OU4 - Mandatory Exercise 4

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Algorithms for objects

Arithmetic with strings

A problem: perform arithmetic operations on natural numbers expressed as a character string

Two natural numbers[1] are given as character strings of *any* length.

The problem is to perform various arithmetic operations on these numbers. In each operation one must examine the character strings digit by digit and determine the next digit in the result. Thus a new character string is created, representing the result of the operation.

A solution to the problem — not complete

```
import java.util.*;      // Scanner
import static java.lang.System.out;

class OperationsWithNaturalNumbersGivenAsStrings
{
    public static void main (String[] args)
    {
        out.println ("OPERATIONS ON NATURAL NUMBERS " +
                     "IN CHARACTER STRINGS");

        // enter two natural numbers
        Scanner    in = new Scanner (System.in);
        out.println ("two natural numbers:");
        String    tal1 = in.next ();
        String    tal2 = in.next ();
        out.println ();

        // add the numbers and show the result
        String    sum = add (tal1, tal2);
```

---

[1]We here define the natural numbers as zero and the positive integers.

1

```java
        show (tal1, tal2, sum, '+');

        // subtract the numbers and show the result
        // *** WRITE YOUR CODE HERE ***
    }


    // The add method accepts two natural numbers represented
    // as character strings and returns their sum as a
    // character string.
    public static String add (String num1, String num2)
    {
        // *** WRITE YOUR CODE HERE ***
    }


    // The subtract method accepts two natural numbers
    // represented as character strings and returns their
    // difference as a character string.
    // The first number is not smaller than the second
    public static String subtract (String num1, String num2)
    {
        // *** WRITE YOUR CODE HERE ***
    }


    // The show method presents two natural numbers, an
    // operator and the result string.
    public static void show (String num1, String num2,
                             String result, char operator)
    {
        // set an appropriate length on numbers and result
        int    len1 = num1.length ();
        int    len2 = num2.length ();
        int    len  = resultat.length ();
        int    maxLen = Math.max (Math.max (len1, len2), len);
        num1 = setLen (num1, maxLen - len1);
        num2 = setLen (num2, maxLen - len2);
        result = setLen (result, maxLen - len);

        // show the expression
        out.println ("  " + num1);
        out.println ("" + operator + " " + num2);
        for (int i = 0; i < maxLen + 2; i++)
            out.print ("-");
        out.println ();
        out.println ("  " + result + "\n");
    }


    // The setLen method prepends the supplied number of
    // spaces ato the beginning of a string
    public static String setLen (String s, int nofSpaces)
    {
        StringBuilder    sb = new StringBuilder (s);
        for (int i = 0; i < nofSpaces; i++)
            sb.insert (0, " ");
```

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```
            return sb.toString ();
        }
}
```

Exercises on the problem and the solution

1. Create an algorithm that adds two natural numbers represented as character strings. Visualize that algorithm; create a series of images that shows how the operation proceeds. Describe the algorithm with the corresponding pseudocode. Implement the algorithm as a Java method.

2. Create an algorithm that subtracts two natural numbers represented as character strings. Visualize that algorithm; create a series of images that shows how the operation proceeds. Describe the algorithm with the corresponding pseudocode. Implement the algorithm as a Java method.

3. Make complete the program `OperationsWithNaturalNumbersGivenAs-Strings` and make it a meaningful unit.

4. If so desired, design and implement algorithms for multiplication and division of natural numbers represented as character strings.