

DEPARTMENT OF INFORMATION TECHNOLOGY, NITK SURATHKAL  
MID SEMESTER EXAMINATION, SEPTEMBER 2018  
IT200: DATA STRUCTURES AND ALGORITHMS

Class: III SEM B.TECH (IT)

Date: 24/09/2018

Time: 1½ Hrs.

Marks: 25

Register No.

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NOTE:

1. Both sides of this paper contain questions.

2. Use Pseudo-code to describe algorithms, unless asked otherwise.

Problem 1:

a) Compute the tightest Big-O representation for the following expressions: [2+2 = 4 marks]  
i)  $3n^2 + 5n + 6$       ii)  $1 + 2 + 3 + \dots + n$       iii)  $n^2 + (\log n)^6$       iv)  $n^{1/2} + n^{\log_2 2}$

b) For two functions  $f(n)$  and  $g(n)$  over non-negative integers, when do we say that  $f(n) = \Theta(g(n))$ ? Give a formal definition and explain with a suitable diagram.

Problem 2:

Perform the following operations *sequentially* on a (initially empty) hash table of size 6. Take your hash function to be  $h(k) = \lfloor 6((0.9k) \bmod 1) \rfloor$  & use linear probing to resolve collisions. Show the new table after each operation: [3 marks]  
insert(12), insert(29), insert(32), insert(31), delete(29), insert(51)

Problem 3:

a) Draw the unique binary tree (showing intermediate steps) for each case given their traversals: [2+3+1 = 6 marks]  
i) Tree 1: Pre-order: f a b e d c g h ; In-order: b e a d f g h c  
ii) Tree 2: In-order: s w x y v z u t ; Post Order: s y x w u t z v  
If no unique binary tree exists for any of the above case, mention it.

b) Write pseudo-code for the **predecessor(x)** function that given a reference to a node **x** in a Binary Search Tree, returns a reference to the predecessor of node **x**. If you are using any other Tree operations within your code, give the pseudo-code for these operations too.

c) Write the postfix form of the expression  $8 - 4 / 2 * 3 / 2 + 7$ .

Problem 4:

a) Write an algorithm to reverse the order of the nodes in a singly linked list. Your algorithm should NOT be recursive, and should run in  $O(n)$  time, traversing the list only once. The list does not have a sentinel node, so the head refers to the node containing the first element. [3+1 = 4 marks]

b) If the Dynamic Set ADT is implemented using unordered arrays, the insert operation takes  $O(n)$  time in the worst case. Is this statement True or False? Give reasons for your answer.

**Problem 5:**

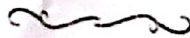
[2+3 = 5 marks]

- a) What are the three main Queue ADT operations? Briefly explain (draw figures of a suitable example) how you can implement all these operations in  $O(1)$  time using a singly linked list. You do not need to write pseudocode here.
- b) The Stack ADT operations are often implemented using an array. Can you describe (in plain words or with pseudo-code) how to implement two stacks using only one array? The Push and Pop operations should run in  $O(1)$  time and neither stack should overflow until the total number of elements in the two stacks equals the length of the array. Only describe how the Push and Pop operations work for the two stacks. Use figure(s) to clarify your explanation.

**Problem 6:**

[3 marks]

Write Python code to define a AVL Tree node: Define a class `AVLTreeNode` with five attributes: `parent`, `key`, `height`, `left_child` and `right_child`. Write a constructor that initialises all the five attributes to `None`. Define a method `numOfDescendants` within this class that computes and returns the number of descendants of that Tree node.





National Institute of Technology Karnataka  
Department of Mathematical and Computational Sciences  
Mid Semester Examination  
MA200: Mathematical Foundations of Information Technology  
8.30 a.m. - 10 a.m., 25/9/2018

Time : 90 Min

Max Marks : 50

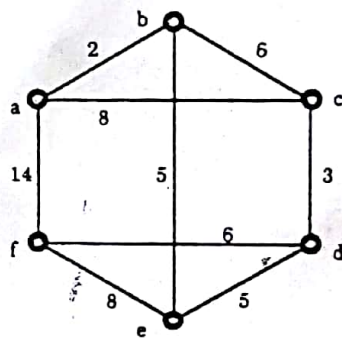
Roll No.....

1. Do the indexing of your answer booklet. (1)
2. Let  $H$  be a graph of order 10 such that  $3 \leq \deg(v) \leq 5$  for each vertex  $v$  in  $H$ . Not every vertex is even. No two odd vertices are of the same degree. What is the size of  $H$ ? (3)
3. The vertices of a simple graph  $G$  of order 9 have degrees 7, 7, 7, 7, 7, 6, 1. Explain properly whether it is possible to deduce whether (12)
  - (a)  $G$  is Eulerian or not.
  - (b)  $G$  is connected or not.
  - (c)  $G$  is bipartite or not.
  - (d)  $G$  is Hamiltonian or not.
4. Find the number of paths of length 2 in the graph  $G$  of the last question. (4)
5. Prove that every simple planar graph with fewer than 12 vertices has a vertex of degree at most 4. (4)
6. A simple connected bipartite graph  $G$  has partite sets  $U$  and  $W$ , where  $|U| = |W| = k \geq 2$ . Prove that if every two vertices of  $U$  have distinct degrees in  $G$ , then  $G$  contains a perfect matching. (4)
7. Three machines  $A$ ,  $B$  and  $C$  produce respectively 50%, 30% and 20% of the total number of items of a factory. The percentages of defective output of these machines  $A$ ,  $B$  and  $C$  are 3%, 4% and 5% respectively. If an item is selected at random, find the probability that the item is defective. (5)

Also find the probability that the item was produced by machine  $A$ .
8. Three points  $a$ ,  $b$  and  $c$  are selected at random from the circumference of a circle. Find the probability that the points lie on a semicircle. (4)
9. Give an example of a graph where Ore's condition is satisfied but Dirac's condition is not satisfied. (3)
10. There are several people in a classroom; some of them know each other. It is true that if two people know the same number of people in the classroom, then there is nobody in the classroom both of these people know. Either prove or disprove that there is someone in the classroom who knows exactly one other person in the classroom. (5)



11. Use Dijkstra's algorithm to find the weights of paths of minimum weights from the vertex  $a$  to each of the other vertices for the following graph: (5)



## DEPARTMENT OF INFORMATION TECHNOLOGY, NITK SURATHKAL

Mid SEMESTER EXAMINATION, Sep 2018

III sem B.Tech (IT). IT206 Paradigms of Programming

All Questions carry equal marks. Time 1.5 Hours. Marks 10

1. What is the output following code snippet? If there is any error, please specify.

```
class Myclass {
    Myclass(){System.out.println("Hello");}
    void Myclass(){System.out.println("Main");}
    public static void main(String[] args)
    {
        Myclass m = new Myclass();
        m.Myclass();
    }
}
```

2. If the Following code snippet generates a compilation error, suggest syntax correction. Otherwise, what is the output and justify?

```
class Base {
    public void Print() {
        System.out.println("Base");
    }
}
class Derived extends Base {
    public void Print()
    {System.out.println("Derived");}
}
class Main{
    public static void DoPrint( Base o ) {
        o.Print();
    }
    public static void main(String[] args) {
        Base x = new Base(); Base y =
        new Derived();
        Derived z = new
        Derived(); DoPrint(x); DoPrint(y); DoPrint(z);
    }
}
```

3. What is the output of the Program?

```
class Grandparent {
    public void Print()
    {System.out.println("Grandparent's
    Print()");}
}
class Parent extends Grandparent { }
class Child extends Parent {
    public void Print() { super.Print();
```

```
System.out.println("Child's Print()");}
}
public class Main1 {
    public static void main(String[] args) {
        Child c = new Child(); c.Print();
    }
}
```

4. What will be the output of the program?

```
class Test extends Thread {public void run(){
    System.out.println("Run");}}
class Myclass {
    public static void main(String[] args)
    {
        Test t = new Test(); t.start();
        t.join(); System.out.println("Main");
    }
}
```

5. Imagine a random hash code is printed for the object "st" of the "Base" class. Do you think the below code will work? Even if it works whether the hash code is same for "st" objects created in "Derived" and "Derived1" Class. If it works and the hash code is different suggest a way make the hash code same for the "st" objects.

```
class Base {
    private static Base myObj;
    private Base(){ }
    public static Base getInstance(){if(myObj
    == null){ myObj = new Base(); }
    return myObj;
}
}
class Derived extends Thread{
    public void run()
    {
        Base st =
        Base.getInstance(); System.out.println("In
        thread" + st.hashCode());
    }
}
```



```

class Derived1 extends Thread{
public void run()
{
    Base st =
Base.getInstance();System.out.println("In
thread" + st.hashCode());
}}
public class BaseTest{

    public static void main(String a[]){
        Derived d = new
Derived();Derived1 d1 = new Derived1();
        d.start();d1.start();
    }
}

```

6. Imagine a random hash code for the object "st" of the "Base" class, what is the output? Justify your answer.

```

class Base {
    private static Base myObj;
    private Base(){ }
    public static Base getInstance(){
        if(myObj == null){ myObj = new Base();
        }
        return myObj;
    }
}
class Derived extends Thread{
public void run()
{ Base st = new Base();
    System.out.println("In Derived" +
st.hashCode());
}}

public class BaseTest1{
    public static void main(String a[]){
        Derived d = new Derived(); d.start();}
}

```

7. Write the full program so that the following code snippet should be the correct one?

```

Card card;
card = new Valentine( "Joe", 14 );
card.greeting(); // some meaningful
message
card = new Holiday( "Bob" );
card.greeting();
card = new Birthday( "Emily", 12 );
card.greeting();

```

8. Explain the output of the following.

```

class exception_handling
{   public static void main(String args[])
    {   try
        { System.out.print("Hello" + " " + 1 / 0);}
        catch(ArithmeticException e)
        {System.out.print("World"); }}
}

```

9. Whether the following code compiles? If so, state the reasons?

```

interface Herbivore {public void
eatPlants();}
interface Omnivore {public void
eatPlants();public void eatMeat();}
class Bear implements Herbivore,
Omnivore {
    public void eatMeat()
    {System.out.println("Eating meat");}
    public void eatPlants()
    {System.out.println("Eating plants");}
}
class Myclass {
    public static void main(String[] args)
    {   Bear b = new Bear(); b.eatPlants();
        b.eatMeat(); } }

```

10. Which of the following statements can be inserted in the blank so that the code will compile successfully? (Choose all that apply)

```

public class Snake {}
public class Cobra extends Snake {}
public class GardenSnake {}
public class SnakeHandler {
    private Snake snake;
    public void setSnake(Snake snake) { this.snake
= snake; }
    public static void main(String[] args) {
        new SnakeHandler().setSnake(-----blank is
here-----);
    }
}

```

- ☒ A. new Cobra()  
☐ B. new GardenSnake()  
☒ C. new Snake()  
☐ D. new Object()  
☐ E. new String("Snake")  
☒ F. null

DEPARTMENT OF INFORMATION TECHNOLOGY, NITK SURATHKAL  
MID SEMESTER EXAMINATION, SEPTEMBER 2018  
IT202: UNIX PROGRAMMING AND PRACTISE

Class: III SEM B.TECH (IT)  
Date: 27/09/2018

Time: 90 Min.  
Marks: 40

Register No.

17ET248

NOTE: Answer all the Questions to the Point only.

1. Analyse the following commands and provide the possible output: (10M)  
(a) data 1> file1 2> file2  
(b) echo "Hello" 1>file1 2>&1  
(c) echo " Hello" | od -bc >/dev/null  
(d) cat file1 -- file4  
(e) cp /etc/passwd /dev/pts/0
2. Consider two files i.e file1 and file2 given below and analyse the output of the following commands. (6M)  

\$ cat file1	\$ cat file2
123456	123456
7890	bh9i
abcd	abc

  
(a) cmp -l file1 file2  
(b) comm -3 file1 file2  
(c) cp -i file1 file2
3. (a) Assume that you have joined a company and given a current employee list emp.lst. It may contain one or more entry of an employee. Find out the number of employees, using terminal commands. (3M)  
(b) Are redirection operators better than pipe operator? Justify your answer. (3M)
4. Devise wild-card pattern to match all the file names which (5M)  
a) starts with numbers and contains at least one special character \$, #, %, &  
b) are not ending with vowels

5. (a) Consider a directory having subdirectory, write a shell script which accepts command line arguments to copy the whole directory to new directory name (taken from the argument) and delete the old directory. (4M)
- (b) How will you change the default permission for files? (2M)
- (c) Devise a command that counts the number of hidden file names in your home directory. (3M)
6. (a) Suggest one of the Unix utilities to a user, who wants to store all his/her terminal activities. (2M)
- (b) You need to accept a secret code through a shell script. What command will you run in the script to make sure that your keyboard input is not displayed? (2M)

-----ALL THE BEST-----



DEPARTMENT OF INFORMATION TECHNOLOGY, NITK SURAT  
MID SEMESTER EXAMINATION, SEPTEMBER 2018

IT201: Digital Design and Computer Organization

Class: III SEM B.TECH (IT)

Date: 29/09/2018

Time: 1½ Hrs.

Marks: 25

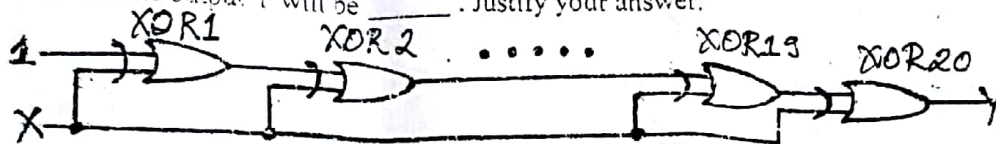
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NOTE:1. Answer All Questions with suitable steps/procedure

- i.  $(10110.0101)_2 = ( \quad )_{10}$
- ii.  $(521.789)_{10} = ( \quad )_8$
- iii. 2's Complement of  $1101100 = \quad$  [3M]

2. The digital circuit shown in the figure consists of a cascade of 20 XOR gates. If the input is X then the output Y will be  $\quad$ . Justify your answer.



3. Design a combinational logic circuit that counts the number of 1's present in three inputs A, B and C. Its output is a two-bit number  $X_1 X_0$ , representing that count in binary. Assume active-HIGH logic.

- (a) Write the truth table for this circuit.
- (b) Find the minimized logic equations for outputs  $X_1$  and  $X_0$ ; use a K-map if needed.
- (c) Draw the corresponding logic diagram for this circuit. Label all inputs and outputs. [3M]

4. Design a 4-bit Magnitude Comparator that is used in CPUs using Logic Gates only. [4M]

5. Simplify the following expression using the postulates and theorems of Boolean algebra. Eliminate all group complements. Justify each step by stating the Boolean theorem or postulate you use. Do Not use a Karnaugh map to simplify the expressions.

$$(A \cdot B \cdot C)(A + C)(A - C) \quad [3M]$$

6. Realize the following functions using 4x1 Multiplexer:

$$f_1(x,y,z) = \sum m(0,2,3,5,7)$$

$$f_2(x,y,z) = y' - z$$

[5M]

7. A flip-flop has four operations: clear to 0, no change, complement, and set to 1 when the applied inputs are 00, 01, 10 and 11, respectively.

- a) Tabulate the Characteristic Table.
- b) Derive the Characteristic Equation.
- c) Tabulate the Excitation Table.
- d) Show how this flip-flop can be converted into a D flip-flop. [5M]

## MID SEMESTER LAB EXAM – IT202

- a. Write a shell script to read two matrices from the user and give the product of these two matrices (6M)
- b. Write a shell script to read a text file and dynamically create text files with each line content as the file name and same line content as the content of the created text file. Make sure that the input file is sorted in alphabetical order and should not contain any duplicates. (Example shown below) (4M)

Scat input\_file.txt

Python

Java

PHP

C++

PHP

output:

Scat C++.txt	Scat Java.txt	Scat PHP.txt	Scat Python.txt
C++	Java	PHP	Python