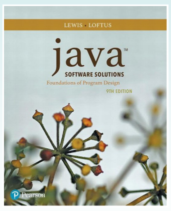
Chapter 1
Introduction



Java Software Solutions

Foundations of Program Design

9th Edition

John Lewis

William Loftus

PEARSON

Focus of the Course

- Object-Oriented Software Development
  - problem solving
  - program design, implementation, and testing
  - object-oriented concepts
    - classes
    - objects
    - encapsulation
    - inheritance
    - polymorphism
  - the Java programming language

Introduction

- We start with the fundamentals of computer processing
- Chapter 1 focuses on:
  - programming and programming languages
  - an introduction to Java
  - an overview of object-oriented concepts

Outline

→ **The Java Programming Language**

Program Development

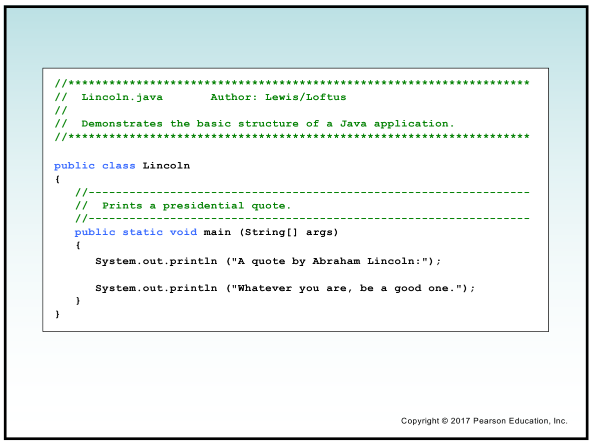
Object-Oriented Programming

Java

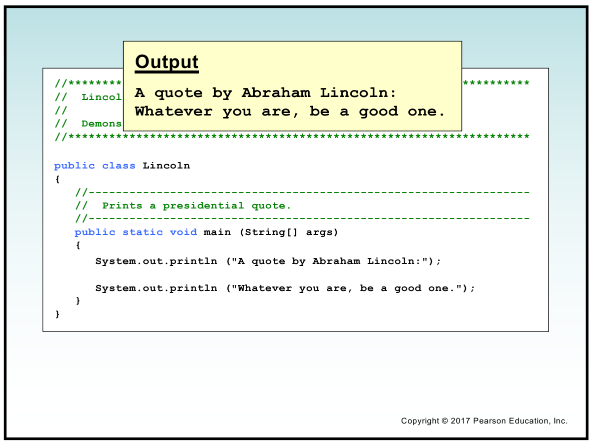
- The Java programming language was created by Sun Microsystems, Inc.
- It was introduced in 1995 and its popularity has grown quickly since
- A *programming language* specifies the words and symbols that we can use to write a program
- A programming language employs a set of rules that dictate how the words and symbols can be put together to form valid *program statements*

Java Program Structure

- In the Java programming language:
  - A program is made up of one or more *classes*
  - A class contains one or more *methods*
  - A method contains program *statements*
- These terms will be explored in detail throughout the course
- A Java application always contains a method called `main`
- See `Lincoln.java`



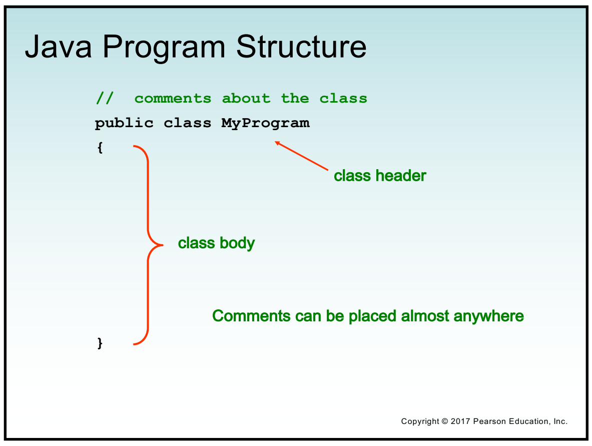
```
//********************************************************************
//  Lincoln.java       Author: Lewis/Loftus
//
//  Demonstrates the basic structure of a Java application.
//********************************************************************

public class Lincoln
{
   //-----------------------------------------------------------------
   //  Prints a presidential quote.
   //-----------------------------------------------------------------
   public static void main (String[] args)
   {
      System.out.println ("A quote by Abraham Lincoln:");

      System.out.println ("Whatever you are, be a good one.");
   }
}
```



Output

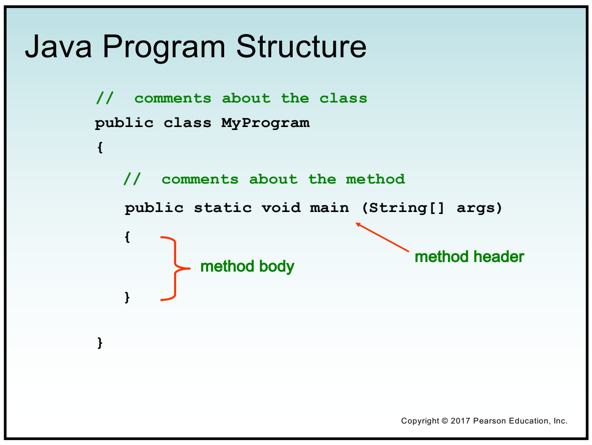
```
A quote by Abraham Lincoln:
Whatever you are, be a good one.
```

```
//********                                              **********
//  Lincol
//
//  Demons
//********************************************************************

public class Lincoln
{
   //-----------------------------------------------------------------
   //  Prints a presidential quote.
   //-----------------------------------------------------------------
   public static void main (String[] args)
   {
      System.out.println ("A quote by Abraham Lincoln:");

      System.out.println ("Whatever you are, be a good one.");
   }
}
```



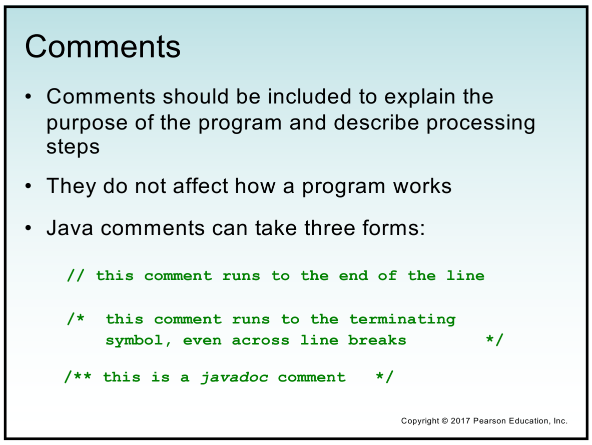
Java Program Structure

```
//  comments about the class
public class MyProgram
{



}
```



Java Program Structure

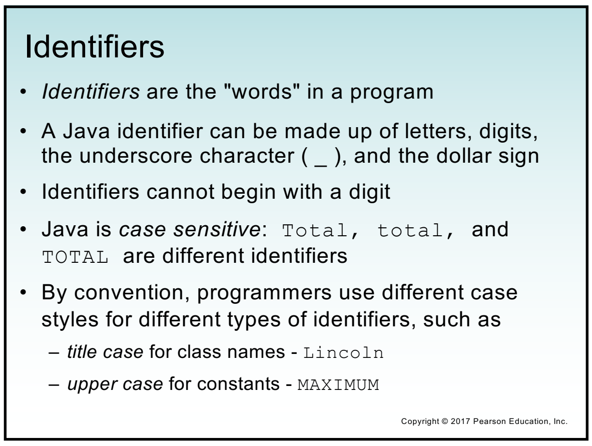
```
//  comments about the class
public class MyProgram
{
   //  comments about the method
   public static void main (String[] args)
   {
                                          method header
         method body

   }

}
```



Comments

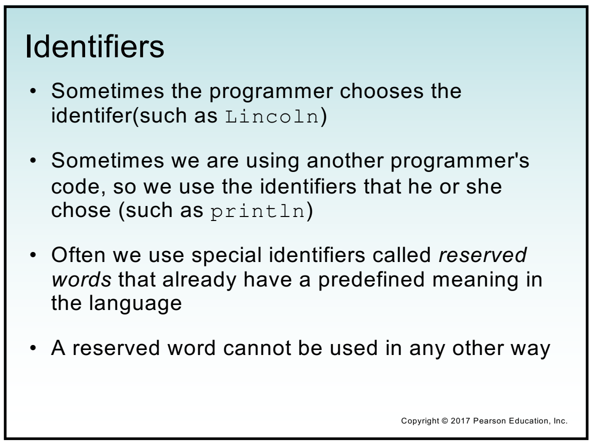
- Comments should be included to explain the purpose of the program and describe processing steps
- They do not affect how a program works
- Java comments can take three forms:

```
// this comment runs to the end of the line

/*  this comment runs to the terminating
    symbol, even across line breaks        */

/** this is a javadoc comment   */
```



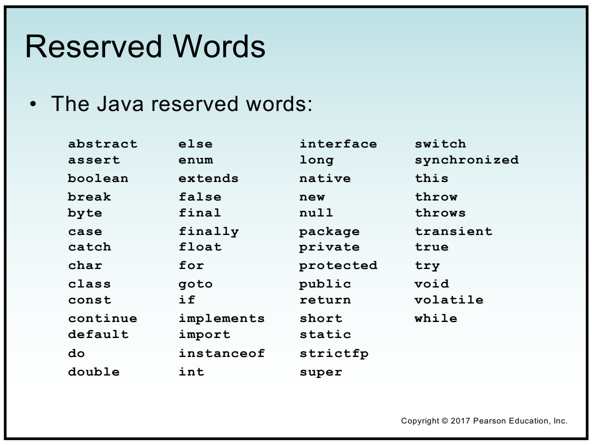
Identifiers

- *Identifiers* are the "words" in a program
- A Java identifier can be made up of letters, digits, the underscore character (_), and the dollar sign
- Identifiers cannot begin with a digit
- Java is *case sensitive*: `Total`, `total`, and `TOTAL` are different identifiers
- By convention, programmers use different case styles for different types of identifiers, such as
  - *title case* for class names - `Lincoln`
  - *upper case* for constants - `MAXIMUM`



Identifiers

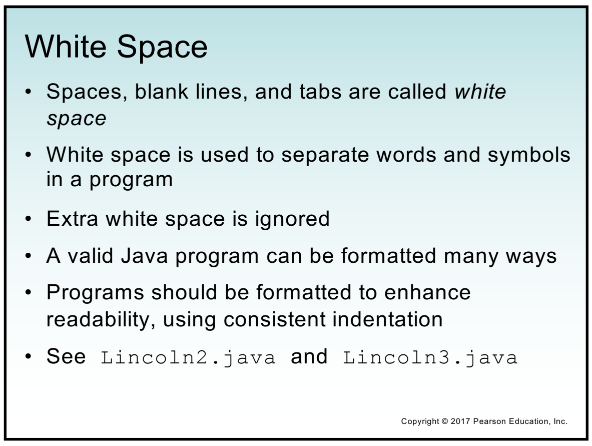
- Sometimes the programmer chooses the identifer(such as `Lincoln`)
- Sometimes we are using another programmer's code, so we use the identifiers that he or she chose (such as `println`)
- Often we use special identifiers called *reserved words* that already have a predefined meaning in the language
- A reserved word cannot be used in any other way



Reserved Words

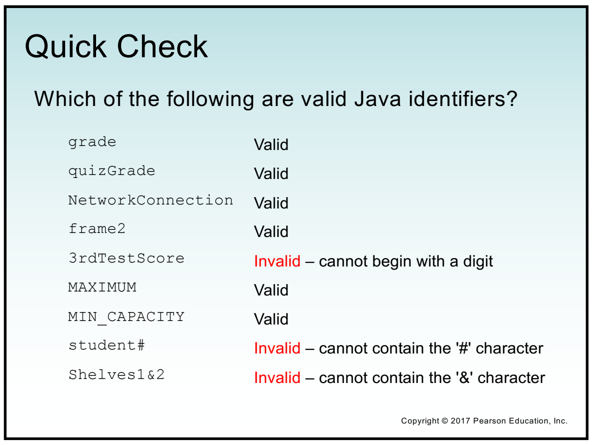
- The Java reserved words:

abstract	else	interface	switch
assert	enum	long	synchronized
boolean	extends	native	this
break	false	new	throw
byte	final	null	throws
case	finally	package	transient
catch	float	private	true
char	for	protected	try
class	goto	public	void
const	if	return	volatile
continue	implements	short	while
default	import	static	
do	instanceof	strictfp	
double	int	super	



White Space

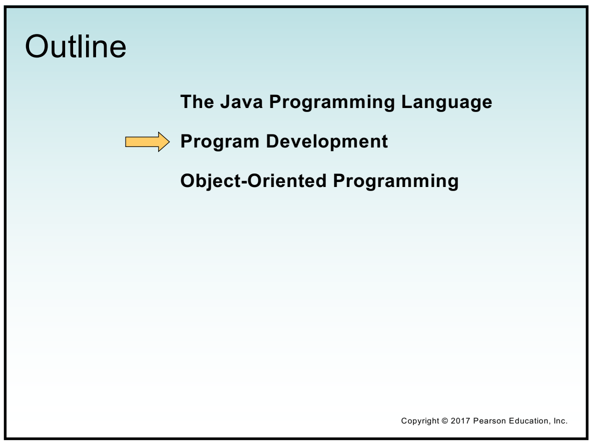
- Spaces, blank lines, and tabs are called *white space*
- White space is used to separate words and symbols in a program
- Extra white space is ignored
- A valid Java program can be formatted many ways
- Programs should be formatted to enhance readability, using consistent indentation
- See `Lincoln2.java` and `Lincoln3.java`



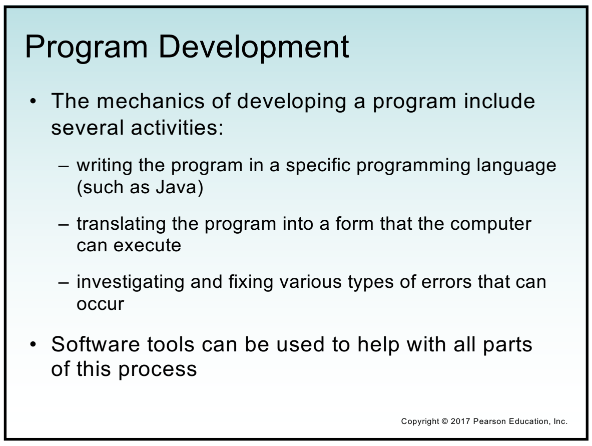
Quick Check

Which of the following are valid Java identifiers?

`grade`	Valid
`quizGrade`	Valid
`NetworkConnection`	Valid
`frame2`	Valid
`3rdTestScore`	Invalid – cannot begin with a digit
`MAXIMUM`	Valid
`MIN_CAPACITY`	Valid
`student#`	Invalid – cannot contain the '#' character
`Shelves1&2`	Invalid – cannot contain the '&' character

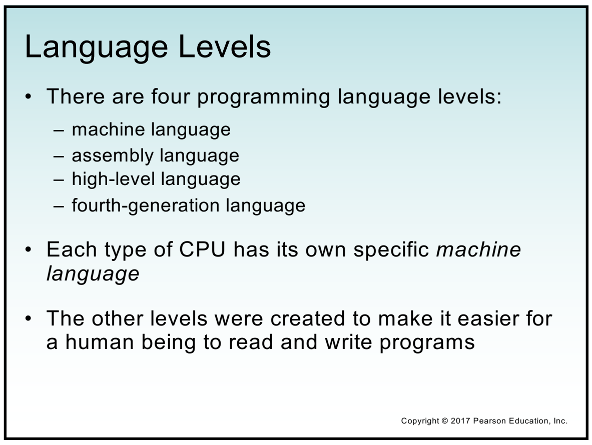


Outline



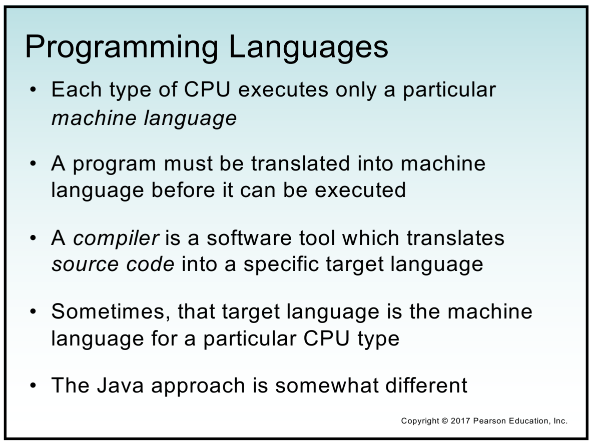
Program Development

- The mechanics of developing a program include several activities:
  – writing the program in a specific programming language (such as Java)
  – translating the program into a form that the computer can execute
  – investigating and fixing various types of errors that can occur
- Software tools can be used to help with all parts of this process



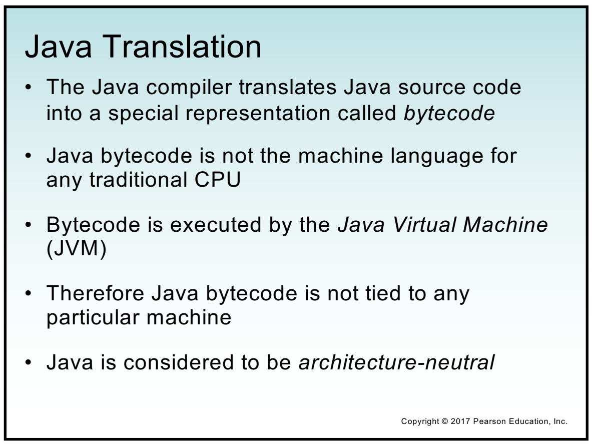
Language Levels

- There are four programming language levels:
  - machine language
  - assembly language
  - high-level language
  - fourth-generation language
- Each type of CPU has its own specific *machine language*
- The other levels were created to make it easier for a human being to read and write programs



Programming Languages

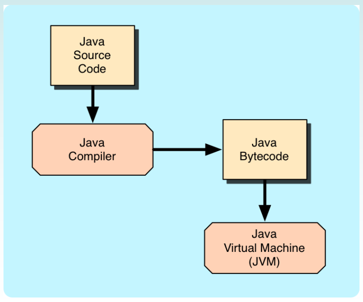
- Each type of CPU executes only a particular *machine language*
- A program must be translated into machine language before it can be executed
- A *compiler* is a software tool which translates *source code* into a specific target language
- Sometimes, that target language is the machine language for a particular CPU type
- The Java approach is somewhat different



Java Translation

- The Java compiler translates Java source code into a special representation called *bytecode*
- Java bytecode is not the machine language for any traditional CPU
- Bytecode is executed by the *Java Virtual Machine* (JVM)
- Therefore Java bytecode is not tied to any particular machine
- Java is considered to be *architecture-neutral*

Java Translation



Development Environments

- There are many programs that support the development of Java software, including:
  - **Java Development Kit (JDK)**
  - Eclipse
  - NetBeans
  - IntelliJ
  - BlueJ
  - **jGRASP**
- Though the details of these environments differ, the basic compilation and execution process is essentially the same

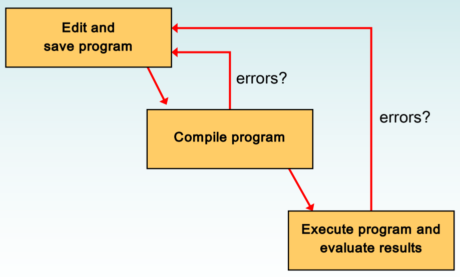
Syntax and Semantics

- The *syntax rules* of a language define how we can put together symbols, reserved words, and identifiers to make a valid program
- The *semantics* of a program statement define what that statement means (its purpose or role in a program)
- A program that is syntactically correct is not necessarily logically (semantically) correct
- A program will always do what we tell it to do, not what we meant to tell it to do

Errors

- A program can have three types of errors
- The compiler will find syntax errors and other basic problems (*compile-time errors*)
  - If compile-time errors exist, an executable version of the program is not created
- A problem can occur during program execution, such as trying to divide by zero, which causes a program to terminate abnormally (*run-time errors*)
- A program may run, but produce incorrect results, perhaps using an incorrect formula (*logical errors*)

Basic Program Development

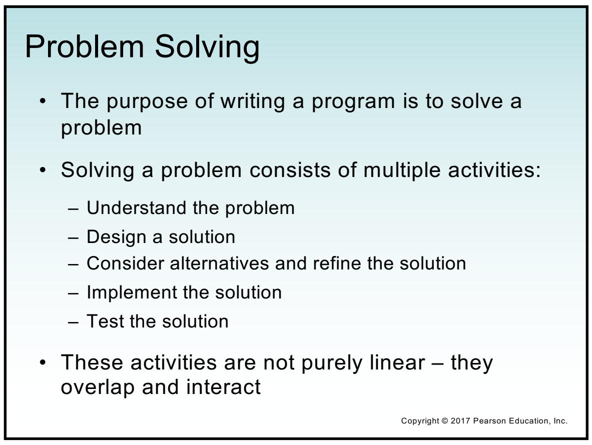


Outline

The Java Programming Language

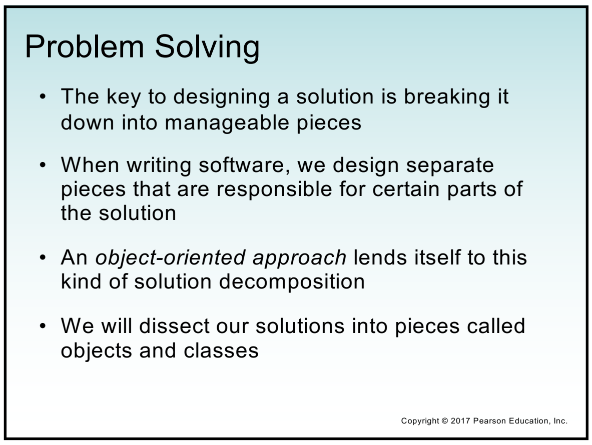
Program Development

➡ **Object-Oriented Programming**



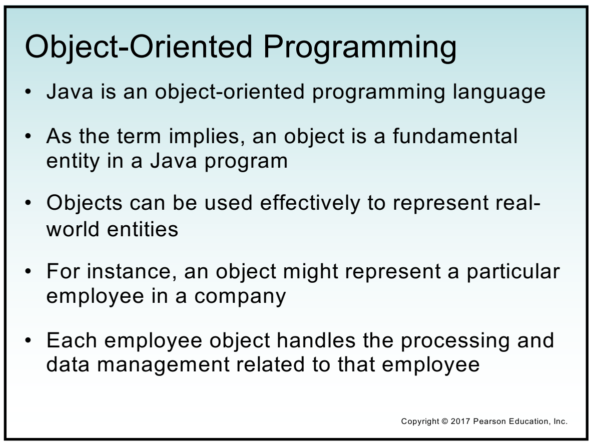
Problem Solving

- The purpose of writing a program is to solve a problem
- Solving a problem consists of multiple activities:
  - Understand the problem
  - Design a solution
  - Consider alternatives and refine the solution
  - Implement the solution
  - Test the solution
- These activities are not purely linear – they overlap and interact



Problem Solving

- The key to designing a solution is breaking it down into manageable pieces
- When writing software, we design separate pieces that are responsible for certain parts of the solution
- An *object-oriented approach* lends itself to this kind of solution decomposition
- We will dissect our solutions into pieces called objects and classes



Object-Oriented Programming

- Java is an object-oriented programming language
- As the term implies, an object is a fundamental entity in a Java program
- Objects can be used effectively to represent real-world entities
- For instance, an object might represent a particular employee in a company
- Each employee object handles the processing and data management related to that employee

Objects

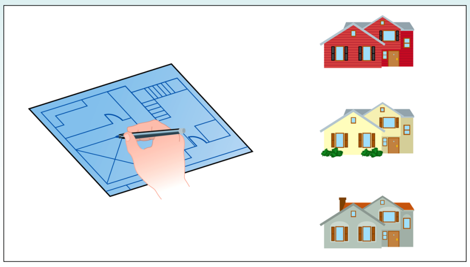
- An object has:
  - *state* - descriptive characteristics
  - *behaviors* - what it can do (or what can be done to it)
- The state of a bank account includes its account number and its current balance
- The behaviors associated with a bank account include the ability to make deposits and withdrawals
- Note that the behavior of an object might change its state

Classes

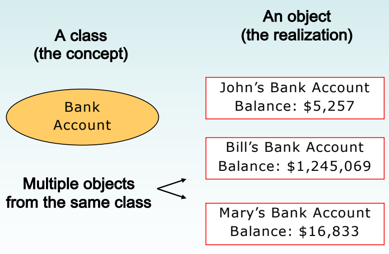
- An object is defined by a *class*
- A class is the blueprint of an object
- The class uses methods to define the behaviors of the object
- The class that contains the main method of a Java program represents the entire program
- A class represents a concept, and an object represents the embodiment of that concept
- Multiple objects can be created from the same class

Class = Blueprint

- One blueprint to create several similar, but different, houses:

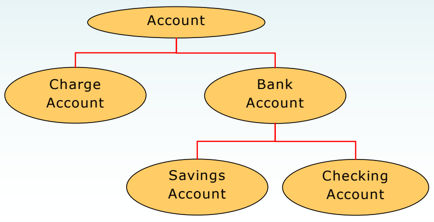


Objects and Classes



Inheritance

- One class can be used to derive another via *inheritance*
- Classes can be organized into hierarchies



Summary

- Chapter 1 focused on:
  - programming and programming languages
  - an introduction to Java
  - an overview of object-oriented concepts