18CSC201J – DATA STRUCTURES AND ALGORITHMS

ASSIGNMENTS

1. Create a student database with 5 students using doubly linked list in which each student data like roll number, name, marks of 5 subjects (marks between 0 and 100) are stored in the nodes by creating structures.

   i) Print the students' details by traversing in both the direction.

   ii) Calculate the average marks of the student and display his grade as per the grade mapping below along with name and roll number.

Mark Range	Grade
90 - 100	O
80 - 89	A
70 - 79	B
60 - 69	C
50 - 59	D
0 - 49	F

2. Create a stack with 5 books using doubly linked list in which the data relevant to the books such as book title, authors name, publisher name, year of publication, ISBN number, and price are stored in the nodes by creating structures.

   i) Print the book details in Last In First Out (LIFO) order.

   ii) Calculate the total price of the books purchased by a customer.

3. In a single processor system, the processor is allocated with 5 jobs to complete the task in First Come First Serve (FCFS) manner where each job is allowed to be executed for 2ms of time in each turn. Create a linked list and store the job information is as follows:

Job ID	Total execution time(ms)
P001	04
P002	02
P003	05
P004	03
P005	01

i) Create a circular queue and complete all the jobs allocated in a circular manner.

ii) Update the execution time as remaining time after every iteration.

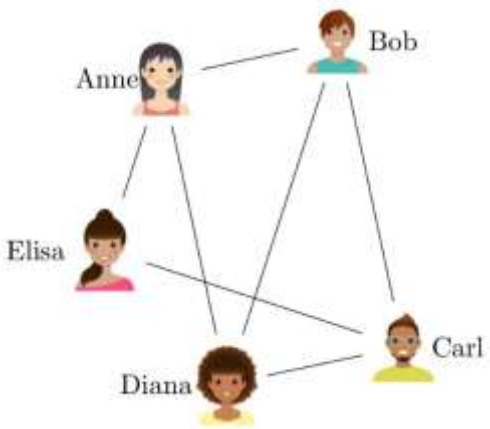
iii) Finally print the number of turns each job undergone for processing.

4. Create a database for a family with 8 members whose data such as name, sex, age and adhar number are stored.

   i) Construct a Binary Search Tree (BST) based on the age as key element.

   ii) Display the details of the members whose age is less than 18.

5. Construct a graph for the following friends' network whose data like name, place and phone number are maintained in a database.



   i) Print the number of cycles formed between their networks.

   ii) Print the details of each group that forms the cycle.

6. Create a structure as date which contains 3 integers such as day, month, and year. Now build a structure named data consists of three integers: day, month, and year.

   i) Create a program that reads the user's input, validates the data entered by the user, and then displays the date on the screen using structures. If you type 29,2,2021, for example, that is an invalid date because 2021 is not a leap year. Similarly, June does not contain 31 days, therefore 31,06,2011 is incorrect.

7. The following is a brief description of Joseph's question: No. 1, 2, 3, 4,..., n participants were sitting in the needle direction, each with a password (positive integer). The number of reports will be stopped when M, and the person who reports M is listed, and the password will be used as a new M value, starting from the first person to the time in a clockwise manner, and the number of reports will be stopped when M, and the person who reports M is listed. The next person in the clockwise direction begins re-issuing the number of numbers, until all of them have been listed. Create a program to determine the order in which things should be done.

   Basic Prerequisites

   To simulate this process, just save structure in a simple one-way loop list then print the number of each participant in the order to list.

   Data from the tests

   The starting values of M is 30; N=8, and the passwords are:4,2,8,3,5,9,5, first M value 7 (the exact list of (the correct list of 7, 1, 5), 8, 2, 3, 6).

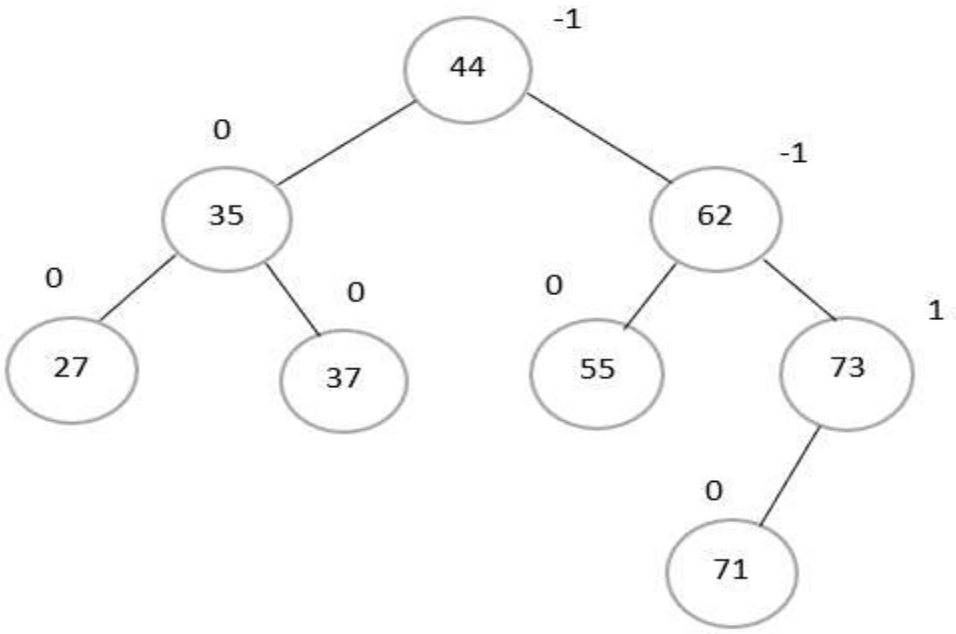
8. Suppose a priority queue consists of five elements implemented as max-heap which and the level-order traversal of the heap is as follows as 21,17,14,12,11. In addition, extra two more new elements are inserted such as '9' and '16', in the heap, based on the order. Obtain the level order traversal of the heap following the insertion of the element.

9. Construct a binary search tree using the following input:

   99, 1, 47, 13, 54, 33, 5, 68, 24, 86, 24, 56, 46

   i) Insert the elements 20, 38, 44, 53, and 62 into the tree
   ii) Delete the elements from tree such as 24, 54, 1, and 47.

10. Make use of AVL tree and insert the following elements 16, 80, 28, 12, 18, 24, 25, and 2 in order. After inserting the elements, you are supposed to delete nodes 37, 62, 12, and 2 from the AVL tree formed.



11. Using open addressing technique with the help of auxiliary hash function h′(x)=x to insert the keys 12,23,32,3,14,27,18,87,58 into a hash table of length n=11

    Consider inserting the keys 12,23,32,3,14,27,18,87,58 into a hash table of length n=11 using open addressing with the auxiliary hash function h′(x)=x.

    i. Using linear Probing, by inserting these keys try to display the results.

    ii. By applying quadratic probing of c1=1 and c2=3

    iii. By applying double hashing, evaluate the function with p1(x)=x and p2(x) = 1+(x mod (n−1)).

12. Create a structure/class for a group of 5 students holding data for their Regn no., Name, Branch, CGPA

    a) Call linear search function to display data of student with a particular Regn no.

    b) Call bubble sort function to arrange data of students according to Regn no.

    c) Apply binary search on the above output (part b) to display data of a student with a particular Regn no.

    d) Use and modify Insertion sort logic to arrange data of students in descending order of CGPA.

13. Create a student Record Management system using linked list that can perform the following operations:

- Insert Student record
- Delete student record
- Show student record
- Search student record

The student record should contain the following items

- Name of Student
- Roll Number of Student
- Course in which Student is Enrolled
- Total Marks of Student

14. An investor buys and sells shares of stock in various companies listed in the stock market. What if the person sells 120 shares of a particular company for $90 each at a time when the person owns 150 shares, of which 50 shares were bought in January at $60 each, 50 more in February at $70 each, and 50 more in March at $80 each? Which of those particular shares are being sold?

15. Design an algorithm to count and return the number of nodes in a binary tree that have two children. Express your solution as a pair of Java functions (not BST member functions), which would be implemented in the same package as the BST generic specified.

16. Design an abstract data type Graph to represent a data structure for an undirected graph. Vertices of the graph are uniquely identified using an integer ID field, and a templatized value field. The edges of the graph should have a value field that is templatized to accept any class, and the edge is uniquely identified by the two vertex IDs it is incident upon. The graph ADT should allow you to add, remove and list vertices and edges. The edges incident on a vertex should be maintained as an adjacency list. The ADT should allow you to traverse to incident edges and adjacent vertices from a given vertex.
The header file for the graph ADT should be placed in graph.h and its implementation placed in graph.cpp/.c. These files should only contain the signature and implementation of the graph ADT, respectively, and should be well-documented.

17. Search the element from the given input. Element to be searched with following functionalities

index	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
value	2	4	7	10	13	16	17	20	24	28	31	38	41	43	45

(i)Use the **search ()** keyword for function declaration

(ii)use **MID** term as the middle value calculation

(iii)What sequence of 'middle' values are compared to the target when performing a binary search with target 28?

(iv) What sequence of 'middle' values are compared to the target when performing a binary search with target 16?

(v)What sequence of 'middle' values are compared to the target when performing a binary search with target 5?

18. Create the doubly linked list program using 7 nodes. Each Node will have a reference pointer to its next as well as previous node. Doubly linked list program should follow the below functionalities

(i)Create (): create the doubly linked list with ascending order.

(ii) Insert (): New elements to be inserted in the 2^{nd} index position.

(iii)Delete (): Delete the 5^{th} index position node and display the whole doubly list

(iii)Reverse (): Once all the element are inserted and then reversing a linked list will reverse the list as well as the property ascending becomes descending and vice-versa.

19. Two linked list mentioned below. Given pointers to the heads of two unsorted linked lists, merge them into a single, sorted linked list. Either head pointer may be null meaning that the corresponding list is empty.

(i)Create (): create the two singly linked list.

linked list A: 1->8->10->4

linked list B : 7->9->3->11

(ii)display (): display the created linked list.

(iii) merge (): merge the two given linked list and bring the output as ordered one

output : 1->3->4->8->9->10

Function Description

mergeLists has the following parameters:

- SinglyLinkedListNode pointer headA: a reference to the head of a list
- SinglyLinkedListNode pointer headB: a reference to the head of a list

20. Implement Binary Search Trees with following functionalities
(i) Search (): Search user given item into Recursive & Non-Recursive method

(ii) Insertion (): insert the new element in to the binary tree

(iii) Max (): Find the maximum element of the BST

(iv)Min (): Find the Minimum element of the BST

(v) Delete (): Delete a given node from the BST

21. Create a structure/class for a group of 50 students holding data for their Regn no., Name, Branch, CGPA

(i) Call linear search function to display data of student with a particular Regn no..

(ii) Call bubble sort function to arrange data of students according to Regn no.

(iii) Apply binary search on the above output (part b) to display data of a student with a particular Regn no.

(iv) Use and modify Insertion sort logic to arrange data of students in descending order of CGPA