VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test I - September 2022

Programme	:	**B.Tech. CSE**	Semester	:	**Fall 2022-2023**
Course	:	**Data Structures and Algorithms**	Code	:	**BCSE202L**
Faculty	:	**Srinivasa Rao, Ramesh, Kavya, Manimegalai, Sangeetha, Abinaya, Suguna, Mercy, Vijayalakshmi, Rishikeshan, Muthukumaran, Pavithra**	Class No	:	**CH2022231001052, 1057, 1056, 1055, 1068, 1066, 1053, 1069, 1054, 1064, 1065, 1067**
			Slot	:	**D1+TD1**
Time	:	**90 minutes**	Max.Marks	:	**50**

- **Anwer ALL Questions.**
- **Answer the Questions with your Intelligence Only.**
- **If some information is required for answering any question, assume the same.**

Q.No	sub Q.No	Question Description	Marks
1		Give asymptotic upper and lower bounds for $T(n)$ in each of the following recurrences. Assume that $T(n)$ is constant for $n \leq 2$. Make your bounds as tight as possible , and justify your answers. 1. $T(n) = \sqrt{2} \quad T(n/2) + log\, n$. (5 marks) 2. $T(n) = 0.7 \quad T(n/2) + \frac{1}{n}$. (5 marks)	10
2		Let A be a two-dimensional array of size $m \times n$. The array A have $mn - 1$ positive numbers and one negative number. Write an algorithm to identify the index of the negative number in the array A. Illustrate your algorithm for any sample input.	10

double compute_an(int n)

{ if (n==1)
return 1;

} else { double inner_fraction = compute_an(n-1);
return 1.0 / (1 + inner_fract^n)

3		A sequence is an ordered list of numbers. A sequence is defined as follows: $a_1=1+\frac{1}{1}$, $a_2=1+\frac{1}{1+\frac{1}{2}}$, $a_3=1+\frac{1}{1+\frac{1}{1+\frac{1}{3}}}$, $a_4=1+\frac{1}{1+\frac{1}{1+\frac{1}{1+\frac{1}{4}}}}$, and so on. For a given a positive integer n, write a recursive algorithm to compute a_n and also compute the running time of your algorithm with justification.	10
4		Let α be an operator that denotes an inequality between two values. The operator α is typically placed between two values being compared and signifies that sum of digits of the first number is less than or equal to sum of the digits of the second number. For example, $1111\alpha199$ is true, because $4(=1+1+1+1) \leq 19(=1+9+9)$, but $98\alpha111$ is not true, because $17(=9+8) \leq 3(=1+1+1)$. **Alpha Sort problem**: Let S be an array of n positive integers. Sort the elements of S based on the α operator. For example,let $S = [22, 1111, 11, 9]$. The resultant output should be $[11, 22, 1111, 9]$ or $[11, 1111, 22, 9]$. Write an algorithm for the Alpha Sort problem and illustrate your algorithm for any sample input.	10
5		A polynomial of degree n (in one variable, with real coefficients) is an expression of the form: $a_nx^n+a_{n-1}x^{n-1}+a_{n-2}x^{n-2}+\cdots+a_2x^2+a_1x+a_0$ where $a_n \neq 0, a_{n-1}, a_{n-2}, \cdots, a_2, a_1, a_0$ are real numbers. It is denoted by $P(x)$. For example, $P(x) = 3x^4 - 2x^2 + 1$ is a polynomial of degree 4 and the value of polynomial $P(x)$ at $x = 2$ is $P(2) = 48 - 8 + 1 = 41$. **Polynomial Sort problem**: Let $S = \{P_1(x), P_2(x), \cdots, P_n(x)\}$ be a set of polynomials of different degrees. For a given constant k, sort the elements of S based on the value of polynomials at $x = k$. The values of polynomials at $x = k$ are smaller appear in the beginning and those with highest values appear at the end. For example, let $S = \{P_1(x) = 1 + 2x, P_2(x) = 200, P_3(x) = 4 - 2x + 5x^2, P_4(x) = 1 + 4x^4\}$ and $k = 2$. The resultant output should be $S = \{P_1(x), P_3(x)P_4(x), P_2(x)\}$. Write an algorithm to solve the Polynomial Sort problem and illustrate your algorithm for any sample input.	10

Stack:
Stack Permutation
Tower of hanoi
Celebrity problem
Stock span
Infix to postfix
Infix to prefix

Queue
Circular Queue
Priority

VIT

Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Continuous Assessment Test 1 – February 2024

Programme	:	**B.Tech**	Semester	:	**Winter 23-24**
Course	:	**Data Structures and Algorithms**	Code	:	**BCSE202L**
Faculty	:	**Dr. Senthil Kumar A.M., Dr. Om Kumar C.U.**	Slot	:	**E2 + TE2**
			Class Nbr	:	**CH2023240502720 CH2023240502725**
Time	:	**1 1/2Hours**	Max. Marks	:	**50**

Answer ALL the Questions

If any assumptions are required, assume the same and mention those assumptions in the answer script.

Q.No	Question Description	Marks
a	Frame the recurrence relation and compute the time complexity of the following algorithm. (5 marks)	10

```
Function fibonacci(n)
{
  if n <= 1
  {
    return n;
  }
  else
   return fibonacci(n-1) + fibonacci(n-2)
   }
```

b	Solve the following recurrence relation using substitution method $T(n) = n^{1/2} T(n^{1/2}) + n^{1/2}$ (5 marks)	
2.	Imagine you have a sorted list of numbers, and in this list, every element is repeated twice, except for one unique element that appears only once. For example in the instance [1, 1, 2, 3, 3, 4, 4] 2 appears once. Your task is to identify and find the number that stands out, appearing singularly among the duplicates by an approach. How would you approach solving this puzzle and determining the unique number in the sorted list? Analyze the time complexity of the algorithm.	10
3.	Implement a last-in-first-out (LIFO) stack using only two queues. The implemented stack should support all the functions of a normal stack (push, top, pop, and empty). You must use only standard operations of a queue, which means that only push to back, peek/pop from front, size and is empty operations are valid. For example if the input sequence is ["Display", "push", "push", "top", "pop"] then the output should be null, null, null, 2, 2].	10
4.	Imagine a library where you need to organize a vast collection of books on the bookshelves efficiently. The library has bookshelves dedicated to different genres, and each shelf has limited space and each book has metadata, including its title, author, publication year, pages and genre. Can you implement a recursive sorting technique to sort books by implementing a comparison function books_to_sort ( ) that sorts by comparing the total pages and their genre? Derive the time complexity and justify the usage of your choice.	10

For example if you have the following input:
book1 = Book("The Catcher in the Rye", "Fiction", 220)
book2 = Book("1984", "Dystopian", 328)
book3 = Book("To Kill a Mockingbird", "Classics", 281)
book4 = Book("The Hitchhiker's Guide to the Galaxy", "Sci-Fi", 208)
book5 = Book("Crime and Punishment", "Classics", 430)

5. Given an arithmetic expression ["6", "3", "2", "+", "*", "5", "/"] in Postfix Notation, evaluate the value. For example [“8”, “4”, “+”, “6”, “/”] would evaluate to 2. Demonstrate the tracing and justify 10

⇔⇔⇔

21BCE1808

VIT
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

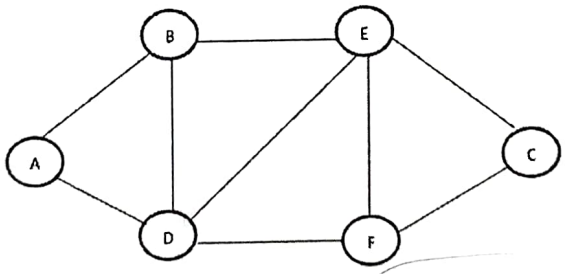
Continuous Assessment Test 2 – April 2024

Programme	:	**B.Tech**	Semester	:	**Winter 23-24**
Course	:	**Data Structures and Algorithms**	Code	:	**BCSE202L**
Faculty	:	**Dr. Senthil Kumar A.M., Dr. Om Kumar C.U.**	Slot	:	**E2 + TE2**
			Class Nbr	:	**CH2023240502720 CH2023240502725**
Time	:	**1 1/2Hours**	Max. Marks	:	**50**

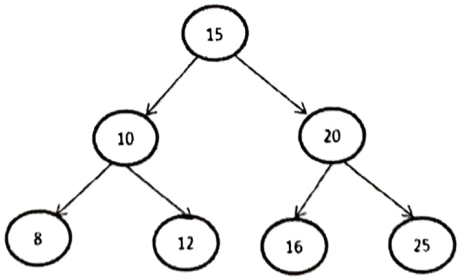
Answer ALL the Questions

If any assumptions are required, assume the same and mention those assumptions in the answer script.

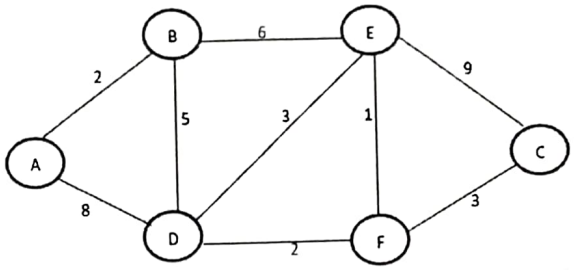
Q.No	Question Description	Marks
1.	Given a Doubly linked list (DLL) 'L', and a specified key 'K', write an algorithm to eliminate all instances of 'K' from L. For example if L is 100<-> 200 <-> 300 <-> 200 <-> 400 <-> 700 <->200 and if the key value 'K' is 200 the resultant output would be 100 <-> 300 <-> 400 <-> 700.	10
2.	Given a Single linked list (SLL) 'L', split 'L' into two linked list L1, L2 such that L1 contains all even numbers from L and L2 contains all odd numbers from L. For example if L is 100-> 200 -> 300 -> 200 -> 400 -> 700 then L1 would be 200 ->200 ->400, L2 would be 100-> 300 -> 700.	10
3.	Write an algorithm to determine whether an undirected graph contains any cycles. A graph is considered cyclic if there exists a path that begins and ends at the same node. For example in the graph given below, the paths A-B-E-D-A is a cycle starting at A and ending at A. Also the path B-D-F-E-B is a cycle that starts and ends at B.	10



4.	Given a Binary Search Tree (BST) and a positive integer k, write an algorithm that identifies the k^{th} smallest node (in terms of value) in the BST. For instance, in the provided BST, the algorithm should determine the 4^{th} smallest node as 15. The 7^{th} smallest node is 25.	10



5. Illustrate the Dijkstra's Algorithm to obtain a shortest path from a source vertex "A" to all other vertices in the following weighted undirected graph. Your illustration should contain all the steps of the algorithm. 10



⇔⇔⇔

Reg. No.:

Name :

VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

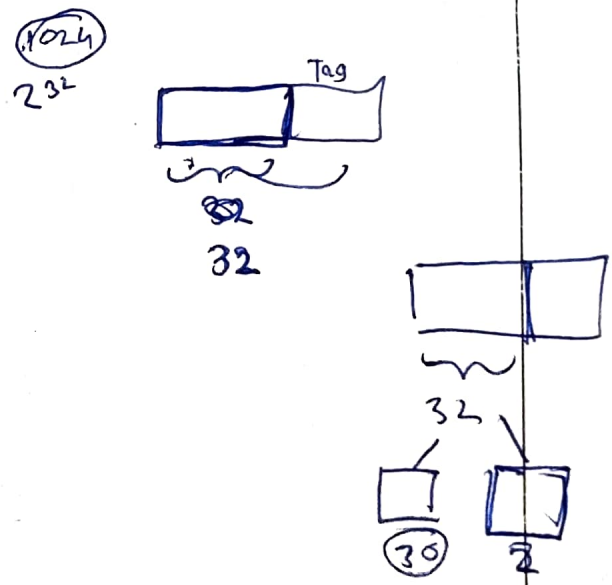
Continuous Assessment Test II – October 2022

Programme	:	**B.Tech. CSE**	Semester	:	**FALL 2022-23**
Course Code	:	**BCSE202L**	Class Nbr	:	**CH2022231001454,1445, 1453, 1425, 1426, 1472, 1447, 1459, 1471, 1423, 1440 1462, 1424, 1457**
Course Title	:	**Data Structures and Algorithms**			
Faculty	:	Dr Balaji C, Dr S. Kirthica, Dr. Joshan Athanesious J, Dr P.Valarmathi, Dr A. VINOTHINI, Dr B. Saleena, Dr Hasmath Farhana, Dr Richa, Dr K.Tamilarasi, Dr. Rajakumar Arul, Dr B.Sahaya Beni Prathiba, Dr Gowdham Prabhakar, Dr N G Bhuvaneswari, Dr Mansoor Hussain D,	Slot	:	**A2 + TA2**
Time	:	**90 Minutes**	Max. Marks	:	**50**

Answer all the Questions (5 X 10 = 50 Marks)

Q. No.	Question	Marks
1.	Let S={ I_1, I_2, …, I_n } be a set of 'n' closed intervals. The intervals are said to be overlapping if $I_1 \cap I_2 \neq \Phi$ (non-empty). The ovelapping intervals I_1=[a1, b1] and I_2=[a2, b2] merged as [min{a1, a2}, max{b1, b2}]. For example, I_1=[2,6] and I_2=[5,7] are overlapping intervals and after merging the resultant interval is [2,7]. Your task is to merge all the overlapping intervals of S and display all the non overlapping intervals. For example, consider the 6 closed intervals as the input given by user as [2, 6],[3,4],[5,7],[8,9],[9, 11],[13,16] then the overlapping interval after merging will be [2,7],[8,11],[13,16]. Which data structure is most suitable to perform the above task. Write an algorithm by using the mentioned data structure . Illustrate your algorithm for any sample input.	10
2.	There are 'n' number of balls in a box. The colors of the balls are red and blue. You are requested to stack the balls in the bottom sealed basket one by one. The order of placing the balls is two consecutive red balls followed by the two consecutive blue balls. Later, create two empty queues. Now, remove the last inserted ball from the basket and place it in the first queue. Similarly remove the next ball from the basket and insert in the second queue. Write an algorithm to repeat this process until the basket is empty and also print the color of the balls in both queues.	10

3.	Create a linked list that consists of integers. Write an algorithm to insert a new element between every pair of two consecutive elements. The new element is the average of two consecutive integers. For example, if the list is 12 --> 34 ---> 56 --> 78 --> 15, then the average of two consecutive integers 12 and 34 is 23 should be inserted between 12 and 34. The average of 34 and 56 is 45, which should be inserted as shown below: 12 --> 23 --> 34 --> 45 --> 56 --> 67-->78-->46.5--> 15.	10
4.	The distance travelled by the first *bus* after *t* seconds is given by the polymomial *P1* while the distance travelled by the second bus after t seconds is given by the polymomial *P2*. Which data structure is most suitable to represent the above scenario. Write an algorithm by using the mentioned data structure to find how far apart will the two buses be after t seconds. For example, Input P1: At^2+Bt P2: Qt^2+Pt Output (A-Q) t^2+(B-P) t	10
5.	Given a binary tree containing n nodes. Write an algorithm to replace each node in the binary tree with the sum of its inorder predecessor and inorder successor. For example if the given tree is as follows 1 / \ 2 3 / \ / \ 4 5 6 7 Then the Output will be 11 / \ 9 13 /\ / \ 2 3 4 3	10



*****