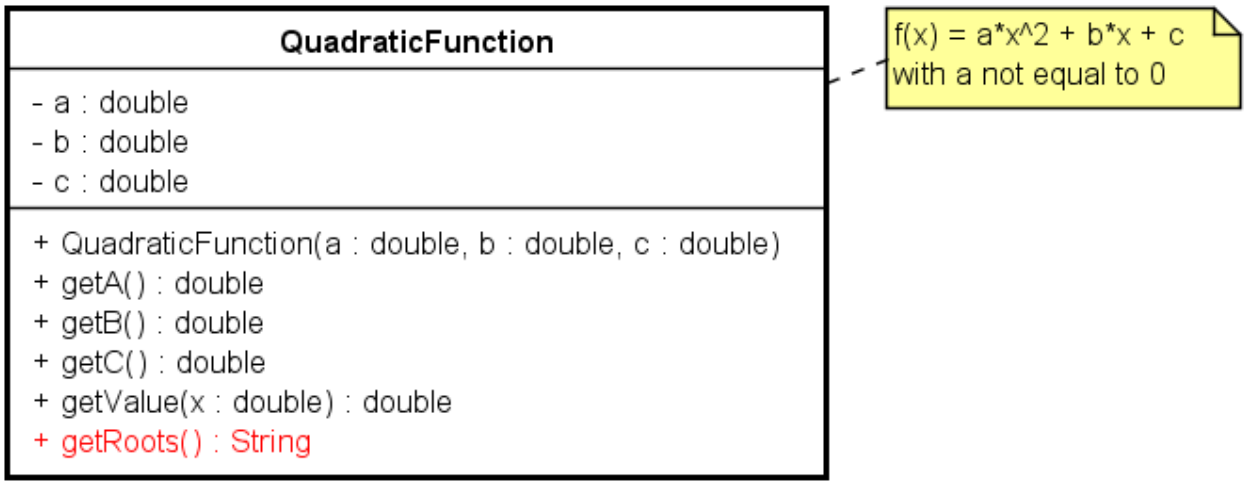
Exercise: QuadraticFunction



Create a new Module and name it `QuadraticFunction`. Everything but method `getRoots` is given on the next page.

Finding the roots of a quadratic function $f(x) = ax^2 + bx + c$ is to solve the equation: $ax^2 + bx + c = 0$. With the determinant defined by $D = b^2 - 4ac$., the solution to the equation can be found as follows:

- If D < 0, the equation has no solutions.
- If D = 0, the equation has one solution: $x = -\frac{b}{2a}$.
- If D > 0, the equation has two solutions: $x = \frac{-b+\sqrt{D}}{2a}$ and $x = \frac{-b-\sqrt{D}}{2a}$.

Implement the method `getRoots` returning a string with the roots in the format:

a) If there are no roots, then return "No roots".
b) If there is exactly one root the return "One root: *XXX*" with *XXX* being the root.
c) If there are two roots then return "Two roots: (*XXX; YYY*)" with *XXX* being the smallest root and *YYY* being the largest root (not in the opposite order).

Hint: `Math.sqrt(d)` returns the square root of `d`.

Implement a test class `QuadraticFunctionTest` doing at least the following:

1. Create a `QuadraticFunction` object with a, b and c either from keyboard input or hardcoded values (literals)
2. Print out the roots using method `getRoots`.
3. Test the program with the following input:
   - (a, b, c) = (1, 2, 2). This should give the output: `No roots`
   - (a, b, c) = (2, -4, 2). This should give the output: `One root: 1.0`
   - (a, b, c) = (2, 5, 2). This should give the output: `Two roots: (-2.0; -0.5)`

Class QuadraticFunction

```
public class QuadraticFunction
{
   private double a;
   private double b;
   private double c;

   public QuadraticFunction(double a, double b, double c)
   {
      this.a = a;
      this.b = b;
      this.c = c;
   }

   public double getA()
   {
      return a;
   }

   public double getB()
   {
      return b;
   }

   public double getC()
   {
      return c;
   }

   public double getValue(double x)
   {
      return a * x * x + b * x + c;
   }

   public String getRoots()
   {
      //TODO: implement this method
   }
}
```

Optional Exercise: if a = 0

If *a = 0* then the function is not quadratic but a linear function. The roots of a linear function *f(x) = bx + c* is to solve the equation: *bx + c = 0* and is as follows:

- If $b = 0$ and $c \neq 0$, the equation has no solutions.
- If $b = 0$ and $c = 0$, the equation is always true (infinite solutions).
- If $b \neq 0$, the equation has one solution: $x = -\frac{c}{b}$.

Refine method `getRoots` to handle also the case *a = 0*.

a) If there are no roots, then return "Not a quadratic function: No roots".
b) If there are infinite solutions, then return "Not a quadratic function: Infinite number of roots".
c) If there is a root the return "A linear function with root: *XXX*" with *XXX* being the root.