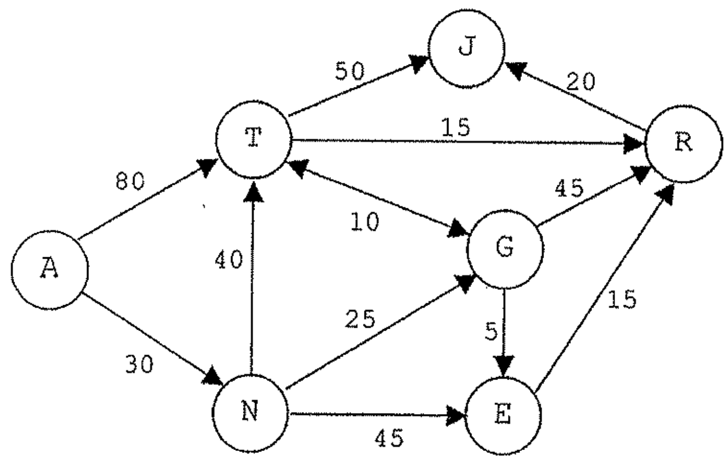
show the contents of **A**[1] to **A**[8] after element **A**[~~5~~] is processed [3]
3.

(iii) Given an array like **A**, with **A**[1] to **A**[**n**] containing a max-heap, write a function to sort the array in ~~*descending*~~ order. [5]
ASCENDING.

[TOTAL: 20 marks]

3.

(a)




(i) Give the adjacency list representation of the graph. [2]

(ii) Give the depth-first and breadth-first traversals of the graph starting at A. Edges of a node are processed in alphabetical order. [2]

(iii) Derive the minimal-cost paths from node A to every other node using Dijkstra's algorithm. For each node, give the cost and the path to get to the node. At each stage of the derivation, show the minimal cost fields, the parent fields and the priority queue. [11]

(b) Assuming the graph in (a) is undirected, draw the minimum spanning tree obtained by using Prims algorithm. You must show the resulting of each stage of the derivation [5]

[TOTAL: 20 marks]

**End of question paper**