

# Voortgezet Programmeren (FEB23007-12)

## 4. Exercise

Deadline for submission: 2013-02-03 23:59 CET

### Instructions

Include in each source file (in class documentation, @author) your names and student numbers. Submit the exercise as a zip file containing `_only_` the source files in root of the zip. Submit via blackboard. Note that incorrectly submitted or non-compiling exercises are automatically awarded 0 points. Remember to document your code with Javadoc-annotations.

### Exercise

The bisection algorithm (see [http://en.wikipedia.org/wiki/Bisection\\_method](http://en.wikipedia.org/wiki/Bisection_method) for description and pseudo-code) is a well-known algorithm in mathematics used to find the root of a function in a particular interval. In this exercise, we want to implement this algorithm in Java and apply it on linear and quadratic functions. A linear function is described as

$$f(x) = ax + b,$$

where  $a$  and  $b$  are commonly known as the slope and intercept respectively, whereas a quadratic function can be described as

$$f(x) = ax^2 + bx + c.$$

We will make use of an interface, since the functions have similar functionalities. For making the program in an object-oriented manner, you should implement (at least) the following standard/unit testing classes:

- **Function**: an interface class containing the general function evaluation method with signature `double evaluate(double at)`.
- **LinearFunction**: a class representing a linear function. The class should have a constructor that takes the slope and intercept as input, be immutable, and implement **Function**.
- **LinearFunctionTest**: a class for unit testing **LinearFunction** public methods.
- **QuadraticFunction**: a class representing a quadratic function. The class should have a constructor that takes the coefficients  $a$ ,  $b$ , and  $c$  as inputs, be immutable, and implement **Function**.
- **QuadraticFunctionTest**: a class for unit testing **QuadraticFunction** public methods.
- **BiSectionMethod**: a class that contains the bisection method. The class should contain a static bisection method that takes as input a **Function** and the interval for evaluation. It should return the value at which the function evaluates as 0. Make sure to document and check for the pre-condition for a valid interval, as the root of  $f(\cdot)$  can only be found in an interval  $[x_1, x_2]$  where  $f(x_1)$  and  $f(x_2)$  have different signs. Make the bisection method parameters TOL and NMAX as public constants within the class (`public static final`).
- **BiSectionMethodTest**: a class for unit testing **BiSectionMethod** public methods.
- **Main**: a main class that constructs functions  $f(x) = 2x + 3$ ,  $g(x) = 7x^2 - 3x - 10$  and applies the bisection algorithm on them at different intervals.