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Wintersemester 22/23

Exercises for the Class

Elements of Computer Science: Programming

Assignment 06

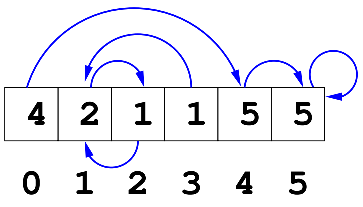
Submission of solutions until 3:30 p.m. at 12.12.2022
at `moodle.uni-trier.de`

- Every task needs to be edited in a meaningful way in order to get a point!
- Please comment your solutions, so that we can easy understand your ideas!
- If you have questions about programming or the homeworks, just ask you teachers!
- **Submission that can't be compiled are rated with 0 points!**

Exercise 1 (Evaluation: Numbers)

Consider a field `array` analogous to the scavenger hunt examples (i.e., it's about repeatedly setting `i=field[i]`). However, all entries in the field are certainly so small that they can be used as an index for the field again. Every 'scavenger hunt' must therefore run in a loop at some point:

With the values `4 2 1 1 5 5`, for example, the following transitions occur in the array and thus obviously also two loops (loop 1 is 5-5-5-..., loop 2 is 1-2-1-2-...):



Now determine how many loops there are in an input field (including the indexes to the indexes leading to the loops).
In the example, the indices 0,4,5 lead into loop 1, the indices 1,2,3 lead into loop 2:

```
Size:   6
Content: 4 2 1 1 5 5
Number of Loops:  2
Assignment of Indexes: 1 2 2 2 1 1
```

Advice: Use a second field `marked` of type `int`, in which you enter for each index the loop in which it is located, if this is already known. So meaningful initial values for the `marked` field are `0`.

You can now proceed as follows:

1. At the beginning of the algorithm no loop is known, so initialize a counter k with the value 0.
2. Then look (repeatedly, see below) at the smallest index `i` that has not yet been assigned to a loop, where `marked[i]` still has the value `0`.

   (At the beginning there is always `i=0`*. This procedure also results in a unique numbering of the loops as "loop 1", "loop 2", etc.).*
3. Then check (e.g. as in task 4 of Assignment 4) whether you reach an already known loop from `i` (i.e. an index `j` is reached from `i`, where `marked[j]` has a value >`0`).
4. If a known loop is reached, save the value found in the loop `marked[j]` in a variable `s`.
5. But if no known loop is reached, you have found a new loop; so increment `k` and also set `s` to the new value of `k`.
6. Now set the `marked` field to the value `s` for `i` and for all indexes that can be reached from `i`.
7. As long as the `marked` field still contains `0` values, repeat this procedure from step 2.
8. At the end, output the value of k and the values of the `marked` field.

It is best to first execute the algorithm "by hand" on some of the evaluation examples before implementing it!

Exercise 2 (Evaluation: Numbers)

Add the following five methods to the predefined program:

1. `sub`: three `int` parameters, `int` return value;
   the smallest number is subtracted from the largest number.
2. `mul`: three `int` parameters, `int` return value;
   the two largest numbers are multiplied by each other.
3. `mean`: thre `int` parameters, `double` return value;
   the arithmetic mean $\frac{a+b+c}{3}$ of the three parameters is determined as `double` and returned. Example: $\frac{1+2+2}{3} = 1,666...$

4. `allEqual`: three `int` parameter, `boolean` return value;
   the `boolean` value `true` is returned if all three parameters have the same value, otherwise the value `false`.

5. `prime`: one `int` parameter, `boolean` return value;
   return `true`, if the `int` number is positive and a prime numbers. Otherwise return `false`

You may only change the default `main` method as follows: If you have implemented a subtask, remove the comment characters from the line beginning of the corresponding case of the `switch` statement. This will activate the subtask.

The `main` method first reads in up to four numbers `st`, `a`, `b`, `c`. The first number `st` determines the subtask to be considered. An example can be found on the next page.

Watch out: The methods to be written by you must all be provided with the modifier `static`!

```
Subtask: 3
Test Values: 1 2 2
1.6666666666666667
```

Exercise 3 (Evaluation: Numbers)

Normally a year is a leap year when the year number is dividable by 4 without remainder. This does not apply if it is dividable by 100 without a remainder. However, if the number is dividable by 400 even without remainder, it is still a leap year.

Implement to methods:

- `isLeapYear` checks if the input parameter is a leap year, corresponding to the previous mentioned rules.

- `nextLeapYear` returns the next leap year (so after the entered year).

`nextLeapYear` should call the method `isLeapYear` (possibly several times). Decide for each method which data to pass and what the return type is.

Write a `main` function that allows corresponding tests of `nextLeapYear`, suitably for the following example:

```
Year:  2018
Next Leap Year: 2016
```

Exercise 4 (Evaluation: predefined `main` method)

Create a Method

```
static boolean charTwice(String s)
```

that has a string `s` as parameter and returns a **`boolean`** value. You can assume that `s != ""` applies. The return value should be **`true`** exactly when a **`char`** occurs in exactly two places in `s`.

Positive tests would be `"Hello"`, `"Yahoo"` or also`"Trier"`. Negative examples are `"Test"`, `"abc"`,`"HalLo"` and `"lalelu"`.

A suitable `main` method is given again.

Exercise 5 (Evaluation: predefined `main` method)

Familiarize yourself with the methods of the `String` class[1]:

1. Create a method

   ```
   static int countOccurrence(String haystack, String needle)
   ```

   that counts at how many positions the string `needle` occurs as a substring in `haystack` For example, the call `countOccurrence("abbbba", "bb")` should return the value 3.

2. Create another method

   ```
   static String extractTag(String s)
   ```

   with the following property: For an argument `s` of the form

   prefix ‘`[`’ *infix* ‘`]`’ *suffix*

   the function `extractTag` should return the substring *Infix*. You can assume that ‘`[`’ and ‘`]`’ both occur exactly once in the correct order in `s`.

   At `extractTag("1234[5678]9")` the string `5678` should be found and returned.

[1]`http://docs.oracle.com/javase/8/docs/api/java/lang/String.html`