

# Introduction to Objects and Debugging

Today, we look at how to create and apply custom object types in Java.

Manager:

Recorder:

Presenter:

Reflector:

## Content Learning Targets

*After completing this activity, you should be able to say:*

- I can define objects and related terms, such as field, attribute, method, constructor.
- I can identify the fields and methods of a Java object.
- I can create new object types in Java.
- Given a Java class, I can construct the corresponding UML class diagram.
- Given a UML class diagram, I can write the corresponding Java code.
- I can use debugging tools.

## Process Skill Goals

*During the activity, you should make progress toward:*

- Verifying program behavior by tracing code with a debugger. (Critical Thinking)



## Model 1 The Die Class

The following class represents an individual “die” in a game of dice. The diagram on the right is a graphical summary of the *attributes* (variables) and *methods* of the class.

```
/**
 * Simulates a die object.
 */
public class Die {

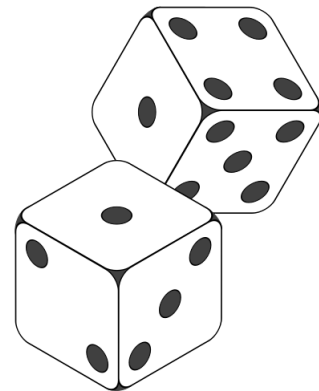
    private int face;

    /**
     * Constructs a die with face value 1.
     */
    public Die() {
        this.face = 1;
    }

    /**
     * @return current face value of the die
     */
    public int getFace() {
        return this.face;
    }

    /**
     * Simulates rolling the die.
     *
     * @return new face value of the die
     */
    public int roll() {
        this.face = (int) (Math.random() * 6) + 1;
        return this.face;
    }
}
```

Die
-face: int
+Die() +getFace(): int +roll(): int



## Questions (10 min)

Start time:

1. Consider the `Die` class:
  - a) What are the attributes?
  - b) What are the methods?
2. In the class diagram (on the upper right):
  - a) What do the + and - symbols represent?
  - b) What does the : represent?
3. Open the provided *Die.java* and run the program several times. Then answer the following questions about the `main` method:
  - a) What is the data type of `d1` and `d2`?
  - b) What are the initial values of the dice?
  - c) What method changed the dice values?
4. Write a statement that declares and initializes a `Die` variable named `lucky`.
5. When you create an object, Java invokes a **constructor**. This method has no return type and has the same name as the class itself. What does the `Die()` constructor do?
6. Notice how the `roll` method refers to `this.face`, yet that variable is not declared in the method. What does the `roll` method change, in terms of the `Die` object?

## Model 2 The Circle Class

Unified Modeling Language (UML) provides a way of graphically illustrating a class's design, independent of the programming language.

Circle
-radius: double
+Circle(radius:double) +getRadius(): double +setRadius(radius:double) +area(): double +circumference(): double <u>+main(args:String[])</u>

### Questions (15 min)

Start time:

7. Consider the Circle class:

- a) How many attributes does it have?
- b) How many methods does it have?

8. Based on Model 1 and Model 2, what is typically **public** and what is typically **private**?

*The following questions will have you implement the Circle class exactly as shown in the UML diagram above. Do not worry about writing Javadoc comments for this activity.*

9. Write the code that declares the radius attribute. An outline of *Circle.java* is provided below for context.

```
public class Circle {  
  
    // constructor goes here  
  
    // other methods go here  
}
```

10. Write the code for the Circle constructor. Notice that, in contrast to Model 1, the Circle constructor has a parameter. Assign the parameter radius to the attribute **this.radius**.

11. Write the code for `getRadius`. (Refer to Model 1 for an example.)
12. Write the code for `setRadius`. Like the constructor, it should assign the parameter to the corresponding attribute.
13. Write the code for `area`. The area of a circle is  $\pi r^2$ .
14. Write the code for `circumference`. The circumference of a circle is  $2\pi r$ .
15. Write a main method that creates a `Circle` object with a radius of 2.0 and displays its area and circumference (using `println`).

## Model 3 Debugging

Questions (25 min)

Start time:

16. Discuss (2 min): If a program is not working the way you expect (e.g., it is not passing all its tests), what are some options for figuring out what's wrong?

A good Integrated Development Environment (IDE) provides a *debugger*, a suite of tools for finding and fixing errors in code. After the debugger demonstration, answer these questions.

17. What is the term for a place in which we tell the debugger to pause program execution?

18. After the debugger pauses, what primary commands do you have available?

19. If you get some type of Java Exception but aren't sure where or why, what can you do?

20. Open *DebugMe.java* and *DebugMeTest.java*. Practice using the debugger to find and fix the bug in `uppercaseIfExclamation`.

21. Practice using the debugger to find and fix the bugs in `kPermutations` and `isArrayDoubled`.

22. Continue debugging practice with *WhackABug.java*. Note the bugs and lessons learned.