1. Complex number:

```java
2
3   public class ComplexNumber {
4       private final double real;
5       private final double imaginary;
6
7       public ComplexNumber(double real, double imaginary) {
8           this.real = real;
9           this.imaginary = imaginary;
10      }
11
12      public double getReal() {
13          return real;
14      }
15
16      public double getImaginary() {
17          return imaginary;
18      }
19
20      public double magnitude() {
21          return Math.hypot(real, imaginary);
22      }
23
24      public ComplexNumber add(ComplexNumber other) {
25          return new ComplexNumber(this.real + other.real,
26                                  this.imaginary + other.imaginary);
27      }
28
29      public ComplexNumber subtract(ComplexNumber other) {
30          return new ComplexNumber(this.real - other.real,
31                                  this.imaginary - other.imaginary);
32      }
33
34      public ComplexNumber multiply(ComplexNumber other) {
35          double a = this.real, b = this.imaginary;
36          double c = other.real, d = other.imaginary;
37          return new ComplexNumber(a * c - b * d, a * d + b * c);
38      }
39
40      public ComplexNumber divide(ComplexNumber divisor) {
41          double c = divisor.real, d = divisor.imaginary;
42          double denom = c * c + d * d;
43          if (denom == 0.0) {
44              throw new ArithmeticException("Division by zero complex number");
45          }
46          double a = this.real, b = this.imaginary;
47          double realPart = (a * c + b * d) / denom;
48          double imagPart = (b * c - a * d) / denom;
49          return new ComplexNumber(realPart, imagPart);
50      }
51
52      @Override
53      public String toString() {
54          if (imaginary >= 0) {
55              return real + " + i" + imaginary;
56          } else {
57              return real + " - i" + Math.abs(imaginary);
58          }
59      }
60
61      public static void main(String[] args) {
62          ComplexNumber z1 = new ComplexNumber(7.5, 4.2);
63          ComplexNumber z2 = new ComplexNumber(8.2, 9.4);
64
65          System.out.println("z1 = " + z1);
```

Problems @ Javadoc 🔍 Declaration 🖳 Console × 📓 Coverage ⓘ Eclipse IDE for Java Developers 2025-09 Release

<terminated> ComplexNumber [Java Application] D:\eclipse-java-2025-06-R-win32-x86_64\eclipse\plugins\org.eclipse.justj.openjdk.hotspot

```
z1 = 7.5 + i4.2
z2 = 8.2 + i9.4
z1 + z2 = 15.7 + i13.600000000000001
z1 - z2 = -0.6999999999999993 - i5.2
z1 * z2 = 22.01999999999999 + i104.94
z1 / z2 = 0.6489717223650384 - i0.23174807197943442
|z1| = 8.595929269136642
|z2| = 12.47397290361014
```

2. Objects and Arrays of Objects

```java
1  package PartII;
2
3  import java.util.concurrent.ThreadLocalRandom;
4
5  public class Gradebook {
6      private final Student[] students;
7
8      public Gradebook(int capacity) {
9          this.students = new Student[capacity];
10     }
11
12     public void addStudent(Student s) {
13         for (int i = 0; i < students.length; i++) {
14             if (students[i] == null) {
15                 students[i] = s;
16                 return;
17             }
18         }
19     }
20
21     public Student findById(int id) {
22         for (Student s : students) {
23             if (s != null && s.getId() == id) return s;
24         }
25         return null;
26     }
27
28     public Student getTopStudent() {
29         Student best = null;
30         double bestAvg = -1.0;
31         for (Student s : students) {
32             if (s == null) continue;
33             double avg = s.getAverage();
34             if (avg > bestAvg) {
35                 bestAvg = avg;
36                 best = s;
37             }
38         }
39         return best;
40     }
41
42     public void printAll() {
43         for (Student s : students) {
44             if (s != null) System.out.println(s);
45         }
46     }
47
48     public static void main(String[] args) {
49         Gradebook gb = new Gradebook(5);
50         gb.addStudent(new Student("Alice"));
51         gb.addStudent(new Student("Bob"));
52         gb.addStudent(new Student("Carol"));
53         gb.addStudent(new Student("David"));
54         gb.addStudent(new Student("Eve"));
55
56         for (Student s : gb.students) {
```

Problems @ Javadoc Declaration Console × Coverage (i) Eclipse IDE for Java De

<terminated> Gradebook [Java Application] D:\eclipse-java-2025-06-R-win32-x86_64\eclipse\plugins\c

```
All students:
Student{id=1, name='Alice', grades=[61, 70, 22, 69, 7], avg=45.80}
Student{id=2, name='Bob', grades=[11, 88, 65, 16, 0], avg=36.00}
Student{id=3, name='Carol', grades=[74, 86, 8, 15, 48], avg=46.20}
Student{id=4, name='David', grades=[80, 5, 36, 35, 96], avg=50.40}
Student{id=5, name='Eve', grades=[72, 36, 30, 37, 59], avg=46.80}

Top student:
Student{id=4, name='David', grades=[80, 5, 36, 35, 96], avg=50.40}
```