# Elementary Programming

## 2.1 Introduction

You will learn elementary programming using Java **primitive** data types and related subjects, such as variables, constants, operators, expressions, and input and output.

## 2.2 Writing Simple Programs

Writing a program involves designing algorithms and data structures, as well as translating algorithms into programming code.

An ***Algorithm*** describes how a problem is solved in terms of the actions to be executed, and it specifies the order in which the actions should be executed.

Computing an area of a circle. The algorithm for this program can be described as follows:

1. Read in the Radius
2. Compute the area using the following formula Area = radius * radius * ∏
3. Display the area.

Java provides data types for representing integers, floating-point numbers, characters, and Boolean types. These types are known as ***primitive data types***.

When you *code*, you translate an algorithm into a **programming language** understood by the computer.

The outline of the program is:

```
// ComputeArea.Java: compute the area of a circle Comment

public class ComputeArea  // Class Name
{
   public static void main(String[] args)// Main Method signature
   {
      double radius; // Data type & variable double
      area;

      // Assign a radius
      radius = 20;

      // Compute area
      area = radius * radius * 3.14159; // Expression

      // Display results
      System.out.println("The area for the circle of radius " + radius + " is "
      + area);
   }
}
```

The program needs to **declare** a symbol called a variable that will represent the radius. **Variables** are used to store data and computational results in the program.

Use descriptive names rather than x and y. Use radius for radius, and area for area. Specify their data types to let the compiler know what radius and area are, indicating whether they are integer, float, or something else.

The program declares radius and area as double-precision variables. The reserved word **double** indicates that radius and area are double-precision floating-point values stored in the computer.

For the time being, we will assign a fixed number to radius in the program. Then, we will compute the area by assigning the expression radius * radius * 3.14159 to area.

The program‟s output is:

The area for the circle of radius 20.0 is 1256.636

A string constant should not cross lines in the source code. Use the **concatenation** operator

(+) to overcome such problem.

## 2.3 Reading Input from the Console

### Getting Input Using Scanner

Create a Scanner object

```
Scanner scanner = new Scanner(System.in);
```

Use the methods next( ), nextByte( ), nextShort( ), nextInt( ), nextLong( ), nextFloat( ), nextDouble( ), or nextBoolean( ) to obtain to a string, byte, short, int, long, float, double, or boolean value. For example,

```
System.out.print("Enter a double value: ");
Scanner scanner = new Scanner(System.in); double d = scanner.nextDouble( );
```

Listing 2.2 ComputeAreaWithConsoleInput.java

```
import java.util.Scanner; // Scanner is in the java.util package

public class ComputeAreaWithConsoleInput {
  public static void main(String[] args) {
    // Create a Scanner object
    Scanner input = new Scanner(System.in);

    // Prompt the user to enter a radius
    System.out.print("Enter a number for radius:"); double radius = input.nextDouble();

    // Compute area
    double area = radius * radius * 3.14159;

    // Display result
    System.out.println("The area for the circle of radius " + radius + " is "
      + area);
  }
}
```

```
Enter a number for radius: 23
The area for the circle of radius 23.0 is 1661.90111
```

## 2.4 Identifiers

Programming languages use special symbols called ***identifiers*** to name such programming entities as variables, constants, methods, classes, and packages.

The following are the rules for naming identifiers:

- An identifier is a sequence of characters that consist of **letters, digits, underscores (_), and dollar signs ($)**.
- An identifier must start with a letter, an underscore (_), or a dollar sign ($). It **cannot** start with a digit.
- An identifier cannot be a **reserved** word. (See Appendix A, "Java Keywords," for a list of reserved words).
- An identifier **cannot** be true, false, or null.
- An identifier can be of **any** length.

For example:

- Legal identifiers are for example: $2, ComputeArea, area, radius, and showMessageDialog.
- Illegal identifiers are for example: 2A, d+4.
- Since Java is **case-sensitive**, X and x are different identifiers.

## 2.5 Variables

Variables are used to **store** data in a program.

You can write the code shown below to compute the area for different radii:

```
// Compute the first area
radius = 1.0;
area = radius*radius*3.14159;
System.out.println("The area is " + area + " for radius "+radius);

// Compute the second area
radius = 2.0;
area = radius*radius*3.14159;
System.out.println("The area is " + area + " for radius "+radius);
```

## Declaring Variables

Variables are used for representing data of a certain **type**.

To use a variable, you declare it by telling the compiler the name of the variable as well as what type of data it represents. This is called variable **declaration**.

Declaring a variable tells the compiler to allocate appropriate memory space for the variable based on its data type. The following are examples of variable declarations:

```
int x;           // Declare x to be an integer variable;
double radius; // Declare radius to be a double variable;
char a;          // Declare a to be a character variable;
```

If variables are of the same type, they can be declared together using **short-hand** form:

```
Datatype var1, var2, …, varn;    variables are separated by commas
```

## 2.6 Assignment Statements and Assignments Expressions

After a variable is declared, you can assign a value to it by using an assignment statement. The syntax for assignment statement is:

**variable = expression;**

```
x = 1;                          // Assign 1 to x; Thus 1 = x is wrong
radius =  1.0;                  // Assign 1.0  to radius;
a = 'A';                        // Assign 'A' to a;
x = 5 * (3     / 2) + 3 * 2; // Assign the value of the expression to x;
x = y + 1;                      // Assign the addition of y and 1 to x;
```

The variable can also be used in the expression.

```
x = x + 1;          // the result of x + 1 is assigned to x;
```

To assign a value to a variable, the variable name must be on the **left** of the assignment operator.

1 = x would be wrong.

In Java, an assignment statement can also be treated as an expression that evaluates to the value being assigned to the variable on the left-hand side of the assignment operator. For this reason, an assignment statement is also known as an **assignment expression**, and the symbol = is referred to as the **assignment operator**.

System.out.println(x = 1); which

is equivalent to

```
x = 1;
System.out.println(x);
```

The following statment is also correct: i = j = k = 1;

which is equivalent to k = 1; j = k; i = j;

## Declaring and Initializing Variables in One Step

You can declare a variable and initialize it in one step.

```
int x = 1;
```

This is equivalent to the next two statements:

```
int x;
x = 1;
```

// shorthand form to declare and initialize vars of same type int i = 1, j = 2;

**Tip**: A variable must be declared **before** it can be assigned a value.

## 2.7 Named Constants

The value of a variable may change during the execution of the program, but a constant represents permanent data that **never** change.

The syntax for declaring a constant:

**final datatype CONSTANTNAME = VALUE;**

final double PI = 3.14159; // Declare a constant final int SIZE = 3;

A constant **must** be declared and initialized before it can be used. You **cannot** change a constant‟s value once it is declared. By convention, constants are named in **uppercase**.

```
// ComputeArea.Java: compute the area of a circle Comment

public class ComputeArea                // Class Name
{
  public static void main(String[] args) // Main Method signature
  {
    final double PI       = 3.14159;          // declare a constant
    double radius =       20;           // assign a radius

    // Compute area
    double area = radius * radius * PI; // Expression

    // Display results
    System.out.println("The area for the circle of radius " + radius + " is "
    + area);
  }
}
```

**Note:** There are three benefits of using constants:

- o You don’t have to **repeatedly** type the same value.
- o The value can be changed in a **single** location.
- o The program is easy to **read**.

## 2.8 Numerical Data Types and Operations

Every data type has a range of **values**. The compiler allocates memory space to store each variable or constant according to its data type.

Java has six numeric types: four for integers and two for floating-point numbers.

| *Name* | *Storage Size* | | *Range* |
|---|---|---|---|
| byte | 8 | bits | $-2^7$ (-128) to $2^7 - 1$ (127) |
| short | 16 | bits | $-2^{15}$ (-32768) to $2^{15} - 1$ (32767) |
| **int** | **32** | **bits** | $-2^{31}$ (-2147483648) to $2^{31} - 1$ (2147483647) |
| long | 64 | bits | $-2^{63}$ to $2^{63} - 1$ |
| **float** | **32** | **bits** | 6 – 7 significant digits of accuracy |
| double | 64 | bits | 14 – 15 significant digits of accuracy |

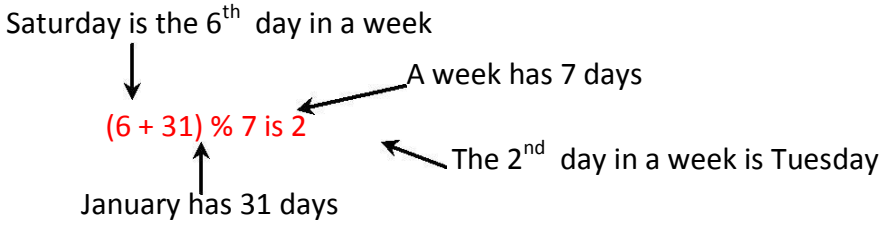
### 2.8.1 Numerical Operators

+, -, *, /, and %

| | | |
|---|---|---|
| 5/2 | yields an integer | 2 |
| 5.0/2 | yields a double value | 2.5 |
| -5/2 | yields an integer value | -2 |
| -5.0/2 | yields a double value | -2.5 |

| | | |
|---|---|---|
| 5 % 2 | yields 1 (the remainder of the division.) | |
| -7 % 3 | yields | -1 |
| -12 % 4 | yields | 0 |
| -26 % -8 | yields | -2 |
| 20 % -13 | yields | 7 |

**Remainder** is very useful in programming. For example, an even number % 2 is always 0 and an odd number % 2 is always 1. So you can use this property to determine whether a number is even or odd. Suppose you know January 1, 2005 is **Saturday**, you can find that the day for February 1, 2005 is Tuesday using the following expression:



LISTING 2.4 DisplayTime.java

```
import java.util.Scanner;

public class DisplayTime {
   public static void main(String[] args) { Scanner
      input = new Scanner(System.in); // Prompt the
      user for input
      System.out.print("Enter an integer for seconds: ");
      int seconds = input.nextInt();

      int minutes = seconds / 60; // Find minutes in seconds int
      remainingSeconds = seconds % 60; // Seconds remaining
      System.out.println(seconds + " seconds is " + minutes +
         " minutes and " + remainingSeconds + " seconds");
  }
}
```

```
Enter an integer for seconds: 500
500 seconds is 8 minutes and 20 seconds
```

A unary operator has only **one** operand. A binary operator has **two** operands.

- **NOTE**

Calculations involving floating-point numbers are **approximated** because these numbers are not stored with complete accuracy. For example,

```
System.out.println(1 - 0.1 - 0.1 - 0.1 - 0.1 - 0.1);
```

displays 0.5000000000000001, not 0.5, and

```
System.out.println(1.0 - 0.9);
```

displays 0.09999999999999998, not 0.1.

Integers are stored **precisely**. Therefore, calculations with integers yield a precise integer result.

### 2.8.2 Numeric Literals

A literal is a **constant** value that appears directly in a program. For example, 34, 1,000,000, and 5.0 are literals in the following statements:

```
int i = 34;
long l = 1000000;
double d = 5.0;
```

#### Integer Literals

An integer literal can be assigned to an integer variable as long as it can **fit** into the variable. A compilation error would occur if the literal were too large for the variable to hold.

For example, the statement byte b = 1000 would cause a **compilation** error, because 1000 cannot be stored in a variable of the byte type.

An integer literal is assumed to be of the **int** type, whose value is between $-2^{31}$ (-2147483648) to $2^{31}-1$ (2147483647).

To denote an integer literal of the long type, append it with the letter L or l (lowercase L). For example, the following code display the decimal value 65535 for hexadecimal number FFFF.

```
System.out.println(0xFFFF);
```

#### Floating-Point Literals

Floating-point literals are written with a decimal point. By **default**, a floating-point literal is treated as a **double** type value.

For example, 5.0 is considered a double value, not a float value.

You can make a number a float by appending the letter f or F, and make a number a double by appending the letter d or D.

For example, you can use 100.2f or 100.2F for a float number, and 100.2d or 100.2D for a double number.

The double type values are **more accurate** than float type values.

```
System.out.println("1.0 / 3.0 is " + 1.0 / 3.0);
```

displays 1.0 / 3.0 is 0.3333333333333333

```
System.out.println("1.0F / 3.0F is " + 1.0F / 3.0F);
```

displays 1.0F / 3.0F is 0.33333334

#### Scientific Notations

Floating-point literals can also be specified in scientific notation; for example,

1.23456e+2, same as 1.23456e2, is equivalent to 123.456, and 1.23456e-2 is equivalent to 0.0123456. E (or e) represents an exponent and it can be either in lowercase or uppercase.

### 2.8.3 Evaluating Java Expressions

For example, the arithmetic expression

$$\frac{3+4x}{5} - \frac{10(y-5)(a+b+c)}{x} + 9\left(\frac{4}{x} + \frac{9+x}{y}\right)$$

can be translated into a Java expression as:

```
(3 + 4 * x)/5 – 10 * (y - 5)*(a + b + c)/x + 9 *(4 / x + (9 + x)/y)
```

Operators contained within pairs of **parentheses** are evaluated first.

Parentheses can be **nested**, in which case the expression in the **inner** parentheses is evaluated first.

Multiplication, division, and remainder operators are applied next. Order of operation is applied from left to right. Addition and subtraction are applied last.

LISTING 2.5 FahrenheitToCelsius.java

```
import java.util.Scanner;

public class FahrenheitToCelsius {
   public static void main(String[] args) { Scanner
      input = new Scanner(System.in);

      System.out.print("Enter a degree in Fahrenheit: "); double
      fahrenheit = input.nextDouble();

      // Convert Fahrenheit to Celsius
      double celsius = (5.0 / 9) * (fahrenheit - 32);
      System.out.println("Fahrenheit " + fahrenheit + " is " +
         celsius + " in Celsius");
   }
}
```

```
Enter a degree in Fahrenheit: 100
Fahrenheit 100.0 is 37.77777777777778 in Celsius
```

## 2.9 Problem: Displaying the Current Time

Write a program that displays current time in GMT (Greenwich Mean Time) in the format hour:minute:second such as 1:45:19.

The **currentTimeMillis** method in the System class returns the current time in milliseconds since the midnight, **January 1, 1970 GMT**. (1970 was the year when the Unix operating system was formally introduced.) You can use this method to obtain the current time, and then compute the current second, minute, and hour as follows.

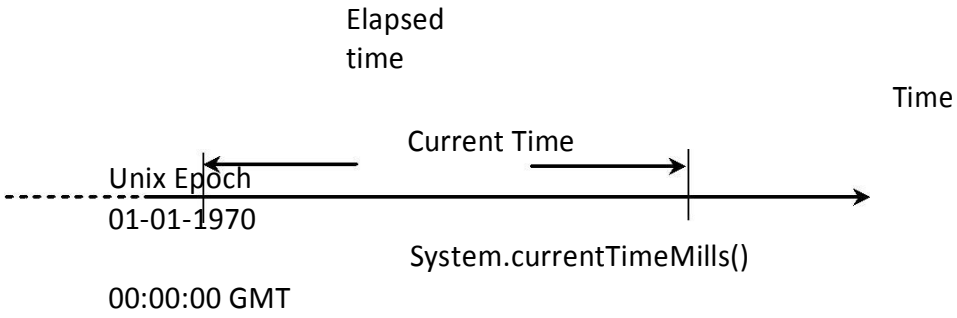



FIGURE 2.2 The System.currentTimeMillis() return the number of milliseconds since the Unix epoch.

Listing 2.6 ShowCurrentTime.java

```
public class ShowCurrentTime {
  public static void main(String[] args) {
    // Obtain the total milliseconds since midnight, Jan 1, 1970 long
    totalMilliseconds = System.currentTimeMillis();

    // Obtain the total seconds since midnight, Jan 1, 1970
    long totalSeconds = totalMilliseconds / 1000;

    // Compute the current second in the minute in the hour long
    currentSecond = (int)(totalSeconds % 60);

    // Obtain the total minutes
    long totalMinutes = totalSeconds / 60;

    // Compute the current minute in the hour
    long currentMinute = (int)(totalMinutes % 60);

    // Obtain the total hours
    long totalHours = totalMinutes / 60;

    // Compute the current hour
    long currentHour = (int)(totalHours % 24);

    // Display results
    System.out.println("Current time is " + currentHour + ":" +
      currentMinute + ":" + currentSecond + " GMT");
  }
```

```
}
```

Current time is 17:31:26 GMT

## 2.10 Shorthand Operators

**Table 2.4 Shorthand Operators**

| *Operator* | *Example* | *Equivalent* |
|---|---|---|
| += | i+=8 | i = i+8 |
| -= | f-=8.0 | f = f-8.0 |
| *= | i*=8 | i = i*8 |
| /= | i/=8 | i = i/8 |
| %= | i%=8 | i = i%8 |

There are two more shortcut operators for incrementing and decrementing a variable by 1. These two operators are ++, and --. They can be used in prefix or suffix notations.

suffix → x++; // Same as x = x + 1;

prefix → ++x; // Same as x = x + 1;

suffix → x—; // Same as x = x - 1;

prefix → —x; // Same as x = x - 1;

**Table 2.5 Increment and Decrement Operators**

| *Operator* | *Name* | *Description* |
|---|---|---|
| ++var | preincrement | The expression (++var) increments var by 1 and evaluates to the ***new*** value in var ***after*** the increment. |
| var++ | postincrement | The expression (var++) evaluates to the *original* value in var and increments var by 1. |
| --var | predecrement | The expression (--var) decrements var by 1 and evaluates to the *new* value in var *after* the decrement. |
| var-- | postdecrement | The expression (var--) evaluates to the *original* value in var and decrements var by 1. |

```
int i = 10;
int newNum = 10 * i++;
```

Same effect as

```
int newNum = 10 * i;
i = i + 1;
```

```
int i = 10;
int newNum = 10 * (++i);
```

Same effect as

```
i = i + 1;
int newNum = 10 * i;
```

Ex:

```
double x = 1.0;
```

```
double y = 5.0;
double z = x-- + (++y);
```

After execution, y = 6.0, **z = 7.0**, and x = 0.0;

Using increment and decrement operators make expressions short; it also makes them complex and difficult to read.

## 2.11 Numeric Type Conversions

Consider the following statements:

```
byte i = 100; long
k = i*3+4;
double d = i*3.1+k/2;
```

Are these statements correct?

When performing a binary operation involving two operands of different types, Java **automatically** converts the operand based on the following rules:

1. If one of the operands is double, the other is converted into double.
2. Otherwise, if one of the operands is float, the other is converted into float.
3. Otherwise, if one of the operands is long, the other is converted into long.
4. Otherwise, both operands are converted into int.

Thus the result of 1 / 2 is **0**, and the result of 1.0 / 2 is **0.5**.

**Type Casting** is an operation that converts a value of one data type into a value of another data type.

Casting a variable of a type with a small range to variable with a larger range is known as **widening** a type. Widening a type can be performed **automatically** without explicit casting. Casting a variable of a type with a large range to variable with a smaller range is known as **narrowing** a type. Narrowing a type must be performed **explicitly**.

**Caution:** Casting is necessary if you are assigning a value to a variable of a smaller type range. A compilation **error** will occur if casting is not used in situations of this kind. Be careful when using casting. **Lost** information might lead to inaccurate results.

```
float f = (float) 10.1; int i =
(int) f;
```

```
double d = 4.5;
int i =(int)d;              // d is     not  changed
System.out.println("d " +        d +   " i " +      i); // answer is d 4.5 i 4
```

**Implicit casting**

```
double d = 3;           // type widening
```

**Explicit casting**

```
int i = (int)3.0; // type narrowing
```

What is wrong?

```
int i = 1;
byte b = i;             // Error because explicit casting is required
```

## 2.12 Problem: Computing Loan Payments

This program lets the user enter the interest rate, number of years, and loan amount and computes monthly payment and total payment.

$$monthlyPayment = \frac{loanAmount \times monthlyInterestRate}{1 - \frac{1}{(1 + monthlyInterestRate)^{numberOfYears \times 12}}}$$

LISTING 2.8 ComputeLoan.java

```
import java.util.Scanner;

public class ComputeLoan {
  public static void main(String[] args) { // Create a
    Scanner
    Scanner input = new Scanner(System.in);

    // Enter yearly interest rate
    System.out.print("Enter yearly interest rate, for example 8.25: ");
    double annualInterestRate = input.nextDouble();

    // Obtain monthly interest rate
    double monthlyInterestRate = annualInterestRate / 1200;

   // Enter number of years
    System.out.print(
      "Enter number of years as an integer, for example 5: ");
      int numberOfYears = input.nextInt();

    // Enter loan amount
    System.out.print("Enter loan amount, for example 120000.95: ");
    double loanAmount = input.nextDouble();

    // Calculate payment
    double monthlyPayment = loanAmount * monthlyInterestRate / (1
      - 1 / Math.pow(1 + monthlyInterestRate, numberOfYears * 12));

      double totalPayment = monthlyPayment * numberOfYears * 12;


    // Display results
    System.out.println("The monthly payment is " + (int)(monthlyPayment * 100) /
      100.0);
    System.out.println("The total payment is " + (int)(totalPayment * 100) / 100.0);
  }
}
```

```
Enter yearly interest rate, for example 8.25: 5.75
Enter number of years as an integer, for example 5: 15
Enter loan amount, for example 120000.95: 250000
The monthly payment is 2076.02
The total payment is 373684.53
```

## 2.13 Character Data Type and Operations

The character data type, char, is used to represent a single character.

A character literal is enclosed in **single** quotation marks.

```
char   letter = 'A';          //    Assigns    A to char variable letter (ASCII)
char   numChar = '4';         //    Assigns    numeric character 4 to numChar (ASCII)
```

**Caution:** A string literal must be enclosed in quotation marks. A character literal is a single chaaracter enclosed in single quotation marks. So **"A" is a string, and „A‟ is a character**.

### 2.13.1 Unicode and ASCII code

Java uses Unicode, a **16-bit** encoding scheme established by the Unicode Consortium to support the interchange, processing, and display of written texts in the world‟s diverse languages (See the Unicdoe Web sit at www.unicode.org for more information.)

Unicode takes **two** bytes, precoded by \u, expressed in four hexdecimal digits that run from

„\u0000‟ to „\uFFFF‟. For example, the "coffee" is translated into Chinese using two characters. The Unicode of these two characters are "\u5496\u5561".

```
char letter = '\u0041'; (Unicode  16-bit encoding scheme) char
numChar = '\u0034'; (Unicode)
```

Unicode can represent 65,536 characters, since FFFF in hexdecimal is 65535.

Most computer ASCII (American Standard Code for Information Interchange), a **7-bit** encoding scheme for reprsenting all uppercase and lowcase letter, digits, puctuation marks, and control characters.

Unicode includes ASCII code with „\u0000‟ to „\u007F‟ corresponding to **128** ASCII characters. (See Appendix B).

**Note:** The increment and decrement operators can also be used on char variables to get the next or preceding Unicode character.

For example, the following statements display character **b**:

```
char        ch        =        'a';
System.out.println(++ch);
```

TABLE B.1 ASCII Character Set in the Decimal Index

| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | nul | soh | stx | etx | eot | enq | ack | bel | bs | ht |
| 1 | nl | vt | ff | cr | so | si | dle | dcl | dc2 | dc3 |
| 2 | dc4 | nak | syn | etb | can | em | sub | esc | fs | gs |
| 3 | rs | us | sp | ! | " | # | $ | % | & | ' |
| 4 | ( | ) | * | + | , | - | . | / | 0 | 1 |
| 5 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | : | ; |
| 6 | < | = | > | ? | @ | A | B | C | D | E |
| 7 | F | G | H | I | J | K | L | M | N | O |
| 8 | P | Q | R | S | T | U | V | W | X | Y |
| 9 | Z | [ | \ | ] | ^ | _ | ` | a | b | c |
| 10 | d | e | f | g | h | i | j | k | l | m |
| 11 | n | o | p | q | r | s | t | u | v | w |
| 12 | x | y | z | { | \| | } | ~ | del | | |

### 2.13.2 Escape Sequences for Special Characters

| *Description* | *Escape Sequence* | *Unicode* |
|---|---|---|
| Backspace | \b | \u0008 |
| Tab | \t | \u0009 |
| Linefeed | \n | \u000A |
| Carriage return | \r | \u000D |
| Backslash | \\ | \u005C |
| Single Quote | \' | \u0027 |
| Double Quote | \" | \u0022 |

Suppose you want to print the **quoted** message show below:

He said “Java is fun”

Here is how to write the statement:

```
System.out.println(“He said \”Java is fun\””);
```

### 2.13.3 Casting between char and Numeric Types

A char can be cast into **any** numeric type, and vice versa.

Implicit casting can be used if the result of a casting **fits** into the target variable. Otherwise expicit casting must be used.

**All** numeric operation can be applied to the char operands.

The char operand is cast into a number if the other operand is a number or a character. If the other operand is a string, the character is concatenated with the

string.

```
int i = 'a'; // Same as int i = (int)'a'; // (int) a is 97

char c = 99; // Same as char c = (char)99;

int i = '1' + '2';// (int) 1 is 49 and (int) 2 is 50
System.out.println("i is " + i);

int j = 1 + 'a'; // (int) a is 97
System.out.println("j is " + 98);
System.out.println(j + " is the Unicode for character " + (char) j);
System.out.println("Chapter " + 2);
```

Output is:

```
i is 99 j
is 98
98 is the Unicode for character b
Chapter 2
```

## 2.15 The String Type

The char type only represents **one character**. To represent a string of **characters**, use the data type called String. For example,

```
String message = "Welcome to Java";
```

String is actually a **predefined class** in the Java library just like the System class and JOptionPane class.

The String type is not a **primitive** type. It is known as a **reference** type. Any Java class can be used as a reference type for a variable.

Reference data types will be thoroughly discussed in Chapter 6, “Classes and Objects.” For the time being, you just need to know how to declare a String variable, how to assign a string to the variable, and how to concatenate strings.

## String Concatenation

The plus sign (+) is the **concatenation** operator if one of the operands is a string.

If one of the operands is a non-string (e.g. a number), the non-string value is **converted** into a string and concatenated with the other string.

```
// Three strings are concatenated
String message = "Welcome " + "to " + "Java";
message += " and Java is fun"; // message = Welcome to Java and Java is fun


// String Chapter is concatenated with number 2
String s = "Chapter" + 2;                // s becomes Chapter2

 // String Supplement is concatenated with character B String s1 =
"Supplement" + 'B'; // s becomes SupplementB


i = 1; j = 3;
System.out.println("i + j is " + i + j); i + j is 13 System.out.println("i +
j is " + (i + j)); i + j is 4
```

## 2.16 Programming Style and Documentation

Programming Style deals with what programs look like.

Documentation is the body of explanatory remarks and comments pertaining to a program. Programming style and documentation are as important as coding. They make the programs easy to read.

### 2.16.1 Appropriate Comments and Comments Style

Include a summary at the beginning of the program to explain what the program does, its key features, its supporting data structures, and unique techniques it uses.

In a long program, you should also include comments that introduce each major step and explain anything that is difficult to read.

Make your comments concise to they do not crowd the program or make it difficult to read. Include your **name**, **class section**, **date**, **instruction**, and a brief **description** at the beginning of the program.

### 2.16.2 Naming Conventions

Use **lowercase** for variables and methods. If a name consists of several words, concatenate all in one, use lowercase for the first word, and **capitalize** the first letter of each subsequent word in the name. Ex: showInputDialog.

Choose **meaningful** and descriptive names. For example, the variables radius and area, and the method computeArea.

**Capitalize** the first letter of each word in the **class** name. For example, the class name ComputeArea.

Capitalize all letters in **constants**. For example, the constant PI.

Do **not** use class names that are already used in Java library. For example, the constants PI and MAX_VALUE.

### 2.16.3 Proper Indentation and Spacing Lines

**Indentation** is used to illustrate the structural relationships between program‟s components or statements.

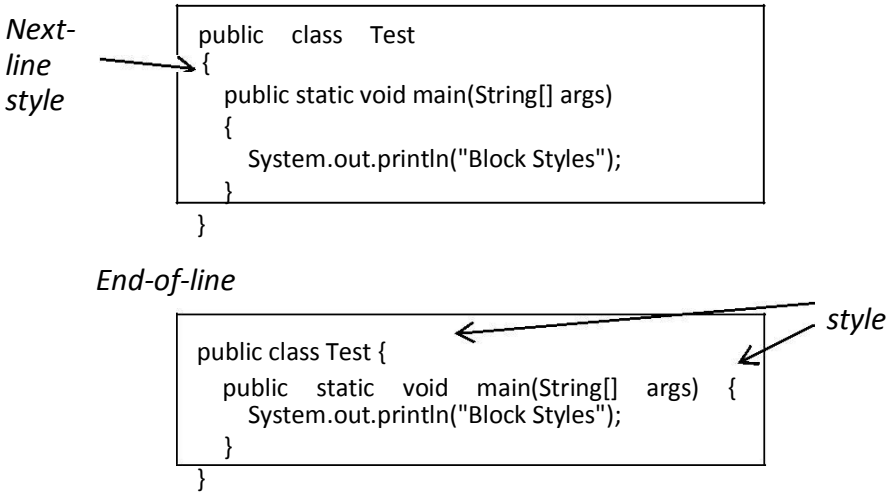
Indent two spaces in each subcomponent more than the structure which it is nested. Use a single space on both sides of a binary operator.

```
boolean b = 3 + 4 * 4 > 5 * (4 + 3)
```

Use a blank line to separate segments of the code.

### 2.16.4 Block Styles

A block is a group of statements surrounded by braces. Use end-of-line style for braces or next-line style.



## 2.17 Programming Errors

### 2.17.1 Syntax Errors "Compilation Error"

Errors that occur during **compilation** are called **syntax errors** or **compilation errors**.

Syntax errors result from errors in code construction, such as mistyping a keyword, omitting some necessary punctuation, or using an opening brace without a corresponding closing brace.

These errors are easily detected, because the compiler tells you where they are and the reasons for them.

```
public class ShowSyntaxErrors {
   public static void main(String[] args) { i = 30;
      System.out.println(i+4);
   }
}
```

### 2.17.2 Runtime Errors

Runtime errors are erros that cause a program to terminate **abnormally**.

Runtime errors occur while an application is running where the environment detects an operation that is impossible to carry out.

For instance, an input error occurs when the user enters an unexpected input value that the program can‟t handle. To prevent input errors, the program should prompt the user to enter the correct type of values.

Another example of a run time error is division by zero.

```
public class ShowRuntimeErrors {
   public static void main(String[] args) { int i = 1 / 0;
   }
}
```

### 2.17.3 Logic Errors

Logic errors occur when a program **doesn't** perform the way it was intended to.

For example, the program doesn't have syntax or runtime errors, but it does not print the correct result.

```
//  ShowLogicErrors.java: The program contains a logic error
//  Suppose you wrote the following program to add number1 to number2
public class ShowLogicErrors {
   public static void main(String[] args) {
     // Add number1 to number2
     int number1 = 3;
     int number2 = 3;
     number2 += number1 + number2;
     System.out.println("number2 is " + number2);
   }
}
```

### 2.17.4 Debugging

- Finding logic errors "***bugs***" is challenging and the process of finding and correcting errors is called ***debugging***.
- You can ***hand-trace*** the program or you can insert print statements in order to show the values of the variables or the execution flow of the program.
- For a large, complex program, the most effective approach for debugging is to use a debugger **utility**.

### 2.18.1 Converting String to Numbers

#### Converting Strings to Integers

The input returned from the input dialog box is a **string**. If you enter a numeric value such as

123, it returns "123". To obtain the input as a number, you have to convert a string into a number.

To convert a string into an **int** value, you can use the **static parseInt** method in the **Integer** class as follows:

```
int intValue = Integer.parseInt(intString);
```

where intString is a numeric string such as "123".

#### Converting Strings to Doubles

To convert a string into a **double** value, you can use the **static parseDouble** method in the **Double** class as follows:

```
double doubleValue = Double.parseDouble(doubleString);
```

where doubleString is a numeric string such as "123.45"