**DSAD Lab Assignment Questions**

Day 1

1. Write a program that takes in a date of the year 2024 and prints out which day it is. You may use the fact that 1st January, 2024 was Monday.

Sample Input: Enter Day and Month: 19 4

Sample Output: Friday

2. Write a program that takes in an integer between 1 and 99 (both inclusive) and prints the number in words.

Sample Input: Enter an integer between 1 and 99: 17

Sample Output: Seventeen

3. Write a program that reads in the coordinates of the vertices of a quadrilateral on the two-dimensional plane in clockwise order and prints 1, if it is regular (all sides are equal) else prints 0.

4. Write a program that takes a positive integer n and returns the number of positive integers less than or equal to n that are divisible by exactly one of 4, 6 and 10.

Sample Input: Enter a positive integer: 20

Sample Output: 6

Explanation: {4,6,8,10,12,16,18,20} - {12, 20}

Day 2

1. You are given a 2D array of size n x n where all the elements are distinct integers between 1 and n^2, and every integer appears exactly once. Starting from any cell in this matrix you can move up, down, left and right in a non-wrap around fashion and without leaving the matrix. Path in a matrix is a sequence of cells based on the four moves. Starting from any cell, a maximum length path is defined as the largest sequence of cells such that the values in the cells along the path are in increasing order with an increment of one encountered in each move. As an example, consider the following 3 x 3 matrix:

|2|5|1|

|3|6|9|

|4|7|8| Starting from (R0, C1) the longest path is 5 -> 6 -> 7 -> 8 -> 9 with length 5

Write a program to find the number of cells and moves starting from a given cell that would give the longest path.

2. A sorted array A with n elements is cyclically right shifted by K positions. For example, the sorted array, 3, 9, 11, 12, 17 cyclically right-shifted by 2 positions is the array 12, 17, 3, 9, 11. You are given the right shifted array A (and n) but not K. Write a program to find out the maximum element of A in O(log n) time.

3. You have a box of N chocolates. On each day, you eat one, two or three chocolates. You want to finish all the chocolates in exactly K days. In how many ways can this be done?

Sample Input:

Enter number of chocolates: 6

Enter number of days: 3

Sample Output: 7

4. Write a program that takes three integers and checks whether the sum of any two is greater than the third.

Day 3

1. Write a program to check if the given array is a zigzag array or not. Zigzag Array: Let A[0,...,n-1] be an array of distinct integer,

we call A as zigzag array if for some indices i and j, 0<i<j<n-1 and A [0,...,i] is sorted in increasing order, A[i,...,j] is sorted in

decreasing order, and, Alj,...,n-1] is sorted in increasing order.

2. You are given an unsorted array A = {a1, a2, ...., an} of n elements and a target sum T. Your task is to locate two

elements a\_i, a\_j, in A (with i! = j) such that a\_i + a\_j is as large as possible, but no larger than T.

3. Given a List of daily stock price (in integer), return the buy and sell price that will maximize the single buy/sell profit. If you

can’t make profit, try to minimize the loss. (The price will be in sorted form with respect to market hours of the day).

Sample Input: 8, 5, 12, 9, 19, 1: profit of 14 Rs.

Sample Input: 21, 12, 11, 9, 6, 3: Loss of 1 Rs.

4. Write a program to check if the given sentence is word-wise palindromic or character-wise palindromic or none of them. (Assume

single space between two words).

Sample input 1: king are you glad you are king: word-wise palindromic

Sample input 2: was it a cat or a cat i saw: character-wise palindromic

5. Read an integer N. Then read in N numbers and print their maximum and second maximum (without use of arrays).

Day 4

1. Let A be an unsorted array with n=2k integers. It is given that exactly half of the elements of array are positive and half of them are negative. Write a program t change A such that the negative and positive elements of the array are positioned alternatively.

- the swapping should be done in-place (do not use extra array)

- the complexity of the program should be O(n)

2. Write a program to build a pentagon P\_n, such that the outermost pentagon in P\_n contains n dots in each side. In second outermost P\_n consists of n-1 dots and so on.

3. Given an integer n, return the least number of perfect squares numbers that sum to n.

- a perfect square is an integer that is the square of an integer; in other words, it is the product of some integer with itself. For example, 1.4.9.16 are perfect squares

- Input: 12, Output: 4 + 4 + 4

- Input: 13, Output: 4 + 9

4. Given an integer n, break it into the sum of k positive integers, where k >= 2, such that the product of those integers are maximum as compared to other possibilities.

- Input: 10

- Output: 3 + 3 + 4, (3 x 3 x 4 = 36)

- Wrong Outputs: 2 + 4 + 4, (2 x 4 x 4 = 32); 5 + 5, (5 x 5 = 25)

Day 5

1. An image is specified by a 2D array of pixels (assume only 2 levels 0 and 1). Write a program to flip the array horizontally (in-place and time complexity of O(n^2)).

2. You are given an array A [0...n-1] storing exactly n of the n+1 integers 0, 1, ..., n. This means that exactly one integer x is missing in A. Your task is to determine x.

- If A is unsorted, write a program which can find x in O(n) time.

- If A is sorted (in ascending order), write a program which can find x in O (log n) time.

3. You are given an integer array A and an integer target T. Your task is to build an expression out of A by adding one of the symbols '+' and '-' before each integer in A and then concatenate all the integers, such that it can attain T.

For example: if A = [2, 1, 1] and T = 2 => +2+1-1, +2-1+1

4. You are given a string of opening and closing parenthesis i.e. ((())((()))). Write a program to return the maximum depth of parentheses.

Day 6

1. Implement a graph traversal algorithm (BFS or DFS) for an undirected graph G(V, E).

2. Write a program to detect cycle in an undirected graph.

3. Let s and t be 2 vertices of an undirected graph G(V, E). A particle sits at vertex s, and wants to reach vertex t. In first hop it expends 1 unit energy, in second hop 2 units, in 3rd hop 4 units. In general, in ith hop, the particle expends 2^i units of energy. Write a program for the particle to reach t from s, after expending minimum possible energy.

4. Write a program to store a binary search tree in array-based representation:

- Any node can appear at any index

- index of root node is maintained separately

- For i=0 to n-1,

\* key[i] stores the key

\* left[i]/right[i] stores the index of the left or right child (-1 it does not exist)

\* Your program must support insertion and deletion in tree (if a key) already exists no change is made

Sample Tree:

Size: 8

Root: 3

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Index: 0 1 2 3 4 5 6 7

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Key: 9 12 21 17 32 4 25 6

Left: -1 -1 -1 7 2 -1 -1 5

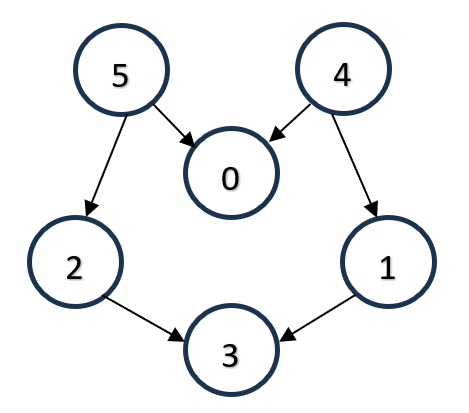
Right: 1 -1 6 4 -1 -1 -1 0

5. You have n gardens, labeled 1 to n, and an array of paths where paths[i] = [x\_i, y\_i] describes a bi-directional path between garden x\_i to garden y\_i. In each garden, you want to plant one of 4 types of flowers. All gardens have at most 3 paths coming or leaving it. Your task is to choose a flower type for each garden such that, for any 2 gardens connected by a path, they have different types of flowers. Return an array answer, where answer[i] is the type of flower planted in (i+1)-th garden.

Day 7

1. Write a Program to generate Topological Sort for Directed Acyclic Graph (DAG).

Output: 5, 4, 2, 3, 1, 0 or 4, 5, 2, 3, 1, 0 or 5, 4, 0, 2, 3, 1



2. You have a set of pairwise distinct Binary Strings. Let ***n*** be the sum of lengths of the Strings. You can store the strings in a rooted Binary tree with atmost ***n+1*** nodes. Some nodes in tree (including all Leaf Nodes) are marked. Imagine each left child is labelled by 0 and each right child is labelled 1. The tree is said to store a Binary String ***s*** if there exists a marked node ***v*** in the tree such that unique path from the root to ***v*** is labelled by the symbols of s and the path ends with a marked node.

1. Write a Program to insert a Binary String ***s*** in tree (if ***s*** already exists, no changes should be made)
2. Write a program to print all strings stored in the tree {complexity: O(n)}

Stored Strings: 0, 000, 0010, 10, 11, 110, 1111

Not Stored Strings: 010, 001

Day 8

1. A hungry mouse is sitting at the South-West corner of a square room (n x n). In the centre of the room lies fabulous food ***F*** considered as point. The mouse starts a sequence of movements in the direction N, E, S, W, N, E, … One movement is made in one minute. In the first movement, the mouse covers ***n*** meters North. Each movement makes the mouse tired. So, in each movement, the minute, the mouse only covers 90% of the distance covered in previous minute. After each move, the mouse checks whether it is within a meter of the food ***F***. If so, it jumps on the food and enjoys dinner. Write a program to find out how many minutes/ moves will be required by the mouse.

Start

2. There are ***n*** student pairs sitting in ***2n*** seats arranged in a row for an exam. The students and seats are represented by an integer array row where ***row[i]*** is the ID of the student sitting in the ***ith***seat. The students are numbered in order, the first student pair being (0,1), the second (2,3) and so on with the last student pair being (2n-1, 2n-1). Write a program to return the minimum number of swaps so that every student pair is sitting side by side.

Example: [0, 2, 1, 3]

Output: 1 {Swap (1, 2)}

Example: [3, 2, 0, 1]

Output: 0 {The students are seated side-by-side with their pairs}

Day 9

1. Write a program to return area of triangle, rectangle, square and circle using:

* Function Overloading
* Function Overriding

2. (a). Write a Java program to create a producer-consumer scenario using the wait() and notify() methods for thread synchronization.

(b). Write a Java program to demonstrate Semaphore usage for thread Synchronization.

3. Write a Java program to create a method that takes a string as input and throws an exception is the string des not contain vowels.