



Bahria University
Discovering Knowledge

BAHRIA UNIVERSITY, (Karachi Campus)

Department of Software Engineering

Assignment #04– Spring 2023

Complex Engineering Problem

COURSE TITLE: **D&AA**
Class: **BSE 4**
Course Instructor: **ENGR. BUSHRA FAZAL KHAN**
Max. Marks: **7 Points**

COURSE CODE: **CSC-321**
Shift: **Morning**
Assignment Date: **05- Jun -2023**
Assignment Due: **15-Jun-2023**

In groups of 4 you are required to present in group in front of the class the problems that have been assigned to your group. Your presentation should have the following sections.

- 1. Explain the Problem**
- 2. Explanation of design approach adopted and reasoning.**
- 3. Algorithm Design and explanation of strategy selected**
- 4. Proof of correctness**
- 5. Analysis calculate time complexity**

Marking scheme

Section 1,2 and 4 CLO 2- 3 Marks

Section 3 CLO 3 -2 Marks

Section 5 CLO 5- 2 Marks

Note:

Each member is required to present his/her part, where the presentation will be followed by cross-questioning from the course instructor. All students should have knowledge regarding the complete contents within the presentation rather than focusing of the contents of his/her part only. presentation MUST be self-made, where its emailed softcopies will be checked for plagiarism.

1. Problem 1 for Group 1

You are given a grid of size $n \times n$ that has the following specifications:

- Each cell in the grid is either empty '.' or occupied '*'.
- **you can't move to an occupied cell.**
- Wesam starts at cell (1,1) and wants to reach Omar who is in cell (3,3).
- Wesam can move vertically, horizontally, and diagonally.

Note: If Wesam is standing at cell (x,y), he can go to $(x+1,y)$, $(x-1,y)$, $(x,y+1)$, $(x,y-1)$, $(x+1,y+1)$, $(x-1,y-1)$.

Note: rows are numbered from top to down, and columns are numbered from left to right.

Write a program to find if Wesam can reach Omar or not.

2. Problem 2 for Group 2

Dominoes have recently expanded their pizza network in Pakistan, but are experiencing a problem regarding production. Now, they have a total of 90 branches in Pakistan, but some branches are producing pizzas in excess and some are facing shortage. Every branch is connected to all other branches via underground pizza lines. Your job is to find the best possible way of utilizing excess pizzas to cover up shortage.

3. Problem 3 for Group 3

You are given a binary array A with elements 0 and 1 of size N , and integer K . Let's call the score of an array the difference between the maximum and minimum element within the array. For example $[1, 0, 0, 1, 0, 0]$, the Score of this given array is $1 - 0 = 1$.

Now you have to partition the array into K continuous subarrays such that the summation of the score of all the subarrays is minimum. You also have to output starting and ending points of the subarrays corresponding to the minimum score, in increasing order of starting point. If there are multiple possibilities then output the subarrays such that starting points will be lexicographically smallest.

4. Problem 4 for Group 4

Once there was a Queen who got trapped on an island. You input to your program a map of island connected with bridges. Each bridge has a Troll and you must pay different amounts of toll to gain access to the bridge, but you also gain points by passing as many islands as possible. Create an algorithm which computes the total toll paid from a given initial position (which is always empty) to the destination (where queen is present) through every path and points gained suggest best possible path.

Design and implement an efficient algorithm which prints the maximum number of island visited to reach to the queen on final destination with lowest amount paid on the tolls.

5. Problem 5 for Group 5

You are given an array A of N integers where the i^{th} element denotes that Bob has $A[i]$ buckets of color i .

In one move, Bob can pick two buckets with the same color and transform them into a bucket of any other color.

Now, Bob is also given an array B of N integers where the i^{th} element denotes that Bob needs at least $B[i]$ buckets of color i . Find if it is possible for Bob to get the required number of buckets for each color using the specified moves. If possible, print 'Yes' else 'No' without quotes.

Note:

- 1-based indexing is followed.

6. Problem 6 for Group 6

Pikachu has recently learnt a new move s . He knows he can work hard and convert it into a stronger move t . Both the moves s and t contain the same number of letters.

In a single day, Pikachu can increase any letter of move s by one, that is, in a single day, he can convert letter A to B , C to D , M to N and so on. He can also convert letter Z to letter A .

Pikachu just realized he also has a hidden ability. It can help him increase any letter of move s by 13, that is, in a single day, he can convert letter A to letter N , B into O , M into Z , O into B and so on.

Now Pikachu wants to know the minimum number of days in which he can convert the move s into move t ?

7. Problem 7 for Group 7

You have N toys and M toy boxes. Initially all boxes are empty, and each box can contain only one toy. Each toy has a price and a box number assigned to it. If you want to choose a toy, you must put it in its assigned box, and of course that box can't be used for any other toys. You need choose some toys (with their boxes) such that summation of their price is maximized.

8. Problem 8 for Group 8

A group of friends is going on a vacation to a beach by a car. One of them is suffering from a severe fever and needs to be taken to hospital in nearest town immediately.

Assume that car consumes one unit of petrol every unit of distance it travels.

The hospital is located in town situated at co-ordinate 0. The car is D units away from the town. On this road, between the town and the current location of the car, there are N petrol stations where the friends can stop to acquire additional petrol.

As the fever is getting worse with time, the friends want to make the minimum possible number of stops for petrol on the way to the town. Fortunately, the capacity of the petrol tank on their car is so large that there is no limit to the amount of petrol it can hold. The car has some initial amount of petrol in tank which is denoted by P .

Determine the minimum number of stops needed to reach the town, or if the freinds cannot reach the town at all.

Note:

The town is situated at co-ordinate 0. All the other distances are given with respect to town's location.

9. Problem 9 for Group 9

Bob sells burgers with three different combinations, B_1 , B_2 and B_3 . There are total X , Y , and Z burgers with combinations, B_1 , B_2 , and B_3 respectively. Each burger has an integer value called deliciousness as follows:

- The deliciousness of the burgers with the B_1 combination are $B_{11}, B_{12}, B_{13}, \dots, B_{1X}$.
- The deliciousness of the burgers with the B_2 combination are $B_{21}, B_{22}, B_{23}, \dots, B_{2Y}$.
- The deliciousness of the burgers with the B_3 combination are $B_{31}, B_{32}, B_{33}, \dots, B_{3Z}$.

Alice decides to buy K boxes containing three burgers, one from each of the combinations. The deliciousness of a box is the sum of the deliciousness of the burgers present inside it.

There are $X * Y * Z$ such ways to select a box. Print the maximum total sum of deliciousness that Alice can get by buying K boxes.

10. Problem 10 for Group 10

There is a mysterious state near the amazon forest in which the roads of each city are only interconnected and are not connected to the roads of any other city. You know the labels for each road and you know the labels for each interconnection of roads. You also know which roads are involved in each inter-connection. Your job is to design and analyse an algorithm to find the number of cities in the country.

Inter-connection: The point where two or more roads meet.