University of Dhaka

Department of Computer Science and Engineering

Second Year First Semester In-course Examination - 2022

CSE-2101: Data Structures and Algorithms

Time: 1.10 Hours Total Marks: 24 +"1"

Name: **Class Roll:**

[Answer all the following questions]

1. [4+2+3+3]

2	7	9	10
left_half			

3	5	8	10	12
right_half				

i. We want to merge the above two arrays using a merge function. Is the following merge function adequate to merge the two arrays? If not, modify the function to correctly merge them.

```
1  def merge(left_half, right_half):
2      merged_arr = []
3      i = j = 0
4      while i < len(left_half) and j < len(right_half):
5          if left_half[i] < right_half[j]:
6              merged_arr.append(left_half[i])
7              i += 1
8          else:
9              merged_arr.append(right_half[j])
10             j -= 1
11     return merged_arr
```

ii. Comment on whether the merge sort algorithm is an in-place algorithm or not, and indicate which feature or line(s) of your pseudo code dictates your decision. Is there any impact of this phenomenon in the efficiency of merge sort algorithm?

iii. In which case, based on the size of the input data, may merge sort not be as efficient or suitable as compared to sorting algorithms having quadratic complexity algorithms? and why? Mention names of two such algorithms.

iv. Compare quick sort with merge sort algorithm in terms of the stability issue. Mention an application where a stable sorting algorithm is required. You should start your discussion by mentioning the property of a stable sort algorithm.

2. i. In general, memoization is a powerful optimization technique for recursive algorithms, but it should be used carefully depending on the specific characteristics of the problem being solved. Write down two cases where memoization would not be an effective strategy. [2+5]

ii. Write a function in a linked list named ***deleteAtPosition*** that takes two parameters: the position of the node to be deleted and the head of the linked list. Implement the function in such a way that it deletes the node at the specified position and updates the pointers of the linked list accordingly. Assume that the linked list is 0-indexed, i.e., the first node is at position 0.

Provide the time complexity of the function, considering n is the size of the linked list, and briefly explain why is that the case. Describe a scenario where you might use the ***deleteAtPosition*** function in a real-world application.

3. We know that a queue can be implemented using various data structures, including arrays and linked lists. Is there any relationship between the above statement and the nature of queues being an Abstract Data Type (ADT)? [2+3]

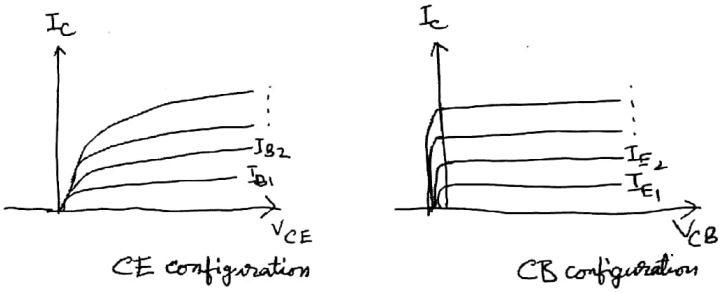
Now, with a suitable example, discuss how the implementation choice of an ADT can impact the benefits of a circular queue.

Mid-term Examination
2nd Year 1st Semester 2022
EEE-2103: Electronic Devices and Circuits

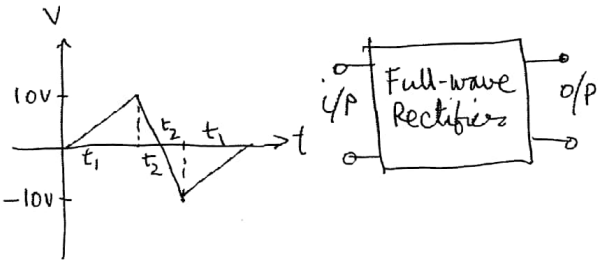
Full Marks: 2000 Time: 1 Hour 15 Mins

1. A transistor can be modeled as two-diodes connected back-to-back. But practically it doesn't behave like a transistor when two diodes are connected back-to-back. Explain the reasons behind this. 200

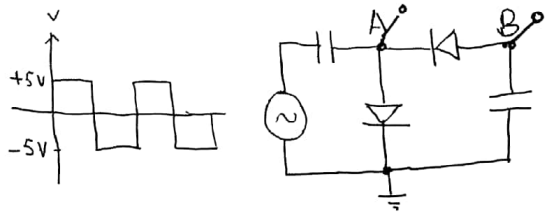
2. The following figures show the output characteristics of transistor common emitter (CE) and common base (CB) configurations. Explain why I_c is 0 near $V_{CE} > 0$ (approximately $V_{CE} = 0.7V$) in CE configuration and I_c is 0 near $V_{CB} < 0$ in CB configuration. 400



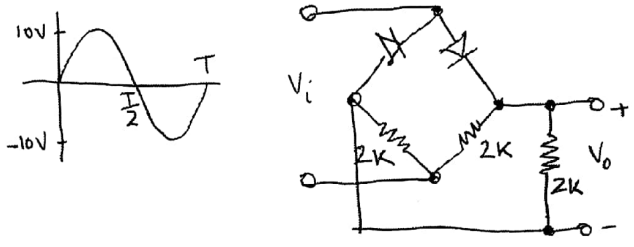
3. Find out the RMS value of the output from a full-wave rectifier circuit. Input is a triangular wave with the following parameters: 300



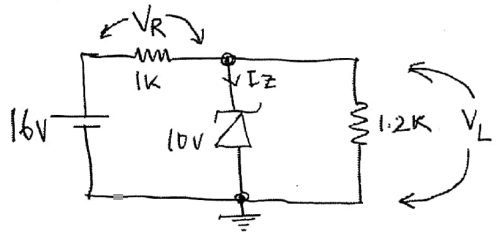
4. Draw the output voltage from the following circuit during the first input cycle (i.e. when the input has just been applied). You are required to show the transient output (not the steady state output). Assume a 10V p-p square wave input. 200



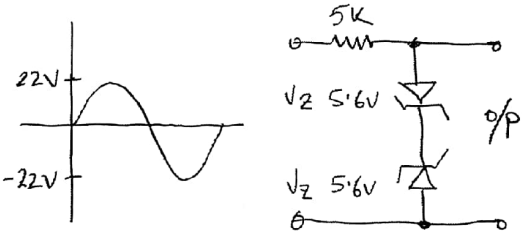
5. Determine the output waveform for the following circuit and calculate the output DC level (average) and the required PIV of each diode. 200



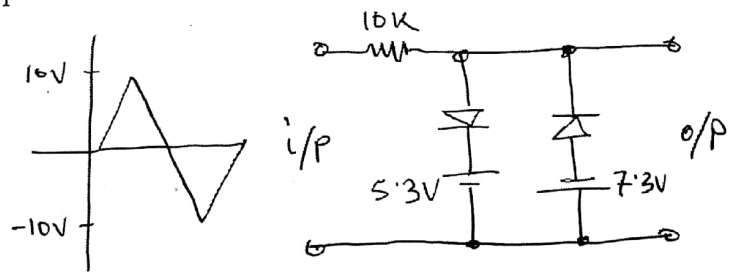
6. Determine V_L, V_R, and I_Z from the circuit below. 300



7. Show the output from the following circuit. 200



8. Show the output from the following circuit. Assume a 20V peak-to-peak triangular wave as input. 200



University of Dhaka
Dept. of Computer Science and Engineering
2nd Year 1st Semester, 2022 Midterm Examination
CSE-2102: Object Oriented Programming

Total Marks: 30 **Date: 6-3-2023** **Time: 75 minutes**

1) Is there anything wrong with the following Java program? If yes, explain. If not, what will be the output of the program? Assume that `Box` class is already properly defined. [3]

```
public class MyClass {
    public static void main(String[] args) {
        Box myBox;
        myBox.width = 30;
        myBox.height = 50;
        System.out.println("myBox's area is " + myBox.area());
    }
}
```

2) What are the ways Java offers to destroy, i.e., to release memory of an object? [3]

3) Consider the following scenario. An employee has three pieces of data: name, ID (a number), and position ("Assistant Manager", "Deputy Manager", and "Manager"). Each of these three positions has a starting salary which are: 50,000 BDT, 60,000 BDT and 80,000 BDT respectively. Each year on January 1, the salary of each employee is increased by 5%. Salary can also be changed when a promotion is achieved by an employee. Salary never changed outside these two conditions. Name and ID are never changed. Position can only be changed after promotion. The company can afford a maximum of 50 employees.

You should write only one class named `Employee` where you need to write code to implement the above scenario. This class should include the main function where the following actions are performed:

a) The company takes two new employees in Assistant Manager and Deputy Manager posts named "Sakib" and "Mahmud" respectively.
b) Sakib gets promotion to "Deputy Manager" post.
c) The year ends, and the company increases salaries of all employees by 5%.

Your code should be as standard as possible as per the OOP practice. [12]

4) The `IntStack` interface along with two classes that implement it are as follows:

```
interface IntStack {
    void push(int item);
    int pop();
}

//An implementation of IntStack that uses fixed storage.
class FixedStack  implements IntStack {
    private int[] stck;
    private int tos;
```

```
    FixedStack(int size){
        stck = new int[size];
        tos = -1;
    }
    public void push (int item){
     if (tos == stck.length-1)    System.out.println("Stack is full.");
     else                         stck[++tos] = item;
    }//push() ends
    public int pop (){
     if (tos < 0)  {
           System.out.println("Stack is empty.");
           return 0;
      }
       else  return  stck[tos--];
    }//pop() ends
}//FixedStack class ends

//An implementation of "growable" stack that uses IntStack
class DynStack  implements IntStack {
    private int[] stck;
    private int tos;
    DynStack(int size){
        stck = new int[size];
        tos = -1;
    }
    public void push (int item){
        //if the stack is full, allocate a larger stack
        if (tos == stck.length - 1) {
            int[] tmp = new int[stck.length*2];
            for (int i = 0; i < stck.length; i++)    tmp[i] = stck[i];
            stck = tmp;
            stck[++tos] = item;
        }
        else  stck[++tos] = item;
    }//push() ends
    public int pop (){
        if (tos < 0)  {
           System.out.println("Stack is empty.");
           return 0;
         }
        else          return  stck[tos--];
    }//pop() ends
}//DynStack class ends
```

a) Draw the class hierarchy for this code. Each class should contain the names of data members and actions. [2]

b) Probably you have already noticed that there is still room for code-reuse in the above code. Modify the code so that further code reuse is enforced. In addition to the above class hierarchy, you should use only one more construct: a (concrete/abstract) class or an interface. Note that the private nature of the data should be kept unchanged. [10]

Department of Computer Science and Engineering
University of Dhaka
2nd Year 1st Semester Incourse Examination 2022

Course Code: MATH-2105 Course Title: Linear Algebra

Time: 1 hour 15 minutes Full Marks: 30

Answer all FIVE questions. Each question carries 06 marks

1. Solve the following linear system using Gauss-Jordan Elimination

$$\begin{aligned} x_1 + 3x_2 - 2x_3 + 2x_5 &= 0 \\ 2x_1 + 6x_2 - 5x_3 - 2x_4 + 4x_5 - 3x_6 &= -1 \\ 5x_3 + 10x_4 + 15x_6 &= 5 \\ 2x_1 + 6x_2 + 8x_4 + 4x_5 + 18x_6 &= 6 \end{aligned}$$

2. Using row operations find inverse of

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 3 \\ 1 & 0 & 8 \end{bmatrix}$$

3. The following vectors span a subspace of R^4. Find a subset of these vectors that forms a basis of this subspace.

$$\begin{aligned} \mathbf{v}_1 &= (1, 2, 2, -1), & \mathbf{v}_2 &= (-3, -6, -6, 3), \\ \mathbf{v}_3 &= (4, 9, 9, -4), & \mathbf{v}_4 &= (-2, -1, -1, 2), \\ \mathbf{v}_5 &= (5, 8, 9, -5), & \mathbf{v}_6 &= (4, 2, 7, -4) \end{aligned}$$

4. Consider the bases $B_1 = \{[2,1,1]^T, [2, -1, 1]^T, [1, 2, 1]^T\}$ and $B_2 = \{[3,1, -5]^T, [1, 1, -3]^T, [-1, 0, 2]^T\}$. Find change of coordinate matrix from B_1 to B_2

5. Determine whether the statement is true or false, and justify your answer.
   a. Every elementary matrix is invertible.
   b. Let A and B be square matrices of the same size. If AB is invertible, then A and B must also be invertible
   c. If $v_1, \ldots, v_n$ are linearly dependent nonzero vectors, then at least one vector vk is a unique linear combination of $v_1, \ldots, v_{k-1}$.

CT 2023 GED 2104 Time: 1 hour Marks: 20

1. What is the meaning of the word "Bangla"? 1
2. From which song the melody of our national anthem was derived? 1
   Who is the composer of that song?
3. Which place is known as the highest point of Bangladesh? Mention it's elevation. 1
4. Why Bijoypur is famous for? 1
5. In which year the 1st European settlement was created in Bengal? 1
   From which country they were from?
6. What are the two international universities of Bangladesh? 1
7. Write down the status of the most of the children in Bangladesh. 2
8. Briefly discuss about the corruption of Bangladesh. 3
9. Write in brief about our upcoming National curriculum of primary and secondary education. 4
10. Discuss about the partition of Bengal in 1905. 5