Data Structures & Algorithms LAB – Fall 2015

(BS-SE-F14 Morning & Afternoon)

Lab # 4

Instructions:

- Make sure that there are no ***dangling pointers*** or ***memory leaks*** in your programs.
- Indent your code properly.
- Use meaningful variable and function names. Follow the naming conventions.
- Use meaningful prompt lines/labels for all input/output that is done by your programs.
- Implement all the functions **in the given order**.

Task # 1

Here is the description of the problem of **Adding two very large numbers** as described in Section 4.1 of the book "Data Structure And Algorithms in C++" (4th Edition) by Adam Drozdek:

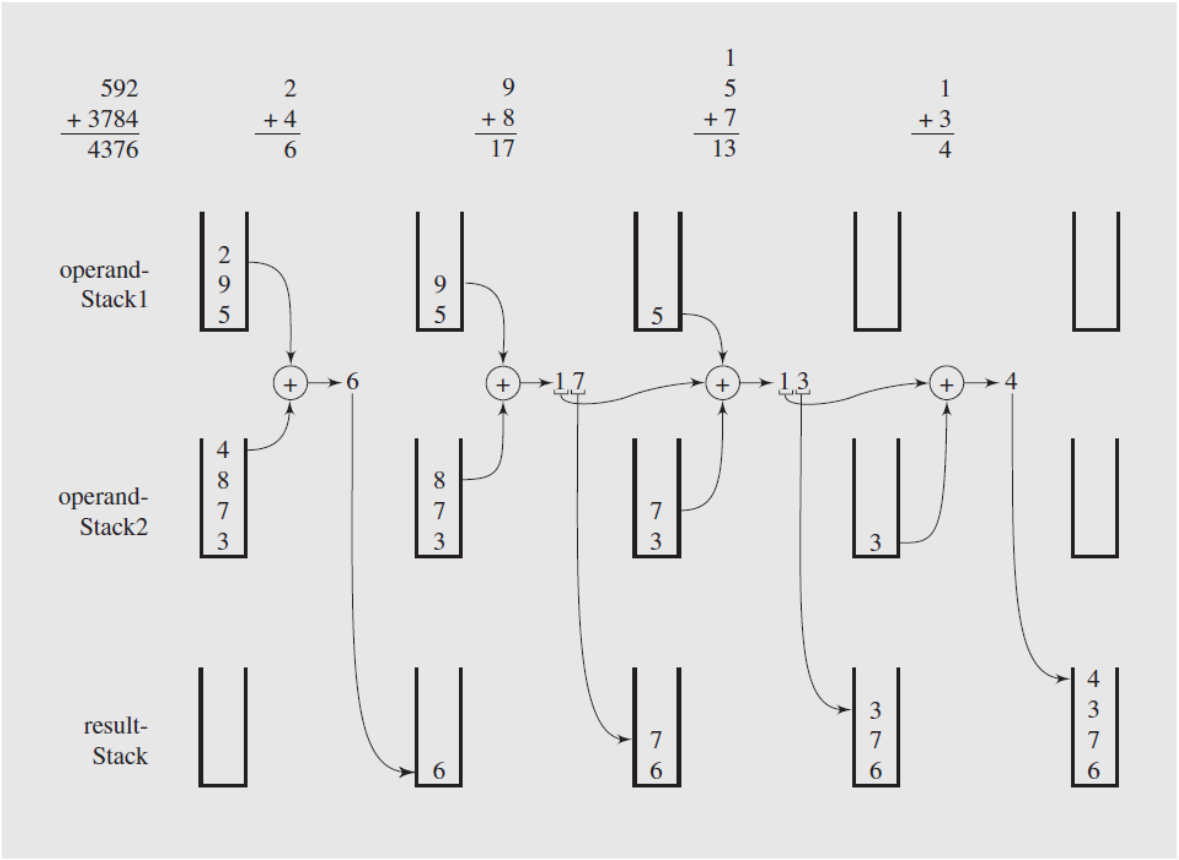
The largest magnitude of integers is limited, so we are not able to add 18,274,364,583,929,273,748,459,595,684,373 and 8,129,498,165,026,350,236, because integer variables cannot hold such large values, let alone their sum. The problem can be solved if we treat these numbers as strings of numerals, store the numbers corresponding to these numerals on two stacks, and then perform addition by popping numbers from the stacks. The pseudocode for this algorithm is as follows:

```
Algorithm addingLargeNumbers()
```

a. *read the numerals (digits) of the first number and store the numbers corresponding to them on **stack-1***
b. *read the numerals (digits) of the second number and store the numbers corresponding to them on **stack-2***
c. *integer **carry** = 0*
d. ***while** at least one stack is not empty*
    i. *pop a number from each nonempty stack and add them to **carry***
    ii. *push the unit part of the sum on the **result-stack***
    iii. *store carry in **carry***
e. *push **carry** on the result stack if it is not zero*
f. *pop numbers from the result stack and display them*

The following figure (from Drozdek's book) shows an example of the application of this algorithm. In this example, numbers 592 and 3,784 are added.

FIGURE 4.3 An example of adding numbers 592 and 3,784 using stacks.



The step-by-step working of the above example is explained below:

1. Numbers corresponding to digits composing the first number (i.e. 295) are pushed onto **operandStack1**, and numbers corresponding to the digits of the second number (i.e. 3,784) are pushed onto **operandStack2**. Note the order of digits on the stacks.
2. Numbers 2 and 4 are popped from the stacks, and the result, 6, is pushed onto **resultStack**.
3. Numbers 9 and 8 are popped from the stacks, and the unit part of their sum, 7, is pushed onto **resultStack**; the tens part of the result, number 1, is retained as a carry in the variable **carry** for subsequent addition.
4. Numbers 5 and 7 are popped from the stacks, added to the **carry**, and the unit part of the result, 3, is pushed onto **resultStack**, and the carry, 1, becomes a value of the variable **carry**.
5. One stack is empty, so a number is popped from the nonempty stack, added to **carry**, and the result is stored on **resultStack**.
6. Both operand stacks are empty, so the numbers from **resultStack** are popped and printed as the final result.

You are required to write a **C++ program** which implements the above algorithm for adding two very large numbers. Here are a few instructions that you need to keep in mind:

1. Implement and use the **`Stack`** class (for storing integers) that we have seen in class.
2. Your program should take two numbers from the user and store them as two **c-strings**. Assume that the maximum number of numerals (digits) in a number is 30.
3. After taking input, your program should determine the sum of these two large numbers using the aforementioned algorithm and display the sum on screen.

Two sample runs of your program may produce the following output:

Sample Run # 1

```
Enter 1st number: 123456789123456789123456789
Enter 2nd number: 123454321123454321123454321


Sum of the two numbers is: 246911110246911110246911110
```

Sample Run # 2

```
Enter 1st number: 123456789123456789123456789
Enter 2nd number: 987654321987654321987654321


Sum of the two numbers is: 1111111111111111111111111110
```