

# Classes and Objects

CMPT220L

Due on Apr 01, 2022 by 11:59 PM

Points: 100

## Problems

1. (*Algebra: quadratic equations*) Design a class named `QuadraticEquation` for a quadratic equation  $ax^2 + bx + c = 0$ . The class contains:

- Private data fields `a`, `b`, and `c` the represent three coefficients.
- A constructor with the arguments for `a`, `b`, and `c`.
- Three getter methods for `a`, `b`, and `c`.
- A method named `getDiscriminant()` that returns the discriminant, which is  $b^2 - 4ac$ .
- The methods named `getRoot1()` and `getRoot2()` for returning two roots of the equation

$$r_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \text{ and } r_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

These methods are useful only if the discriminant is nonnegative. Let these methods return 0 if the discriminant is negative.

Draw the UML diagram for the class then implement the class. Write a test program that prompts the user to enter values for  $a$ ,  $b$ , and  $c$  and displays the result based on the discriminant. If the discriminant is positive, display the two roots. If the discriminant is 0, display one root. Otherwise, display “The equation has no roots.” See Module 3 assignment for sample runs.

2. (*Intersecting point*) Write the following method that returns the intersecting point between two lines ( $p1, p2$ ) and ( $p3, p4$ ):

```
public static Point getIntersectingPoint(Point p1, Point p2, Point p3, Point p4);
```

You'll also need to create a `Point` class with two private data fields `x` and `y` to represent a point.

The intersection point between two lines can be found by solving the following linear equations provided that  $ad - bc$  is not 0:

$$(y_1 - y_2)x - (x_1 - x_2)y = (y_1 - y_2)x_1 - (x_1 - x_2)y_1 \quad (1)$$

$$(y_3 - y_4)x - (x_3 - x_4)y = (y_3 - y_4)x_3 - (x_3 - x_4)y_3 \quad (2)$$

This can be solved using Cramer's rule to solve a  $2 \times 2$  system of linear equations:

$$ax + by = e \quad (3)$$

$$cx + dy = f \quad (4)$$

$$x = \frac{ed - bf}{ad - bc} \quad y = \frac{af - ec}{ad - bc} \quad (5)$$

The method returns null if the two lines are parallel. Write a test program that prompts the user to enter three points and displays the center point. Here is a sample run.

```
Enter x1, y1, x2, y2, x3, y3, x4, y4: 2 2 5 -1.0 4.0 2.0 -1.0 -2.0
The intersecting point is at (2.88889, 1.1111)
```

```
Enter x1, y1, x2, y2, x3, y3, x4, y4: 2 2 7 6.0 4.0 2.0 -1.0 -2.0
The two lines are parallel
```

3. (*Center of a triangle*) Write the following method that returns the center of a triangle:

```
public static Point getCenterPoint(Point p1, Point p2, Point p3);
```

Write a test program that prompts the user to enter three points and displays the center point. Here is a sample run: (*Hint*: Use what you created for the previous problem).

```
Enter x1, y1, x2, y2, x3, y3: 2.5 2 5 -1.0 4.0 2.0
The center point is at (3.8333333333333335, 1.0)
```

## Submission

Make sure you create one Java file per project. Place your .java files under the corresponding folder in your local copy of the GitHub repository, commit and push it to the remote repository. Make sure that the professor has access to the repository (`jfac65-marist`).

```
cmpt220lastname\
  hw07\
    Problem1.java
    Problem2.java
    Problem3.java
    Point.java
```