INDIAN INSTITUTE OF INFORMATION TECHNOLOGY VADODARA

MID-SEMESTER EXAM: AUTUMN 2021

B.TECH. III SEMESTER (GANDHINAGAR & DIU CAMPUS)

MA 201: PROBABILITY AND STATISTICS

MAX MARKS: 10
Duration: 40 MINUTES

INSTRUCTIONS -

1. ATTEMPT ALL FOUR QUESTIONS. ALL QUESTIONS CARRY **ALMOST** EQUAL MARKS.
2. USE OF SCIENTIFIC-CALCULATOR/MATLAB/OCTAVE IS ALLOWED ONLY FOR CALCULATION PURPOSES. THEREFORE, WRITE THE STEPS PROPERLY.
3. ATTEMPT ONE QUESTION AT ONE PLACE. TRY TO MAINTAIN THE QUESTION ORDERING.
4. WRITE YOUR ROLL NO AND PAGE NO WITH SIGN.
5. SCAN THE PDF FILE, RENAME IT AS **MA201_MIDSEMEXAM_YOURINSTITUTEID_NAME.PDF**
6. UPLOAD YOUR **MA201_MIDSEMEXAM_** FILE TO THE GOOGLE-FORM. 15 MINUTES IS GIVEN FOR UPLOADING.

Qus - 1: A continuous random variable X has p.d.f. $f_X(x) = 3x^2, 0 \le x \le 1$.

(a) Find a such that $\Pr\{X > a\} = \dfrac{26}{27}$.

(b) Find b such that $\Pr\{X > b\} = 7\Pr\{X \le b\}$.

(OR)

Qus - 1: Two random variables, X and Y, have the joint distribution $P_{X,Y}(x, y)$,

$P_{X,Y}(x,y)$		x 0	1
y	**0**	0.4	0.3
	1	0.2	0.1

if $R = X + Y$, $S = \min(X, Y)$, and $T = \max(X, Y)$, write the joint distributions $P_{S,T}(s, t)$, $P_{R,S}(r, s)$, and $P_{R,T}(r, t)$ in table form.

Qus - 2: The probability that a man aged 60 will live to be 70 is $p = \frac{2}{3}$. What is the probability that out of 10 men whose age is 60 now, at least 8 will live to be 70? **(WRITE THE STEPS CLEARLY, BEFORE CALCULATION)**

(OR)

Qus - 2: An insurance company found that only 0.01% of the population is involved in a certain type of accident each year. If its 1000 policy holders were randomly selected from the population, what is the probability that not more than two of its clients are involved in such an accident next year? **(WRITE THE STEPS CLEARLY, BEFORE CALCULATION)**

Qus -3: EITHER solve both 3a and 3b

3a: Students of a class were given an aptitude test. Their marks were found to be normally distributed with mean 60 and standard deviation 5. What percentage of students scored more than 60? **(WRITE THE STEPS CLEARLY, BEFORE CALCULATION)**

3b: A manufacturer knows from experience that the resistance of resistors he produces is normal with mean $100\,\Omega$ and standard deviation $2\,\Omega$. What percentage of resistors will have resistance between $98\,\Omega$ and $102\,\Omega$? **(WRITE THE STEPS CLEARLY, BEFORE CALCULATION)**

Hint: $\text{normcdf}(0, 0, 1) = 0.5, \quad \text{normcdf}(1, 0, 1) = 0.8413$

(OR)

Qus - 3: OR solve 3c only

3c: In a normal distribution, 30.85% of items are under 45 and 8.08% are over 64. Find the mean and standard deviation of the distribution. **(WRITE THE STEPS CLEARLY, BEFORE CALCULATION)**

Hint: $\text{norminv}(.3085, 0, 1) = -0.5$ and $\text{norminv}(1 - 0.0808, 0, 1) = 1.4$

IIIT Vadodara
CS203: Mid-Sem Remote Exam

January 15, 2022

Problem 1

[Marks:-4] Sort the functions in increasing order of asymptotic (big-O) complexity with explanation.
(a)$f_1 = n^{\sqrt{n}}$
(b) $f_2 = 2^n$
(c) $f_3 = 10000000n$
(d) $f_4 = \sum_{i=1}^{n}(i+1)$

    Solution:- $f_4 = \sum_{i=1}^{n}(i+1) = \frac{n((n+1)+2)}{2} = \mathcal{O}(n^2)$
$f_1 = n^{\sqrt{n}} = (2^{lg_2\ n})^{\sqrt{n}}$ [Using property(a=b$^{lg_b a}$)]
$=(2^{\sqrt{n}lg_2\ n})$
$f_2 = 2^n$

    Function in increasing order:-f_3, f_4, f_1, f_2

Problem 2

[Marks:-3+3] Consider a recurrence relation $T(n) = \sqrt{n}T(\sqrt{n}) + n$. Prove that $\Theta(nlogn)$ and $\Theta(n)$ are NOT suitable bounds as per definition of Θ bound [Hint: You can use substitution method].
    Solution:- Using Substitution method. Let $\theta(nlogn)$ is your bound. You had to prove that $nlogn$ is both your upper and lower bound.
First check for the upper bound.

$$T(n) = \sqrt{n}T(\sqrt{n}) + n$$
$$\leq \sqrt{n}c\sqrt{n}log\sqrt{n} + n$$
$$= n.c.log\sqrt{n} + n$$
$$= n.c.\frac{1}{2}logn + n \leq cnlogn$$

The last inequality assumes only that $1 \leq c.\frac{1}{2}.logn$. This is correct if n is sufficiently large and for any constant c, no matter how small. The above proof says that our guess is correct for the upper bound. Now, let us prove the lower bound for this recurrence.

$$T(n) = \sqrt{n}T(\sqrt{n}) + n$$
$$\geq \sqrt{n}k\sqrt{n}log\sqrt{n} + n$$
$$= n.k.log\sqrt{n} + n$$
$$= n.k.\frac{1}{2}logn + n \geq knlogn$$

The last inequality assumes only that $1 \leq k.\frac{1}{2}.logn$. This is incorrect if n is sufficiently large and for any constant k. This guess is incorrect for the lower bound. Thus, we understood the $\theta(nlogn)$ is too big and not the correct θ bound.

Now assume $\theta(n)$ is your upper bound.

$$T(n) = \sqrt{n}T(\sqrt{n}) + n$$
$$\leq \sqrt{n}k\sqrt{n}\sqrt{n} + n$$
$$= n.c + n$$
$$n(c+1) \nleq cn$$

Lower bound is easy to prove directly, that is true. Thus it seems $\theta(n)$ is too small and $\theta(nlogn)$ is too big. This proves our statement.

Problem 3

(**Marks:- 3+2+2**) Write the "Bottom-up iterative algorithm" that will find the length for Longest Common Subsequence (LCS) which contains only vowels.

- Show your algorithmic steps to above problem. Also write the algorithm that prints the LCS.

- Give justification for Time and Space complexity of your solution.

- Show all the steps of your solution as input strings X as your First Name and Y as your Second Name. Example: $X_1 = "RAKESH"$ and $Y_1 = "SINGH"$ then LCS would be ZERO. $X_2 = "RAKESH"$ and $Y_2 = "RAMESH"$ then LCS would be $"AE"$.

Solution:-
// function to find the length of longest common subsequence which contains all vowel characters
isVowel(char ch)
{
if $(ch ==' a'||ch ==' e'||ch ==' i'||ch ==' o'||ch ==' u')$
return true;
else
return false;
}

$lcs(X, Y, m, n)$
{
$L[m+1][n+1]$;
i, j;

// Following steps build L[m+1][n+1] in bottom up fashion. Note:- that L[i][j] contains length of LCS of X[0..i-1] and Y[0..j-1]
for (i = 0; i <= m; i++) {
for (j = 0; j <= n; j++) {
if (i == 0 || j == 0)
L[i][j] = 0;

else if ((X[i - 1] == Y[j - 1]) isVowel(X[i - 1]))
L[i][j] = L[i - 1][j - 1] + 1;

else
L[i][j] = max(L[i - 1][j], L[i][j - 1]);
}
}

// L[m][n] contains length of LCS for X[0..n-1] and Y[0..m-1] which contains all vowel characters
return L[m][n]; }
Time complexity: $O(mn)$
Space Complexity $O(mn)$
Example needs to be checked individually on his/her name.

Problem 4

(Marks:- 2+2+4) We have given a set of numbers in an array which is first increasing and then decreasing. For example:{3, 10, 20, 38, 120, 100, 60, 30, 7}. Maximum is 120.
(a)Write first the naive algorithm and the complexity which finds the maximum value from the list.

Solution:- We can traverse the array and keep track of maximum and element. And finally return the maximum element. **Simply check Linear search algo has been written or not.**
Time Complexity : $O(n)$

(b) Can you write the algorithm which can improve the complexity further?

Solution:- We can modify the standard Binary Search algorithm for the given type of arrays.
i) If the mid element is greater than both of its adjacent elements, then mid is the maximum.

ii) If mid element is greater than its next element and smaller than the previous element then maximum lies on left side of mid.

Time Complexity: $O(logn)$

(c) Show the steps of insertion of the above elements from array (one at a time) in the Heap. You can make either Max-Heap or Min-Heap.
Solution:- You had to make either the max-heap or min-heap on the above input and show the steps.

Problem 5

(Marks:- 4+2+2+2) An array $A[1 \ldots n]$ is said to have a *majority element* if more than half of its entries are the same. Given an array, the task are following:

1. Design an efficient divide and conquer algorithm to tell whether the array has a *majority element*, and, if so, to find that element.

2. Give the recurrence relation of your solution.

3. Find the complexity of your solution using Recursion Tree method.

4. Give an example of your working solution to any input of your choice.

Solution: Many have done this question, so I am not writing this solution.

Time: 40 Minutes   Date: 12/11/2021

Max. Marks: 50

Read the instructions carefully.
⇌ Attempt ALL the questions.
⇌ Take fresh Notebook to write the answers for all sessions in sequential manner.
⇌ On top of each page, write Institute ID, Name and Signature. Evaluation will not be done for page without the detail.
⇌ Write each new answer in the new page.
⇌ Scan the pages and save in pdf format with file name: 202051###_Student name#.pdf.
⇌ (For example: 201951123_abc_Gn (Section1 or Section2) or ICD Campus.pdf)
⇌ Upload the file on Google Classroom. No need to send as an email attachment.
⇌ Keep the Notebook and submit to me on arrival at the Institute

Questions (10 Earks Each)

Q1. Take the last four digits of your roll number. If the digit is >=0 & <=3 consider the logic 0, if digit is >=4 & <=6 consider the X (don't care) condition and if digit is >=7 & <=9 consider logic 1. Find the output of the multiplexer (choose as per the requirement).

Q2. Reduce the expression f=∑m(0,2,3,4,5,6) using mapping and Take your roll number digits and add them. If the sum is an even number then realize this circuit using the two input NAND gates only else using the basic gates.

Q3. Minimize the expression using K-map
   1. f(a,b,c) = ∑m(0,1,6,7) + ∑d(3,4,5)
   2. f(a,b,c) = ∑m(0,1,3,5,78,9,11,13,15)

Q4. A circuit has four inputs D,C,B,A encoded in natural binary form where A is the least significant bit. The inputs in the range 0000=0 to 1011=11 represents the months of the year from January (0) to December (11). Input in the range 1100-1111(i.e.12 to 15) cannot occur. The output of the circuit is true if the month represented by the input has 31 days. Otherwise the output is false. The output for inputs in the range 1100 to 1111 is undefined. Draw the truth table to represent the problem and obtain the function F as a Sum of minterm. - Use the Karnaugh map to obtain a simplified expression for the function F. Construct the circuit to implement the function using NOR gates only.

Q5. Take the last digit of your roll number (if zero then take the next non-zero number). Convert the digit into a 4-digit binary number. Take a pair of binary numbers from LSB as an input to the S-R flip flop. Find the next state of the flip flop. Draw the truth table and diagram of the S-R flip flop with rising clock edge.

****************************End ********************************

Indian Institute of Information Technology, Vadodara & DIU

Mid Sem Exam

Course Code: SC-201   **Course Name**: Environment Science

Time: 40:00 Min.   **Total Marks**: 10

I. Short Answers (3 Marks)

1) Define biodiversity and discuss the types of biodiversity with example

Or

2) Difference between Renewable and Non Renewable Resource

II. Long Answers (7 Marks)

1. Discuss the issue of conservation and displacement a case study of The Kuno wildlife sanctuary

Indian Institute of Information Technology Vadodara

B. Tech (CSE/IT) Semester III (Autumn 2021-22)

Examination: Mid Semester Examination (Remote Session)

Course ID: CS 201

Course name: Object Oriented Design and Programming

Full Marks: 40

Date: 10.11.2021

Exam Slot: 10:00 – 10:40

Exam Duration: 40 minutes

Scan & Upload: 10:40 – 11:00

Instructions

1. **Attempt ALL questions**.

2. Use a Notebook to write the answers to Remote session test.

3. Answer all questions in the same Notebook.

4. Answers should be readable, else they may not be considered for grading.

5. All answered pages should be scanned properly. Please check the scanned copy before submitting.

6. The final PDF uploaded should contain all pages sequentially arranged.

7. The uploaded PDF file should be renamed as **courseid_rollno.pdf**.

8. Late submission is <u>not allowed</u>, and would be penalized during grading.

Q.1. Fill the numbered dotted lines with O-O specific class (or implementation) constructs. Mention the Number and Name, no need to draw the entire diagram.   **[6 Marks]**

```
                                              (10) ..................
        Customer    1          (4) ...................              0..*    Order    ◄ – – – – – (1) ..............
        - name                                                              date
        # address                              ▼ Payment    1..*      1     status      ◄ – – – – (2) .............
        + age                                                               calcTax
                                                 amount                      calcTotal    ◄ – – – (3) .............
                                                                            calcTotalWeight
                                                                                   1  ◄ – – – (6) ................
        (11)  + denotes ............                                                    (8) ........................
                                                      (9) ...............                   (7) .................
        (12)  # denotes ............
                                                                            line item  1..*
                             △
     ┌──────────┬──────────┼──────────┐
   Credit       Cash     Cheque      Order Detail   ►              Item
   number    cashTendered  name      quantity     0..*    1   shippingWeight
   type                    bankId     taxStatus                 description
   expDate                                                      getPriceforQuantity
                           authorized calcSubTotal              getWeight
   authorized                         calcWeight

              ............... (5)
```

Q.2. Identify classes and their attributes for each of the requirements (F1 to F7). Use proper notations for representing classes. Need to present the class diagram.   **[6 Marks]**

A point-of-sale application needs to record all purchases. Here are a few facts:
- F1: Customers make purchases.
- F2: Customers have names.
- F3: Purchases have dates.
- F4: One or more items are sold in a purchase.
- F5: Items have prices and descriptions.
- F6: Purchases have amounts equal to the sum of the prices of the items sold.
- F7: Customer Smith purchases copies of Ulysses and Moby Dick.

Q.3. Give three differences between an interface and an abstract class in Java. **[6 marks]**

Q.4. Consider the following class definition that is written without methods. Instead, it has comments followed by blank areas denoted by …………… to describe what each method has to do. Underline Add method definitions in those blank areas as indicated in the

comment. You will get two marks for each correct method definition. Write only the five method definitions, no need to write the entire program. **[10 Marks]**

```java
/**
 * The VideoTape class holds information about a single television programme recorded
on *a video tape and it is used in a video shop system. It holds the video tape details.
 */

public class VideoTape
{
  private String title; // the title of the programme
  private String classification; // classification of the programme (comedy, drama, action,
or  romance)
  private int time; // the running time of the programme in minutes

// Create a new video tape with a given title, classification, and time.

 public VideoTape (String fullTitle, String programClassification, int runningTime )
 {
  title = fullTitle;
  classification = programClassification;
  time = runningTime;
 }

// Return the title of this video tape.
………….

// Return the classification of this video tape.
………….

// Return the time of this video tape as a string in the following format: 2:06.
………….

// Set a new classification for this video tape.
………….

/* Print the details of the video tape to the output terminal in the following format:
* Aman Singh (COMEDY) 2:16
 */

…………..
```

Q.5. Design a class called **ISBN** to represent an International Standard Book Number, or ISBN for short. The ISBN consists of 10 digits divided into 4 parts.
For example, the ISBN 0 941831 39   6 represents the following information:

The first part: The first digit "0" signifies the book is from an English speaking country.
The second part: "941831" identifies the publisher.
The third part: "39" is the title number for the book.
The fourth part: "6" is a check digit to indicate that the sum of the ISBN digits is 10.

The class should have a constructor and methods to set and get the ISBN as a string.

Design a **Book** class that represents relevant information about a book, including the book's title, author, publisher, city and date of publication, and price. The class should also include the field **ISBN** isbnNum; where **ISBN** is the class defined above.

This class should include a constructor and the following methods:
- **setBookISBN:** to set the ISBN for the book.
- **getAuthor:** to return the author of the book.
- **getBookISBN:** to get the ISBN of the book.
- **printDetails:** to print the information of a book in the following form:

Book Title: Object First with Java
Book Author: David j. Barnes and Michael Kolling
Publisher: Prentice Hall
ISBN: 0 941831 39 6

<u>Define only the two classes **Book** and **ISBN**.</u>   **[8 Marks]**

Q.6. What is wrong with the following class definitions? How would you fix them? The line numbers are mentioned beside every program line. Mention the line number which needs modification (if any), and also depict what modification should be made. The explanation with respect to each modification should be mentioned.   **[4 marks]**

```
[1] class Employee
[2] {
[3]     private String name;
[4]     private int id;

[5]     public Employee (String name, int id)
[6]     {
[7]         this.name = name;
[8]         this.id = id;
[9]     }

[10]    public String getName ( ) { return name; }
```

```
[11]    public int getId ( ) { return id; }
[12]  }

[13]  class Manager extends Employee
[14]  {
[15]    private String department;

[16]    public Manager (String name, int id, String department)
[17]    {
[18]       this.name = name;
[19]       this.id = id;
[20]       this.department = department;
[21]    }

[22]    public void getDeprtment ( ) { return department; }
[23]  }
```