International College of Business & Technology
Department of Information Technology

Data Structures and Algorithms

Name: ID:

Date: 01/07/2022

Instructions to Candidates:

- Time allowed**: 3 hours (additional 2 hours given for Submission)**
- No of MCQ Questions – 20 (Part I)
- No of structured Questions - 3 (Part II)

- This is a closed book examination – this means you are not permitted to use any textbooks or study aids in the examination.
- You must answer the All the questions
- You should put a cross through any work you do not wish to be marked.
- Weightage -100%

Part I **(LO1, LO2, LO3, LO4)**

Part I (20 MCQ question – 1 mark for each question)

1. Advantages of an array

   A) Data items of mixed data types can be stored

   B) Cannot increase the size dynamically

   C) Adjacent memory allocation

   D) Need of using respective index to access items/ Random access allowed

2. You need to insert the following given keys into a binary search tree
   45, 10, 7, 90, 12, 50, 13, 39, 57
   What is the height of your BST?
   A) 3

   B) 4

   C) 5

   D) 6

3. What is the output of the following piece of code?

```
public class JavaApplication3 {

  public static int addNum(int a, int b){
        System.out.println(addNum(a, b));
        return addNum(a, b);
    }

    public void findAverage(int x, int y){
        int sum = addNum(x, y);
        System.out.println("The average is : "+ sum/2);
    }
    /**
     * @param args the command line arguments
     */
    public static void main(String[] args) {
        // TODO code application logic here
        int sum = addNum(3, 4);
        System.out.println(sum);
    }
}
```

   A) 7

B) 3.5

C) The average is 3.5

D) Stack overflow error

4. Is there any method which is being called recursively both as directly and indirectly in the above piece of code given? (Question 3)

   A) No

   B) Yes

   C) Only direct recursion

   D) Only indirect recursion

5. Not that a disadvantage of a linked list is,
   A) Can change the list size dynamically

   B) No need of adjacent physical memory allocation

   C) None of above

   D) Both A and B

6. What is the method used in java to remove and element from a queue?
   A) dequeue()

   B) pop()

   C) remove()

   D) insert()

7. If the elements “X”, “Y”, “Z” , “A” and “N” are placed in a queue and then items are removed for two times, in what order will they be removed?

   A) NA

   B) XY

   C) Error

   D) None of above

8. In a stack, if a user tries to insert an element in to an already filled stack it is called,

   A) Underflow

   B) Empty collection

   C) Overflow

   D) Garbage Collection

9. Consider the following doubly linked list: head-1-2-3-4-5-tail. What will be the list after performing the given sequence of operations?

```
Node temp = new Node(6,head,head.getNext());
Node temp1 = new Node(0,tail.getPrev(),tail);
head.setNext(temp);
temp.getNext().setPrev(temp);
tail.setPrev(temp1);
temp1.getPrev().setNext(temp1);
```

   A) head-0-1-2-3-4-5-6-tail

   B) head-1-2-3-4-5-6-tail

   C) head-6-1-2-3-4-5-0-tail

   D) head-0-1-2-3-4-5-tail

10. Which of these is an incorrect array declaration?

    A) int arr[] = new int[5] ;

    B) int [] arr = new int[5] ;

    C) int arr[]; arr = new int[5];

    D) int arr[] = int [5] new;

11. After performing these set of operations on a double-ended queue, what does the final list look contain?

    a. InsertFront(10);
    b. InsertFront(20);
    c. InsertRear(30);
    d. DeleteFront();
    e. InsertRear(40);
    f. InsertRear(10);
    g. DeleteRear();
    h. InsertRear(15);
    i. display();

    A) 10 30 10 15

    B) 20 30 40 15

    C) 20 30 40 10

    D) 10 30 40 15

12. User perform following operations on a stack of size 4.

    a. push (1)
    b. pop ()
    c. push (2)
    d. push (3)
    e. pop ()
    f. push (4)
    g. pop ()
    h. push (5)

    How many number of elements are left at the end of last operation? In which order they (at the end of last operation) can be accessed?

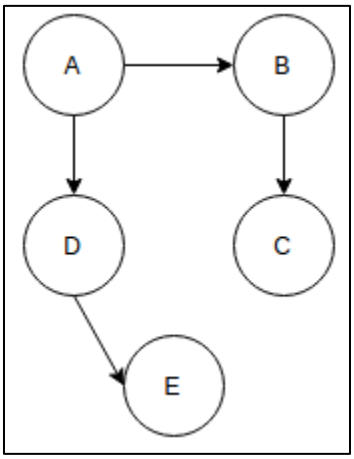
    A) No items: 4, sequence: 1,2,3,4

    B) No items: 2, sequence: 5,2

    C) No items: 2, sequence: 2,5

    D) No items: 5, sequence: 5,4,3,2,1

13. What would be the DFS (Depth First Search) traversal of the given Graph?



A) ABCED

B) AEDCB

C) EDCBA

D) ADECB

14. What are the number of swaps and iterations required to sort the array arr={1, 2, 4, 8, 7, 5, 6, 3} using bubble sort?

A) Swaps: 11, iterations :5

B) Swaps: 10, iterations :4

C) Swaps: 10, iterations :5

D) None of above

15. Which one of the following is the correct option to create a new node in singly linked list?

A) ptr= (node*)malloc(sizeof(node*))

B) ptr=(node)malloc(sizeof(node))

C) ptr=(node*)malloc(sizeof(node))

D) None of the above

16. Which of the following sorting algorithm is in place?

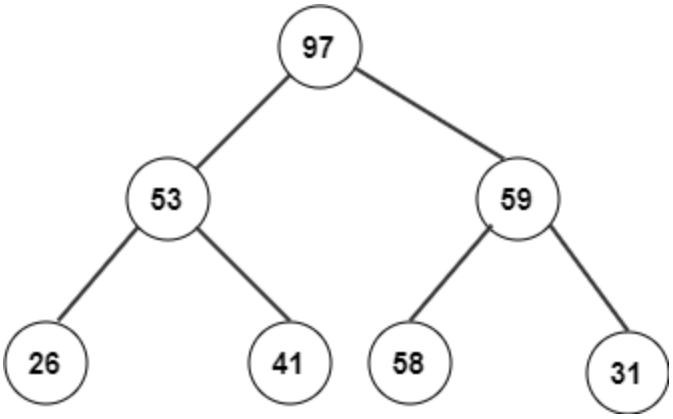
A) Merge sort

B) Radix sort

C) Recursive bubble sort

D) Heap sort

17. Consider the following heap after “buildheap” phase. What will be its corresponding array?



A) 26,53,41,97,58,59,31

B) 26,31,41,53,58,59,97

C) 26,41,53,97,31,58,59

D) 97,53,59,26,41,58,31

18. In dynamic programming, the technique of storing the previously calculated values is called,

    A) Saving value property

    B) Storing value property

    C) Memorization

    D) Mapping

19. Breadth First Search is equivalent to which of the traversal in the Binary Trees?

    A) Pre-Order traversal

    B) Post-Order traversal

    C) Level-Order traversal

    D) In-Order traversal

20. A hash table of length 10 uses open addressing with hash function h(k)=k mod 10, and linear probing. After inserting 6 values into an empty hash table, the table is as shown below.

0	
1	
2	42
3	23
4	34
5	52
6	46
7	33
8	
9	

Which one of the following choices gives a possible order in which the key values could have been inserted in the table?

A) 46, 42, 34, 52, 23, 33

B) 34, 42, 23, 52, 33, 46

C) 46, 34, 42, 23, 52, 33

D) 42, 46, 33, 23, 34, 52

Part II

a) Task 1 (Marks 20)

"Life Academy" is a library chain that is identified in private sector of Sri Lanka and has joined hands with Sri Lanka Ministry of Education in order to provide with the access to different categories of education and entertainment books to the school students island wide. They have been using the approach in order to provide the books via borrowing them using a membership card. So they only had the students provided with books to be collected physically by visiting any of the branches of their library, wherever they are located in.

Now, along with the pandemic and the consequences that had badly affected the paper and publishing industry with the inflation in Sri Lanka, they are taking necessary steps to convert their service in to a software and web service: simply as an e-library.

As the initial requirement, they need to let the students to access the details of the books and to read them online, randomly by using the book id(ISBN) number or the book category/book name/author name etc. Just in case, they need to have the memory to be allocated effectively and to have them managed by the admin side in most possible convenient way.

Additionally, they need to traverse through both the directions when digging through the details of each and every book object(books).

- Identify and properly justify the most suitable data structure with their operations for above requirement. (Explain and evaluate the advantages and disadvantages of suitable data structure. And evaluate the suitability of selected algorithm with real-time examples)

b) Task 2 (Marks 30)

Crate a Program for search value in the given integer array.

Note: Student can select any search algorithm for execute the program.

93 10 87 80 34 104 100 23 66

1. Create an appropriate Java class.
2. Create a method to Sort the above mention array
3. Create a method to search value 34 in the given array
4. Create a method to print the values in array and method require array parameter
5. Create the main method to declare the given array. Call Sort and display methods.

c) *Task 3 (Marks 30)*

To improve the performance of the system memory management and recursion algorithms, play big role.

1. List out and explain the complexity factors used to evaluate the performance of a certain algorithm using data structures. Provide suitable examples to justify your answer that how are these mentioned factors going to affect with the performance of the overall program.
2. What is recursion in data structure? Identify the advantages and disadvantages of recursion algorithms.
3. Develop method for recursion algorithm to print Fibonacci sequence considering the input to the method as 6.

End of the Paper