Summative Assignment 2

LC Data Structures and Algorithms

due date 24 March 2025, 12pm

You are given two of binary strings (Lists of 0s and 1s) x and y of the same length n represented as Java `Strings`.

The goal of this assignment is to find whether the first string can transformed into the second by applying operations from a given set a finite number of times, and find the minimum number of applications needed. Operations can be applied to any contiguous subset of the string.

Question 1. Consider the set of operations consisting of swapping two adjacent bits:

$$01 \to 10 \quad \text{and} \quad 10 \to 01$$

Example. *The string* 0011 *can be reached from* 1010 *by the following sequence of operations:*

$$0\mathbf{01}1 \to \mathbf{01}01 \to 10\mathbf{01} \to 1010$$

(a) Write a `boolean` function `reachable1` which takes two binary strings `x` and `y` and returns true only if `x` can be transformed into `y` using these operations.

(b) Write an `int` function `distance1` which takes two binary strings `x` and `y` and returns the minimum number of applications of these operations needed to turn `x` into `y`. Return `-1` if `y` is not reachable from `x` under these operations.

Question 2. Consider the set of the following three operations:

$$110 \to 001, \quad 011 \to 100, \quad \text{and} \quad 101 \to 110$$

Write an `int` function `distance2` which which takes two binary strings `x` and `y` and returns the minimum number of applications of these operations needed to turn `x` into `y`. Return `-1` if `y` is not reachable from `x` under these operations. What is the upper bound of the time and space complexity of your solution?

Hint: *Consider this as a graph searching problem.*

Submission

Submission is via Canvas, and it **must contain the following two files**:

- Java source file named '`Solution.java`' containing a `class Solution` with the following methods:

```
public class Solution {
    // Question 1a
    public static boolean reachable1(String x, String y);
    // Question 1b
    public static int distance1(String x, String y);

    // Question 2
    public static int distance2(String x, String y);
}
```

  If you rename the class or its methods you will lose marks.

- A text/pdf file that gives, with justification, upper bounds of the time and space complexity of your **Question 2** solution in terms of the length n of the input strings.