AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer and Systems Engineering Department
Third Year Computer Engineering Students

2nd Semester, 2016-2017	Course Code: CSE323	Time : 3.00 Hrs

Programming and Data Structures

The exam consists of **six** Questions in **Three** Pages.   **Total Marks: 110 Marks**   1/3

Question 1 [18 Marks]

Complete with short answers

a) The depth of a max heap of 23 nodes is _____ *a* _____ and in the worst case when inserting a new node it needs big O of ____ $n \log n$ ____

b) Hashing is used mainly to access __ similar __ number of elements.

c) A binary search tree with n nodes, divide the space into __ $\frac{n+1}{2} - 1$ __ regions.

d) For sparse graphs, the linked-list implementation of a graph is __ better __ than matrix representation.

e) A complete directed graph with 8 vertices has __ 56 __ edges.

f) Two different binary search trees (with the same elements but different arrangement) have the same __ in __ traverse

g) An algorithm that finds the sum of all terminal nodes is (inorder/preorder/postorder).

h) (Close/Open/direct mapping) hashing is the most suitable for memory.

i) A priority queue can be developed using (single linked list/array/stack)

Comment

Question 2 [18 Marks]

State whether each of the following statements is true or false and correct the false ones

a) In a max heap, the value of the left child of a node is always less than the value of the right child.

b) The running time of finding the maximum element in a max heap and readjusting is O(logN) where N is the number of elements in the heap.

c) The smallest value in a binary search tree (BST) is always stored at the root of the tree.

d) An O(N logN) algorithm is slower than an O(N * N) algorithm.

e) A close hashing of expected key range of 1000 and expected n of 200 can effectively use a bucket size B of 1000.

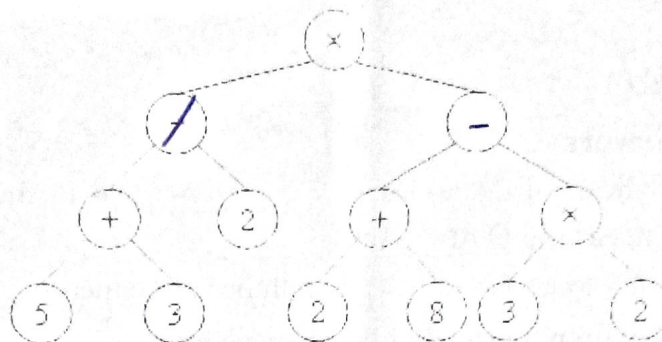f) To delete a dynamically allocated tree, the best traversal method is inorder
_____ Post _____

Question 3 [18 Marks]

Given the following expression tree

a) Evaluate the expression   [2 Marks]

b) Find the inorder and post order traverse of the tree   [4 Marks]

c) Write down a C++ class for this tree node   [4 Marks]

d) Write down code for method preorder traverse that prints the *Pre* ~~postfix~~ of th given expressing represented by the tree   [4 Marks]

e) Write down a C++ member function of class Tree to count the number of terminal nodes in the tree   *Count all*   [4 Marks]

Question 4 [18 Marks]

Give the following heap
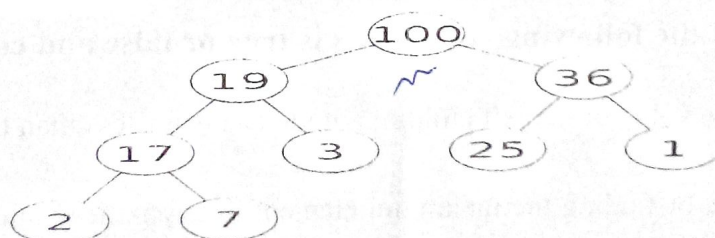

a) Find the array representation of the given heap   [3 Marks]

b) What is the right child of the node with index 3   [3 Marks]

c) Insert a new node of value 21 and show how the new heap will look like   [5 Marks]

d) Remove the node with value 100 from the heap and show the new heap after arrangement *Starting from original*   [5 Marks]

e) What is the big O of a function called **Peek_Maximum** (that finds the maximum value in the heap)   [2 Marks]

Question 5 [20 Marks]

Given the following undirected graph about social networks

a) Represent this graph using matrix or linked list [4 Marks] and <u>justify</u> your choice [2 Marks]

b) Using **Prim** algorithm, show step by step how to find Minimum spanning tree starting from node *Claire* [6 Marks] and find its cost [2 Marks]

c) Using **Dijkstra** algorithm, find the shortest path and its cost starting from node *Dennis* and ending at node *Alice* [6 Marks]
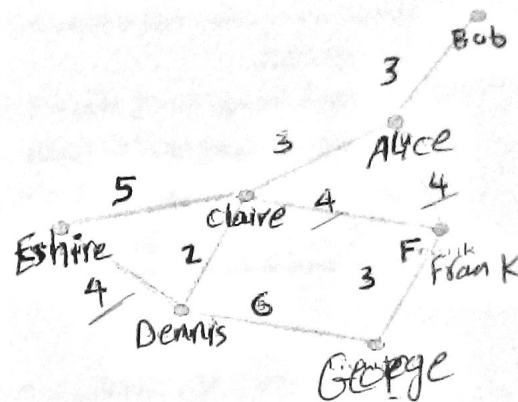
Question 6 [18 Marks]

Following is an example of open hashing with hash function $H(K) = k \% 7$
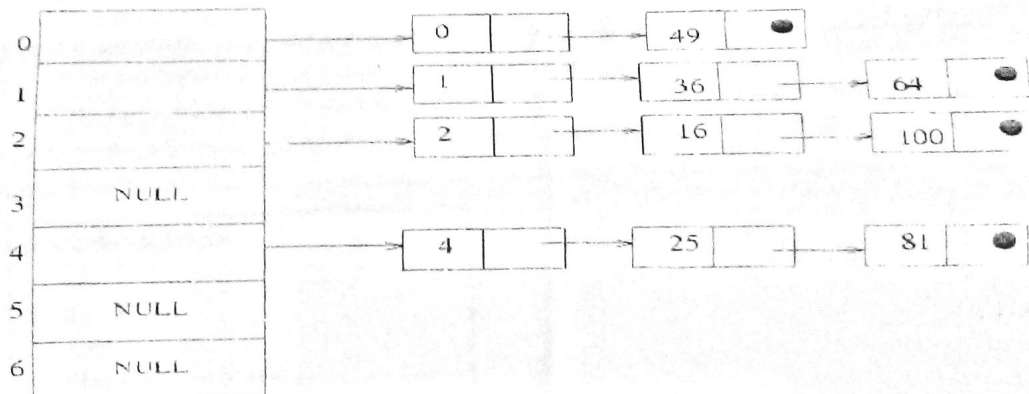
a) Compute the average access to each of the given 11 values   [4 Marks]

b) Add the following six elements with the given order 8, 10, 9, 18, 29, 27   [4 Marks]

c) Is the hash function $H(k) = (k*k) \% 7$ better than $k \% 7$ [2 Marks]. provide reasons or analysis   [3 Marks]

d) Create a close-hashing table with bucket size of 20 and add the above 11 elements in it in an ascending order and compute the number of collisions   [5 Marks]

GOOD LUCK

Exam. Date : 4 June 2017