Introduction to Java
CS9053 Section I
Thursday 6:00 PM – 8:30 PM
Prof. Dean Christakos
Sept. 18th, 2025
Due: Sept. 26th, 2025 11:59 PM

Part I – Creating Objects

1. ComplexNumber: In the lecture you have seen the creation of a circle. Here you are going to create a complex number. As you will remember a complex number as a real part, **a**, and an imaginary part, **b**, given by $a + ib$.

   The magnitude of a Complex Number $z = a + ib$ is given by

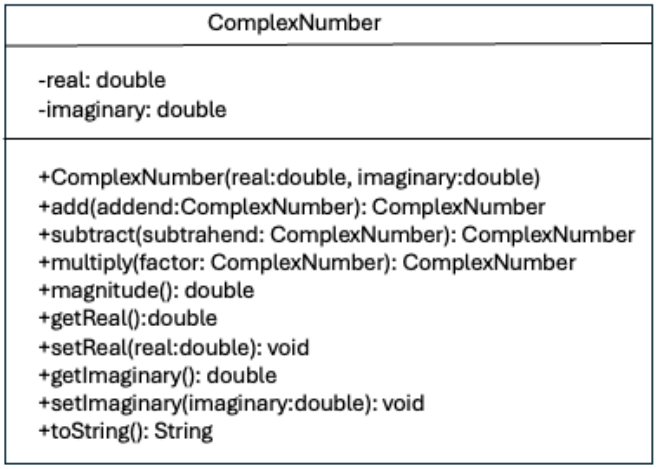
$$|z| = \sqrt{a^2 + b^2}$$

Addition and subtraction are performed by adding/subtracting the real part with the real part and then the imaginary part with the imaginary part.

Multiplying two imaginary numbers $y = a_1 + ib_1$ and $z = a_2 + ib_2$ is given by:

$$y \times z = (a_1a_2 - b_1b_2) + i(a_1b_2 + a_2b_1)$$

You will create a class ComplexNumber using the following UML:



In standard UML parlance, "+" indicates that a field or method is public and "-" indicates that a field or method is private. An underlined field or method indicates it is static.

Create two complex numbers, *7.5 + i4.2* and *8.2 + i9.4* and add then, subtract them, and multiply them.

toString() should return a String that says <**real> + i<imaginary>** where <real> and <imaginary> are the values of the real and imaginary fields.

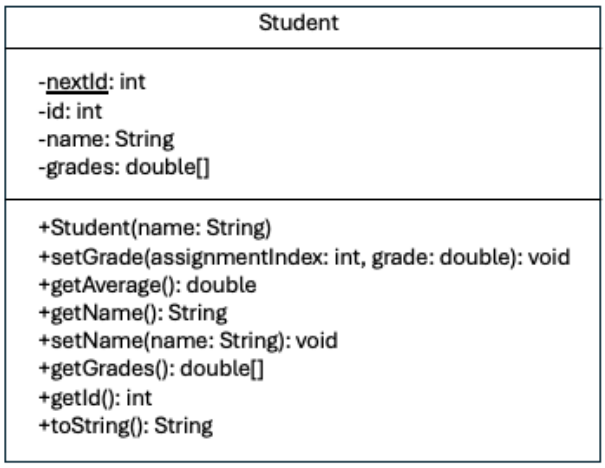
1 Points Extra credit: implement ComplexNumber divide(ComplexNumber divisor)

2. Objects and Arrays of Objects

Your objective is to develop the **Student** and **Gradebook** classes and to use their methods. The classes are described below to guide you.

a) Student

The **Student** class contains data related to a student. Here is the UML:



TASKS / Requirements:

1. **Student Constructor →**
    a. The grades array should have a length of x (in this case 5) and be initialized with the values of -1, indicating that there is no grade for that index yet.
    b. The constructor should automatically generate an ID.
2. **getGrades() →** should return a **copy** of the grades array, not the original grades array.
3. **setGrades(assignmentIndex, grade) →**
    a. should set the grade of an existing index of the grades array with a grade value of between 0-100 (inclusive).
    b. Error Handling →If the call violates either of those constraints, it should do nothing.
4. **getAverage() →**
    a. should calculate the average of the existing grades in the grades array for a given student
    b. If there are only a few grades for a student then → -1 values do not count towards the average.

b) Gradebook

Here you are going to create a Gradebook class that contains an array of Student objects. It also has the following methods:

Requirements:

1. **void addStudent(Student s)** → add a student to the first available null slot
2. **Student findById(int id)** → return the student or null if not found
3. **Student getTopStudent()** → return the student with the highest average
4. **void printAll()** → print info for all Students

5. In the **main method**, you will:
    a. Create a Gradebook with space for 5 students
    b. Create and add 5 Student objects
    c. Set random grades for each assignment (from 0-100)
    d. Print all students
    e. Print the top student

The UML for the Gradebook is: