Module 2

Object-Oriented Programming

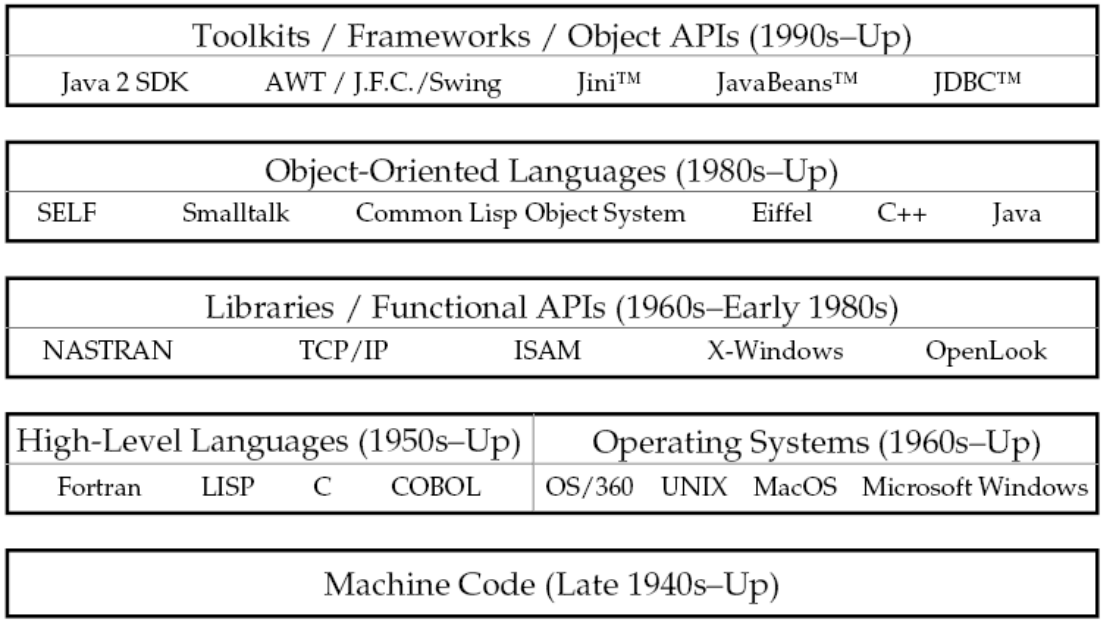
Objectives

- Define modeling concepts: *abstraction*, *encapsulation*, and *packages*
- Discuss why you can reuse Java technology application code
- Define *class*, *member*, *attribute*, *method*, *constructor*, and *package*
- Use the access modifiers `private` and `public` as appropriate for the guidelines of encapsulation
- Invoke a method on a particular object
- Use the Java technology application programming interface (API) online documentation

Relevance

- What is your understanding of software analysis and design?
- What is your understanding of design and code reuse?
- What features does the Java programming language possess that make it an object-oriented language?
- Define the term *object-oriented*.

Software Engineering



The Analysis and Design Phase

- Analysis describes *what* the system needs to do:

  Modeling the real-world, including actors and activities, objects, and behaviors
- Design describes *how* the system does it:
  - Modeling the relationships and interactions between objects and actors in the system
  - Finding useful abstractions to help simplify the problem or solution

Abstraction

- Functions – Write an algorithm once to be used in many situations
- Objects – Group a related set of attributes and behaviors into a class
- Frameworks and APIs – Large groups of objects that support a complex activity; Frameworks can be used *as is* or be modified to extend the basic behavior

Classes as Blueprints for Objects

- In manufacturing, a blueprint describes a device from which many physical devices are constructed.
- In software, a class is a description of an object:
  - A class describes the data that each object includes.
  - A class describes the behaviors that each object exhibits.
- In Java technology, classes support three key features of object-oriented programming (OOP):
  - Encapsulation
  - Inheritance
  - Polymorphism

Declaring Java Technology Classes

- Basic syntax of a Java class:

```
<modifier>* class <class_name> {
  <attribute_declaration>*
  <constructor_declaration>*
  <method_declaration>*
}
```

- Example:

```
1   public class Vehicle {
2     private double maxLoad;
3     public void setMaxLoad(double value) {
4       maxLoad = value;
5     }
6   }
```

Declaring Attributes

- Basic syntax of an attribute:

```
<modifier>* <type> <name> [ = <initial_value>];
```

- Examples:

```
1   public class Foo {
2     private int x;
3     private float y = 10000.0F;
4     private String name = "Bates Motel";
5   }
```

Declaring Methods

- Basic syntax of a method:

```
<modifier>* <return_type> <name> ( <argument>* ) {
  <statement>*
}
```

- Examples:

```
1   public class Dog {
2     private int weight;
3     public int getWeight() {
4       return weight;
5     }
6     public void setWeight(int newWeight) {
7       if ( newWeight > 0 ) {
8         weight = newWeight;
9       }
10    }
11  }
```

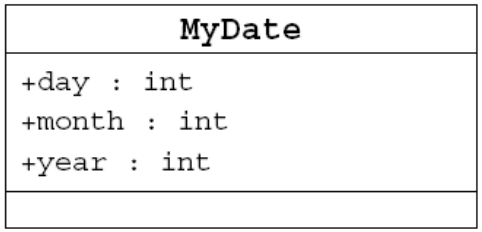
Accessing Object Members

- The *dot* notation is: ***<object>.<member>***
- This is used to access object members, including attributes and methods.
- Examples of dot notation are:

```
d.setWeight(42);
d.weight = 42;  // only permissible if weight is public
```

Information Hiding

The problem:

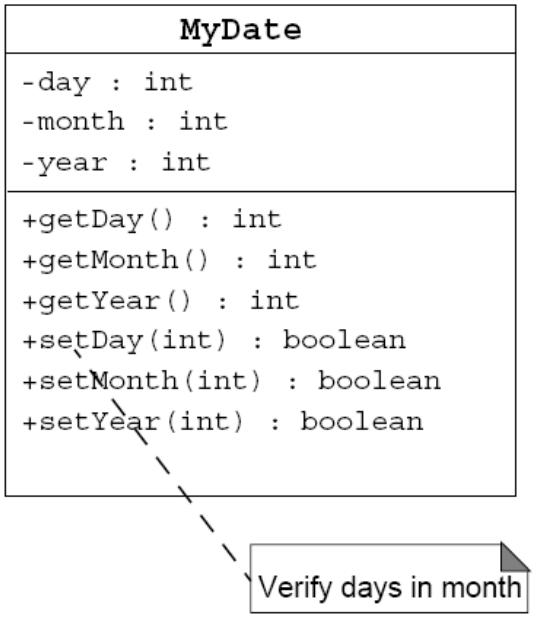


Client code has direct access to internal data (`d` refers to a `MyDate` object):

```
d.day = 32;
// invalid day

d.month = 2; d.day = 30;
// plausible but wrong

d.day = d.day + 1;
// no check for wrap around
```

Information Hiding

The solution:

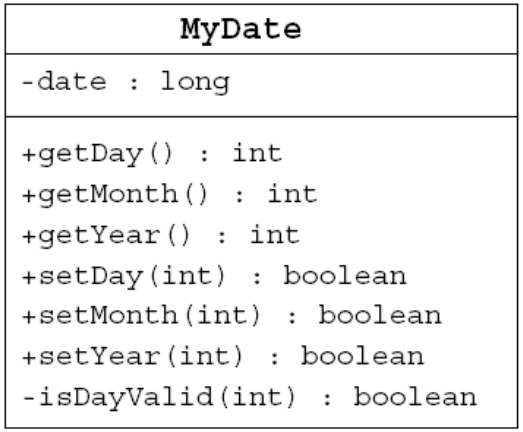


Client code must use setters and getters to access internal data:

```
MyDate d = new MyDate();

d.setDay(32);
// invalid day, returns false

d.setMonth(2);
d.setDay(30);
// plausible but wrong,
// setDay returns false

d.setDay(d.getDay() + 1);
// this will return false if wrap around
// needs to occur
```

Encapsulation

- Hides the implementation details of a class
- Forces the user to use an interface to access data
- Makes the code more maintainable



Declaring Constructors

- Basic syntax of a constructor:

```
[<modifier>] <class_name> ( <argument>* ) {
  <statement>*
}
```

- Example:

```
1   public class Dog {
2
3     private int weight;
4
5     public Dog() {
6        weight = 42;
7     }
8   }
```

The Default Constructor

- There is always at least one constructor in every class.
- If the writer does not supply any constructors, the default constructor is present automatically:
  - The default constructor takes no arguments
  - The default constructor body is empty
- The default enables you to create object instances with `new Xxx()` without having to write a constructor.

Source File Layout

- Basic syntax of a Java source file is:

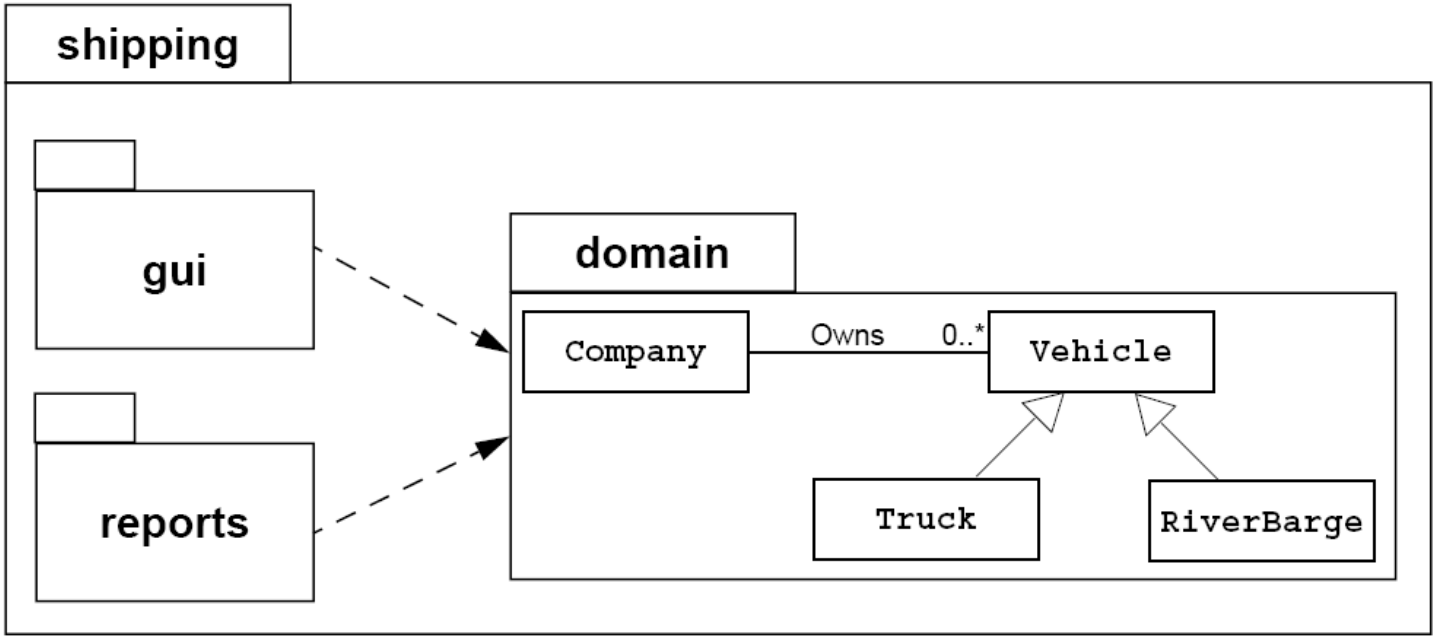
```
[<package_declaration>]
<import_declaration>*
<class_declaration>+
```

- For example, the `VehicleCapacityReport.java` file is:

```
1   package shipping.reports;
2
3   import shipping.domain.*;
4   import java.util.List;
5   import java.io.*;
6
7   public class VehicleCapacityReport {
8     private List vehicles;
9     public void generateReport(Writer output) {...}
10  }
```

Software Packages

- Packages help manage large software systems.
- Packages can contain classes and sub-packages.



The package Statement

- Basic syntax of the package statement is:

  ```
  package <top_pkg_name>[.<sub_pkg_name>]*;
  ```

- Examples of the statement are:

  ```
  package shipping.gui.reportscreens;
  ```

- Specify the package declaration at the beginning of the source file.
- Only one package declaration per source file.
- If no package is declared, then the class is placed into the default package.
- Package names must be hierarchical and separated by dots.

The `import` Statement

- Basic syntax of the `import` statement is:

```
import <pkg_name>[.<sub_pkg_name>]*.<class_name>;
OR
import <pkg_name>[.<sub_pkg_name>]*.*;
```

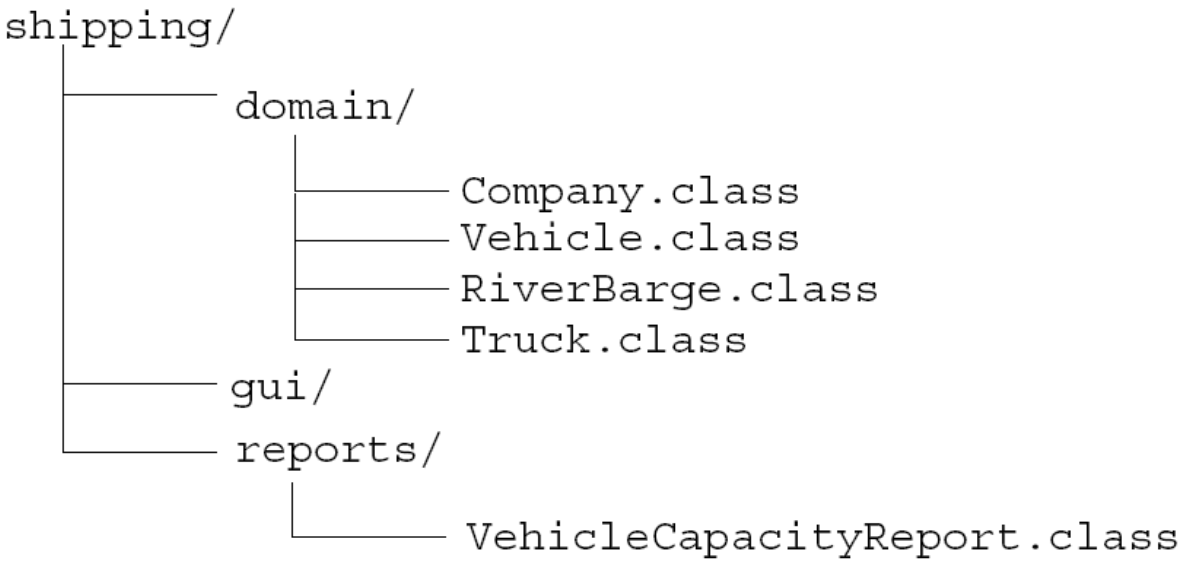
- Examples of the statement are:

```
import java.util.List;
import java.io.*;
import shipping.gui.reportscreens.*;
```

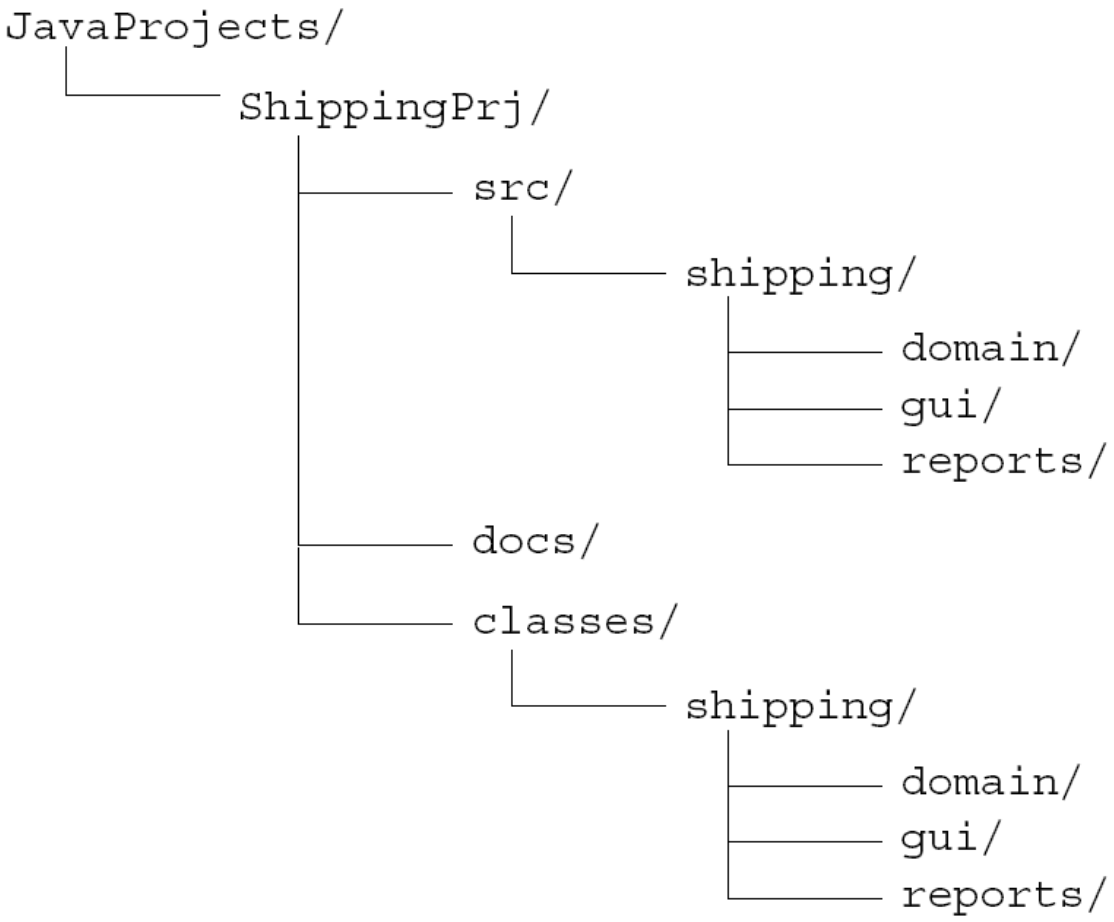
- The import statement does the following:
  - Precedes all class declarations
  - Tells the compiler where to find classes

Directory Layout and Packages

- Packages are stored in the directory tree containing the package name.
- An example is the shipping application packages.



Development



Compiling Using the `-d` Option

```
cd JavaProjects/ShippingPrj/src
javac -d ../classes shipping/domain/*.java
```

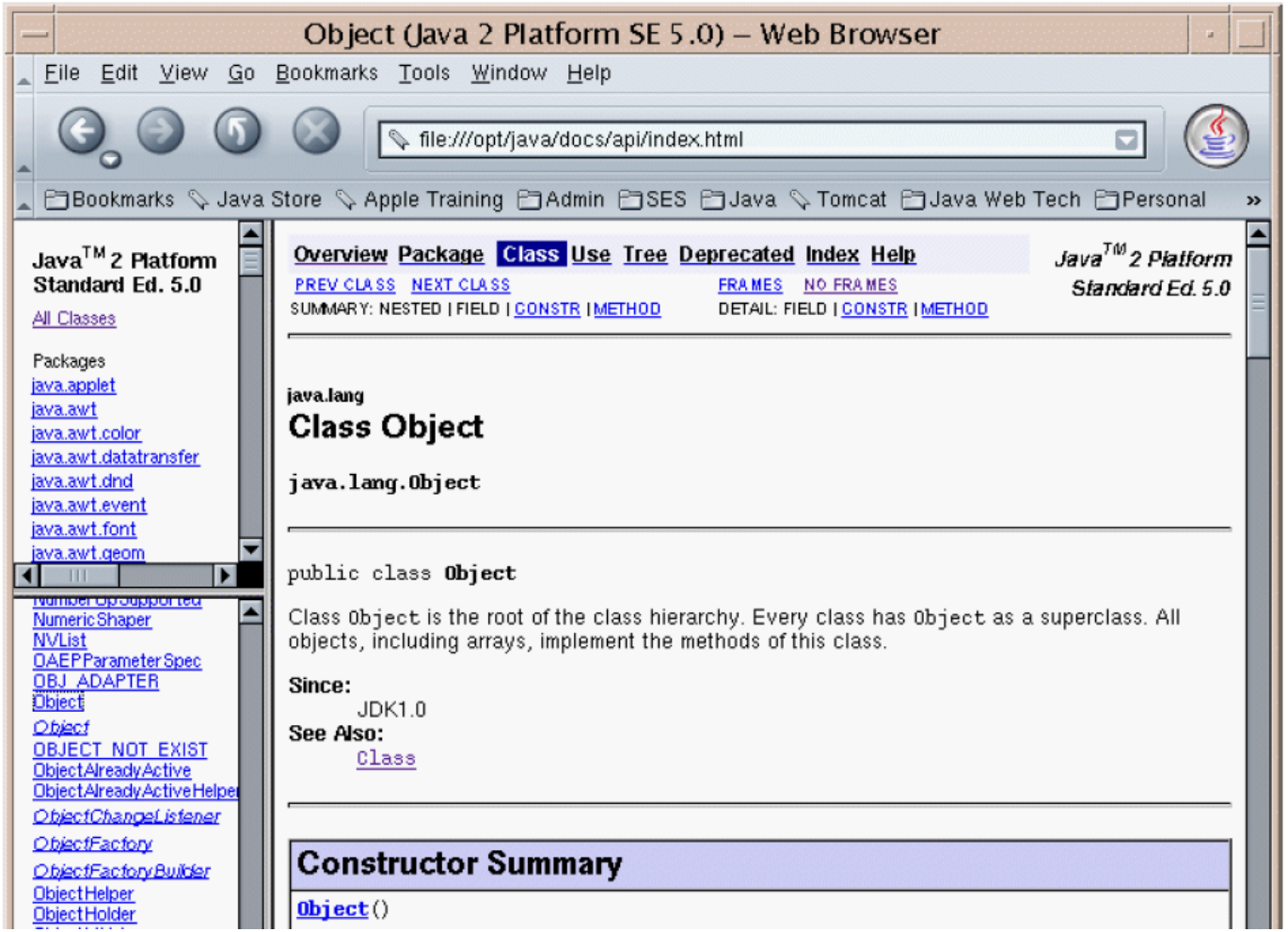
Terminology Recap

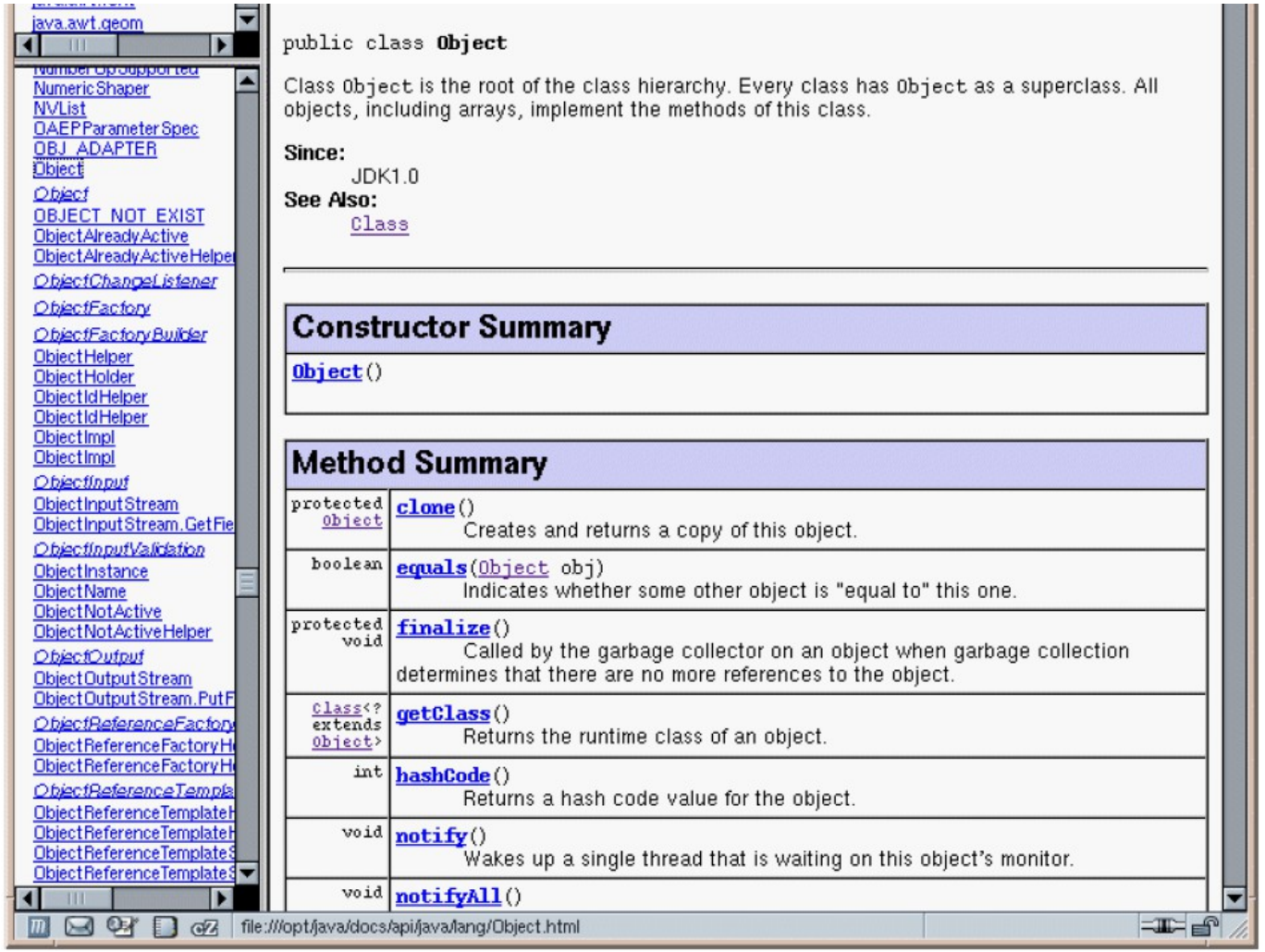
- Class – The source-code blueprint for a run-time object
- Object – An instance of a class;
  also known as *instance*
- Attribute – A data element of an object;
  also known as *data member*, *instance variable*, and *data field*
- Method – A behavioral element of an object;
  also known as *algorithm*, *function*, and *procedure*
- Constructor – A *method-like* construct used to initialize a new object
- Package – A grouping of classes and sub-packages

Using the Java Technology API Documentation

- A set of Hypertext Markup Language (HTML) files provides information about the API.
- A frame describes a package and contains hyperlinks to information describing each class in that package.
- A class document includes the class hierarchy, a description of the class, a list of member variables, a list of constructors, and so on.

Java Technology API Documentation With HTML3




java.awt.geom
NumericShaper
NVList
OAEPParameterSpec
OBJ_ADAPTER
Object
Object
OBJECT_NOT_EXIST
ObjectAlreadyActive
ObjectAlreadyActiveHelper
ObjectChangeListener
ObjectFactory
ObjectFactoryBuilder
ObjectHelper
ObjectHolder
ObjectIdHelper
ObjectIdHelper
ObjectImpl
ObjectImpl
ObjectInput
ObjectInputStream
ObjectInputStream.GetFie
ObjectInputValidation
ObjectInstance
ObjectName
ObjectNotActive
ObjectNotActiveHelper
ObjectOutput
ObjectOutputStream
ObjectOutputStream.PutF
ObjectReferenceFactory
ObjectReferenceFactoryH
ObjectReferenceFactoryH
ObjectReferenceTempla
ObjectReferenceTemplateH
ObjectReferenceTemplateH
ObjectReferenceTemplateS
ObjectReferenceTemplateS
public class Object
Class Object is the root of the class hierarchy. Every class has Object as a superclass. All objects, including arrays, implement the methods of this class.
Since:
JDK1.0
See Also:
Class
Constructor Summary
Object()
Method Summary
protected Object clone() Creates and returns a copy of this object.
boolean equals(Object obj) Indicates whether some other object is "equal to" this one.
protected void finalize() Called by the garbage collector on an object when garbage collection determines that there are no more references to the object.
Class<? extends Object> getClass() Returns the runtime class of an object.
int hashCode() Returns a hash code value for the object.
void notify() Wakes up a single thread that is waiting on this object's monitor.
void notifyAll()
file:///opt/java/docs/api/java/lang/Object.html