ELEC 2543 Object-Oriented Programming and Data Structures

Second Semester, 2020-2021

Mid-Term Test 1 (Programming Test)

March 19 (Friday), 2021, 9:30am – 10:30am

Overview: In this test, you are going to develop a class representing complex numbers. Please refer to <https://en.wikipedia.org/wiki/Complex_number> for basics of complex numbers. All your submission should go through VPL.

**Task 1: Complex.java (20 points)**

Define class Complex representing complex numbers according to the following. Test your class using driver program TestTask1.java. The sample output is in output1.txt.

No other methods can be defined in class Complex unless those specified in Tasks 1 – 3.

1. Define two instance variables for representing the real part and imaginary part of a complex number. You can assume both the real part and imaginary part are integers. You should use appropriate visibility modifiers and appropriate data types.
2. Develop a constructor for class Complex. The constructor accepts two parameters, in the order of real part and imaginary part.
3. Develop the toString() method of Complex. The output format is “real part +/- imaginary part i”. There is no space between number, sign, and *i*. Please refer to the sample output for examples.

**Task 2: Complex number functions (20 points)**

Define the following three methods in class Complex. Test your implementation using TestTask2.java. The sample output is output2.txt.

boolean equals(Complex c)

This method returns true if both c and the object calling this method represent the same complex number (same real part value and same imaginary part value).

Complex conjugate()

This method returns a new complex number representing the conjugate of the object calling this method. The conjugate of the complex number  *x* + *yi* is *x* − *yi*.

Complex multiply(Complex c)

This method returns a new complex number representing the result of multiplying *c* with the object calling this method. Given two complex numbers *x + yi* and *u + vi*. The multiplication results is *(xu – yv) + (xv + yu)i*.

**Task 3: More functions and number formatting (60 points)**

Define the following two methods for getting the polar coordinates of the complex number. The following picture, which can be found in the wiki page, shows the relation between Cartesian Complex plane with Polar Complex plane.

<https://en.wikipedia.org/wiki/Complex_number#/media/File:Complex_number_illustration_modarg.svg>

Let the polar coordinates of complex number *x + yi* be *r* and *ϕ*.

Method magnitude() returns *r* in double data type.

Method radian() returns *ϕ* in the range of *(−π, π]*. [Note: read Math.atan2 method.]

After you have defined the two methods, complete Task3.java such that at most four decimal digits are displayed for non-integer values.

The sample output of Task3.java can be found in output3.txt.