*What's in a name? That which we call a rose
By any other name would smell as sweet.*
—William Shakespeare

*When faced with a decision, I always ask, "What
would be the most fun?"*
—Peggy Walker

*"Take some more tea," the March Hare said to Alice,
very earnestly. "I've had nothing yet," Alice replied in
an offended tone: "so I can't take more." "You mean
you can't take less," said the Hatter: "It's very easy to
take more than nothing."*
—Lewis Carroll

2

Introduction to Java Applications

Objectives

In this Chapter you'll learn:

- To write simple Java applications.
- To use input and output statements.
- Java's primitive types.
- Basic memory concepts.
- To use arithmetic operators.
- The precedence of arithmetic operators.
- To write decision-making statements.
- To use relational and equality operators.

Self-Review Exercises

2.1 Fill in the blanks in each of the following statements:

a) A(n) _____ begins the body of every method, and a(n) _____ ends the body of every method.

ANS: left brace ({), right brace (}).

b) The _____ statement is used to make decisions.

ANS: if.

c) _____ begins an end-of-line comment.

ANS: //.

d) _____, _____ and _____ are called white space.

ANS: Space characters, newlines and tabs.

e) _____ are reserved for use by Java.

ANS: Keywords.

f) Java applications begin execution at method _____.

ANS: main.

g) Methods _____, _____ and _____ display information in a command window.

ANS: System.out.print, System.out.println and System.out.printf.

2.2 State whether each of the following is *true* or *false*. If *false*, explain why.

a) Comments cause the computer to print the text after the // on the screen when the program executes.

ANS: False. Comments do not cause any action to be performed when the program executes. They are used to document programs and improve their readability.

b) All variables must be given a type when they are declared.

ANS: True.

c) Java considers the variables number and NuMbEr to be identical.

ANS: False. Java is case sensitive, so these variables are distinct.

d) The remainder operator (%) can be used only with integer operands.

ANS: False. The remainder operator can also be used with noninteger operands in Java.

e) The arithmetic operators *, /, %, + and - all have the same level of precedence.

ANS: False. The operators *, / and % are on the same level of precedence, and the operators + and - are on a lower level of precedence.

2.3 Write statements to accomplish each of the following tasks:

a) Declare variables c, thisIsAVariable, q76354 and number to be of type int.

ANS: `int c, thisIsAVariable, q76354, number;`
  or
  `int c;`
  `int thisIsAVariable;`
  `int q76354;`
  `int number;`

b) Prompt the user to enter an integer.

ANS: `System.out.print( "Enter an integer: " );`

c) Input an integer and assign the result to int variable value. Assume Scanner variable input can be used to read a value from the keyboard.

ANS: `value = input.nextInt();`

d) Print "This is a Java program" on one line in the command window. Use method System.out.println.

ANS: `System.out.println( "This is a Java program" );`

e) Print "This is a Java program" on two lines in the command window. The first line should end with Java. Use method System.out.println.

ANS: `System.out.println( "This is a Java\nprogram" );`

f) Print "This is a Java program" on two lines in the command window. The first line should end with Java. Use method System.out.printf and two %s format specifiers.

ANS: System.out.printf("%s\n%s\n", "This is a Java", "program");

g) If the variable number is not equal to 7, display "The variable number is not equal to 7".

ANS: if (number != 7)
            System.out.println("The variable number is not equal to 7");

2.4 Identify and correct the errors in each of the following statements:

a) if (c < 7);
        System.out.println "c is less than 7");

ANS: Error: Semicolon after the right parenthesis of the condition (c < 7) in the if.
            Correction: Remove the semicolon after the right parenthesis. [*Note:* As a result, the output statement will execute regardless of whether the condition in the if is true.]

b) if (c => 7)
        System.out.println("c is equal to or greater than 7");

ANS: Error: The relational operator => is incorrect. Correction: Change => to >=.

2.5 Write declarations, statements or comments that accomplish each of the following tasks:

a) State that a program will calculate the product of three integers.

ANS: // Calculate the product of three integers

b) Create a Scanner called input that reads values from the standard input.

ANS: Scanner input = new Scanner(System.in);

c) Declare the variables x, y, z and result to be of type int.

ANS: int x;
        int y;
        int z;
        int result;
        or
        int x, y, z, result;

d) Prompt the user to enter the first integer.

ANS: System.out.print("Enter first integer: ");

e) Read the first integer from the user and store it in the variable x.

ANS: x = input.nextInt();

f) Prompt the user to enter the second integer.

ANS: System.out.print("Enter second integer: ");

g) Read the second integer from the user and store it in the variable y.

ANS: y = input.nextInt();

h) Prompt the user to enter the third integer.

ANS: System.out.print("Enter third integer: ");

i) Read the third integer from the user and store it in the variable z.

ANS: z = input.nextInt();

j) Compute the product of the three integers contained in variables x, y and z, and assign the result to the variable result.

ANS: result = x * y * z;

k) Display the message "Product is" followed by the value of the variable result.

ANS: System.out.printf("Product is %d\n", result);

2.6   Using the statements you wrote in Exercise 2.5, write a complete program that calculates and prints the product of three integers.

     ANS: The solution to Self-Review Exercise 2.6 is as follows:

```java
1   // Ex. 2.6: Product.java
2   // Calculate the product of three integers.
3   import java.util.Scanner; // program uses Scanner
4
5   public class Product
6   {
7      public static void main( String[] args )
8      {
9         // create Scanner to obtain input from command window
10        Scanner input = new Scanner( System.in );
11
12        int x; // first number input by user
13        int y; // second number input by user
14        int z; // third number input by user
15        int result; // product of numbers
16
17        System.out.print( "Enter first integer: " ); // prompt for input
18        x = input.nextInt(); // read first integer
19
20        System.out.print( "Enter second integer: " ); // prompt for input
21        y = input.nextInt(); // read second integer
22
23        System.out.print( "Enter third integer: " ); // prompt for input
24        z = input.nextInt(); // read third integer
25
26        result = x * y * z; // calculate product of numbers
27
28        System.out.printf( "Product is %d\n", result );
29     } // end method main
30  } // end class Product
```

```
Enter first integer: 10
Enter second integer: 20
Enter third integer: 30
Product is 6000
```

Exercises

*NOTE: Solutions to the programming exercises are located in the **ch02solutions** folder. Each exercise has its own folder named **ex02_##** where ## is a two-digit number representing the exercise number. For example, exercise 2.14's solution is located in the folder **ex02_14**.*

2.7   Fill in the blanks in each of the following statements:

    a) _____ are used to document a program and improve its readability.

    ANS: Comments.

    b) A decision can be made in a Java program with a(n) _____.

    ANS: if statement.

    c) Calculations are normally performed by _____ statements.

    ANS: assignment statements.

    d) The arithmetic operators with the same precedence as multiplication are _____ and

    _____.

    ANS: division (/), remainder (%)

e) When parentheses in an arithmetic expression are nested, the _____ set of parentheses is evaluated first.

ANS: innermost.

f) A location in the computer's memory that may contain different values at various times throughout the execution of a program is called a(n) _____.

ANS: variable.

2.8 Write Java statements that accomplish each of the following tasks:

a) Display the message `"Enter an integer: "`, leaving the cursor on the same line.

ANS: `System.out.print( "Enter an integer: " );`

b) Assign the product of variables `b` and `c` to variable `a`.

ANS: `a = b * c;`

c) State that a program performs a sample payroll calculation (i.e., use text that helps to document a program).

ANS: `// This program performs a simple payroll calculation.`

2.9 State whether each of the following is *true* or *false*. If *false*, explain why.

a) Java operators are evaluated from left to right.

ANS: False. Some operators (e.g., assignment, =) evaluate from right to left.

b) The following are all valid variable names: `_under_bar_`, `m928134`, `t5`, `j7`, `her_sales$`, `his_$account_total`, `a`, `b$`, `c`, `z` and `z2`.

ANS: True.

c) A valid Java arithmetic expression with no parentheses is evaluated from left to right.

ANS: False. The expression is evaluated according to operator precedence.

d) The following are all invalid variable names: `3g`, `87`, `67h2`, `h22` and `2h`.

ANS: False. Identifier `h22` is a valid variable name.

2.10 Assuming that `x = 2` and `y = 3`, what does each of the following statements display?

a) `System.out.printf( "x = %d\n", x );`

ANS: `x = 2`

b) `System.out.printf( "Value of %d + %d is %d\n", x, x, ( x + x ) );`

ANS: `Value of 2 + 2 is 4`

c) `System.out.printf( "x =" );`

ANS: `x =`

d) `System.out.printf( "%d = %d\n", ( x + y ), ( y + x ) );`

ANS: `5 = 5`

2.11 Which of the following Java statements contain variables whose values are modified?

a) `p = i + j + k + 7;`

b) `System.out.println( "variables whose values are modified" );`

c) `System.out.println( "a = 5" );`

d) `value = input.nextInt();`

ANS: (a), (d).

2.12 Given that $y = ax^3 + 7$, which of the following are correct Java statements for this equation?

a) `y = a * x * x * x + 7;`

b) `y = a * x * x * ( x + 7 );`

c) `y = ( a * x ) * x * ( x + 7 );`

d) `y = ( a * x ) * x * x + 7;`

e) `y = a * ( x * x * x ) + 7;`

f) `y = a * x * ( x * x + 7 );`

ANS: (a), (d), (e)

2.13   State the order of evaluation of the operators in each of the following Java statements, and show the value of x after each statement is performed:

      a)   x = 7 + 3 * 6 / 2 - 1;

      ANS: *, /, +, -; Value of x is 15.

      b)   x = 2 % 2 + 2 * 2 - 2 / 2;

      ANS: %, *, /, +, -; Value of x is 3.

      c)   x = (3 * 9 * (3 + (9 * 3 / (3))));

      ANS: x = (3 * 9 * (3 + (9 * 3 / (3))));

                         4   5   3   1   2

          Value of x is 324.

2.19   What does the following code print?

```
System.out.println( "*\n**\n***\n****\n*****" );
```

ANS:

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

2.20   What does the following code print?

```
System.out.println( "*" );
System.out.println( "***" );
System.out.println( "*****" );
System.out.println( "****" );
System.out.println( "**" );
```

ANS:

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

2.21   What does the following code print?

```
System.out.print( "*" );
System.out.print( "***" );
System.out.print( "*****" );
System.out.print( "****" );
System.out.println( "**" );
```

ANS:

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

2.22 What does the following code print?

```
System.out.print( "*" );
System.out.println( "***" );
System.out.println( "*****" );
System.out.print( "****" );
System.out.println( "**" );
```

ANS:

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

2.23 What does the following code print?

```
System.out.printf( "%s\n%s\n%s\n", "*", "***", "*****" );
```

ANS:

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