Software Internship Assignment

Borda Academy

Prepared for Borda Academy Internship Candidates

Created by Borda Software Team

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Introduction

This document is prepared for software developer intern candidates who applied for Borda Academy Summer Internship Program. Please read the instructions carefully.

- This document contains 7 questions and one extra question which will not affect your overall score to be accepted to this program.
- It is not necessary to solve all the questions completely. Any submission will be evaluated and you may proceed to face to face interview.
- We also care about your research abilities and problem-solving skills. Even if you do not know how to solve a question, you may do research and try to solve the question. Your answer does not have to be correct.
- You may use one of the following programming languages: C++, C#, Java.
- Write your answers in a single PDF file named "Report.pdf" and place your source codes and all other question related files in separate folders named Q1 to Q8. The report must be typed in English.
- When you complete the assignment, send a single ZIP file named as "Name_Surname.zip" containing your report and all the question related folders.
- Plagiarism is not appreciated.

Questions

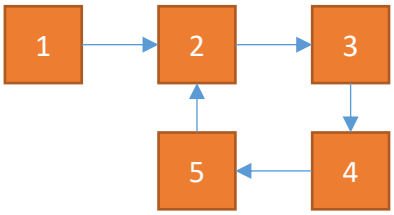
Question 1

Location class represents a location in a building. It has name and *Point* which corresponds to the coordinates. What would be the output of each *Display* statement below? Explain in detail.

```
struct Point
{
    int X;
    int Y;
}

class Location
{
    Point Point;
    string Name;

    Location(int X, int Y, string Name)
    {
        this.Point.X = X;
        this.Point.Y = Y;
        this.Name = Name;
    }

    void Display()
    {
        Print("X: " + Point.X + " Y: " + Point.Y + " Name: " + Name);
    }
}

void Main()
{
       Location kitchen = new Location(X:10, Y:20, Name: "Kitchen");
       Location bathroom = new Location(X: 40, Y: 70, Name: "Bathroom");

       kitchen.Display();
       bathroom.Display();

       kitchen.Point = bathroom.Point;

       kitchen.Display();
       bathroom.Display();

       bathroom.Point.X += 25;
       bathroom.Point.Y += 25;

       kitchen.Display();
       bathroom.Display();

       kitchen = bathroom;

       kitchen.Display();
       bathroom.Display();

       kitchen.Point = bathroom.Point;

       kitchen.Display();
       bathroom.Display();

       bathroom.Point.X += 25;
       bathroom.Point.Y += 25;

       kitchen.Display();
       bathroom.Display();
}
```

Question 2

A singly-linked list has a loop if an item in the list references one of the previous items. An example loop is illustrated below. Notice that item 5 references item 2 and that causes a loop.



Construct a singly-linked list structure without using framework provided classes and write a function to find whether a singly-linked list contains a loop or not.

Question 3

Write two functions to find n^{th} Fibonacci number using the following methods: iterative method and recursive method. Please explain which one runs faster and why? What techniques would you use to make the slower one run faster?

Question 4

There is a magician called "the Octopus" with the ability of predicting the frisbee team that is supported. The frisbee league has n teams labeled from 1 to n. The magician places all the team cards as an $m \times m$ grid where $n = m^2$, and asks the supporter to tell the row number of which his/her team's card on. After that, the magician rearranges the cards and asks the same question again. Finally, the magician finds out the team.

Given necessary inputs, try to find out the team that is supported.

Input Format

- The first line contains one integer, n.
- The next m lines contain m space-separated integers, describing the first arrangement.
- The next line contains one integer, the answer for the first arrangement.
- The next m lines contain m space-separated integers, describing the second arrangement.
- The next line contains one integer, the answer for the second arrangement.

Constraints

- $m \leq 100$

Output Format

The output may be one of the following ones:

- Print the team number, if your program predicts correctly.
- Print "Magician failed", if your program finds more than one possible teams.
- Print "Supporter cheated", if your program does not find any card.

Sample Input

```
16
1 2 3 4
5 6 7 8
9 10 11 12
13 14 15 16
2
1 2 5 4
3 11 6 15
9 10 7 12
13 14 8 16
3
```

Sample Output

```
7
```

Question 5

Write a program that replaces all the same adjacent characters with another character starting from a particular index in a given matrix.

Input Format

- The first line contains two space-separated integers n and m denoting the size of the matrix as row and column counts respectively.
- The second line contains two space-separated integers $i = 0 \ldots n-1$ and $j = 0 \ldots m-1$ indicating the starting element index.
- The third line contains a character to be replaced with the ones located in the matrix.
- The subsequent lines describe the matrix.

Constraints

- $n < 10^4$
- $m < 10^4$

Output Format

- Print the modified matrix.

Sample Input

```
10 10
3 9
C
Y Y Y G G G G G G G
Y Y Y Y Y Y G X X X
G G G G G G G X X X
W W W W W G G G G X
W R R R R R G X X X
W W W R R G G X X X
W B W R R R R R R X
W B B B B R R X X X
W B B X B B B B X X
W B B X X X X X X X
```

Sample Output

```
Y Y Y G G G G G G G
Y Y Y Y Y Y G C C C
G G G G G G G C C C
W W W W W G G G G C
W R R R R R G C C C
W W W R R G G C C C
W B W R R R R R R C
W B B B B R R C C C
W B B C B B B B C C
W B B C C C C C C C
```

Question 6

Two teams, Team A and B, are playing a strategy game called BIBG - BordaloT's Battleground. The playground has a total of n camps labeled from 1 to n and it can be represented as a tree, where nodes correspond to camps and edges correspond to the roads between camps. Each camp has military power represented as an integer value which is the number of connected ally camps.

In each iteration, camps which have a neighbor enemy camp with higher military point will be taken by the enemy. However, military points will not change till the next iteration. The game will continue until there is no camp which could be taken by enemy. At the end of the game, the team controlling more camps will be the winner.

Given a map of playground find and print which team will win the game.

Input Format

- The first line contains one integer, n.
- The next line contains space-separated integers, describing camps of Team A.
- The next line contains space-separated integers, describing camps of Team B.
- The next line contains one integer, the number of rows, m.
- The next m lines contains two space-separated integers, describing a road between camps

Constraints

- $n \leq 10^2$

Output Format

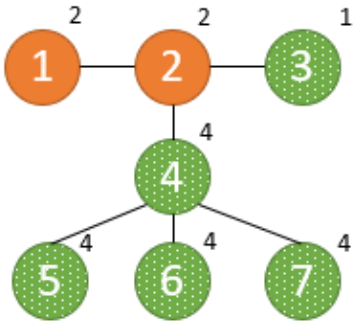
- Print number of iterations and winner team

Sample Input

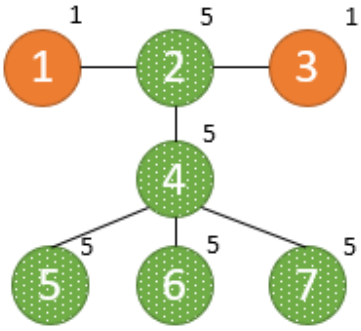
```
7
1 2
3 4 5 6 7
6
1 2
2 3
2 4
4 5
4 6
4 7
```

Sample Output

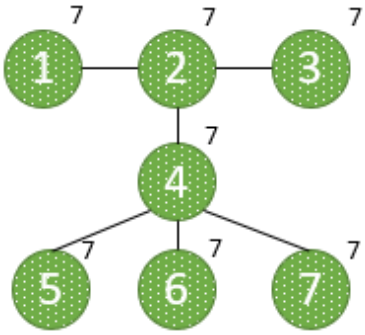
```
2
Team B
```



Initial State



After First Iteration



After Second Iteration

At the first iteration, Team A captures Camp 3 since Camp 2's military point is higher than Camp 3's. At the same time Team B captures Camp 2 since Camp 4's military point is higher than Camp 2's.

At the second iteration, Team B captures Camp 1 and Camp 3 since Camp 4 has higher military point than both.

After the second iteration, there will be no camp which could be taken by enemy. So, the game finishes and the winner would be Team B.

Question 7

A simple content-based HTML page is designed to provide two features: toggling image visibilities and highlighting keywords. The page is coded using Bootstrap, jQuery, mark.js and the source code is accessible from https://github.com/bordatech/sia18. However, some of the features do not work as expected.

Please explain the following errors and correct them:

a) Toggle Images function does not work as expected since when an image gets hidden, a gap occurs.
b) Search function is designed as displaying an error message when user tries to search for empty keyword. However, the function never shows the error message.
c) Search function also highlights words in the footer area which is not desired.
d) Searching a word repetitively breaks the user interface.

This question is asked for the applicants who are interested in machine learning and data science. The applicants answered to this question might be considered for further projects. However, it will not affect your overall score to be accepted to this program.

Extra Question

A well-defined problem in indoor localization via radio signals is estimating the actual distance between the receiver and the signal source. The receiver can measure the power of the signal in arbitrary units considering the antenna and potential cable loss. Received Signal Strength Indicator (RSSI) is a single negative number used to indicate the signal power. The higher the RSSI values, the stronger the signal. However, this property is very sensitive to various factors such as the receiver's orientation or the large objects located in the environment.

With this motivation, we collect some data in an office environment. The data consist of two columns. The first column indicates the distance between the receiver and the signal source, and the latter denotes the measured RSSI values at that distance in centimeters. We provide the data as it is collected without any modification. The data is accessible from https://github.com/bordatech/sia18.

We would like you to solve the problem with your own approach. Appropriate solution must be in the form of a function of which input is the RSSI and the output is the estimated distance in centimeters. You must present and analyze your answer in detail so that we can understand your approach well. Use plotting if necessary. You are free to use any programming languages, frameworks, libraries or additional tools. Your answer will be evaluated according to your approach and the steps of your solution. Remember, there is no correct solution.