Data Structures (CS- 213)
Spring 2018
Assignment #2
Instructor: Mohammad Asad Abbasi
Assigned: 6 Aril, 2018
Deadline: 01 May, 2018, 4:30pm

Submission Instructions:
- Any information outside the lecture notes and text book should be cited.
- You shall submit written part in hard copy (hand written) to Mr Faaiz in Lab 05 and email programming part to the email address m.asadabbasi@yahoo.com.
- The subject line of email should include Data Structures assignment 2, student name, roll number and section. **Example (Data Structure assignment 2 (Fahad Ahmed, 113, A)).**
- Late submission will be penalized at 10% of total assignment marks per day.

Question # 1

What are the major data structures used in the following areas:
    RDBMS
    Network data model
    Hierarchical data model

Question # 2

If you are using C/C++ language to implement the heterogeneous linked list, what pointer type will you use?

Question # 3

Write a program to find kth smallest element in an array num[n], where n and k are given as input from user.

Question # 4

Write code to implement quick sort. Derive time complexity of quick sort in best and worst case.

Question # 5

Write code to implement shell sort. Derive time complexity of quick sort in best and worst case.

Question # 6

Write code to implement radix sort. Derive time complexity of quick sort in best and worst case.

Question # 7

Write code to implement merge sort. Derive time complexity of quick sort in best and worst case.

Question # 8

What is/are the data structure/s used to perform recursion? Explain how.

Question # 9

What do you understand by structured programming? Explain.

Question # 10

Suggest a way of implementing two stacks in one array such that as long as space is there in an array, you should be able to add an element in either stack. Using your proposed method, write algorithms for push and pop operations for both the stacks.

Question # 11

Bubble sort algorithm is inefficient because it continues execution even after an array is sorted by performing unnecessary comparisons. Therefore, the number of comparisons in the best and worst cases are the same. Modify the algorithm in such a fashion that it will not make the next pass when the array is already sorted.

Question # 12

Explain main operations of heap sorts with the help of example.

Question # 13

Sort the following data in descending order using heap sort 85, 15, 25, 95, 145, 55, 165, 75. Show all steps.

Question # 14

Write a program to read 10 integers from keyboard and store them in the file 'My File'.

Question # 15

Suppose the element being searched for is not found in an array of 100 elements. What is the average number of comparisons needed in a sequential and binary search to determine that the element is not there.

Question # 16

Describe circular queues with their applications. Write program to implement circular queues.

Question # 17

Construct the AVL tree for the following data: 20, 1, 2, 25, 15, 70, 30, 75, 10, 35. Show clearly rotation/s used.

Question # 18

Discuss threaded binary trees with the help of an example.

Question # 19

Write a program to create a binary tree with user input and determine the sum of all tree nodes. Also give the algorithm for this.

Question # 20

Two Binary Trees are similar if they are both empty or if they are both nonempty and left and right sub trees are similar. Write an algorithm to determine if two Binary Trees are similar.

Question # 21

What is a Binary Search Tree (BST)? Create a BST for the given sequence of numbers 45, 36, 76, 23, 89, 115, 98, 39, 41, 56, 69, 48. Traverse resultant tree in Preorder, Inorder and Postorder.

Question # 22

What are expression trees? Represent the following expression using a tree. Comment on the result that you get when this tree is traversed in Preorder, Inorder and postorder.

(a-b) / ((c*d)+e)

Question # 23

Construct a complete binary tree with depth 3. For this tree maintained in memory using linked representation. Make the adjacency list and adjacency matrix for this tree.

Question # 24

Prove the hypothesis that "A tree having 'm' nodes has exactly (m–1) edges or branches".

Question # 25
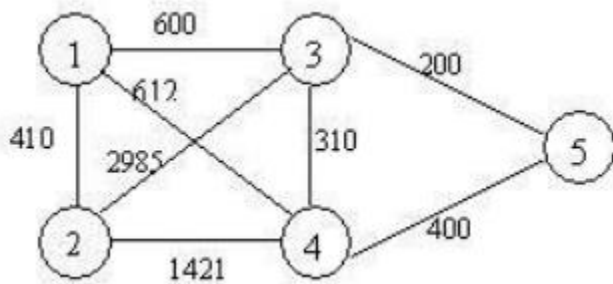
Create a heap with following list of keys:

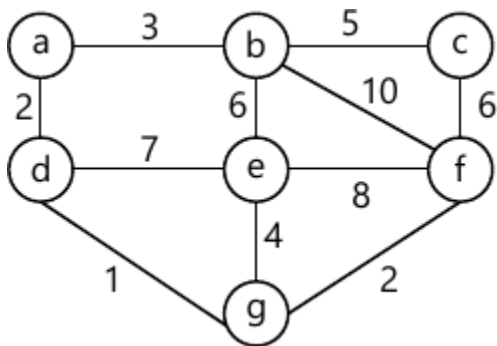8, 20, 9, 4, 15, 10, 7, 22, 3, 12

Question # 26

Find the minimum spanning tree of the following graph by using Kruskul's algorithm.

Question # 27

Convert the given graph with weighted edges to minimal spanning tree.

Question # 28

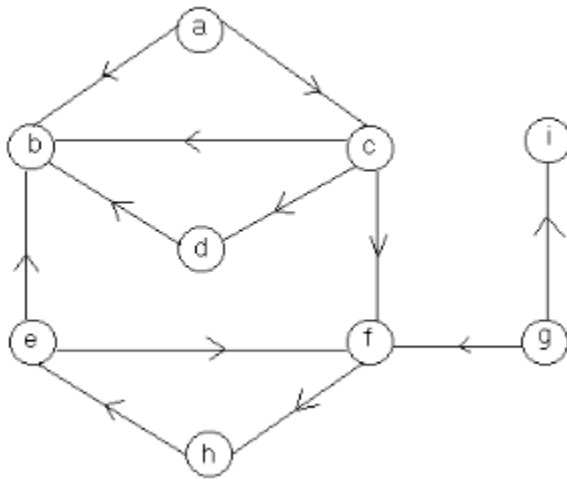Find the shortest path from a to f, in the following graph using Dijkstra's Algorithm.

Question # 29

Write code for the following functions w.r.t. AVL tree:

      (i) Rotate Left

      (ii) Rotate Right

Question # 30

Give the adjacency matrix and adjacency list of the following graph.

Question # 31

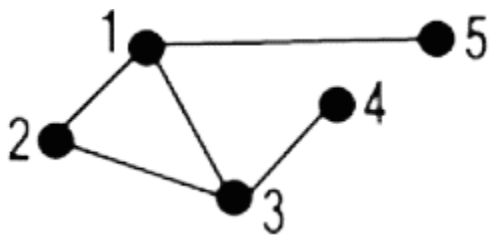Draw the directed graph that corresponds to the following adjacency matrix.

	V0	V1	V2	V3
V0	1	0	1	0
V1	1	0	0	0
V2	0	0	0	1
V3	1	0	1	0

Question # 32

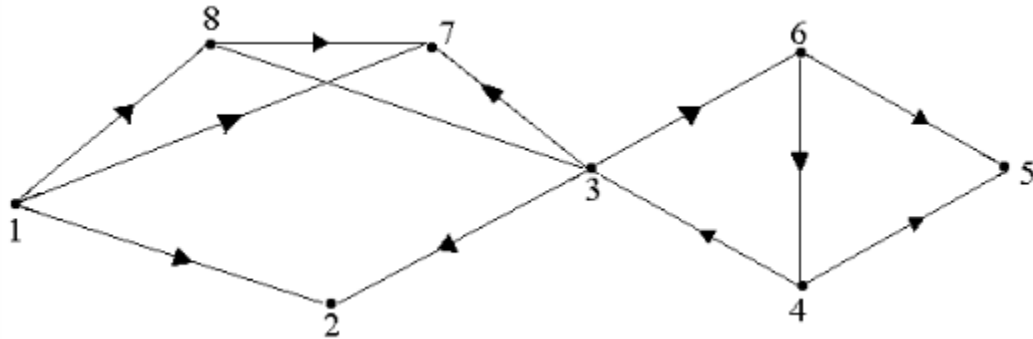Discuss skip lists with some examples.

Question # 33

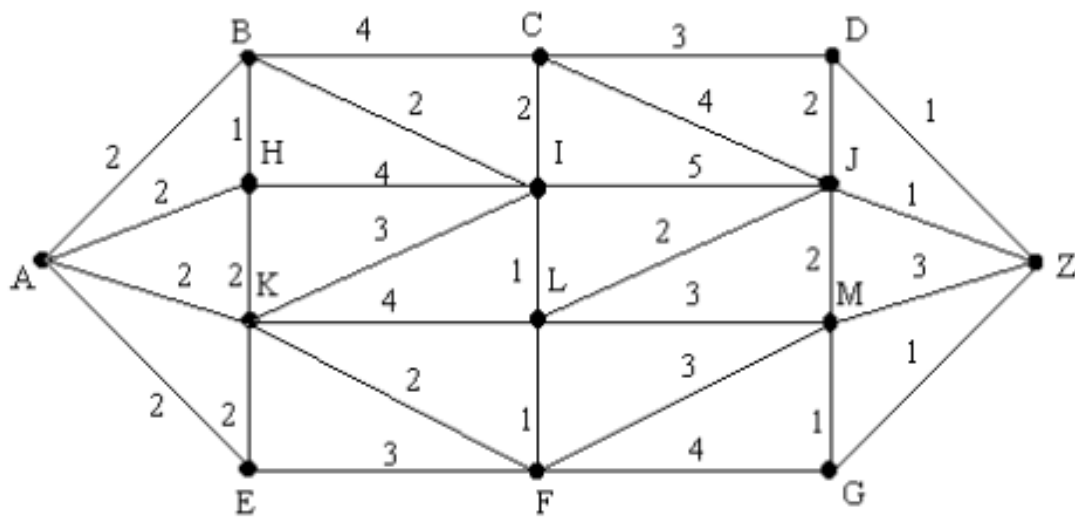Explain the representations of graph. Represent the given graph using any two methods.

Question # 34

Show the result of running BFS and DFS on the directed graph given below using vertex 3 as source. Show the status of the data structure used at each stage.

Question # 35

Find the shortest path from A to Z using Dijkstra's Algorithm.

Question # 36

What is a Spanning tree of a graph? What is minimum spanning tree? Execute Prim's Kruskal's algorithm to find the minimum spanning tree of the following graph.