Ex1)

(*Stopwatch*) Design a class named `StopWatch`. The class contains:

- Private data fields `startTime` and `endTime` with getter methods.
- A no-arg constructor that initializes `startTime` with the current time.
- A method named `start()` that resets the `startTime` to the current time.
- A method named `stop()` that sets the `endTime` to the current time.
- A method named `getElapsedTime()` that returns the elapsed time for the stopwatch in milliseconds.

Draw the UML diagram for the class then implement the class. Write a test program that measures the execution time of sorting 100,000 numbers using selection sort.

Ex2)

(*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` that 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

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

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 the one root. Otherwise, display "The equation has no roots." See Programming Exercise 3.1 for sample runs.

Ex 3)

(*Algebra:* $2 \times 2$ *linear equations*) Design a class named `LinearEquation` for a $2 \times 2$ system of linear equations:

$$\begin{aligned} ax + by &= e \\ cx + dy &= f \end{aligned} \qquad x = \frac{ed - bf}{ad - bc} \qquad y = \frac{af - ec}{ad - bc}$$

- Private data fields `a`, `b`, `c`, `d`, `e`, and `f`.
- A constructor with the arguments for `a`, `b`, `c`, `d`, `e`, and `f`.
- Six getter methods for `a`, `b`, `c`, `d`, `e`, and `f`.
- A method named `isSolvable()` that returns true if $ad - bc$ is not 0.
- Methods `getX()` and `getY()` that return the solution for the equation.

Draw the UML diagram for the class then implement the class. Write a test program that prompts the user to enter `a`, `b`, `c`, `d`, `e`, and `f` and displays the result. If $ad - bc$ is 0, report that "The equation has no solution." See Programming Exercise 3.3 for sample runs.

Ex 4)

(*Algebra: 2 × 2 linear equations*) Design a class named `LinearEquation` for a 2 × 2 system of linear equations:

$$\begin{aligned} ax + by &= e \\ cx + dy &= f \end{aligned} \qquad x = \frac{ed - bf}{ad - bc} \qquad y = \frac{af - ec}{ad - bc}$$

isSolvable()
getX()
getY()

Ex5)

(*Geometry: intersecting point*) Suppose two line segments intersect. The two endpoints for the first line segment are (`x1`, `y1`) and (`x2`, `y2`) and for the second line segment are (`x3`, `y3`) and (`x4`, `y4`). Write a program that prompts the user to enter these four endpoints and displays the intersecting point. As discussed in Programming Exercise 3.25, the intersecting point can be found by solving a linear equation. Use the `LinearEquation` class in Programming Exercise 9.11 to solve this equation. See Programming Exercise 3.25 for sample runs.

Ex6)

(*The* **Account** *class*) Design a class named **Account** that contains:

- A private **int** data field named **id** for the account (default **0**).
- A private **double** data field named **balance** for the account (default **0**).

- A private **double** data field named **annualInterestRate** that stores the current interest rate (default **0**). Assume that all accounts have the same interest rate.
- A private **Date** data field named **dateCreated** that stores the date when the account was created.
- A no-arg constructor that creates a default account.
- A constructor that creates an account with the specified id and initial balance.
- The accessor and mutator methods for **id**, **balance**, and **annualInterestRate**.
- The accessor method for **dateCreated**.
- A method named **getMonthlyInterestRate()** that returns the monthly interest rate.
- A method named **getMonthlyInterest()** that returns the monthly interest.
- A method named **withdraw** that withdraws a specified amount from the account.
- A method named **deposit** that deposits a specified amount to the account.

Draw the UML diagram for the class then implement the class. (*Hint*: The method **getMonthlyInterest()** is to return monthly interest, not the interest rate. Monthly interest is **balance * monthlyInterestRate**. **monthlyInterestRate** is **annualInterestRate / 12**. Note **annualInterestRate** is a percentage, for example 4.5%. You need to divide it by 100.)

Write a test program that creates an **Account** object with an account ID of 1122, a balance of $20,000, and an annual interest rate of 4.5%. Use the **withdraw** method to withdraw $2,500, use the **deposit** method to deposit $3,000, and print the balance, the monthly interest, and the date when this account was created.