Examination: **III B. Tech. CSE**   Time: **02 Hours**
Subject: **Data Structures Lab (CSC204)**   Max. Marks: **40**

Instructions:
1. Answer any **Two** questions. All the questions have equal weightage.
2. Program file should be named as AdmissionNo_QuestionNo., e.g., 20JE0014_Q1. Save your program files into a folder, named <*AdmissionNo_endSem*> and zip the folder.
3. Email your zip file to ds.lab.cse.2021@gmail.com for the evaluation. Must write your Admission number, Name, and DSLab_Endsem in the subject line of the e-mail. (e.g., DSLab_Endsem: 20JE0014_Ankit).
4. Use of Internet is strictly prohibited. You must not copy code from the internet. Plagiarism of the submitted code will be checked and if your code found to be copied from any source, your exam will be cancelled. If your code is found copied from any other student, then both students will get **zero** marks.
5. Your camera should be on during the examination.

Questions:

1. An e-commerce website maintains database of all its customers. The shopping history of each customer is stored in the database in order to find the preferences of customers. The preferences of customers are utilized to provide appropriate recommendations to the users to increase the sell. The company also tries to find out the similarities between the users. The group of users who have similarities in the preferences may get same recommendations. Therefore, clustering of users is an important task for this application. In this problem, you have dissimilarity scores between different users. Your task is to group the users into different clusters. You are required to utilize graph data structure to solve this problem. Suppose a graph $G = (V, E)$ is an undirected graph in which each vertex represents a user and each edge shows the dissimilarity score between two users. The dissimilarity score is assigned in the range [1, 9], where 1 indicates almost similarity and 9 indicates almost dissimilarity between two users. To group different users, you need to implement a clustering method that groups similar type of graph vertices. The clustering method utilizes Minimum Spanning Tree (MST) to find the clusters. The clustering method utilizes following steps:

   a) Construct a graph $G = (V, E)$ based on the given number of users and their relationships.
   b) Find Minimum Spanning Tree (MST) of the graph.
   c) The edges with highest weights are removed from MST to make the graph disconnected. For example, if we are partitioning the graph into K clusters, then we delete $K - 1$ edges from MST which contains highest weights.
   d) Each set of connected vertices are extracted from the graph. Each set represent a cluster.

$Enter\ number\ of\ users = 5$

$Enter\ number\ of\ edges = 7$

$Enter\ K = 3$

$Weight\ of\ edge\ (1,2) = 3$

$Weight\ of\ edge\ (1,3) = 2$

$Weight\ of\ edge\ (2,3) = 4$

$Weight\ of\ edge\ (2,5) = 8$

$Weight\ of\ edge\ (3,4) = 7$

$Weight\ of\ edge\ (3,5) = 9$

$Weight\ of\ edge\ (4,5) = 5$

Sample Output:

$Cluster1 = \{1,2,3\}$

$Cluster\ 2\ = \{4\}$

$Cluster\ 3 = \{5\}$

2. Implement a program using binary search tree data structure. Apply the following operations over the binary search tree:
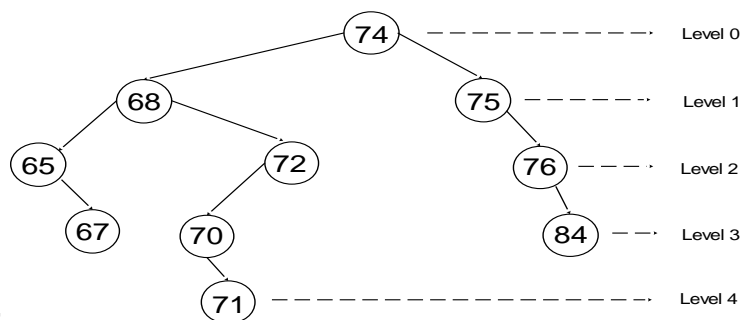
   a) At first, take segment of text message as input from the user. Input text message should not contain repeated letters. By using the ASCII values of the letters of the text message as key-nodes, construct a binary search tree.

   Sample Input:

   $Enter\ the\ text\_message$: $JDHKFALGTC$

   Sample Output:

   $ASCII\ values\ of\ text\_message\ letters$: 74 68 72 75 70 65 76 71 84 67
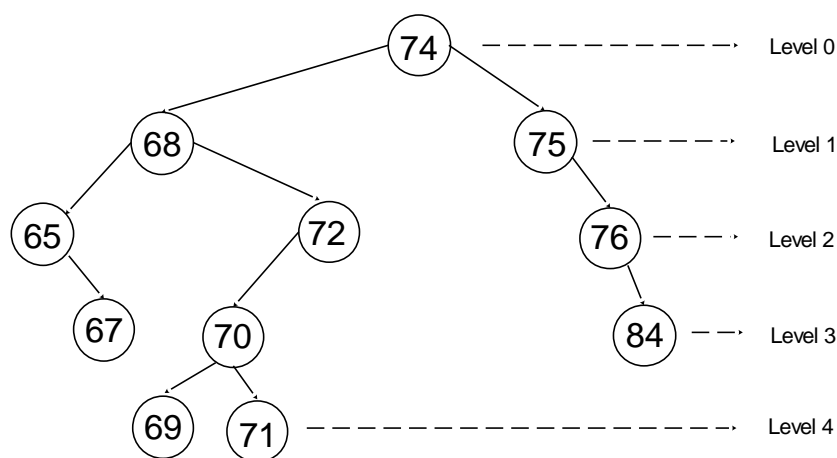

$Binary\ search\ tree$:

b) Take another letter as input from the user. Now, search the binary search tree. If the ASCII value of the user-given letter is already present in the binary search tree then your program should print an error message as "*ASCII code of duplicate letter cannot be inserted into the tree*". Otherwise, insert the ASCII code of user-given letter at appropriate location within the binary search tree.

Sample Input:

Enter the letter to be inserted into binary search tree: E

Sample Output:

Constructed binary search tree:

c) In next step, take level of binary search tree as input from the user and delete the key-nodes present at the user-given level of the binary search tree where root node of the tree is considered to be at level '0'.

Sample Input:

Enter the level of binary search tree at which keys are to be deleted: 2

Sample Output:

Binary search tree obtained after key_node deletion at level 2:
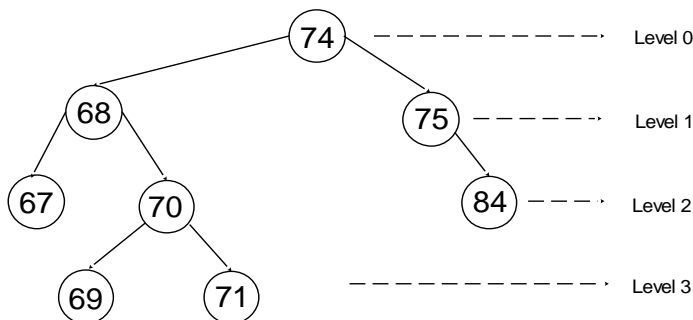
3. Owner of a grocery shop requires a software to keep track of all the available products in his shop. To develop this software, a software developer decided to utilize a doubly linked list. Details of all the products will be stored in that linked list. Each node of the linked list will contain the information about **Product_ID, Product_Name, Expiry_Date, Price** and **Stocks** of a particular product. Your task in this problem is to create a doubly linked list and take the input for at least three different products and then perform the following task:

a) Write a function *SortByPrice* to sort all the product in ascending order according to their price using *bubble sort* algorithm.

   Suggested Output:

Product_ID	Product_Name	Expiry_Date	Price	Stocks
0003	B	01-01-2022	30	8
0001	C	03-65-2023	70	3
0008	A	22-12-2021	90	5

b) Write a function *ExpiryDate* to check the expiry date for a given **Product_ID** by utilizing the *sequential search* algorithm.

   Sample Input: 0008

   Sample Output: 22-12-2021