

INTE2512 Object Oriented Programming

Lab - OOP 1

1. Java API has the **GregorianCalendar** class in the **java.util** package, which you can use to obtain the year, month, and day of a date. The no-arg constructor constructs an instance for the current date, and the methods `get(GregorianCalendar.YEAR)`, `get(GregorianCalendar.MONTH)`, and `get(GregorianCalendar.DAY_OF_MONTH)` return the year, month, and day.

Write a program to perform two tasks:

- Display the current year, month, and day.
 - The **GregorianCalendar** class has the method **setTimeInMillis(long)**, which can be used to set a specified elapse time since January 1, 1970. Set the value to **1234567898765L** and display the year, month, and day.
2. Design a class named **StopWatch**. The class contains:
 - Private attributes **startTime** and **endTime** with get methods.
 - A no-arg constructor that initializes **startTime** with the current time.
 - A method **start()** that resets the **startTime** to the current time.
 - A method **stop()** that resets the **endTime** to the current time.
 - A method **getElapsedTime()** that returns the elapsed time for the stopwatch in milliseconds.

Draw a class diagram for this class and then implement the class. Write a test program that measures the execution time of sorting 100,000 numbers using [selection sort](#).

3. Design a class named **QuadraticEquation** for a quadratic equation **$ax^2 + bx + c = 0$** . The class contains:
 - Private attributes *a*, *b*, *c* that represent three coefficients.
 - A constructor with the arguments for *a*, *b*, and *c*.
 - Three get methods for *a*, *b*, *c*.
 - A method **getDiscriminant()** that return the discriminant **$b^2 - 4ac$** .
 - Methods **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 a class diagram for this class and then implement the class. Write a test program that prompts the user to enter values for *a*, *b* then displays the result based on the

discriminant. If the discriminant is positive, display two roots. If the discriminant is 0, display one root. Otherwise, display "The equation has no roots."

4. Design a class named **LinearEquation** for a system of 2 x 2 linear equations:

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

The class contains:

- Private attributes a, b, c, d, e, and f.
- A constructor with the arguments for a, b, c, d, e, and f.
- Six get methods for a, b, c, d, e, and f.
- A method **isSolvable()** that returns true if (ad – bc) is not 0 and false otherwise.
- Methods **getX()** and **getY()** that return the solution for the equation.

Draw a class diagram for this class and then implement the class. Write a test program that prompts the user to enter a, b, c, d, e, and f then displays the solution. If (ad – bc) is 0, report that "The equation has no solution."

5. Identify the classes (with suitable attributes and methods) and their relationships in the following problem and present them in a class diagram.

Ella wants to write a program to maintain her contact list efficiently. Each contact must have a name, a phone number, an email, and an address. The program has the following functions:

- Display the list of contacts by name
- Read a contact from the list
- Create a new contact
- Update a contact
- Delete a contact
- Search the contact list by a given string
- Display the list of contacts by one of the given fields

6. Identify the classes (with suitable attributes and methods) and their relationships in the following problem and present them in a class diagram.

A weather station is a package of software-controlled instruments which collects data, performs some data processing and transmits this data for further processing. The instruments include air and ground thermometers, an anemometer, a wind vane, a barometer and a rain gauge. Data is collected periodically. When a command is issued to transmit the weather data, the weather station processes and summarizes the collected data. The summarized data is transmitted to the mapping computer when a request is received.

7. The United States Federal Income Tax Rates for 2021 has four tax filing types: unmarried individuals, married individuals filing separately, married individuals filing jointly, and heads of households. The detailed tax brackets and tax rates for each type are described in [this article](#).

Draw a class diagram for the class **Tax** (with suitable attributes and methods) and then implement the class. Write a test program that uses the **Tax** class to print the 2021 tax table for incomes from \$9,000 to \$690,000 with intervals of \$10,000 for all four tax filing types.