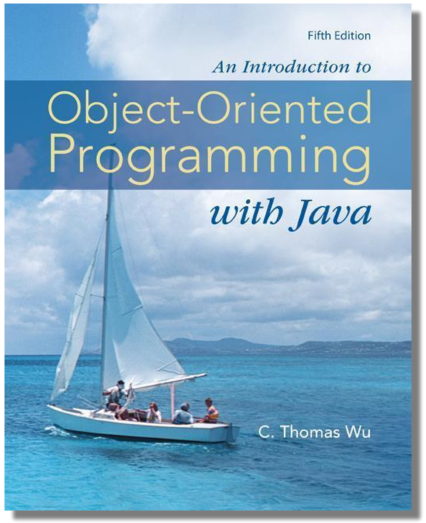


Chapter 1

Introduction to Object-Oriented Programming and Software Development

Objectives

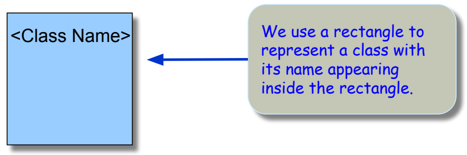
After you have read and studied this chapter, you should be able to

- **Name the basic components** of object-oriented programming
- Differentiate **classes** and **objects**.
- Differentiate class and instance **methods**.
- Differentiate class and instance **data values**.
- Draw program diagrams using **icons** for classes and objects
- Describe significance of **inheritance** in object-oriented programs
- Name and explain the stages of the **software lifecycle**

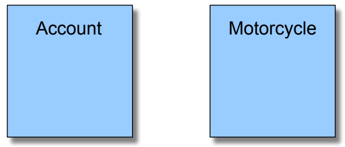
Classes and Objects

- Object-oriented programs use objects.
- An *object* is a thing, both tangible and intangible. Account, Vehicle, Employee, etc.
- To create an object inside the computer program, we must provide a definition for objects—how they behave and what kinds of information they maintain —called a *class*.
- An object is called an *instance* of a class.

Graphical Representation of a Class

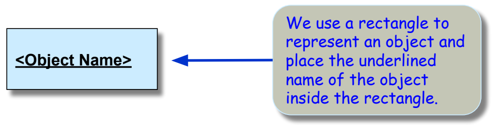

<Class Name>
We use a rectangle to represent a class with its name appearing inside the rectangle.

Example:

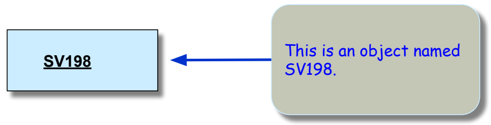


The notation we used here is based on the industry standard notation called *UML*, which stands for Unified Modeling Language.

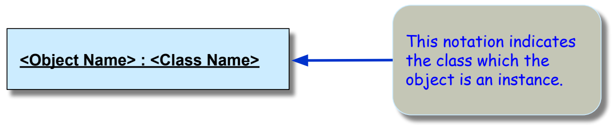
Graphical Representation of an Object


<Object Name>
We use a rectangle to represent an object and place the underlined name of the object inside the rectangle.

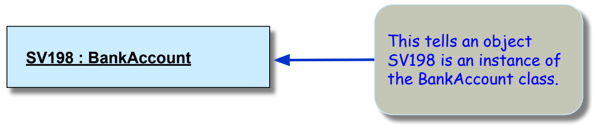
Example:



An Object with the Class Name


<Object Name> : <Class Name>
This notation indicates the class which the object is an instance.

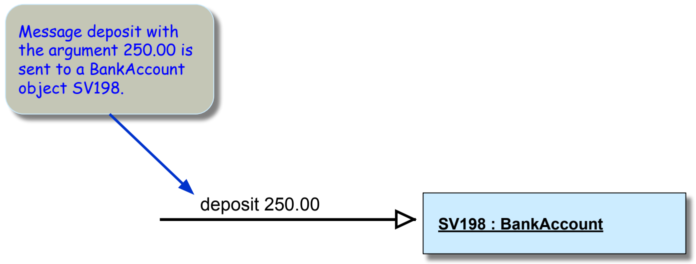
Example:


SV198 : BankAccount
This tells an object SV198 is an instance of the BankAccount class.

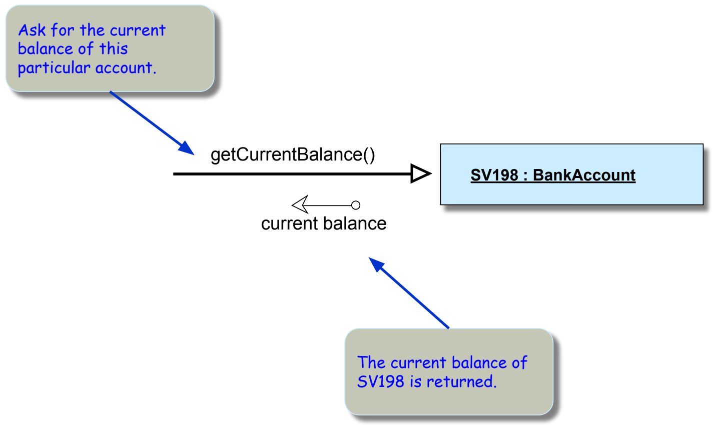
Messages and Methods

- To instruct a class or an object to perform a task, we send a *message* to it.
- You can send a message only to the classes and objects that understand the message you sent to them.
- A class or an object must possess a matching *method* to be able to handle the received message.
- A method defined for a class is called a *class method*, and a method defined for an object is called an *instance method*.
- A value we pass to an object when sending a message is called an *argument* of the message.

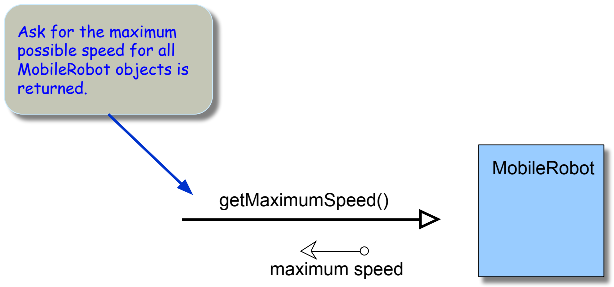
Sending a Message


Message deposit with the argument 250.00 is sent to a BankAccount object SV198.
deposit 250.00
SV198 : BankAccount

Sending a Message and Getting an Answer


Ask for the current balance of this particular account.
getCurrentBalance()
SV198 : BankAccount
current balance
The current balance of SV198 is returned.

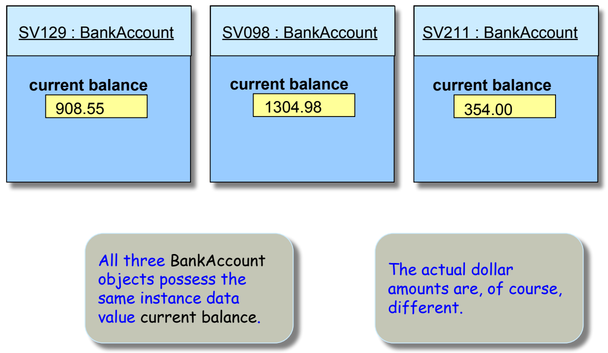
Calling a Class Method


Ask for the maximum possible speed for all MobileRobot objects is returned.
getMaximumSpeed()
MobileRobot
maximum speed

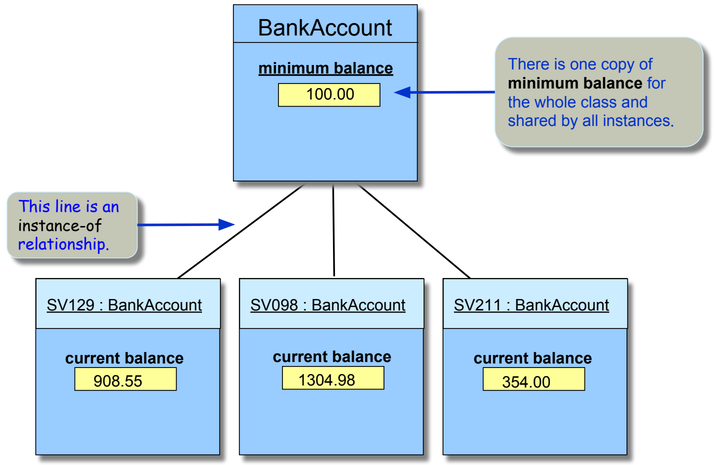
Class and Instance Data Values

- An object is comprised of data values and methods.
- An *instance data value* is used to maintain information specific to individual instances. For example, each BankAccount object maintains its balance.
- A *class data value* is used to maintain information shared by all instances or aggregate information about the instances.
- For example, minimum balance is the information shared by all Account objects, whereas the average balance of all BankAccount objects is an aggregate information.

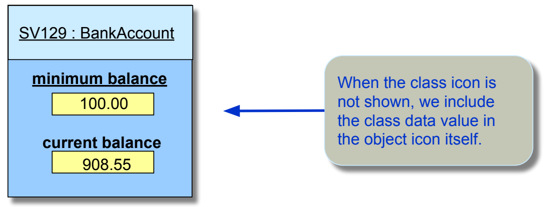
Sample Instance Data Value


SV129 : BankAccount
current balance
908.55
SV098 : BankAccount
current balance
1304.98
SV211 : BankAccount
current balance
354.00
All three BankAccount objects possess the same instance data value current balance.
The actual dollar amounts are, of course, different.

Sample Class Data Value



Object Icon with Class Data Value

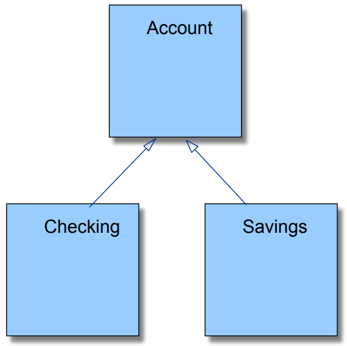

SV129 : BankAccount
minimum balance
100.00
current balance
908.55
When the class icon is not shown, we include the class data value in the object icon itself.

Inheritance

- *Inheritance* is a mechanism in OOP to design two or more entities that are different but share many common features.
  - Features common to all classes are defined in the *superclass.*
  - The classes that inherit common features from the superclass are called *subclasses*.
    - We also call the superclass an *ancestor* and the subclass a *descendant*.

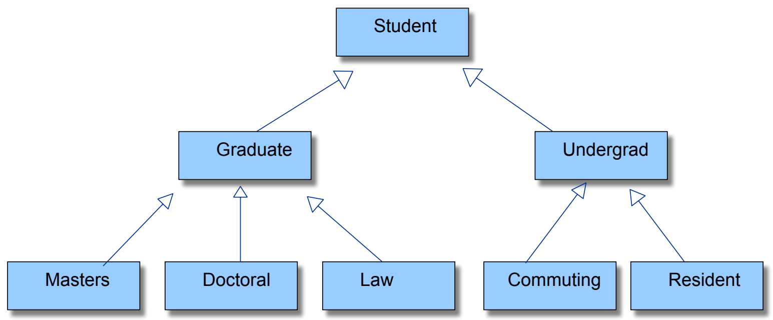
A Sample Inheritance

- Here are the superclass **Account** and its subclasses **Savings** and **Checking**.



Inheritance Hierarchy

- An example of inheritance hierarchy among different types of students.



Software Engineering

- Much like building a skyscraper, we need a disciplined approach in developing complex software applications.
- *Software engineering* is the application of a systematic and disciplined approach to the development, testing, and maintenance of a program.
- In this class, we will learn how to apply sound software engineering principles when we develop sample programs.

Software Life Cycle

- The sequence of stages from conception to operation of a program is called *software life cycle*.
- Five stages are
  - Analysis
  - Design
  - Coding
  - Testing
  - Operation and Maintenance

Eng. Software - Análise

In the analysis phase, we perform a feasibility study. We **analyze** the problem and **determine whether a solution is possible**.

If a solution is possible, the result of this phase is a **requirements specification** which describes the **features** of a program.

Eng. Software - Design

In the design phase, we turn a requirements specification into a **detailed design** of the program.

For an object-oriented design, the output from this phase will be a **set of classes/objects** that fulfill the requirements.

Eng. Software - Coding

In the coding phase, we implement the design into an actual program, in our case, a **Java program**.

Eng. Software - Testes

In the testing phase, we run the program using different sets of data to verify that the program runs according to the specification.

Two types of testing are possible for object-oriented programs: **unit testing** and **integration testing**. With unit testing, we test classes individually. With integration testing, we test that the classes work together correctly.

Eng. Software - Testes

Activity to eliminate programming error is called **debugging**.

An error could be a result of **faulty implementation** or **design**.

When there's an error, we need to backtrack to **earlier phases** to eliminate the error.

Eng. Software - Manutenção

Finally, after the testing is successfully concluded, we enter the **operation phase** in which the program will be put into **actual use**.

The most important and time-consuming activity during the operation phase is software maintenance.