Introduction to Java

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Overview

- **Introduction**
  - History, Characteristics of Java language
- **Java Language Basics**
  - Data types, Variables, Operators and Expressions
- **Anatomy of a Java Program**
  - Comments, Packages, Classes, Reserved Words, Modifiers, Blocks, Statements, Methods and main Method
- **Concepts of Object-Oriented Programming**
  - Objects, Classes, Inheritance, Interface and Package

History

- Developed by James Gosling at Sun Microsystems.
- Released by Sun Microsystems in 1995.
- Hotjava – The first java-enabled web browser
- J2EE, J2ME and J2SE

Characteristics

- Simple, object-oriented, and familiar
- Robust and secure
- Architecture-neutral and portable
- High performance
- Interpreted, threaded, and dynamic

Data Types

- A data type is a scheme for representing values.
  - Values are not just numbers, but any kind of data that a computer can process.
- A data type defines a kind of data that is represented by a variable
- Java data types are case sensitive.

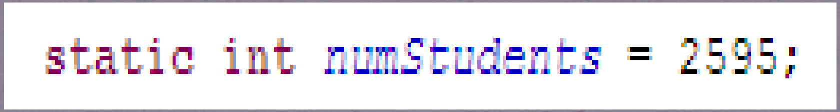
Primitive Data Types

Data Type	Size (byte)	Range
byte	1	-128 to 127
boolean	1	true or false
char	2 (Unicode)	A-Z, a-z, 0-9, etc.
short	2	-32768 to 32767
int	4	(about) -2 million to 2 million
float	4	-3.4E38 to 3.4E18
long	8	(about) -10E18 to 10E18
double	8	-1.7E308 to 1.7E308

- There are only eight primitive data types.
- New primitive data types cannot be created by a programmer

Variables

- Variables are labels that describe a particular location in memory and associate it with a data type.



```
static int numStudents = 2595;
```

- A declaration of a variable is where the program allow memory for the variable.
  - instance variables: declared without “static”
  - class variables: declared with “static”
  - local variables and Parameters

Operators

- Operators are special symbols that perform specific operations on one, two, or three operands, and then return a result.
  - assignment, arithmetic, and unary operators

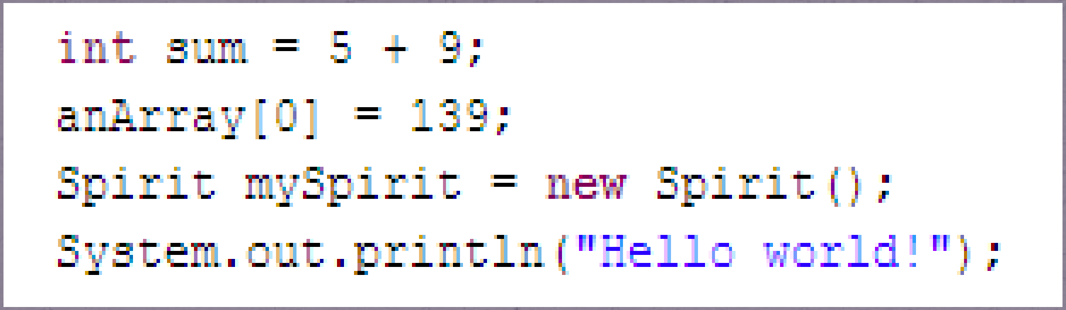
    “=”; “+”, “*”; “++”, “!”
  - equality, relational, and conditional operators

    “==”, “!=”, “<=”; “||”, “?:”
  - bitwise and bit shift operators

    “~”, “&”, “>>”

Expressions

- An expression is a construct made up of variables, operators, and method invocations.

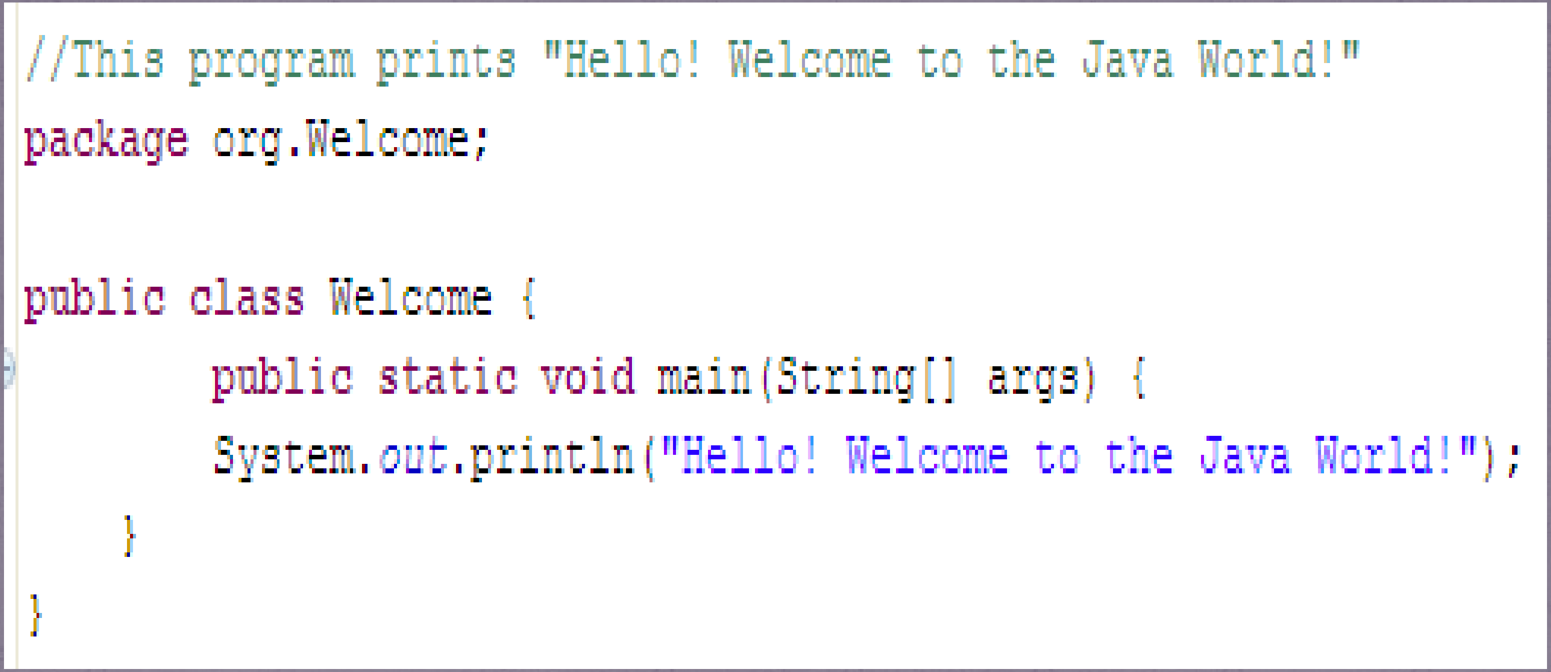


```
int sum = 5 + 9;
anArray[0] = 139;
Spirit mySpirit = new Spirit();
System.out.println("Hello world!");
```

- An expression can return other types of values as well.
- A compound expression can be constructed from various smaller ones.

Anatomy of A Java Program

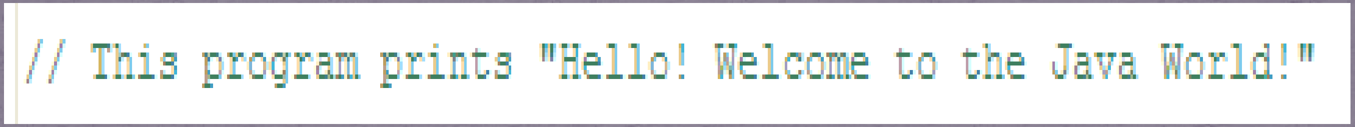
- A simple java Program



```
//This program prints "Hello! Welcome to the Java World!"
package org.Welcome;

public class Welcome {
        public static void main(String[] args) {
        System.out.println("Hello! Welcome to the Java World!");
    }
}
```

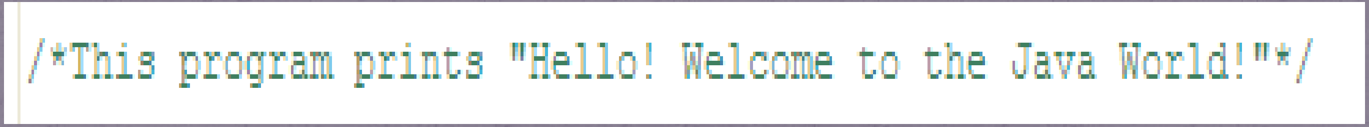
Comments

- Comments in Java are preceded in two types:
  - Line comments: Line comments are precede by two slashes "//" in a line.



```
// This program prints "Hello! Welcome to the Java World!"
```

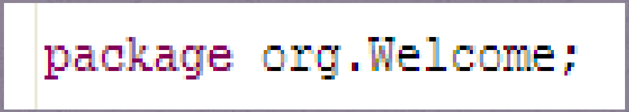
  - Paragraph comments: Paragraph comments are enclosed between "/*" and "*/" in one or multiple lines.



```
/*This program prints "Hello! Welcome to the Java World!"*/
```

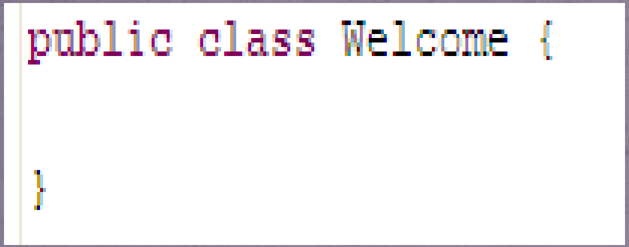
Package

- The second line of the program is the package name.
- It specifies the package name, org.Welcome for the class Welcome.



```
package org.Welcome;
```

Classes



```
public class Welcome {


}
```

- The class is the essential Java construct.
- A class is a template.
- A program is defined by using one or more classes.

Reserved Words

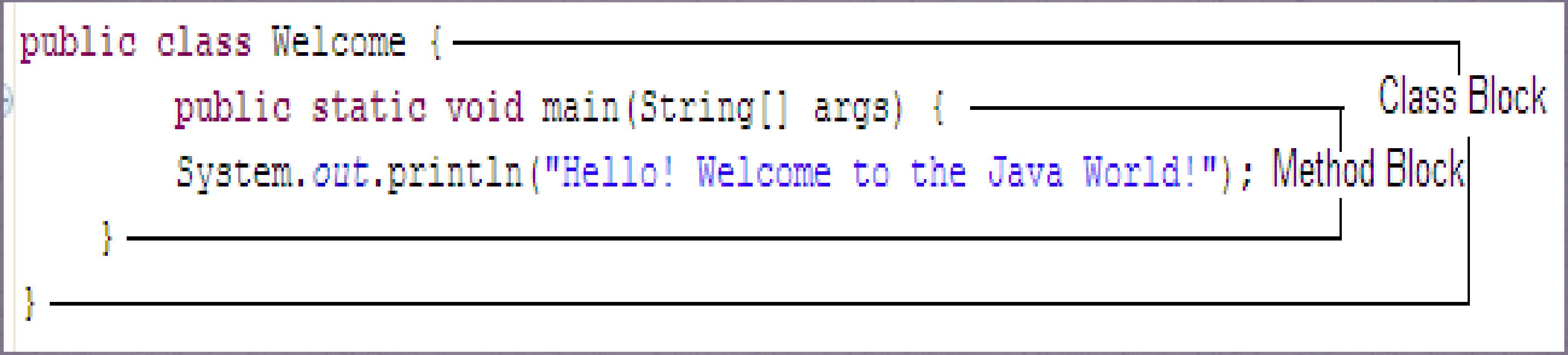
- Reserved words (Keywords) are words that have a specific meaning to the compiler and cannot be used for other purposes (name of variables, classes, methods…) in the program.
- Examples:
  - When the compiler sees the word *class*, it understands the word after *class* is the name for the class.
  - *public, void, static* are also reserved words.

Modifiers

- Certain reserved words are called modifies that specify the properties of the data, methods, and classes and how they can be used.
- Examples:
  - A **public** datum, method, or class can be accessed by other programs.
  - *private, protected, static and void* are also modifiers.

Blocks

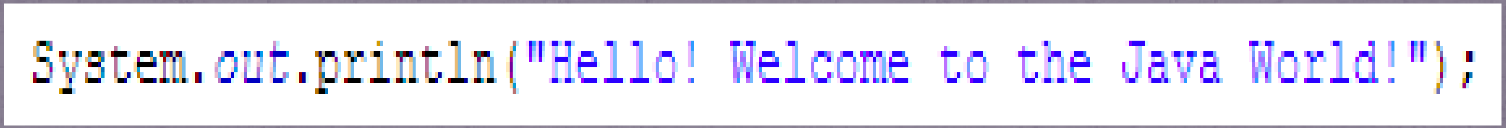
- A pair of braces in a program forms a block for a group components of a program.



```
public class Welcome {
        public static void main(String[] args) {
        System.out.println("Hello! Welcome to the Java World!");
    }
}
```

Statements

- A statement represents an action or a sequence of actions.
- A statement ends with a semicolon “;”.



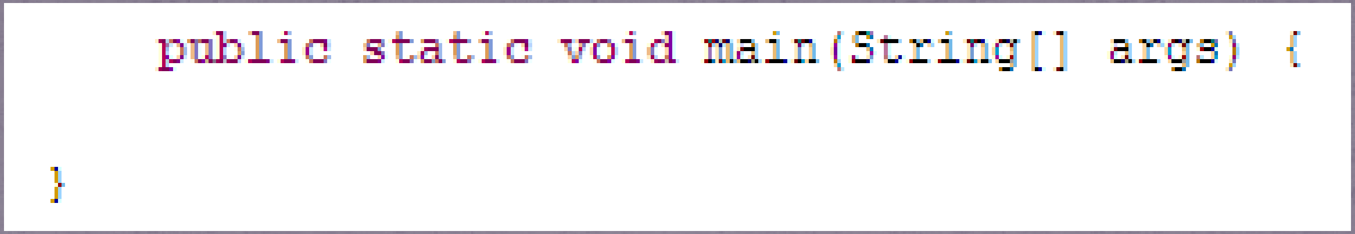
```java
System.out.println("Hello! Welcome to the Java World!");
```

Methods

- A method is a collection of statements that performs a sequence of operations to display a message on the console.
- A method can be used even without fully understanding the details of how it works.
- A method is used by invoking a statement with a string argument which is enclosed within parentheses.

main Method

- The *main* method provides the control of the program flow.
- The Java interpreter executes the application by invoking the *main* method.



```
        public static void main(String[] args)  {


  }
```

Objects

- Objects are key to understand OO technology.
- An object is a structured block of data.
- An object may use many bytes of memory.
- An object stores its state in fields and exposes its behavior through methods.
- The data type of an object is its class.
- Creating an object is called instantiation.

Classes

- The class is the essential Java construct.
- A class is a blueprint or prototype from which objects are created.
- A class is a description of a group of objects with similar properties and behaviors.
- A class is a pattern for an object.
- A class does not create any objects.

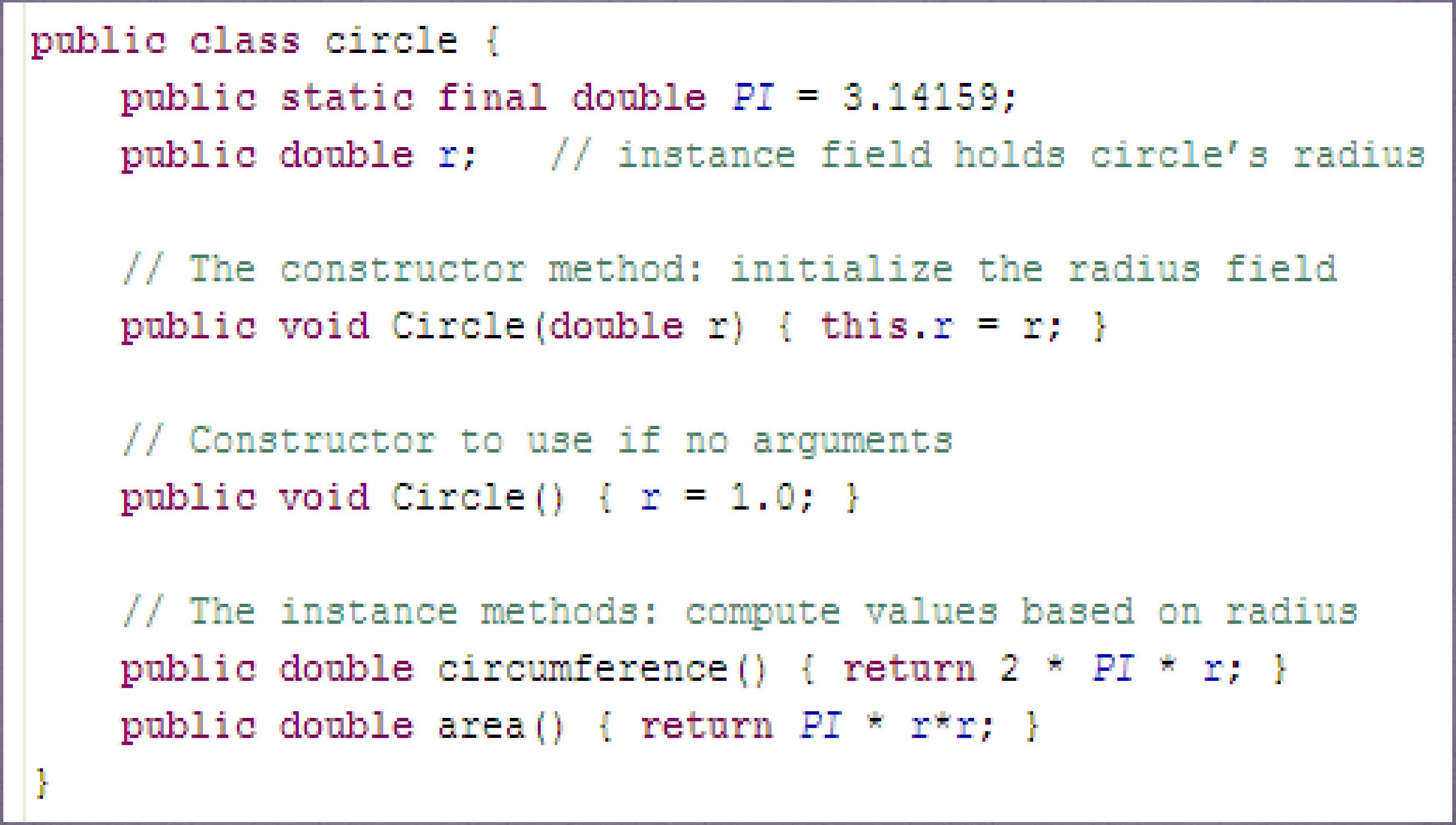
Classes

- A class consists of
  - a collection of fields, or variables, very much like the named fields of a struct.
  - all the operations (called methods) that can be performed on those fields.
  - can be instantiated.
- A class describes objects and operations defined on those objects.

Constructors

- Classes should define one or more methods to create or construct instances of the class.
- Their name is the same as the class name.
- Constructors are differentiated by the number and types of their arguments.
- If none constructor is defined, a default one will be created.
- Constructors do not return anything.

Example

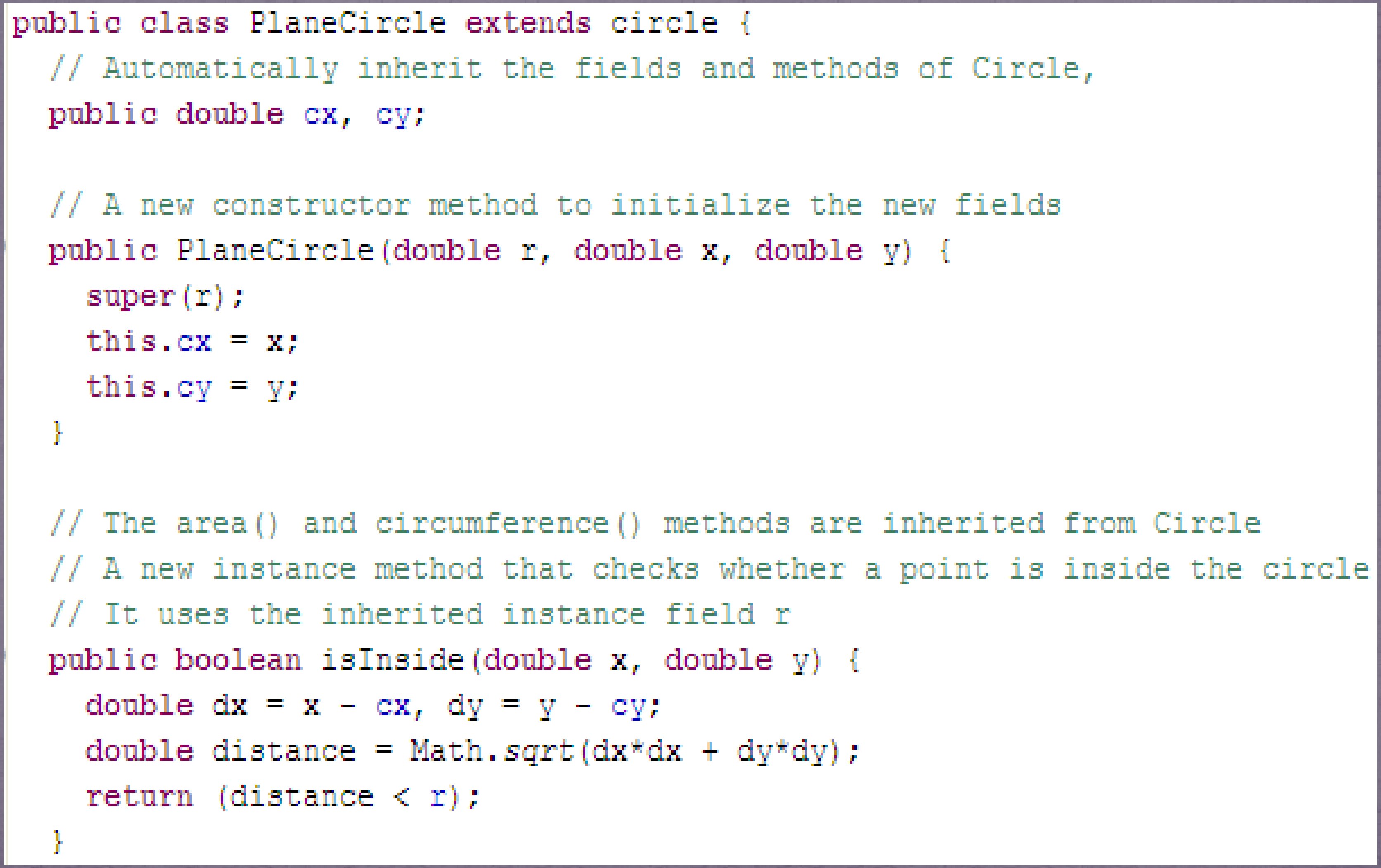


```
public class circle {
    public static final double PI = 3.14159;
    public double r;   // instance field holds circle's radius

    // The constructor method: initialize the radius field
    public void Circle(double r) { this.r = r; }

    // Constructor to use if no arguments
    public void Circle() { r = 1.0; }

    // The instance methods: compute values based on radius
    public double circumference() { return 2 * PI * r; }
    public double area() { return PI * r*r; }
}
```

Inheritance

- Classes are arranged in a hierarchy.
- Inheritance enables to define a new class based on a class that already exists.
- A class that is derived from another class is called a subclass. The class from which the subclass is derived is called a superclass.
- A class inherits fields and methods from all its superclasses, whether direct or indirect.
- A subclass can override methods that it inheritance, or it can hide fields or methods that it inherits.

Example

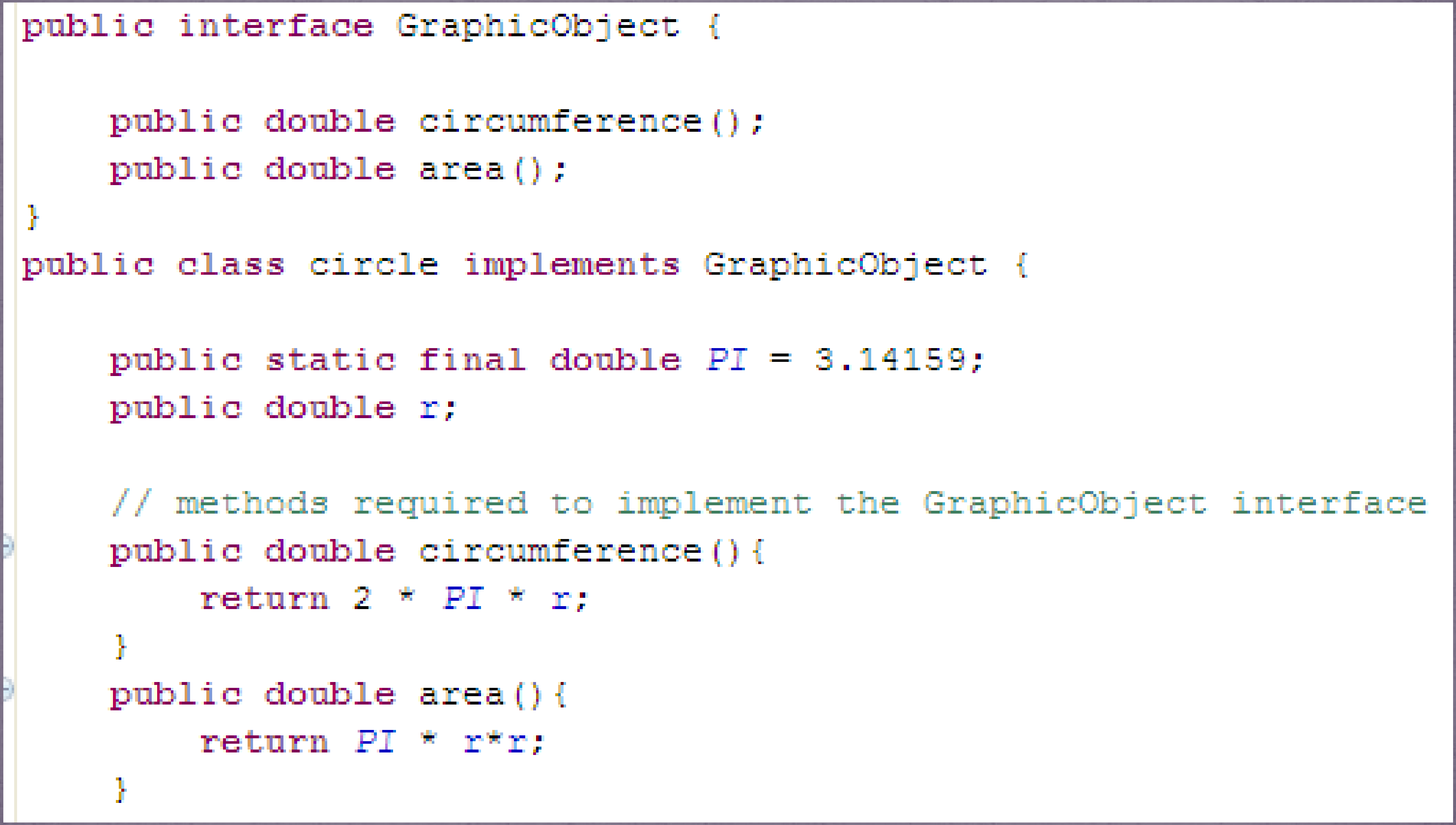


```java
public class PlaneCircle extends circle {
  // Automatically inherit the fields and methods of Circle,
  public double cx, cy;

  // A new constructor method to initialize the new fields
  public PlaneCircle(double r, double x, double y) {
    super(r);
    this.cx = x;
    this.cy = y;
  }

  // The area() and circumference() methods are inherited from Circle
  // A new instance method that checks whether a point is inside the circle
  // It uses the inherited instance field r
  public boolean isInside(double x, double y) {
    double dx = x - cx, dy = y - cy;
    double distance = Math.sqrt(dx*dx + dy*dy);
    return (distance < r);
  }
```

Interface

- An interface defines a protocol of communication between two objects.
- An interface declaration contains signatures, but no implementations, for a set of methods, and might also contain constant definitions.
- A class that implements an interface must implement all the methods declared in the interface.
- An interface name can be used anywhere a type can be used.

Example



```
public interface GraphicObject {

    public double circumference();
    public double area();
}
public class circle implements GraphicObject {

    public static final double PI = 3.14159;
    public double r;

    // methods required to implement the GraphicObject interface
    public double circumference(){
        return 2 * PI * r;
    }
    public double area(){
        return PI * r*r;
    }
```

Encapsulation

- Encapsulation means hiding the details of an object's internals from the other parts of a program. The object can be used only through its access methods, which are carefully written to keep the object consistent and secure.
- Encapsulation is designed to make an object look like a black box: The insides of the box are hidden from view.
- On the outside are some controls which are the only way that the user can use the box.

Abstract Classes and Methods

- An abstract class is a class that is declared abstract.
- Abstract classes cannot be instantiated, but they can be subclassed.
- An abstract method is a method that is declared without an implementation.
- Not everything defined in an abstract class needs to be abstract.
- However, if a class includes even one abstract method, the class itself must be declared abstract.

Abstract Classes vs. Interfaces

- Unlike interfaces, abstract classes can contain fields that are not static and final, and they can contain implemented methods.
- Abstract classes provide a partial implementation, leaving it to subclasses to complete the implementation.
- Abstract classes are most commonly subclassed to share pieces of implementation.
- If an abstract class contains only abstract method declarations, it should be declared as an interface instead.

Package

- A package is a namespace for organizing a set of related classes and interfaces in a logical manner.
- A package is a grouping of related types providing access protection and name space management.
- Conceptually, packages can be thought as being similar to different folders on computer.
- To create a package for a type, put a *package* statement as the first statement in the source file that contains the type (class, interface, enumeration, or annotation type).

Thank you!