The Dragon Academy Computer Science G11 at The Dragon Academy Term 3 Test 1

April 16, 2019

1 Questions (40%)

- 1. (Ktica) Consider the following array of integers a = [343, 76, 4, -56, 8]. Explain on paper how the Merge-Sort algorithm works. In order to do that, simply workout step by step what the algorithm would do.
- 2. (Ktica) Explain what an array and a linked list are in C. What is the advantage of linked lists over an array?
- 3. (Ktica) You are given an array of 128 numbers, a. We say we query the array every time we reference an item of it, e.g., a[3]. You are given now an arbitrary number x. How many query steps will you need to find out if x is in array a or not? Distinguish both cases, when a is sorted and when it's not.
- 4. (Ktica) List the four basic steps involved in developing an algorithm to solve a given problem.

2 Problems (60%, kTICa)

Each of the following problems has the same weight toward the final mark on this test.

Problem J1: Quadrant Selection

Time limit: 1 second

Problem Description

A common problem in mathematics is to determine which quadrant a given point lies in. There are four quadrants, numbered from 1 to 4, as shown in the diagram below:

y ↑	
Quadrant 2	Quadrant 1
B (-12, 5) ●	• A (12, 5)
C (-12, -5)•	• D (12, -5)
Quadrant 3	Quadrant 4

For example, the point A, which is at coordinates (12, 5) lies in quadrant 1 since both its x and y values are positive, and point B lies in quadrant 2 since its x value is negative and its y value is positive.

Your job is to take a point and determine the quadrant it is in. You can assume that neither of the two coordinates will be 0.

Input Specification

The first line of input contains the integer $x (-1000 \le x \le 1000; x \ne 0)$. The second line of input contains the integer $y (-1000 \le y \le 1000; y \ne 0)$.

Output Specification

Output the quadrant number (1, 2, 3 or 4) for the point (x, y).

Sample Input 1

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12
5
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Output for Sample Input 1

Sample Input 2 9 -13

Output for Sample Input 2

4

Problem J2: Shifty Sum

Time limit: 1 second

Problem Description

Suppose we have a number like 12. Let's define *shifting a number* to mean adding a zero at the end. For example, if we shift that number once, we get the number 120. If we shift the number again we get the number 1200. We can shift the number as many times as we want.

In this problem you will be calculating a *shifty sum*, which is the sum of a number and the numbers we get by shifting. Specifically, you will be given the starting number N and a non-negative integer k. You must add together N and all the numbers you get by shifting a total of k times.

For example, the shifty sum when N is 12 and k is 1 is: 12 + 120 = 132. As another example, the shifty sum when N is 12 and k is 3 is 12 + 120 + 1200 + 12000 = 13332.

Input Specification

The first line of input contains the number N ($1 \le N \le 10000$). The second line of input contains k, the number of times to shift N ($0 \le k \le 5$).

Output Specification

Output the integer which is the shifty sum of N by k.

Sample Input

12 3

Output for Sample Input 13332