JAVA™ PROGRAMMING

Chapter 1: Creating Java Programs

Objectives

- Define basic programming terminology
- Compare procedural and object-oriented programming
- Describe the features of the Java programming language
- Analyze a Java application that produces console output

Objectives (cont'd.)

- Compile a Java class and correct syntax errors
- Run a Java application and correct logic errors
- Add comments to a Java class
- Create a Java application that produces GUI output
- Find help

Learning Programming Terminology

- **Computer program**
  - A set of written instructions that tells the computer what to do
- **Machine language**
  - The most basic circuitry-level language
  - A **low-level programming language**

Learning Programming Terminology (cont'd.)

- **High-level programming language**
  - Allows you to use a vocabulary of reasonable terms
- **Syntax**
  - A specific set of rules for the language
- **Program statements**
  - Similar to English sentences
  - **Commands** to carry out program tasks

Learning Programming Terminology (cont'd.)

- **Compiler** or **interpreter**
  - Translates language statements into machine code
- **Syntax error**
  - Misuse of language rules
  - A misspelled programming language word
- **Debugging**
  - Freeing program of all errors
- **Logic errors**
  - Also called **semantic errors**
  - Incorrect order or procedure
  - The program may run but provide inaccurate output

Comparing Procedural and Object-Oriented Programming Concepts

- **Procedural programming**
  - Sets of operations executed in sequence
  - **Variables**
    - Named computer memory locations that hold values
  - **Procedures**
    - Individual operations grouped into logical units
- **Object-oriented programs**
  - Create classes
    - Blueprints for an object
  - Create objects from classes
  - Create applications

Comparing Procedural and Object-Oriented Programming Concepts (cont'd.)

- Object-oriented programming was used most frequently for two major types of applications
  - **Computer simulations**
  - **Graphical user interfaces (GUIs)**
    - Not all object-oriented programs are written to use a GUI
- Object-oriented programming differs from traditional procedural programming
    - Polymorphism
    - Inheritance
    - Encapsulation

Understanding Classes, Objects, and Encapsulation

- **Class**
  - Describes objects with common properties
  - A definition
  - An instance
- **Attributes**
  - Characteristics that define an object
  - Differentiate objects of the same class
  - The value of attributes is an object's **state**
- **Objects**
  - Specific, concrete **instances** of a class

Understanding Classes, Objects, and Encapsulation (cont'd.)

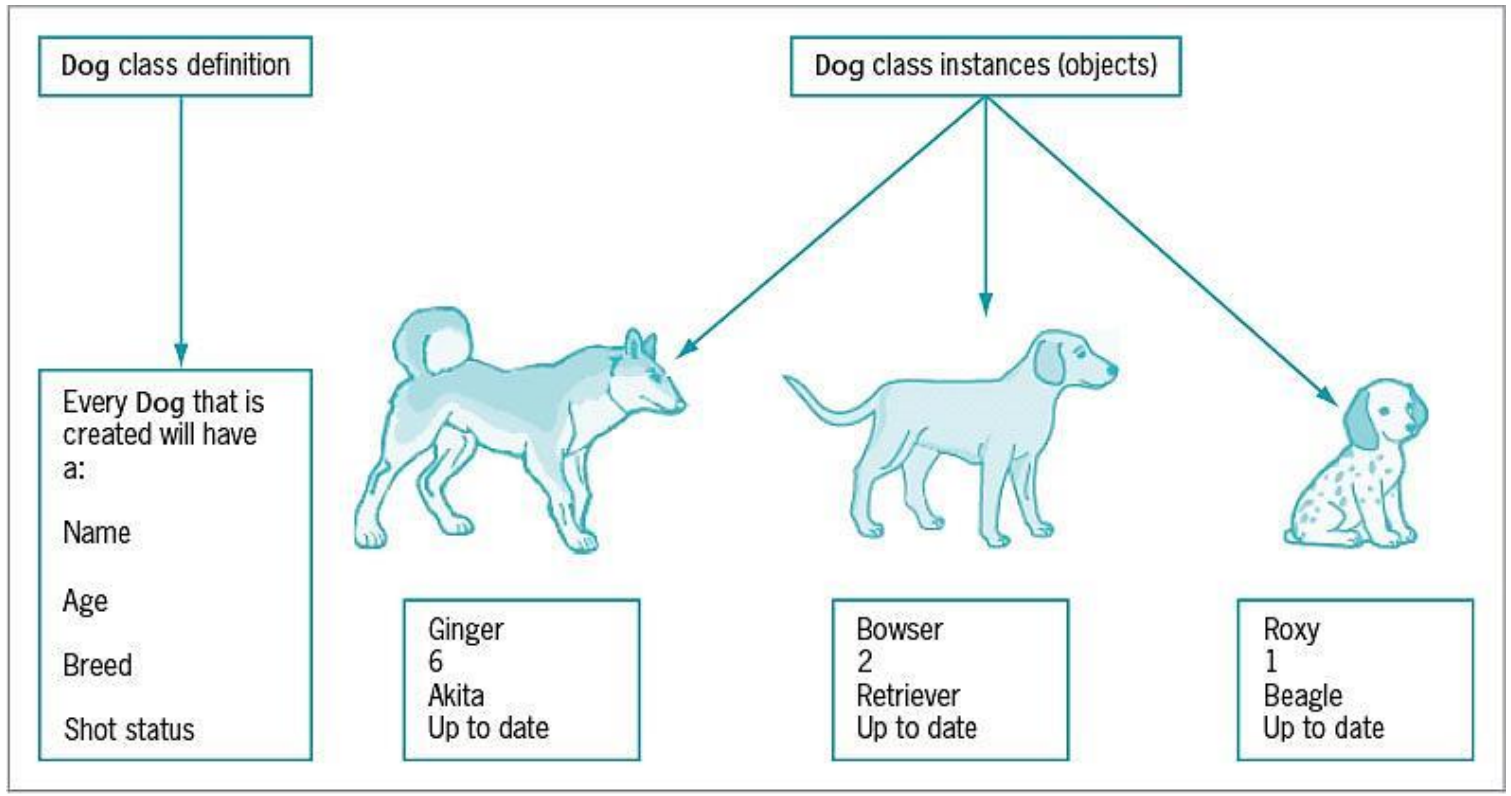


Figure 1-2 Dog class definition and some objects created from it

Understanding Classes, Objects, and Encapsulation (cont'd.)

- **Method**
  - A self-contained block of program code that carries out an action
  - Similar to a procedure
- **Encapsulation**
  - Conceals internal values and methods from outside sources
  - Provides security
  - Keeps data and methods safe from inadvertent changes

Understanding Inheritance and Polymorphism

- **Inheritance**
  - An important feature of object-oriented programs
  - Classes share attributes and methods of existing classes but with more specific features
  - Helps you understand real-world objects
- **Polymorphism**
  - Means “many forms”
  - Allows the same word to be interpreted correctly in different situations based on context

Features of the Java Programming Language

- **Java**
  - Developed by Sun Microsystems
  - An object-oriented language
  - General-purpose
  - Advantages
    - Security features
    - **Architecturally neutral**

Features of the Java Programming Language (cont'd.)

- **Java** (cont'd.)
  - Can be run on a wide variety of computers
  - Does not execute instructions on the computer directly
  - Runs on a hypothetical computer known as a **Java Virtual Machine (JVM)**
- **Source code**
  - Programming statements written in high-level programming language

Features of the Java Programming Language (cont'd.)

- **Development environment**
  - A set of tools used to write programs
- **Bytecode**
  - Statements saved in a file
  - A binary program into which the Java compiler converts source code
- **Java interpreter**
  - Checks bytecode and communicates with the operating system
  - Executes bytecode instructions line by line within the Java Virtual Machine

Features of the Java Programming Language (cont'd.)

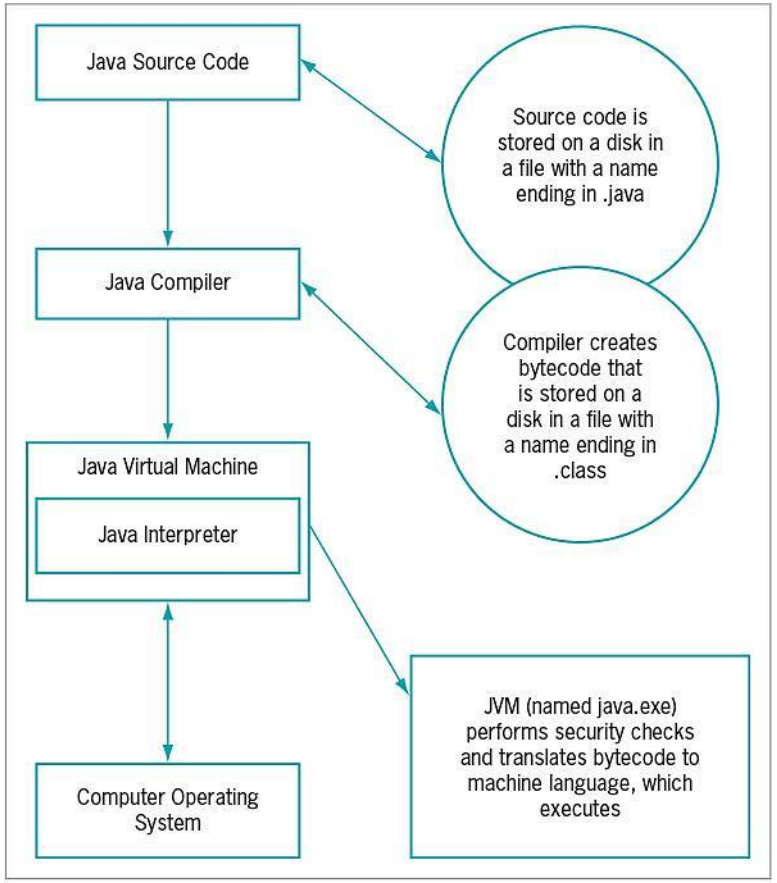


Figure 1-3 The Java environment

Java Program Types

- **Java applications**
  - Called Java stand-alone programs
  - **Console applications**
    - Support character output
  - **Windowed applications**
    - Menus
    - Toolbars
    - Dialog boxes

Analyzing a Java Application that Produces Console Output

- Even the simplest Java application involves a fair amount of confusing syntax
- Print “First Java application” on the screen

Analyzing a Java Application that Produces Console Output (cont'd.)

```
public class First
{
   public static void main(String[] args)
   {
      System.out.println("First Java application");
   }
}
```

Figure 1-4 The First class

Understanding the Statement that Produces the Output

- **Literal string**
  - Will appear in output exactly as entered
  - Written between double quotation marks
- **Arguments**
  - Pieces of information passed to a method
- Method
  - Requires information to perform its task
- `System` class
  - Refers to the standard output device for a system

Understanding the Statement that Produces the Output (cont'd.)

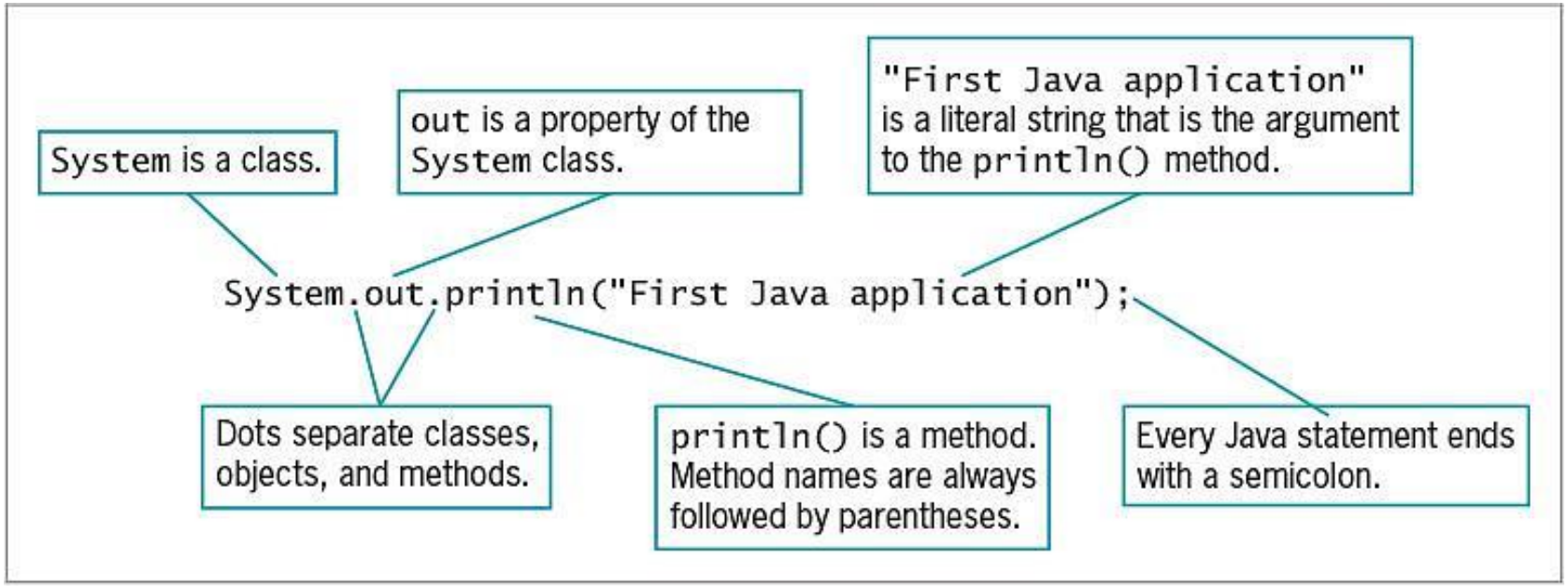


Figure 1-5 Anatomy of a Java statement

Understanding the `First` Class

- Everything used within a Java program must be part of a class
- Define a Java class using any name or **identifier**
- Requirements for identifiers
  - Must begin with one of the following:
    - Letter of the English alphabet
    - Non-English letter (such as α or π)
    - Underscore
    - Dollar sign
  - Cannot begin with a digit

Understanding the `First` Class (cont'd.)

- Requirements for identifiers (cont'd.)
  - Can only contain:
    - Letters
    - Digits
    - Underscores
    - Dollar signs
  - Cannot be a Java reserved keyword
  - Cannot be `true`, `false`, or `null`
- **Access specifier**
  - Defines how a class can be accessed

Understanding the `First` Class (cont'd.)

abstract	continue	for	new	switch
assert	default	goto	package	synchronized
boolean	do	if	private	this
break	double	implements	protected	throw
byte	else	import	public	throws
case	enum	instanceof	return	transient
catch	extends	int	short	try
char	final	interface	static	void
class	finally	long	strictfp	volatile
const	float	native	super	while

Table 1-1 Java reserved keywords

Understanding the `First` Class (cont'd.)

Class Name	Description
`Undergradstudent`	New words are not indicated with initial uppercase letters, making this identifier difficult to read
`Inventory_Item`	Underscore is not commonly used to indicate new words
`BUDGET2012`	Using all uppercase letters for class identifiers is not conventional
`budget2012`	Conventionally, class names do not begin with a lowercase letter

Table 1-3 Legal but unconventional and nonrecommended class names in Java

Understanding the `First` Class (cont'd.)

Class Name	Description
`Inventory Item`	Space character is illegal in an identifier
`class`	`class` is a reserved word
`2016Budget`	Class names cannot begin with a digit
`phone#`	The number symbol (#) is illegal in an identifier

Table 1-4 Some illegal class names in Java

Understanding the `First` Class (cont'd.)

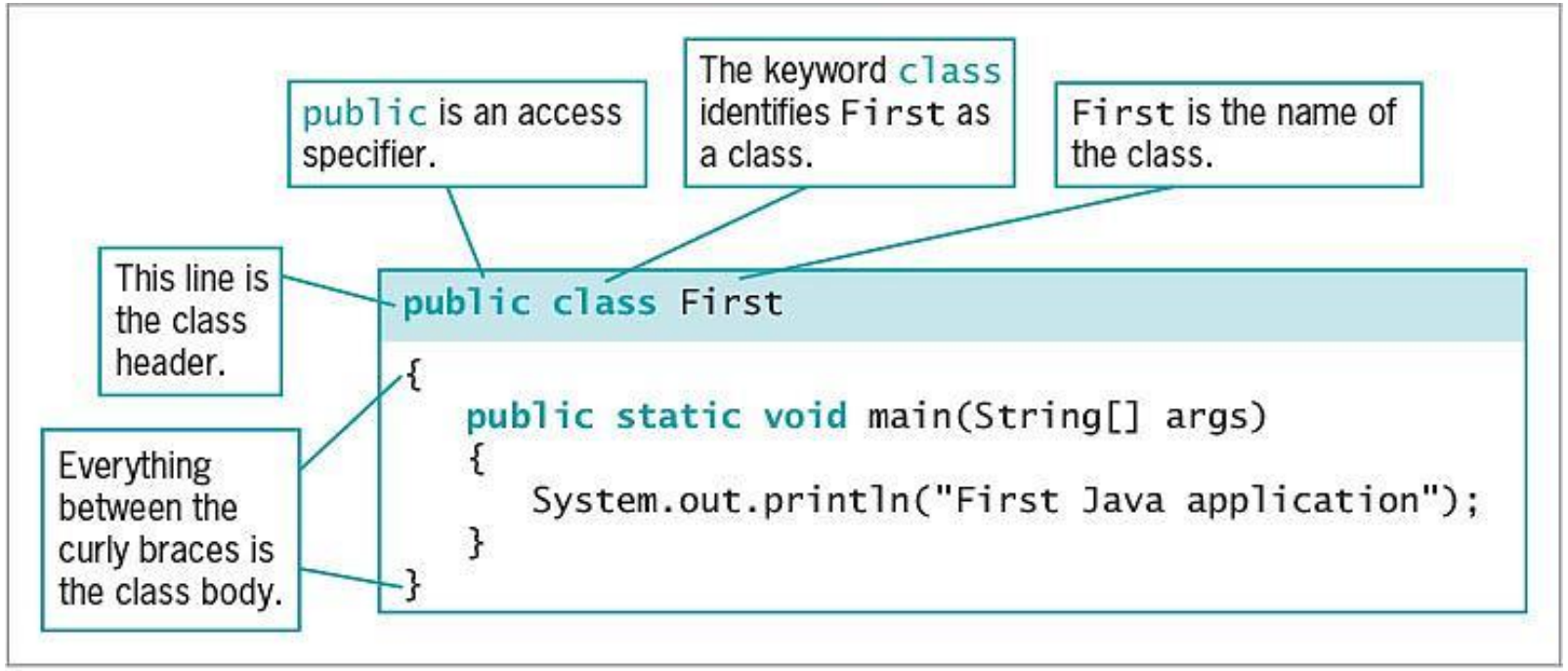


Figure 1-6 The parts of a typical class

Indent Style

- Use **whitespace** to organize code and improve readability
- For every opening curly brace ({) in a Java program, there must be a corresponding closing curly brace

  (})
- Placement of the opening and closing curly braces is not important to the compiler
- **Allman style** used in text

Understanding the `main()` Method

- **`static`**
  - A reserved keyword
  - Means the method is accessible and usable even though no objects of the class exist
- **`void`**
  - Use in the `main()` method header
  - Does not indicate the `main()` method is empty
  - Indicates the `main()` method does not return a value when called
  - Does not mean that `main()` doesn't produce output

Understanding the `main()` Method (cont'd.)

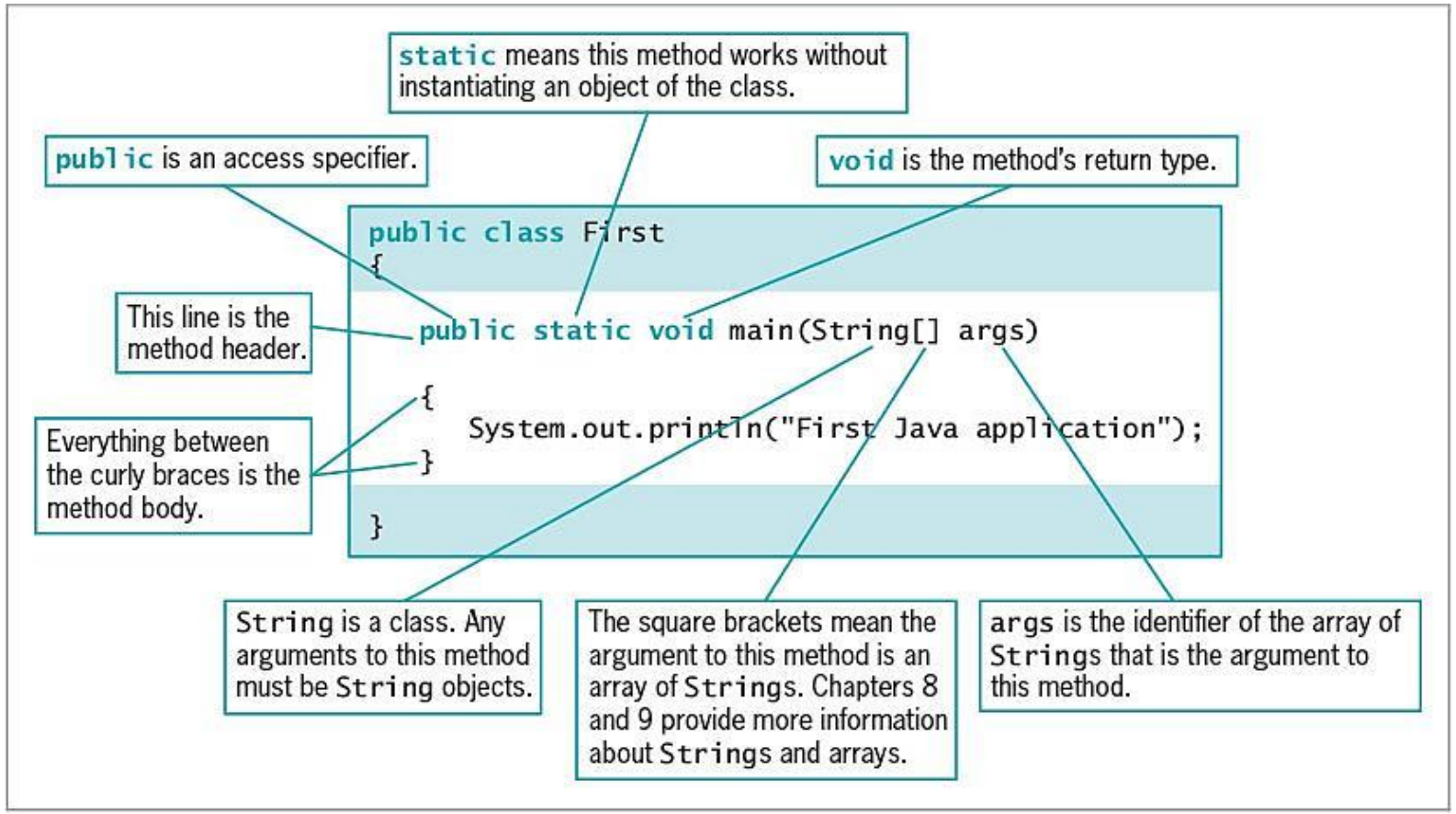


Figure 1-7 The parts of a typical `main()` method

Understanding the `main()` Method (cont'd.)

```
public class AnyClassName
{
   public static void main(String[] args)
   {
      /******/
   }
}
```

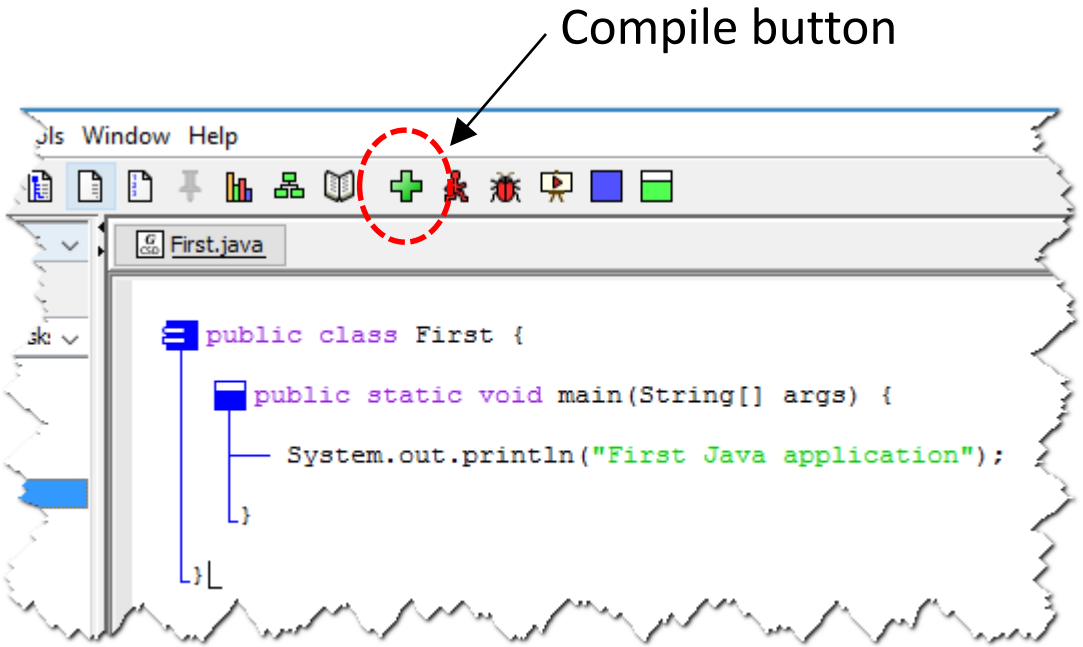
Figure 1-8 Shell code

Saving a Java Class

- Saving a Java class
  - Save the class in a file with exactly the same name and .java extension
    - For public classes, class name and filename must match exactly

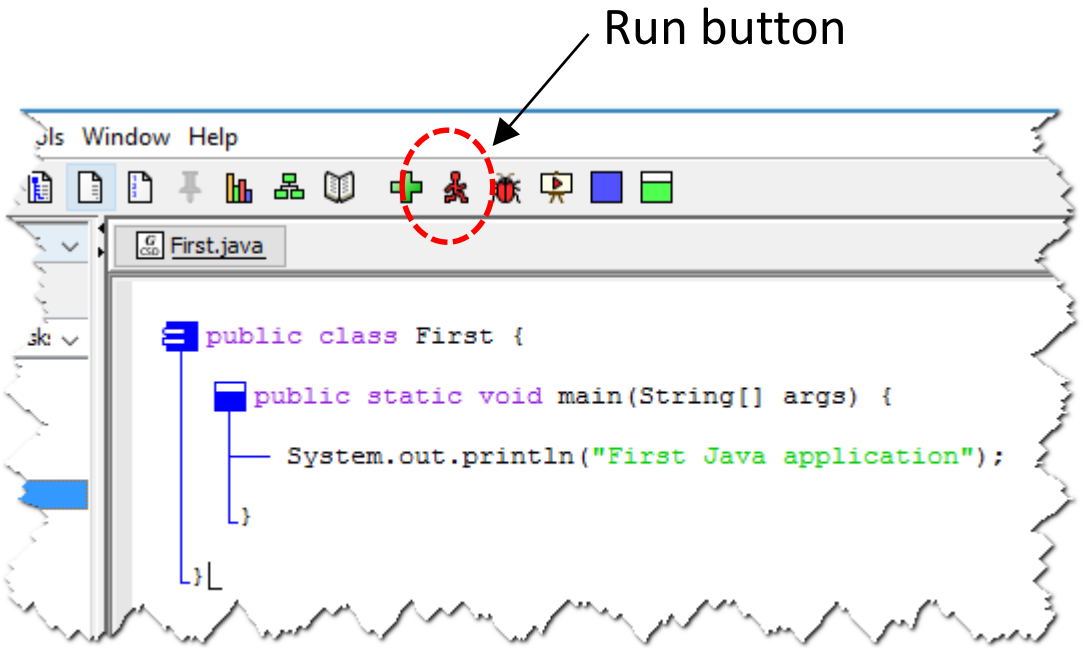
Compiling a Java Class and Correcting Syntax Errors

- Compiling a Java class
  - Compile the source code into bytecode
  - Translate the bytecode into executable statements
    - Using a Java interpreter
  - Type `javac First.java`
- Compilation outcomes



Running a Java Application and Correcting Logical Errors

- Run the application from the command line
  - Type `java First`
- Shows the application's output in the command window
- The class is stored in a folder named Java on the C drive



Running a Java Application and Correcting Logical Errors (cont'd.)

```
----jGRASP exec: java First
----   at: 06/07/2017 12:33:35 PM

----jGRASP wedge: pid for wedge is 7688.
----jGRASP wedge2: pid for wedge2 is 11960.
----jGRASP wedge2: CLASSPATH is ";.;;;C:\Program Files (x86)\jGRASP\extensions\classes".
----jGRASP wedge2: working directory is [T:\Teaching\cp1\Practicals\2017\Semester 2\Lab_tasks\
----jGRASP wedge2: actual command sent ["C:\PROGRA~1\Java\JDK18~1.0_4\bin\java.exe" First].
----jGRASP wedge2: pid for process is 10528.
First Java application

----jGRASP wedge2: exit code for process is 0.
----jGRASP: operation complete.
```

Modifying a Compiled Java Class

- Modify the text file that contains the existing class
- Save the file with changes using the same filename
- Compile the class with the `javac` command
- Interpret the class bytecode and execute the class using the `java` command

Modifying a Compiled Java Class (cont'd.)

```
public class First
{
   public static void main(String[] args)
   {
      System.out.println("My new and improved");
      System.out.println("Java application");
   }
}
```

Figure 1-18 First class containing output modified from the original version

Correcting Logical Errors

- **Logic error**
  - The syntax is correct but incorrect results were produced when executed
- **Run-time error**
  - Not detected until execution
  - Often difficult to find and resolve

Adding Comments to a Java Class

- **Program comments**
  - Nonexecuting statements added to a program for documentation
  - Use to leave notes for yourself or others
  - Include the author, date, and class's name or function
- **Comment out** a statement
  - Turn it into a comment
  - The compiler does not translate, and the JVM does not execute its command

Adding Comments to a Java Class (cont'd.)

- Types of Java comments
  - **Line comments**
    - Start with two forward slashes (//)
    - Continue to the end of the current line
    - Do not require an ending symbol
  - **Block comments**
    - Start with a forward slash and an asterisk (/*)
    - End with an asterisk and a forward slash (*/)

Adding Comments to a Java Class (cont'd.)

- Types of Java comments (cont'd.)
  - **Javadoc** comments
    - A special case of block comments
    - Begin with a slash and two asterisks (/**)
    - End with an asterisk and a forward slash (*/)
    - Use to generate documentation

Adding Comments to a Java Class (cont'd.)

```
// Demonstrating comments
/* This shows
   that these comments
   don't matter */
System.out.println("Hello"); // This line executes
   // up to where the comment started
/* Everything but the println()
     is a comment */
```

Figure 1-21 A program segment containing several comments

Creating a Java Application that Produces GUI Output

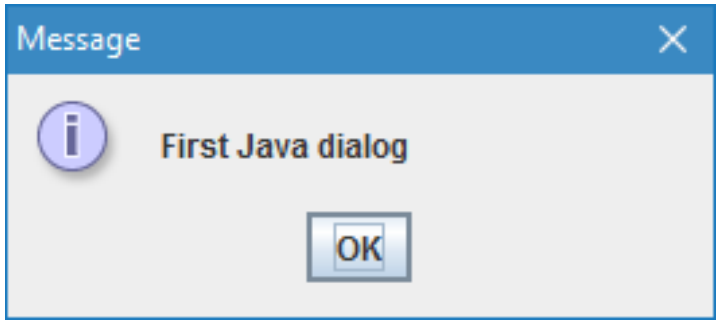
- `JOptionPane`
  - Produces dialog boxes
- **Dialog box**
  - A GUI object resembling a window
  - Messages placed for display
- **`import` statement**
  - Use to access a built-in Java class
- **Package**
  - A group of classes

Creating a Java Application that Produces GUI Output (cont'd.)

```
import javax.swing.JOptionPane;
public class FirstDialog
{
   public static void main(String[] args)
   {
      JOptionPane.showMessageDialog(null, "First Java dialog");
   }
}
```

Figure 1-22 The FirstDialog class

Creating a Java Application that Produces GUI Output (cont'd.)



Finding Help

- **Java API**
  - Also called the Java class library
  - Provides prewritten information about Java classes
- **FAQs** on the Java Web site
- Java Development Kit (**JDK**)
  - A software development kit (**SDK**) of programming tools
  - Free to download

Don’t Do It

- Don’t forget the file’s name must match the class name
- Don’t confuse these terms:
  - Parentheses, braces, brackets, curly braces, square brackets, and angle brackets
- Don’t forget to end a block comment
- Don’t forget that Java is case sensitive
- Don’t forget to end every statement with a semicolon
  - Do not end class or method headers with a semicolon
- Don’t forgot to recompile when making changes