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 the encapsulation
- Invoke a method on a particular object

Objectives

- In a Java program, identify the following:
  - The package statement
  - The import statements
  - Classes, methods, and attributes
  - Constructors
- Use the Java technology application programming interface (API) online documentation

Software Engineering

Toolkits / Frameworks / Object APIs (1990s – up)				
Java 2 SDK	AWT / Swing	Jini	Java Beans	JDBC

Object-Oriented Languages (1980s – up)					
SELF	Smalltalk	Common Lisp Object System	Effiel	C++	Java

Libraries / Functional APIs (1960s – early 1980s)				
NASTRAN	TCP/IP	ISAM	X-Windows	OpenLook

High-Level Languages (1950s –up)				Operating Systems (1960s – up)			
Fortran	LISP	C	COBOL	OS/360	UNIX	MacOS	MS-Windows

Machine Code (late 1940s – up)

The Analysis and Design Phase

- Analysis describes what the system needs to do:
  - Modeling the real-world: 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:

```
< modifiers> class < class_name> {
    [< attribute_declarations>]
    [< constructor_declarations>]
    [< method_declarations>]
}
```

- Example:

```
public class Vehicle {
    private double maxLoad;
    public void setMaxLoad(double value{
        maxLoad = value;
    }
}
```

Declaring Attributes

- Basic syntax of an attribute:

  < modifiers> <type> <name>;

- Examples:

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

Declaring Methods

- Basic syntax of a method:

```
<modifiers> <return_type> <name>
    ([< argument_list>]) {
        [< statements>]
    }
```

- Examples:

```
public class Dog {
    private int weight;
    public int getWeight() {
        return weight;
    }
    public void setWeight(int newWeight) {
        weight = newWeight;
    }
}
```

Accessing Object Members

- The “dot” notation:

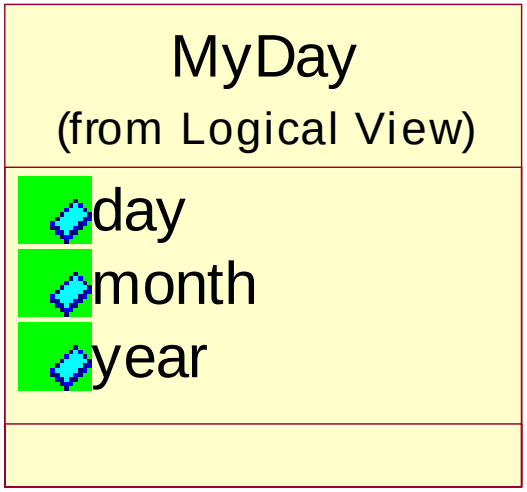
```
<object>.<member>
```

- This is used to access object members including attributes and methods
- Examples:

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

Information Hiding

- The Problem:

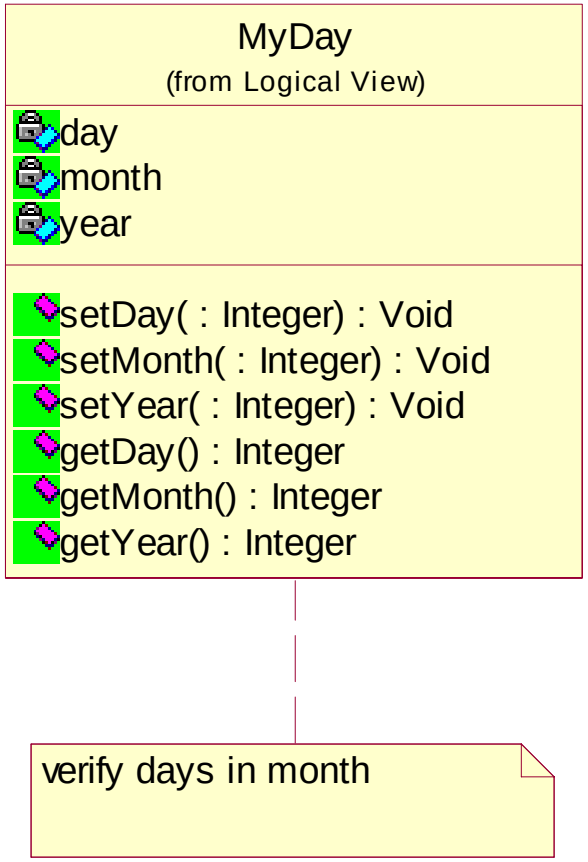


Client code has direct access to internal data:

```
MyDate d = new MyDate();
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:

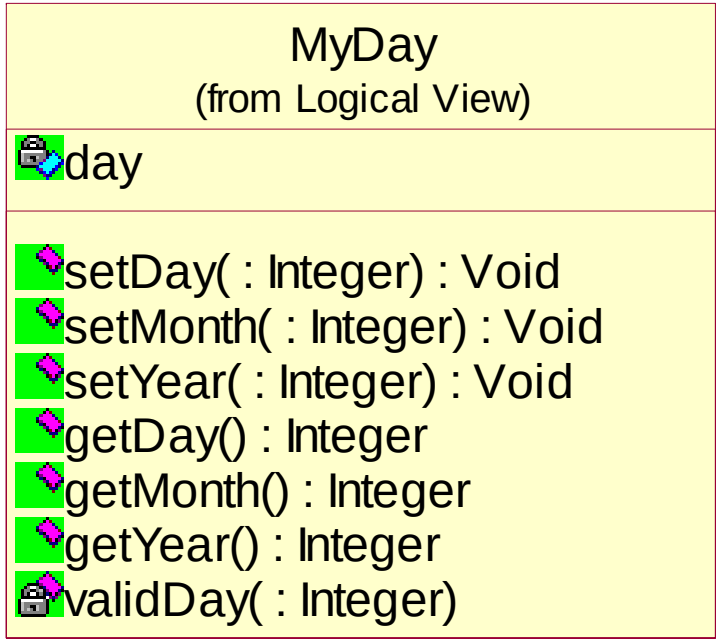


Client code must use setters/getters to access internal data:

```
MyDate d = new MyDate();
d.setDay(32);
// invalid day, returns false
d.setMonth(2);
d.setDay(30);
// plausible but wrong
d.setDay(d.getDay() + 1);
```

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


```
1 public class Dog {
2   private int weight;
3
4   public Dog() {
5         weight = 42;
6   }
7
8   public int getWeight() {
9         return weight;
10  }
11  public void setWeight(int newWeight) {
12    weight = newWeight;
13  }
14}
```

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 has no body
- 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:

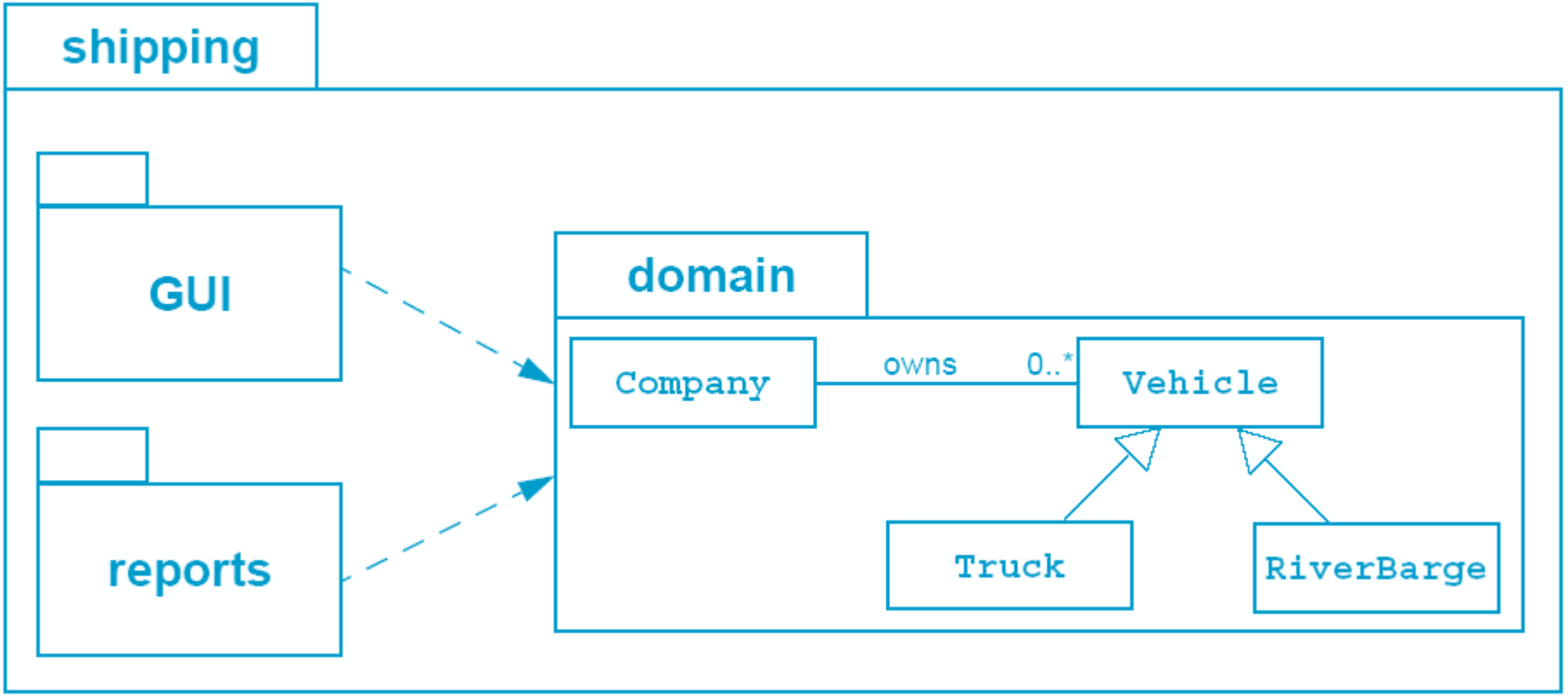
```
[< package_declaration>]
[< import_declarations>]
< class_declaration>+
```

- Example, the VehicleCapacityReport.java file:

```
package shipping.reports;
import shipping.domain.*;
import java.util.List;
import java.io.*;
public class VehicleCapacityReport {
    private List vehicles;
    public void generateReport(Writer output)
    {...}
}
```

Software Packages

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



The package Statement

- Basic syntax of the package statement:

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

- Example:

```
package shipping.reports;
```

- 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 “belongs” to the default package.
- Package names must be hierarchical and separated by dots.

The `import` Statement

- Basic syntax of the import statement:

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

- OR

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

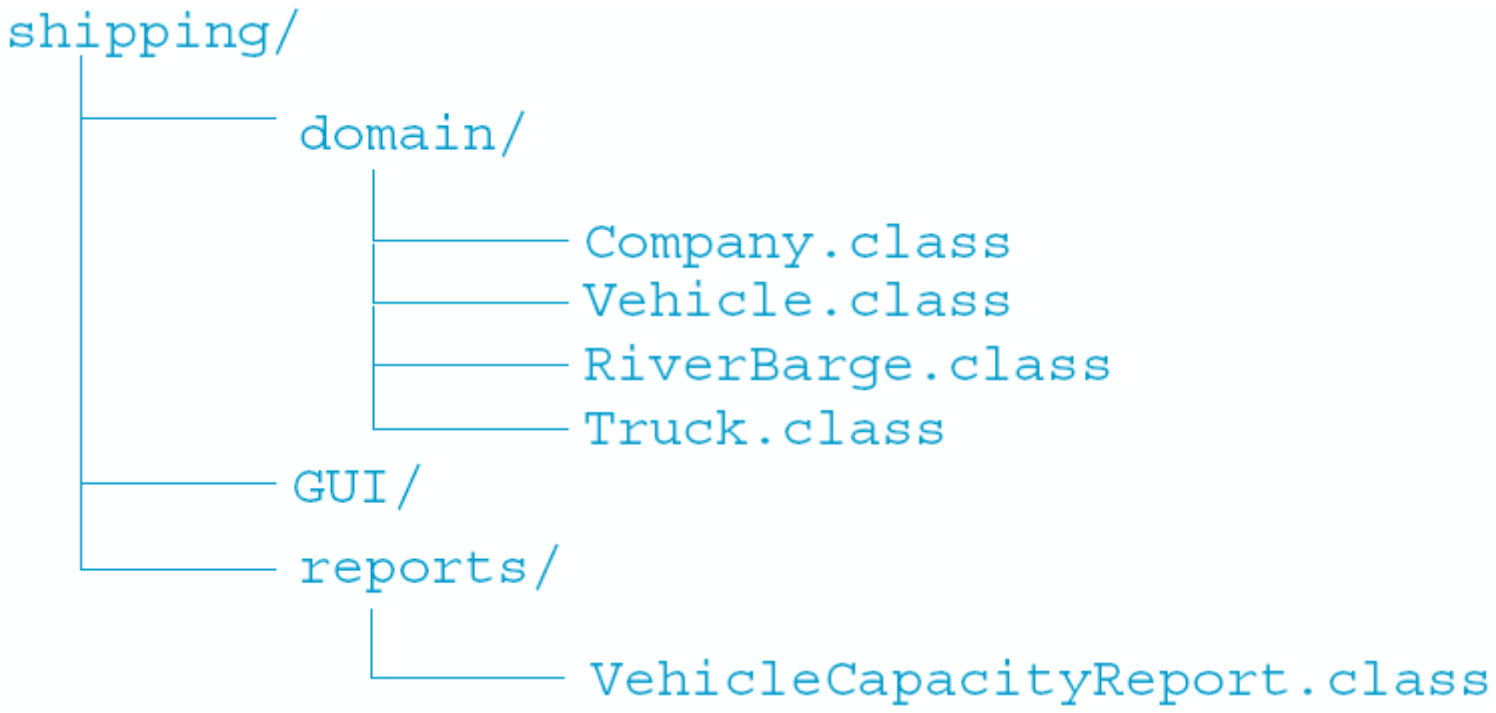
- Examples:

```
import shipping.domain.*;
import java.util.List;
import java.io.*;
```

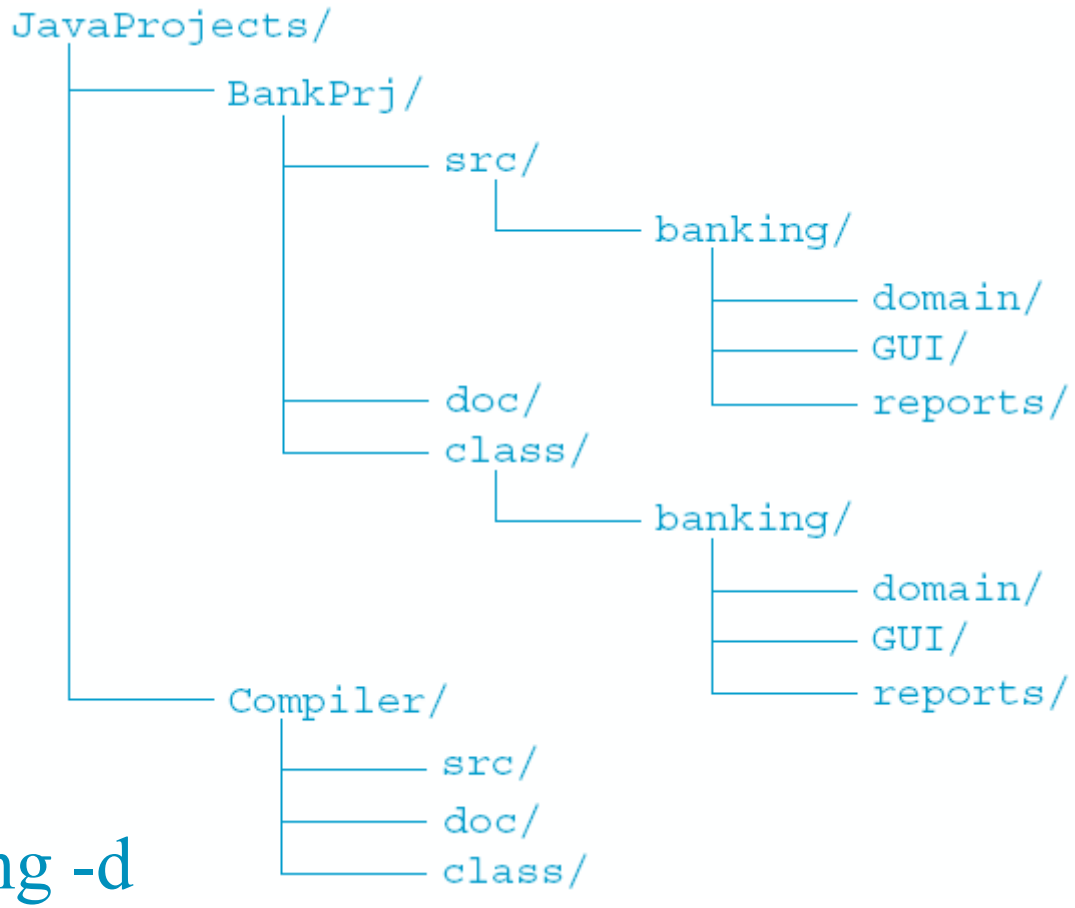
- Precedes all class declarations
- Tells the compiler where to find classes to use

Directory Layout and Packages

- Packages are stored in the directory tree containing the package name.
- Example, the "shipping" application packages:



Development



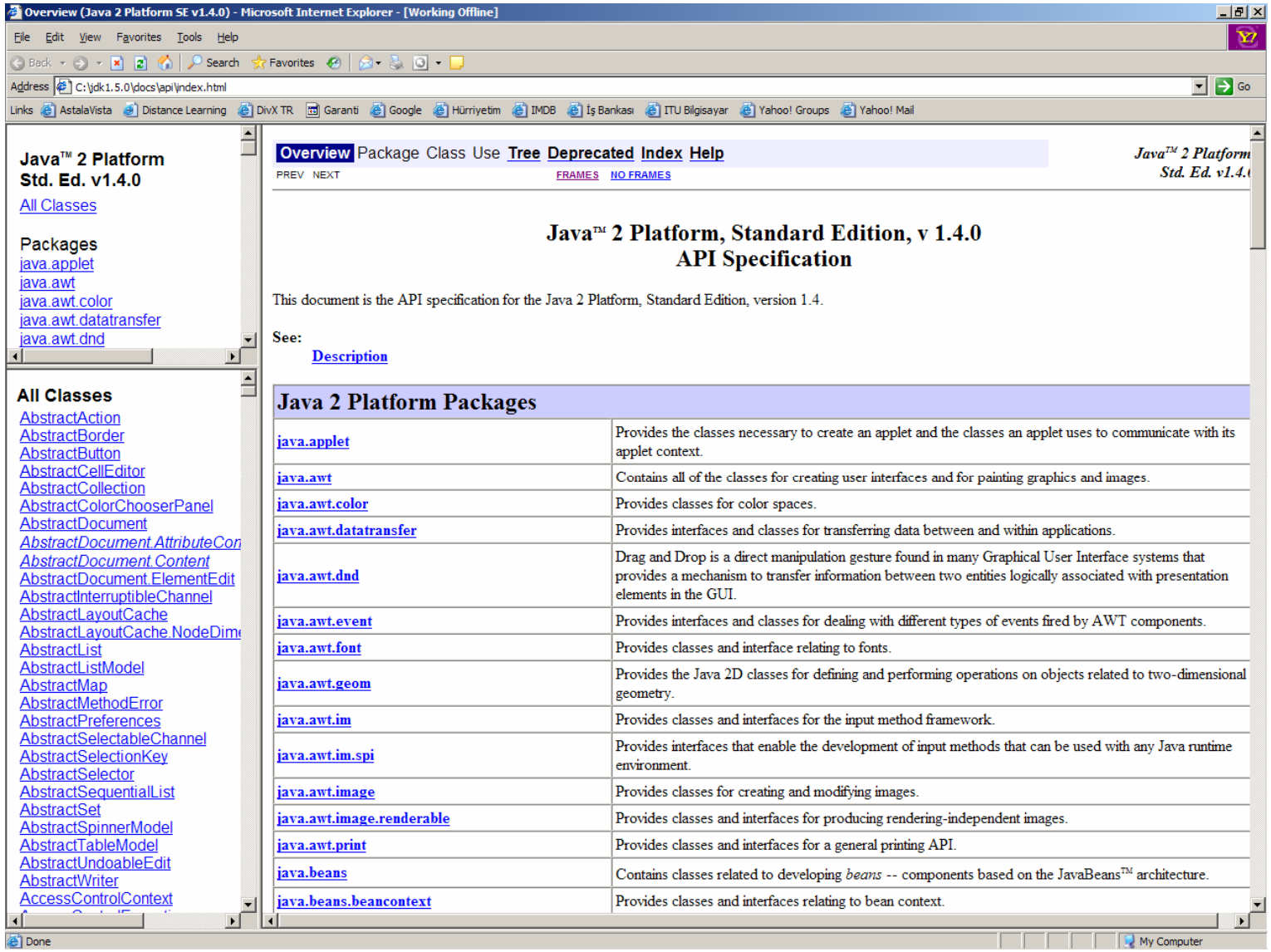
- Compiling using -d

```
cd JavaProjects/BankPrj/src
javac -d ../class banking/domain/*.java
```

Using the Java API Documentation

- A set of Hypertext Markup Language (HTML) files provides information about the API.
- One package contains hyperlinks to information on all of the classes.
- A class document includes the class hierarchy, a description of the class, a list of member variables, a list of constructors, and so on.

Example API Documentation Page



Declaring Java Technology Classes

```
public class Circle {
    private double x, y, r;  // The center and the radius of the circle
    public Circle ( double x, double y, double r ) {
        this.x = x;  this.y = y;   this.r = r;
    }
    public void setCenter(double a,double b){ x=a ; y=b ; }
    public void setRadius(double R){ r=R; }
    public double circumference( ) { return 2 * 3.14159 * r; }
    public double area( ) { return 3.14159 * r*r; }
}
```

Declaring Attributes

```
public class Circle {
  private double x, y, r;  // The center and the radius of the circle
  public Circle ( double x, double y, double r ) {
      this.x = x;  this.y = y;   this.r = r;
  }
  public void setCenter(double a,double b){ x=a ; y=b ; }
  public void setRadius(double R){ r=R; }
  public double circumference( ) { return 2 * 3.14159 * r; }
  public double area( ) { return 3.14159 * r*r; }
}
```

Declaring Methods

```
public class Circle {
    private double x, y, r;  // The center and the radius of the circle
   public Circle ( double x, double y, double r ) {
        this.x = x;  this.y = y;   this.r = r;
    }
    public void setCenter(double a,double b){ x=a ; y=b ; }
    public void setRadius(double R){ r=R; }
    public double circumference( ) { return 2 * 3.14159 * r; }
    public double area( ) { return 3.14159 * r*r; }
}
```

Accessing Object Members

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

```
c.setCenter(8.7,23.5) ;
c.setRadius(3.14) ;
double a = c.area() ;
```

Information Hiding

```
Circle c ;
...
c = new Circle();
...
c.x = 2.0;
c.y = 2.0;
c.r = 1.0;
```

Declaring Constructors

```
public class Circle {
    private double x, y, r;  // The center and the radius of the circle
    public Circle ( double x, double y, double r ) {
        this.x = x;  this.y = y;   this.r = r;
    }
    public void setCenter(double a,double b){ x=a ; y=b ; }
    public void setRadius(double R){ r=R; }
    public double circumference( ) { return 2 * 3.14159 * r; }
    public double area( ) { return 3.14159 * r*r; }
}
```

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,
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- Enables you to create object instances with `new ClassName()` without having to write a constructor.

2# Object-Oriented Programming

- Exercise-1: “Java 2 Platform API Specification”
- Exercise-2: “Encapsulation”
- Exercise-3: “Creating a Simple Bank Package”

Sun microsystems

HANDS-ON LAB