Object-Oriented Programming

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Software Engineering

Toolkits / Frameworks / Object APIs (1990s–Up)

Java 2 SDK | AWT / J.F.C./Swing | Jini™ | JavaBeans™ | JDBC™

Object-Oriented Languages (1980s–Up)

SELF | Smalltalk | Common Lisp Object System | Eiffel | 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 Microsoft Windows

Machine Code (Late 1940s–Up)

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:

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

Declaring Attributes

- Basic syntax of an attribute:

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

- Examples:

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

Declaring Methods

- Basic syntax of a method:

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

- Examples:

```
public class Dog {
   private int weight;
   public int getWeight() {
      return weight;
   }
   public void setWeight(int newWeight) {
      if ( newWeight > 0 ) {
         weight = newWeight;
      }
   }
}
```

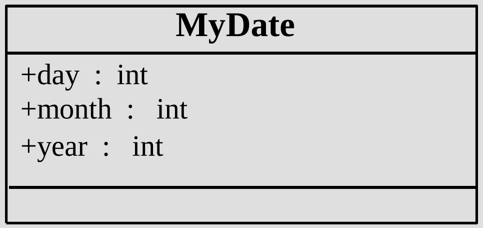
Accessing Object Members

- 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:

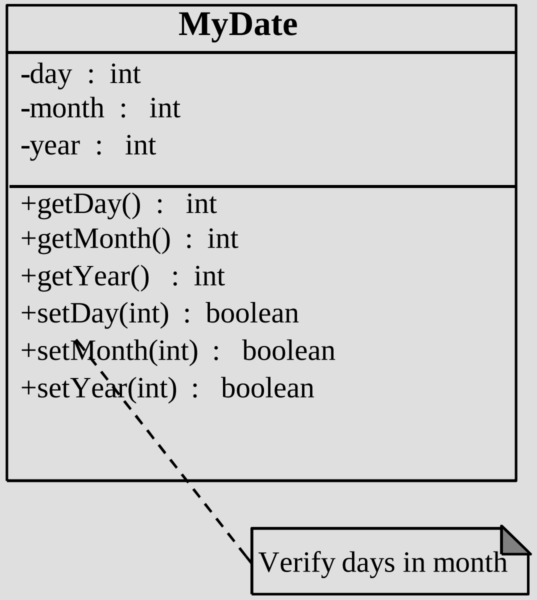


Client code has direct access to internal data (d refers to a MyDate object):

```
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:

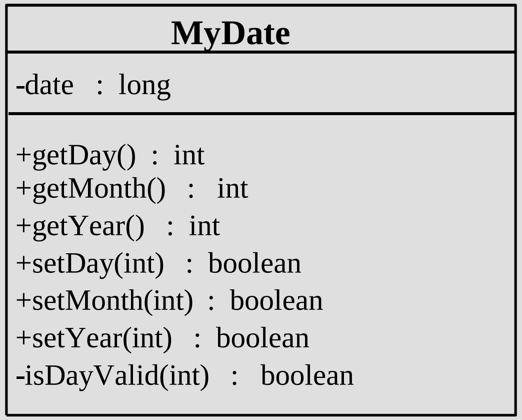


Client code must use setters and getters to access internal data:

```
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:

```
public class Dog {

    private int weight;

    public Dog() {
        weight = 42;
    }
}
```

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>+

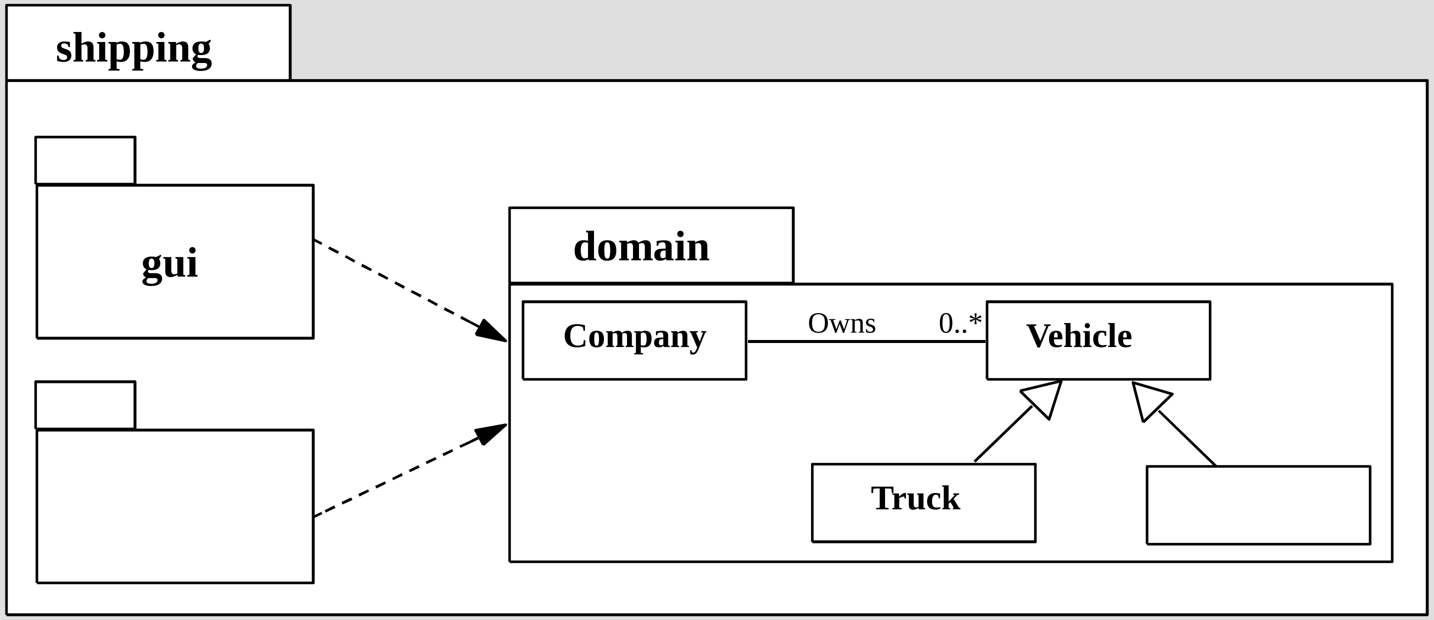
- For example, the VehicleCapacityReport.java file is:

```
package shipping.reports;

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

public class VehicleCapacityReport {
   private List vehicles;
   public void generateReport(Writer output) {...}
}
```

lattelecom

Software Packages

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



The packageStatement

- Basic syntax of the packagestatement 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 importStatement

- 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.

```
shipping/
 |
 |------ domain/
 |          |
 |          |------ Company.class
 |          |------ Vehicle.class
 |          |------ RiverBarge.class
 |          |------ Truck.class
 |------ gui/
 |------ reports/
            |
            |------ VehicleCapacityReport.class
```

Development

```
JavaProjects/
  └── ShippingPrj/
        ├── src/
        │     └── shipping/
        │           ├── domain/
        │           ├── gui/
        │           └── reports/
        ├── docs/
        └── classes/
              └── shipping/
                    ├── domain/
                    ├── gui/
                    └── reports/
```