DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING SUBJECT CODE: ANALYSIS AND DESIGN OF ALGORITHMSWORKBOOK

Lab 1:

Date of the Session: /_____/____ **Time of the Session:___to_____**

Pre-Lab Task:

1) During lockdown Mothi gets bored by his daily routene while scrolling youtube he found an algorithm that looks different Mothi is very crazy about algorithms but he can't solve algorithms of multiple loops so that he strucked and need your help to find the time complexity of that Algorithm

   Algorithm that was found on internet:

```
Algorithm KLU(int n)
{
    int count=0;
    for(int i=0;i<n;i*2)
    {
        for(int j=n;j>0;j/3)
        {
            for(int k=0;k<n;k++)
            {
                count++;
            }
        }
    }
}
```

2) Klaus Michaelson is interviewer so he prepared a bunch of questions for the students. He mainly focused on algorithms. Among all the questions the easiest question is what is the time complexity of the following C function is so can answer to this?

```
int recursive (int n)
{

        if (n == 1)

                return (1);

        else

                return (recursive (n-1) + recursive (n-1));

}
```

3) Mothi has 2 algorithms and he also know their time functions. Now he wants to analyze which one is greater function? But Mothi don't know how to compare two time functions. your task is to analyze the given two time functions and judge which one is greater and also justify with your solution

a) T1(n) = (log(n^2)*log(n))
   T2(n) = log(n*(logn)^10)

b) T1(n) = 3*(n)^(sqrt(n))
   T2(n) = (2)^(sqrt(n)*logn) (consider logn with base 2)

In-Lab Task:

1) Caroline Forbes is an intelligent girl, every time she wins in any contest or programme, and also solves complex problems so I want to give her a challenge problem that is Sort an array of strings according to string lengths. If you are smarter than her try to solve the Problem faster than her?

Example:

Input: {"You", "are", "beautiful", "looking"}
Output: You are looking beautiful

2) Kiran Kumar is the Assistant Professor of Computer science department so he

Just ask interact with the students and helps the students to solve the complex

problems in an easier way so, the problem given by the sir is

Sort an array according to count of set bits?

Example:

Input: arr[] = {1, 2, 3, 4, 5, 6};
Output: 3 5 6 1 2 4
Explanation:
3 - 0011
5 - 0101
6 - 0110
1 - 0001
2 - 0010
4 - 0100
hence the non-increasing sorted order is
{3, 5, 6}, {1, 2, 4}

3) During the final skill exam teacher was given a problem and asked everyone to write the algorithm to it, and also advised that try to implement a different approach from others
   Question: Write an algorithm to calculate sum of first 'n' natural numbers

   Mothi, one of the student in the class thinking that his friends will write an efficient Algorithm to that question. So, he wants to write a Worst approach to make that algorithm as unique

   Algorithm:

```
Algorithm SumOfNNaturalNums(int n)
{
    int count=0;
    for(i=1;i<=n;++)
    {
        for(j=1;j<=i;j++)
        {
            count++;
        }
    }
    return count
}
```

Post-Lab Task:

1) Given an array arr[] of N strings, the task is to sort these strings according to the number of upper case letters in them try to use zip function in order to get the format.

Input arr[] = poiNtEr aRRAy cOde foR

Output: [('cOde', 1), ('foR', 1), ('poiNtEr', 2), ('aRRAy', 3)]

“aRRAy” R, R, A->3 Upper Case Letters

“poiNtEr” N, E->2 Upper Case Letters

“cOde” O->2 Upper Case Letters

“foR” R->3 Upper Case Letters

2) In KLU streets we have lots of electrical poles.
Note: all poles are sorted with respective to their heights.

Professor Hari Vege given the H = height of one pole to Mothi then asked him to print the position of that pole, here we consider index as a position. Mothi is very good at algorithms so he written an algorithm to find that position. But he is very poor at finding time complexity. Your task is to help your friend Mothi to analyze the Time complexity of the given problem.

```
int BinarySearch (int a, int low, int high, int tar)
 {
     int mid; if (low > high) return 0;
     mid = floor((low + high)/2)
     if (a[mid] == tar)
          return mid;
     else if (tar < a[mid])

               return BinarySearch (a, low, mid-1, tar)

     else

               return BinarySearch (a, mid+1, high, tar)

  }
```

(For Evaluator's use only)

Comment of the Evaluator (if Any)	Evaluator's Observation Marks Secured:_____out of _____ Full Name of the Evaluator: Signature of the Evaluator Date of Evaluation:

Lab 2:

Date of the Session: / / **Time of the Session: to**

Prerequisite:

Pre-Lab-Task:

1) Given a text txt[0..n-1] and a pattern pat[0..m-1], write a function search (char pat [], char txt[]) that prints all occurrences of pat[] in txt[]. You may assume that n > m.

Use naïve string algorithm?

Input: txt[] = "THIS IS A TEST TEXT"

pat[] = "TEST"

Output: Pattern found at index 10

Input: txt[] = "AABAACAADAABAABA"

pat[] = "AABA"

Output: Pattern found at index 0

Pattern found at index 9

2) Solve the following test case using Knuth-Morris-Pratt (KMP)Algorithm?

Index 0 1 2 3 4 5 6 7 8 9

Text S = b c m a l m n x y z

Pattern P = m a l

Solution:

3) Write down the Algorithm for rabin-karp for string matching and explain time complexity of the algorithm?

In-Lab Task:

1. Mr. foo was working on string algorithms. He was very confused by Rabin-Karp-algorithm. He wants you to explain the algorithm. And he wants to know how many spurious hits does the Rabin-karp matcher encounters in text T=31415926535..... Where working module q=11 and p=26.

2. Mr. foo also wants to explain the naive approach for string matching. As he was busy in discovering new algo's, he assigned the work to you. and solve a problem using the algo. You can consider the text T=" abaaac" and p=" bab". also find in how many comparisons does p matches in the given text.

Post-Lab Task:

1) Given a pattern of length- 5 window, find the valid match in the given text by step by step process explanation.

Pattern: 2 1 9 3 6

Modulus: 21

Index: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21

Text: 9 2 7 2 1 8 3 0 5 7 1 2 1 2 1 9 3 6 2 3 9 7

2) For the Prelab-question 1 solve the problem using naive string pattern matching approach and compare the time complexities.

(For Evaluator's use only)

Comment of the Evaluator (if Any)	Evaluator's Observation Marks Secured:_____out of _____ Full Name of the Evaluator: Signature of the Evaluator Date of Evaluation:

Lab 3:

Date of the Session: / / Time of the Session: to

Pre-Lab Task:

1) Stefan is a guy who is suffering with OCD.He always like to align things in an order.

He got a lot of strings for his birthday party as gifts. He like to sort the strings in a unique way. He wants his strings to be sorted based on the count of characters that are present in the string. For example

“aaabbc”-> “cbbaaa”

If in case when there are two characters is same, then the lexicographically smaller onw will be printed first

“aabbcc”-> “aabbcc”.

Input:

2

aabbccdd
aabcc
Output:
aabbccdd
baacc

2) Odd-Even Transposition Sort compares two adjacent numbers and change them, if the first number is greater than the second number to get an ascending order list.
Implement the algorithm to the given list:
10 8 4 9 6 7 5 2

In-Lab Task:

1) Andrea is working in a photo studio where his boss has given him a task to arrange the photos of a family members. He is French and he don't know English somehow he managed to send the list of names to you (his friend). Help Andrea to sort the photos.

(note: implement the odd even merge algorithm)

Input:

No of names

String containing the list of names with a tab space.

Input:

5

Neil Katherine Harry Stefan Dennis

Output:

Dennis Harry Katherine Neil Stefan

2) India has banned PUBG for violated the rules and storing the data in Chinese servers. It has collaborated with Kraftan India and renamed as BGMI, entering into Indian gaming market. Now we know that BGMI consisting of TDM, after finishing every TDM match it gives the MVP and the sorted order of players based on their game play. We need to develop a program to sort and print the MVP and the sorted ordered players based on their game play with these conditions:

1. If kills difference between any two players in a team is less than or equal two (<=5).

    1.1. sort according to the kills per death ratio of those players (ascending)

2. If kills between among the players is >=5 sort based on kills done by each player.

3. Print the MVP

Input Format: first contains n which describes no. of persons played the game. Each person contains name, no. of kills, K/D

Output Format:

display the sorted order of the players by applying the given conditions.

test case:

Input: 3

name1 15 2 15

name2 14 2 8

name3 11 1 1

Output:

name2

name1

name3

Post-Lab Task:

1) Winni is sharing his information with his friend secretly in a chat. But he thinks that message should not understandable to anyone only for him and his friend. So he sent the message in the following format.

Input:

a1b2c3d4e

Output:
abbdcfdhe

Explanation:
The digits are replaced as follows:
- s[1] -> shift('a',1) = 'b'
- s[3] -> shift('b',2) = 'd'
- s[5] -> shift('c',3) = 'f'
- s[7] -> shift('d',4) = 'h'

2) We have send a packets from computer A to B. Instead of sending full packet at a time we have send the sub-packets so in order to convert that large into smaller chunks. (dividing the large packet) It is an unreliable network. At most 4 character can be transmitted implement it using the sliding window algorithm.

(For Evaluator's use only)

Comment of the Evaluator (if Any)	Evaluator's Observation Marks Secured:_____out of _____ Full Name of the Evaluator: Signature of the Evaluator Date of Evaluation:

Lab 4:

Date of the Session: / / ** **Time of the Session: to

Prerequisite:

Pre-Lab-Task:

1) Write a Divide and Conquer Algorithm to find the minimum distance between the pair of the points given in an array. Find the time complexity of the algorithm.

P[] = {{2, 3}, {12, 30}, {40, 50}, {5, 1}, {12, 10}, {3, 4}}

2) Write a divide and conquer algorithm for finding the maximum and minimum in the sequence of numbers. Find the time complexity.

3) Trace out the output of the following using Merge sort.

10, 49, 32, 67, 45, 4, 7, 2, 1, 51, 78, 34, 89, 87, 36, 29, 3, 9, 11.

In-Lab Task:

1. Harry's Aunt and family treats him badly and makes him work all the time. Dudley, his cousin got homework from school and he as usual handed it over to Harry but Harry has a lot of work and his own homework to do.

   The homework is to solve the problems which are numbered in numerical he tries to solve random question after solving random questions he did not put those questions in order Dudley will return in a time of n*logn harry has to arrange them as soon as possible Help Harry solve this problem so that he can go on and do his own homework.

   Input format:

   - First line of the input contains the number of problems solved by harry.
   - Second line of the input contains the array of serial number of problems solved by harry randomly.

   Input

   9

   15,5,24,8,1,3,16,10,20

   Output

   1, 3, 5, 8, 10, 15, 16, 20, 24

2) A group of 9 friends are playing a game, rules of the game are as follows: Each member will be assigned with a number and the sequence goes like e.g.: 7,6,10,5,9,2,1,15,7. Now they will be sorted in ascending order in such a way that tallest one will be sorted first. Now your task is to find the order of indices based on initial position of the given sequence and print the order of indices at the end of the iteration.

Post-Lab Task:

1) Suppose a merge sort algorithm, for input size 64, takes 30 secs in the worst case. What is the maximum input size that can be calculated in 6 minutes (approximately)?

2) Chris and Scarlett were playing a block sorting game where Scarlett challenged Chris that he has to sort the blocks which arranged in random order. And Scarlett puts a restriction that he should not use reference of first, median and last blocks to sort, and after sorting one block with reference of other block, for next iteration he has to choose another block as the reference not the same block (random pivot).

   Now, Chris wants help from you to sort the blocks. He wanted to sort them in a least time. Help him with the least time complexity sorting algorithm.

   Input format

   First line of input contains the number of test cases.

   Next t lines of input contain

   The number of blocks provided by Scarlett.

   The array of blocks.

(For Evaluator's use only)

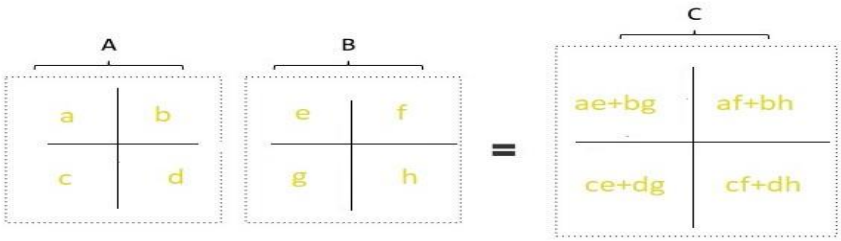
Comment of the Evaluator (if Any)	Evaluator's Observation Marks Secured:_____out of _____ Full Name of the Evaluator: Signature of the Evaluator Date of Evaluation:

Lab 5:

Date of the Session: / / ** **Time of the Session: to

Pre-Lab Task:

1) Trace the output of the following matric multiplication using Strassen's Multiplication Method



A, B and C are the Matrices of Size NxN

a, b, c and d are the sub Matrices of A of size N/2xN/2

e, f, g and h are the sub Matrices of B of size N/2xN/2

2) China had recently banned cryptocurrency. Due to this cryptocurrency cost has fallen drastically. Mr. Lee has lost a lot so he couldn't afford a stock advisor. He came to you (his friend) for help. He has the prices of stock on i th day. Help him to find the maximum profit he can achieve. You may complete as many transaction as you like.

Input format:

7

[1,2,3,4,5,6,7]

Output format:

6

Explanation: Buy the stock on 1st day at cost 1Rupee and sell the stock on 7th day at cost 7 Rupee and get profit of 6 rupees

In-Lab Task:

1) You are given 2 matrices of any size N*N. Write a program to find the product of the two matrix (use Strassen's Matrix Multiplication).

2) Mr. Lee is working in a construction where they had to fencing around trees in a field. The owner has asked a rough estimate to do fencing in that field such all the trees lie inside that region. Consider yourself as a cost estimator who works under Mr. Lee. You are given location of all the trees and you need to find the points that include this fencing. You need to output the tree that are included in the fencing.

   Input:

   points = [[1,1], [2,2], [2,0], [2,4], [3,3], [4,2]]

   Output:

   [[1,1], [2,0], [3,3], [2,4], [4,2]]

3) In a school there was conducted a contest among two groups. As part of the contest each group have to re-arrange the cards that had given to the members in ascending order. Consider yourself as a part of the team and find the best possible way to win that round.

   Input Format:

   3

   3

   [[2,5,6], [4,8,7], [9,3,1]]

   Output format:

   [1,2,3,4,5,6,7,8,9]

Post-Lab Task:

1) Mr. Hari Kumar own a fruit market. In the market there are many sellers who are selling many kinds of fruits. More than one fruits sellers can sell same kind of fruit. Mr. Hari Kumar wants to arrange their information in the sorted order based on their names of the sellers and id of the fruits. You have to arrange the same type of fruits in the same order as original order.

0-mangoes 1-apples

[Hint: Use counting sort algorithm]

Input format:

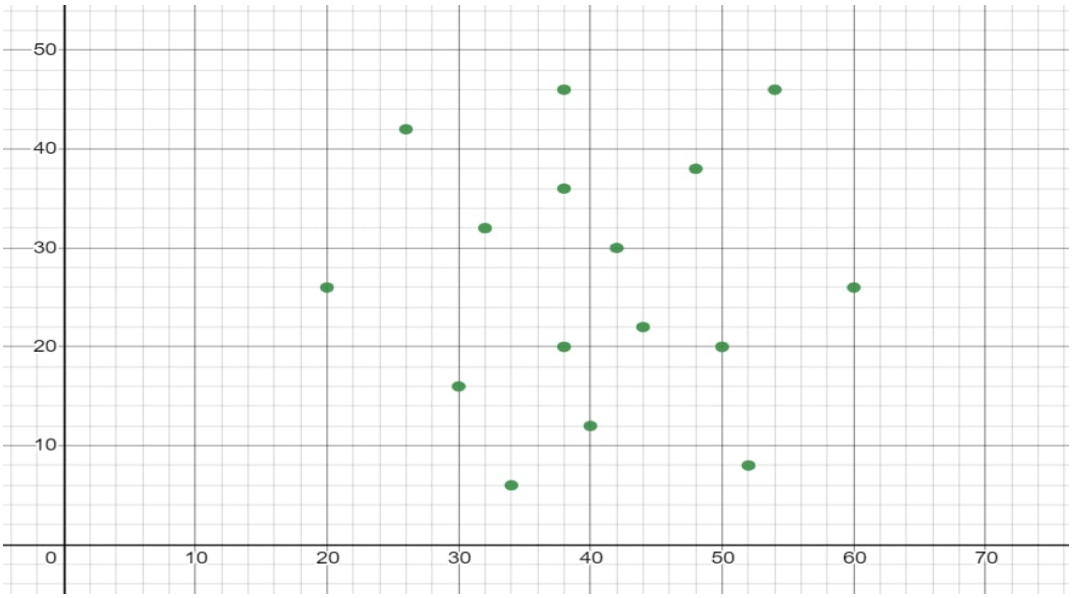
4

[[0, c], [1, b], [0, a], [1, d]]

Output format:

[[0, a], [0, c], [1, b], [1, d]]

2) Given a set of points in the plane, apply convex hull algorithm to the given points and explain it step by step process.



(For Evaluator's use only)

Comment of the Evaluator (if Any)	Evaluator's Observation Marks Secured:_____out of _____ Full Name of the Evaluator: Signature of the Evaluator Date of Evaluation:

Lab 6:

**Date of the Session: / / ** **Time of the Session: to **

Prerequisite:

Pre-Lab-Task:

1) Explain why 0-1 Knapsack problems cannot be solved using greedy method unlike fractional knapsack.

2) Categorise the Following as single source or multiple source shortest path algorithms.

Floyd-Warshall algorthm

Dijkstra algorithm

Bellman-Ford algorithm

3) List down various shortest path greedy algorithms.

In-Lab Task:

1) Illustrate the working code for 0-1 Knapsack problem.

2) Solve the Travelling Salesman Problem (TSP) using the greedy approach.

   (TSP: Given a set of cities and distance between every pair of cities, the problem is to find the shortest possible route that visits every city exactly once and returns to the starting point.)

Post-Lab Task:

1) Given an array of jobs where every job has a deadline and associated profit if the job is finished before the deadline. It is also given that every job takes a single unit of time, so the minimum possible deadline for any job is 1. How to maximize total profit if only one job can be scheduled at a time.

Example:

Input:

Four Jobs with following

deadlines and profits

JobID	Deadline	Profit
a	4	20
b	1	10
c	1	40
d	1	30

Output:

Following is maximum

2) There are N Mice and N holes are placed in a straight line.
Each hole can accomodate only 1 mouse.
A mouse can stay at his position, move one step right from x to x + 1, or move one step left from x to x − 1. Any of these moves consumes 1 minute.
Assign mice to holes so that the time when the last mouse gets inside a hole is minimized.

Example: positions of mice are: 4 -4 2

Positions of holes are: 4 0 5

Input:

A : list of positions of mice

B : list of positions of holes

Output:

single integer value

(For Evaluator's use only)

Comment of the Evaluator (if Any)	Evaluator's Observation Marks Secured:_____out of _____ Full Name of the Evaluator: Signature of the Evaluator Date of Evaluation: