Homework Assignment

3 Intersections

This assignment consists of two problems that are to be solved by one program

The first problem is to find the roots (solutions of $f(x) = 0$) of a quadratic function f, defined on input. Furthermore, the discriminant of f and the top of the corresponding parabola are to be calculated.

The second problem is to intersect this parabola with a given line.

The methods (functions) that are mentioned in the problem description are to be defined in your program exactly as they are described, with name, parameters, and return type. Your program should use these methods.

- `double f(double a, double b, double c, double x)` is the quadratic function that has to be analysed, it computes $ax^2 + bx + c$;
- `double discr(double a, double b, double c)` computes the discriminant of f, i.e., $b^2 - 4ac$.
- `double rnd(double d)` rounds d off to three decimals. Use this function when printing doubles (and don't use it in calculations, only in printing!). You can use the following implementation:
  `return Math.round( d * SHIFT ) / SHIFT;`
  where `SHIFT` is defined by `double SHIFT = 1000;` Put this line near the top of the class.
- `double solve1(double a, double b, double c)` computes the greatest of the two roots of $ax^2 + bx + c$; if there is only one root, this one should be returned; if there is no root, the return value is unspecified (no requirements).
- `double solve2(double a, double b, double c)` computes the smallest of the two roots of $ax^2 + bx + c$; if there is only one root, this one should be returned; if there is no root, the return value is unspecified (no requirements).

Use methods and other functions to your own discretion. Good structure will be rewarded. Big mess will be punished.

3.1 Input

1. Three decimal numbers (in the range of `double`) specifying the coefficients a, b, and c of the quadratic function $ax^2 + bx + c$, in this order. You may assume that $|a| > 0.0001$.
2. Two decimal numbers p and q (in the range of `double`), representing the line defined by $y = px + q$.

These numbers are separated by whitespace (spaces, newlines, etc.). You may not assume any other formatting, such as one line per number, etc.

3.2 Output

1. For the root finding part, the following lines are to be output. Quotes are not part of the output.

   `discriminant:` followed by the discriminant of f
   `root:` followed by the largest root
   `root:` followed by the smallest root

`top:` followed by the coordinates of the top, between parentheses, separated by a comma and one space.

If there are no roots, the lines with the roots should be replaced by `no roots`.

When there is only one root, still two roots are to be printed, both with the same value.

2. For the intersection with the line, the following lines are to be output.

   `intersection point:` followed by the coordinates of one intersection point between parentheses, separated by a comma and one space
   `intersection point:` followed by the coordinates of the other intersection point between parentheses, separated by a comma and one space

   If there is no intersection, the two lines above should be replaced by `no intersection`.

   If there is one intersection point, this point should be output twice.

All floating point values (doubles) are printed with maximally 3 decimals (use the function `rnd`, see above).

3.3 Remarks

3.3.1 Comma f*ing

Java (in particular, the Scanner object) consults the *locale* setting of your computer to see whether it should expect a decimal comma or a decimal point when inputting decimal numbers. For the tests that Peach performs, this setting is irrelevant, since Peach uses its own environment and tests with corresponding input (it uses decimal points).

If you nevertheless really want to override this behaviour, add the line

```
Locale.setDefault( Locale.US );
```

to the beginning of your programming, i.e., the beginning of the body of `main`. (Make sure you have `import java.util.*;` before the class definition.) The `print` and *println* methods always seem to use decimal points.

3.3.2 Mathematical hints

The discriminant determines the number of roots: When it is positive, there are two roots, when it is 0, there is one root, when it is negative, there are no (real) roots.

The roots of a quadratic function can be found with the abc-formula (or *wortelformule*). You know what I mean. Or look it up.

The x-coordinate of the top can be computed from the coefficients a and b of the corresponding function. Look up or derive the formula.

3.4 Examples

3.4.1 Example

Input

```
1.0 -2.0 -3.0
2.0 -3.0
```

Output

```
dicsr: 16.0
root: 3.0
root: -1.0
top: (1.0, -4.0)
intersection point: (4.0, 5.0)
intersection point: (0.0, -3.0)
```

3.4.2 Example

Input

```
1 1 1 1 1
```

Output

```
discr: -3.0
no roots
top: (-0.5, 0.75)
intersection point: (0.0, 1.0)
intersection point: (0.0, 1.0)
```