Building Java Programs

Chapter 8
Lecture 8-1: Classes and Objects

reading: 8.1-8.2
self-checks: Ch. 8 #1-9
exercises: Ch. 8 #1-4
Problem

- Declaring same group of related variables several times in a program
  
  ```java
  int x1 = 3;
  int y1 = 5;
  int x2 = 12;
  int y2 = 4;
  ```

- Annoying and redundant
- Unclear and hard to keep track of variables
Solution: Objects

- Group together related variables into an **object**
  - Like creating your own data structure out of Java building blocks

```java
public class <object name> {
    <field(s)>;
}
```

- Syntax to use this data structure:

```java
<object> <variable> = new <object>());
```
Solution: Objects

- Group together related variables into an **object**
  - Like creating your own data structure out of Java building blocks

```java
public class Point {
    int x;
    int y;
}
```

- Syntax to use this data structure:
  ```java
  Point p1 = new Point();
  ```
Two Uses for Java Classes

- **class**: A program entity that represents either:
  1. A program / module, or
  2. A template for a new type of objects.

- The `DrawingPanel` class is a template for creating `DrawingPanel` objects.

- **object**: An entity that combines state and behavior
Java class: Program

- **An executable program** with a **main method**
  - Can be run; statements execute procedurally
  - What we’ve been writing all quarter

```java
public class BMI2 {
    public static void main(String[] args) {
        giveIntro();
        Scanner console = new Scanner(System.in);
        double bmi1 = getBMI(console);
        double bmi2 = getBMI(console);
        reportResults(bmi1, bmi2);
    }
    ...
}
```
Java class: Object Definition

- A **blueprint** for a new data type
  - Not executable, not a complete program
- Created objects are an **instance** of the class

- Blueprint:
  ```java
  public class Point { 
      int x;
      int y;
  }
  ```

- Instance:
  ```java
  Point p1 = new Point();
  ```
Blueprint analogy

- iPod blueprint
  - state:
    - current song
    - volume
    - battery life
  - behavior:
    - power on/off
    - change station/song
    - change volume
    - choose random song

- iPod #1
  - state:
    - song = "Octopus’s Garden"
    - volume = 17
    - battery life = 2.5 hrs
  - behavior:
    - power on/off
    - change station/song
    - change volume
    - choose random song

- iPod #2
  - state:
    - song = "Lovely Rita"
    - volume = 9
    - battery life = 3.41 hrs
  - behavior:
    - power on/off
    - change station/song
    - change volume
    - choose random song

- iPod #3
  - state:
    - song = "For No One"
    - volume = 24
    - battery life = 1.8 hrs
  - behavior:
    - power on/off
    - change station/song
    - change volume
    - choose random song
Abstraction

- **abstraction**: A distancing between ideas and details.
  - We can use objects without knowing how they work.

- Abstraction in an iPod:
  - You understand its external behavior (buttons, screen).
  - You don't understand its inner details, and you don't need to.
Client and Object Classes

- **client program**: A program that uses objects.
  - Example: HW6 Names is a client of DrawingPanel and Graphics.

- **object**: An entity that combines state and behavior
  - *state*: data fields
  - *behavior*: methods
The Object Concept

- **procedural programming**: Programs that perform their behavior as a series of steps to be carried out

- **object-oriented programming (OOP)**: Programs that perform their behavior as interactions between objects
  - Takes practice to understand the object concept
Fields

- **field**: A variable inside an object that is part of its state.
  - Each object has *its own copy* of each field.

- Clients can access/modify an object's fields
  - access: `<variable> . <field>`
  - modify: `<variable> . <field> = <value>;`

- Example:

```java
Point p1 = new Point();
Point p2 = new Point();
System.out.println("the x-coord is " + p1.x); // access
p2.y = 13; // modify
```
Behavior

- Objects can tie related data and behavior together

**instance method:** A method inside an object that operates on that object

```java
public <type> <name> (<parameter(s)>) {
    <statement(s)>
}
```

- Syntax to use method:
  `<variable> . <method>(<parameter(s)>);`

- Example:
  ```java
  pl.translate(11, 6);
  ```
Implicit Parameter

• Each instance method call happens on a particular object.
  • Example: `p1.translate(11, 6);`

• The code for an instance method has an implied knowledge of what object it is operating on.

  • `implicit parameter`: The object on which an instance method is called.
  • Can be referred to inside the object using `this` keyword
Accessors

- **accessor**: An instance method that provides information about the state of an object.

- **Example**:
  ```java
  public double distanceFromOrigin() {
      return Math.sqrt(x * x + y * y);
  }
  ```

- This gives clients "read-only" access to the object's fields.
Mutators

- **mutator**: An instance method that modifies the object’s internal state.

- **Example:**

```java
public void translate(int dx, int dy) {
    x += dx;
    y += dy;
}
```

- This gives clients both read and write access to code.