Summary of Learning Objectives

Define "computer program" and "programming".

- A computer must be programmed to perform tasks. Different tasks require different programs.
- A computer program executes a sequence of very basic instructions in rapid succession.
- A computer program contains the instruction sequences for all tasks that it can execute.

Describe the components of a computer.

- At the heart of the computer lies the central processing unit (CPU).
- Data and programs are stored in primary storage (memory) and secondary storage (such as a hard disk).
- The CPU reads machine instructions from memory. The instructions direct it to communicate with memory, secondary storage, and peripheral devices.

Describe the process of translating high-level languages to machine code.

- Generally, machine code depends on the CPU type. However, the instruction set of the Java virtual machine (JVM) can be executed on different CPUs.
- Because machine instructions are encoded as numbers, it is difficult to write programs in machine code.
- High-level languages allow you to describe tasks at a higher conceptual level than machine code.
- A compiler translates programs written in a high-level language into machine code.

Describe the history and design principles of the Java programming language.

- Java was originally designed for programming consumer devices, but it was first used successfully to write Internet applets.
- Java was designed to be safe and portable, benefiting both Internet users and students.
- Java has a very large library. Focus on learning those parts of the library that you need for your programming projects.

Describe the building blocks of a simple program and the structure of a method call.

- Classes are the fundamental building blocks of Java programs.
- Every Java application contains a class with a main method. When the application starts, the instructions in the main method are executed.
- Use comments to help human readers understand your program.
- A method is called by specifying an object, the method name, and the method parameters.
- A string is a sequence of characters enclosed in quotation marks.

Use your programming environment to write and run Java programs.

- Set aside some time to become familiar with the computer system and the Java compiler that you will use for your class work.
- An editor is a program for entering and modifying text, such as a Java program.

- Java is case sensitive. You must be careful about distinguishing between upper- and lowercase letters.
- Lay out your programs so that they are easy to read.
- The Java compiler translates source code into class files that contain instructions for the Java virtual machine.
- The Java virtual machine loads program instructions from class files and library files.
- Develop a strategy for keeping backup copies of your work before disaster strikes.

Classify program errors as compile-time and run-time errors.

- A compile-time error is a violation of the programming language rules that is detected by the compiler.
- A run-time error causes a program to take an action that the programmer did not intend.

Write pseudocode for simple algorithms.

- Pseudocode is an informal description of a sequence of steps for solving a problem.
- An algorithm for solving a problem is a sequence of steps that is unambiguous, executable, and terminating.

Classes, Objects, and Methods Introduced in this Chapter

Here is a list of all classes, objects, and methods introduced in this chapter. Turn to the documentation in Appendix D for more information.

```
java.io.PrintStream          java.lang.System
    print                        out
    println
```

Media Resources

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- **Worked Example** Writing an Algorithm for Tiling a Floor
- Practice Quiz
- Code Completion Exercises

Review Exercises

★ **R1.1** Explain the difference between using a computer program and programming a computer.

★ **R1.2** What distinguishes a computer from a typical household appliance?

★★ **R1.3** Describe *exactly* what steps you would take to back up your work after you have typed in the HelloPrinter.java program.

★★ **R1.4** On your own computer or on a lab computer, find the exact location (folder or directory name) of
  a. The sample file HelloPrinter.java, which you wrote with the editor.
  b. The Java program launcher java.exe or java.
  c. The library file rt.jar that contains the run-time library.

★ **R1.5** How do you discover syntax errors? How do you discover logic errors?

★★ **R1.6** Write three versions of the HelloPrinter.java program that have different compile-time errors. Write a version that has a run-time error.

★★★ **R1.7** What do the following statements print? Don't guess; write programs to find out.
  a. System.out.println("3 + 4");
  b. System.out.println(3 + 4);
  c. System.out.println(3 + "4");

★★ **R1.8** Write an algorithm to settle the following question: A bank account starts out with $10,000. Interest is compounded monthly at 6 percent per year (0.5 percent per month). Every month, $500 is withdrawn to meet college expenses. After how many years is the account depleted?

★★★ **R1.9** Consider the question in Exercise R1.8. Suppose the numbers ($10,000, 6 percent, $500) were user selectable. Are there values for which the algorithm you developed would not terminate? If so, change the algorithm to make sure it always terminates.

★★★ **R1.10** In order to estimate the cost of painting a house, a painter needs to know the surface area of the exterior. Develop an algorithm for computing that value. Your inputs are the width, length, and height of the house, the number of windows and doors, and their dimensions. (Assume the windows and doors have a uniform size.)

★★ **R1.11** You want to decide whether you should drive your car to work or take the train. You know the one-way distance from your home to your place of work, and the fuel efficiency of your car (in miles per gallon). You also know the one-way price of a train ticket. You assume the cost of gas at $4 per gallon, and car maintenance at 5 cents per mile. Write an algorithm to decide which commute is cheaper.

★★ **R1.12** You want to find out which fraction of your car use is for commuting to work, and which is for personal use. You know the one-way distance from your home to your place of work. For a particular period, you recorded the beginning and ending mileage on the odometer and the number of work days. Write an algorithm to settle this question.

★ **R1.13** In the problem described in How To 1.1 on page 22, you made assumptions about the price of gas and the annual usage. Ideally, you would like to know which car is the better deal without making these assumptions. Why can't a computer program solve that problem?

Programming Exercises

★ **P1.1** Write a program NamePrinter that displays your name inside a box on the console screen, like this:

```
+----+
|Dave|
+----+
```

Do your best to approximate lines with characters, such as |, -, and +.

★★★ **P1.2** Write a program that prints your name in large letters, such as

```
 *   *  **  ****  ****  *   *
 *   *  * *  *   *  *   *  *   *
 *****  *  *  ****  ****   * *
 *   *  ******  *   *  *   *   *
 *   *  *   *  *   *  *   *   *
```

★ **P1.3** Write a program FacePrinter that prints a face, using text characters, hopefully better looking than this one:

```
 /////
 | o o |
(|  ^  |)
 |  [_] |
  -----
```

Use *comments* to indicate the statements that print the hair, ears, mouth, and so on.

★★★ **P1.4** Write a program that prints an animal speaking a greeting, similar to (but different from) the following

```
 /\_/\      -----
( ' ' )  / Hello \
(  -  ) <  Junior |
 | | |   \ Coder!/
(_|_)      -----
```

★ **P1.5** Write a program TicTacToeBoardPrinter that prints a tic-tac-toe board:

```
+---+---+---+
|   |   |   |
+---+---+---+
|   |   |   |
+---+---+---+
|   |   |   |
+---+---+---+
```

★ **P1.6** Write a program StaircasePrinter that prints a staircase:

```
               +---+
               |   |
           +---+---+
           |   |   |
       +---+---+---+
       |   |   |   |
   +---+---+---+---+
   |   |   |   |   |
+---+---+---+---+---+
```

★ **P1.7** Write a program that prints three items, such as the names of your three best friends or favorite movies, on three separate lines.

★★   **P1.8** Write a program that computes the sum of the first ten positive integers,
$1 + 2 + \cdots + 10$. *Hint:* Write a program of the form

```java
public class Sum10
{
    public static void main(String[] args)
    {
        System.out.println(            );
    }
}
```

★★   **P1.9** Type in and run the following program:

```java
import javax.swing.JOptionPane;

public class DialogViewer
{
    public static void main(String[] args)
    {
        JOptionPane.showMessageDialog(null, "Hello, World!");
        System.exit(0);
    }
}
```

Then modify the program to show the message "Hello, *your name*!".

★★   **P1.10** Type in and run the following program:

```java
import javax.swing.JOptionPane;

public class DialogViewer
{
    public static void main(String[] args)
    {
        String name = JOptionPane.showInputDialog("What is your name?");
        System.out.println(name);
        System.exit(0);
    }
}
```

Then modify the program to print "Hello, *name*!", displaying the name that the user typed in.

★★   **P1.11** Run the following program:

```java
import java.net.URL;
import javax.swing.ImageIcon;
import javax.swing.JOptionPane;

public class Test
{
    public static void main(String[] args) throws Exception
    {
        URL imageLocation = new URL(
            "http://horstmann.com/bigjava/duke.gif");
        JOptionPane.showMessageDialog(null, "Hello", "Title",
            JOptionPane.PLAIN_MESSAGE, new ImageIcon(imageLocation));
        System.exit(0);
    }
}
```

Then modify it to show a different greeting and image.

Programming Projects

Project 1.1 This project builds on Exercises P1.9 and P1.10. Your program should read the user's name, then show a sequence of two dialog boxes:

- First, an input dialog box that asks: "What would you like me to do?"
- Then a message dialog box that says: "I'm sorry, *your name*. I'm afraid I can't do that."

Answers to Self-Check Questions

1. A program that reads the data on the CD and sends output to the speakers and the screen.
2. A CD player can do one thing—play music CDs. It cannot execute programs.
3. No—the program simply executes the instruction sequences that the programmers have prepared in advance.
4. In secondary storage, typically a hard disk.
5. The central processing unit.
6. 21 100
7. No—a compiler is intended for programmers, to translate high-level programming instructions into machine code.
8. Safety and portability.
9. No one person can learn the entire library—it is too large.
10. `System.out.println("Hello,"); System.out.println("World!");`
11. Yes—the line starting with // is a comment, intended for human readers. The compiler ignores comments.
12. The printout is `My lucky number is12`. It would be a good idea to add a space after the `is`.
13. Yes, but you must remember to save your file as "plain text."
14. A sequence of random characters, some funny-looking. Class files contain virtual machine instructions that are encoded as binary numbers.
15. A compile-time error. The compiler will not know what to do with the word `Display`.
16. It is a run-time error. After all, the program had been compiled in order for you to run it.
17. When a program has compiler errors, no class file is produced, and there is nothing to run.
18. 4 years:
    0 10,000
    1 12,000
    2 14,400
    3 17,280
    4 20,736

19. Is the number of minutes at most 300?

   a. If so, the answer is $29.95 \times 1.125 = $33.70.

   b. If not,

      1. Compute the difference: (number of minutes) − 300.

      2. Multiply that difference by 0.45.

      3. Add $29.95.

      4. Multiply the total by 1.125. That is the answer.