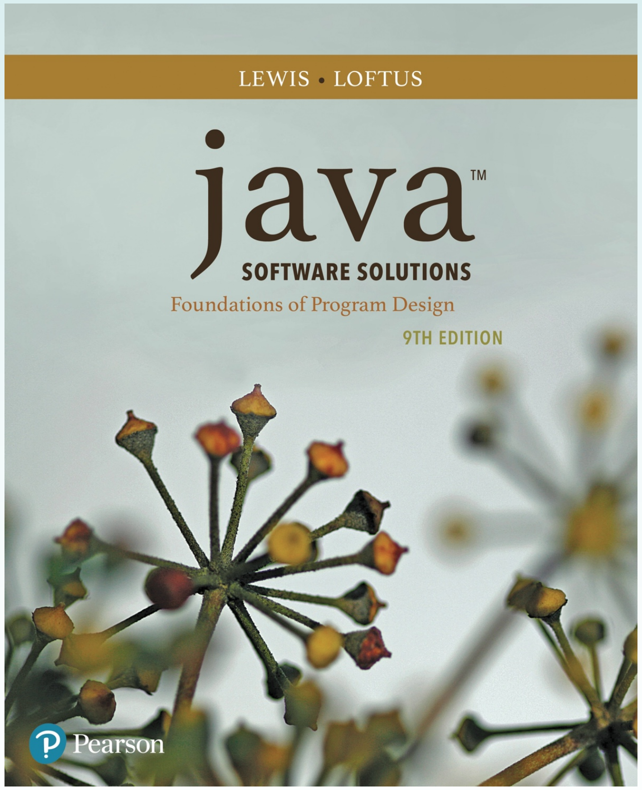
Chapter 1
Introduction



Java Software Solutions

Foundations of Program Design

9th Edition

John Lewis
William Loftus

Focus of the Course

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

Instructor

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- Ph.D. Computer Science
- 5 years in US research laboratory
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  - learn.bcit.ca Comp1510 course (Learning Hub or D2L)

Course Outline: *Read It*

- Evaluation methods
- Required texts
- Course marking guidelines and details
  - quizzes, assignments, midterm, final
- Lectures
- Labs
- Policies and procedures

Expectations

- Polite and civilized behaviour
  - Respect for classmates and instructors
  - One person at a time talking
  - No cell phones
  - No latecomers
  - Feel free to remind your classmates
- Lots of hard work and learning
  - Take responsibility for *your* learning
  - Read the assigned reading before lecture
  - Look at the assignments when they are posted
- Fun and Magic
  - Programming is creating something from nothing

How Much Effort to Put Into This Course?

- This is the foundation for the other programming courses in CST
  - More Java, C, C++, C#
- *All* second year options have programming content
- Comp 1510 is a prerequisite to three second term courses
  - Comp 2510 C, Comp 2526 Java II, Comp 2721 Architecture
  - You will be blocked from these without this course
- Be sure to master this course!!!

How Much Effort to Put Into This Course?

- Expect learning *may* be hard
  - You are rewiring your brain with new habits
  - If you have prior knowledge you may need to unlearn it
- Choose to make the commitment to put in the required effort
  - Burdens freely chosen are lighter
- Programming is learned by doing
  - You will have times of frustration before finding solutions to problems
  - This is normal – never give up
  - You are also learning to work hard

Train and Tame your Mind

- Software development is a mental activity
  - Need sound mind in sound body
- General mental development can help you succeed
- Mindfulness training and meditation
  - BCIT mindfulness workshops and practice
  - Sam Harris' Waking Up app
  - Help with eating, smoking, anxiety
- Self knowledge
  - Where you are coming from; where you are going
  - Your Big-5 personality
  - Your Jungean personality

Meditation Apps

- Not strictly necessary but may be helpful at first
- These seem to be based in authentic practice
  - Waking Up with Sam Harris
    - Totally secular but based on deep Tibetan meditation
  - Headspace by Andy Puddicombe
    - Popular for beginners, too cute for my taste
  - Ten Percent Happier by Dan Harris
    - Lots of authentic meditation teachers
  - Insight Timer App
    - Large free library of guided meditations
    - Good for experienced meditators

Introduction

- We start with the fundamentals of computer processing

- Chapter 1 focuses on:
  - components of a computer
  - how computers store and manipulate information
  - computer networks
  - the Internet and the World Wide Web
  - programming and programming languages
  - an introduction to Java
  - an overview of object-oriented concepts

Outline

Computer Processing

Hardware Components

Networks

➡ 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 it's 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 Versions

- Versions are important – pay attention
- Java is very active with a new version coming every 6 months with new features
  - The new one replaces the old one which becomes unsupported
- Periodically, a version is chosen for long term support (LTS)
  - We are using Java 11, the latest LTS version
  - Do not install newer versions

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`

Java Program Structure

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




}
```

class header

class body

Comments can be placed almost anywhere

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 identifier (such as `Lincoln`)
- Sometimes we are using another programmer's code, so we use the identifiers that they chose (such as `println`)
- Some things that look like identifiers are called *reserved words*
  - These are used for the structure of the program
- Reserved words cannot be used as identifiers

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`	

Quick Check

Which of the following are valid Java identifiers?

```
grade
quizGrade
NetworkConnection
frame2
3rdTestScore
MAXIMUM
MIN_CAPACITY
student#
Shelves1&2
```

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

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`

Outline

Computer Processing

Hardware Components

Networks

The Java Programming Language

➡ Program Development

Object-Oriented Programming

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

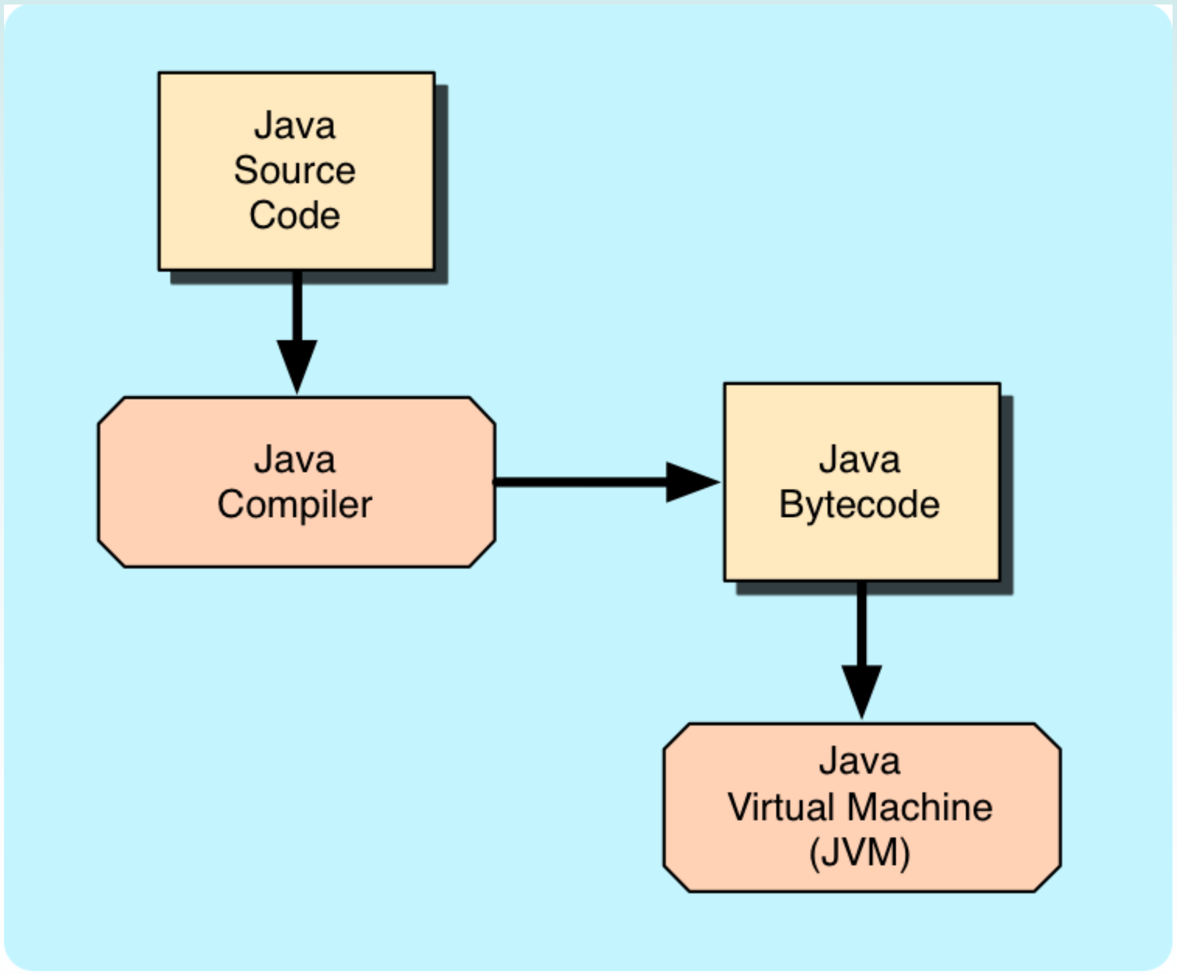
Programming Languages

- 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
  - BlueJ
  - jGRASP
- Though the details of these environments differ, the basic compilation and execution process is essentially the same

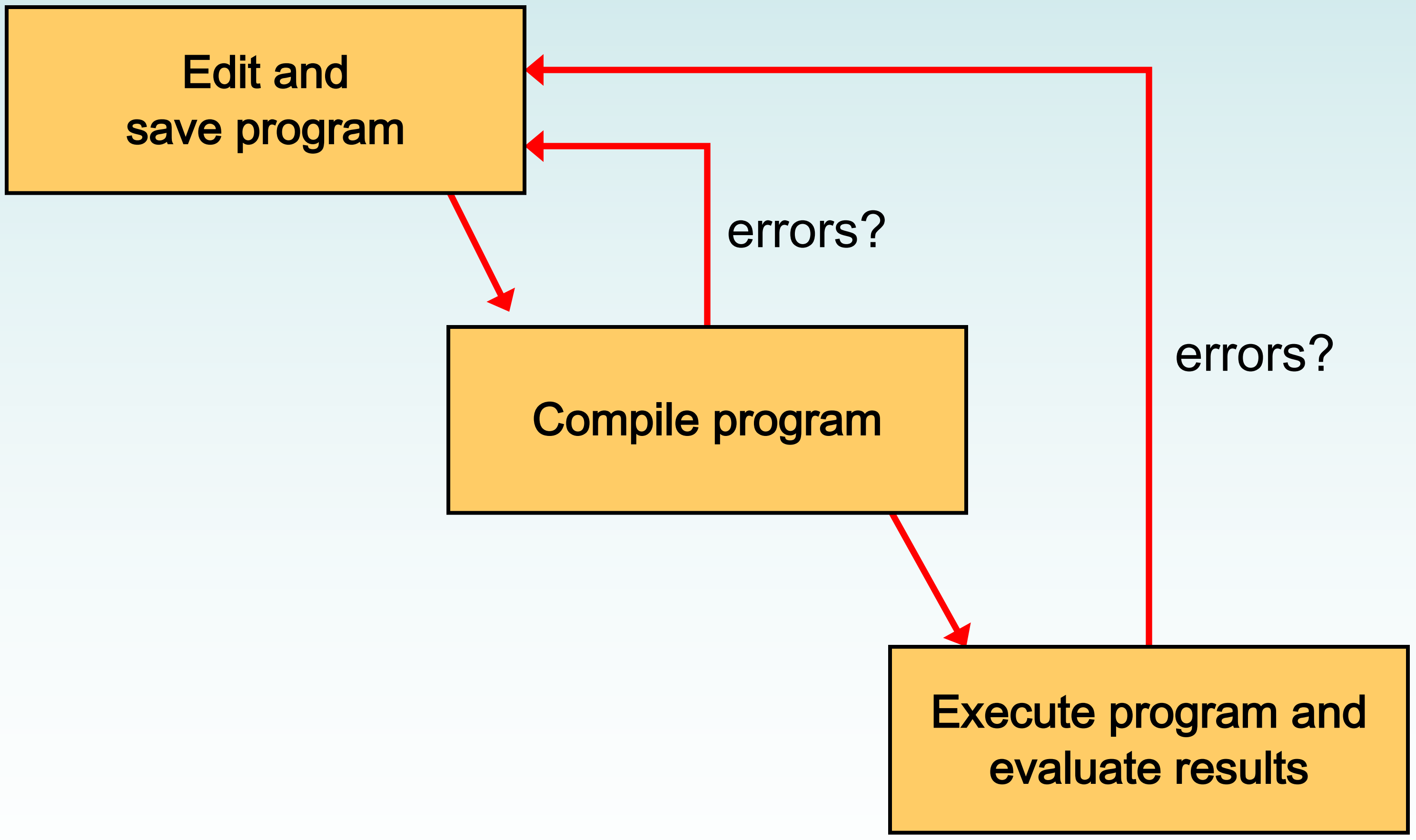
Syntax and Semantics

- 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 <u>meant</u> 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

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

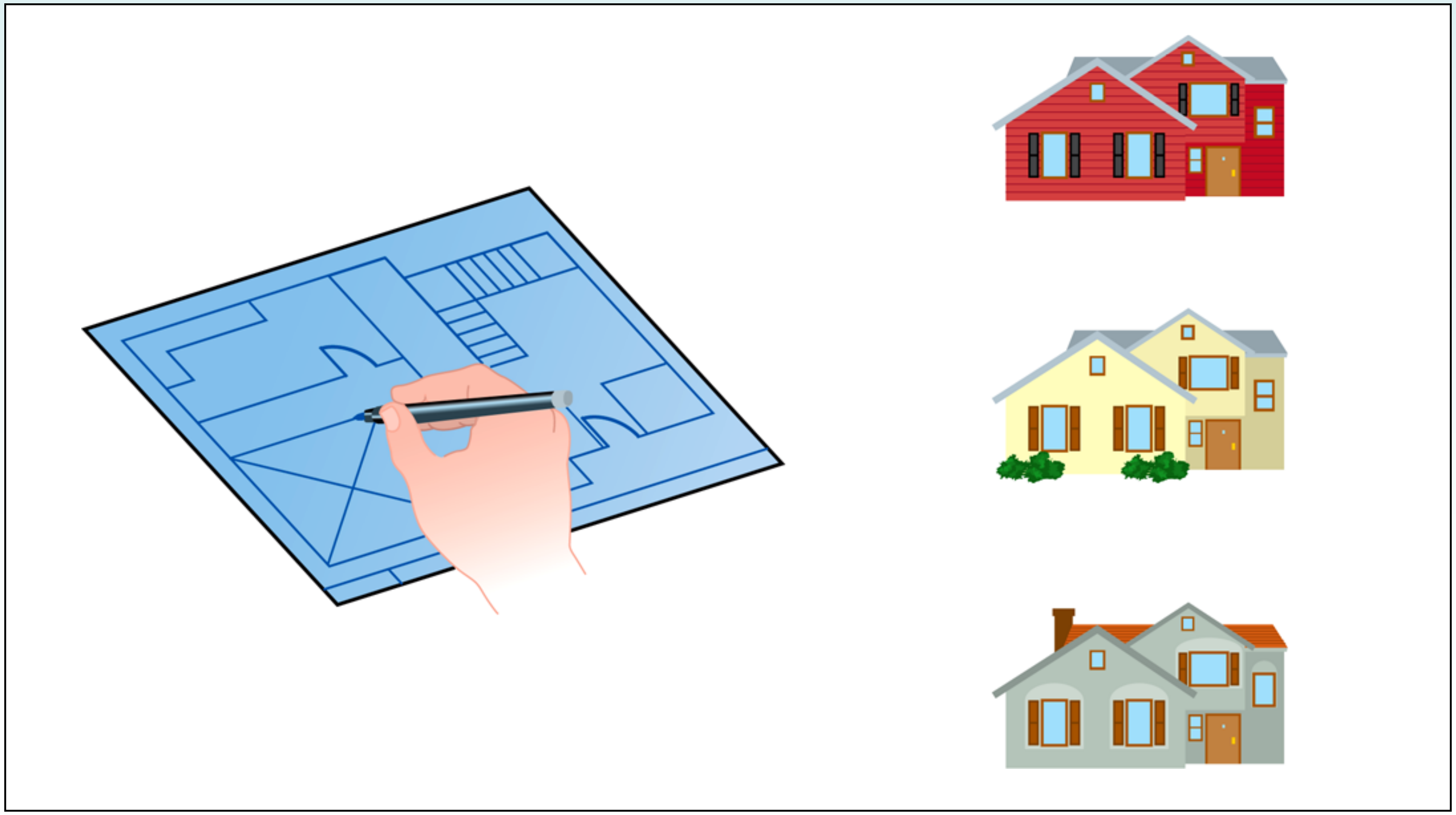
- An object has:
  - *state* - descriptive characteristics
  - *behaviors* - what it can do (or what can be done to it)
- The state of a bank account includes its account number and its current balance
- The behaviors associated with a bank account include the ability to make deposits and withdrawals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

Classes

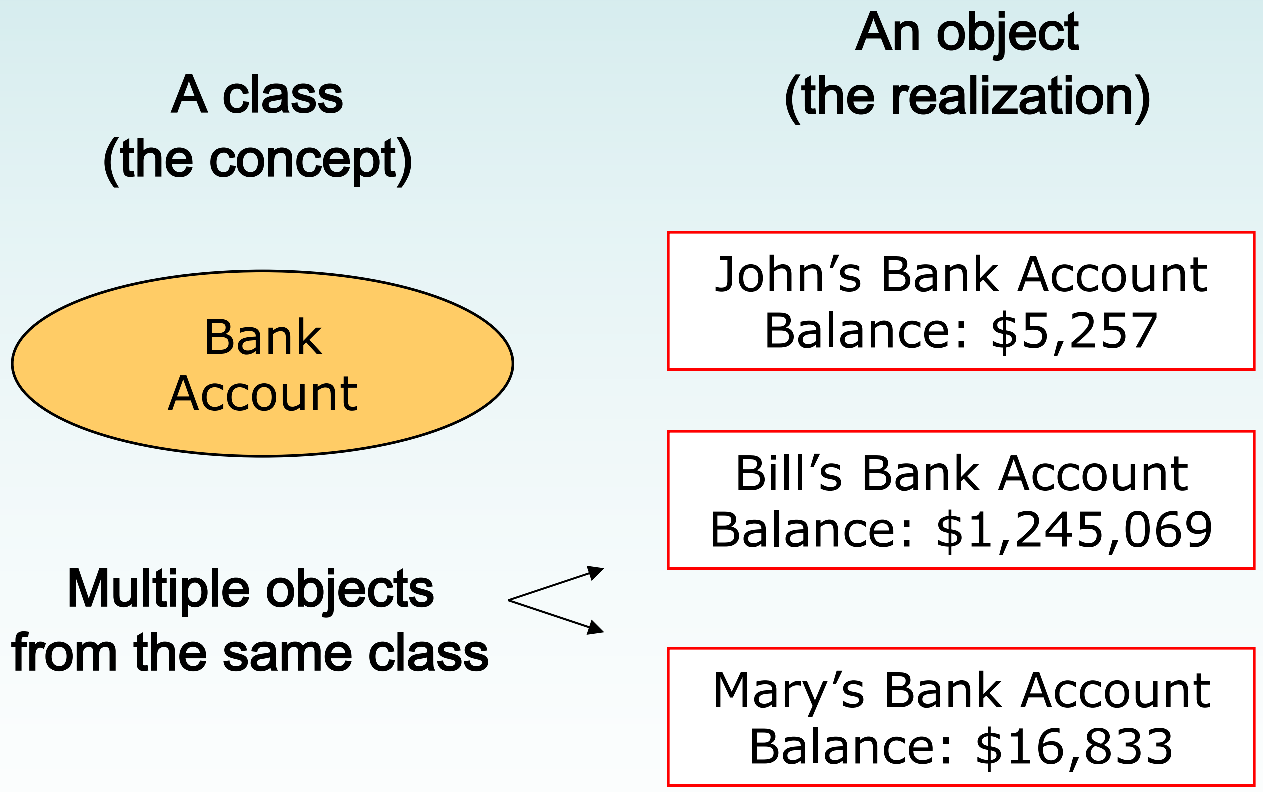
- An object is defined by a *class*
- A class is the blueprint of an object
- The class uses methods to define the behaviors of the object
- The class that contains the main method of a Java program represents the entire program
- A class represents a concept, and an object represents the embodiment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

Class = Blueprint

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

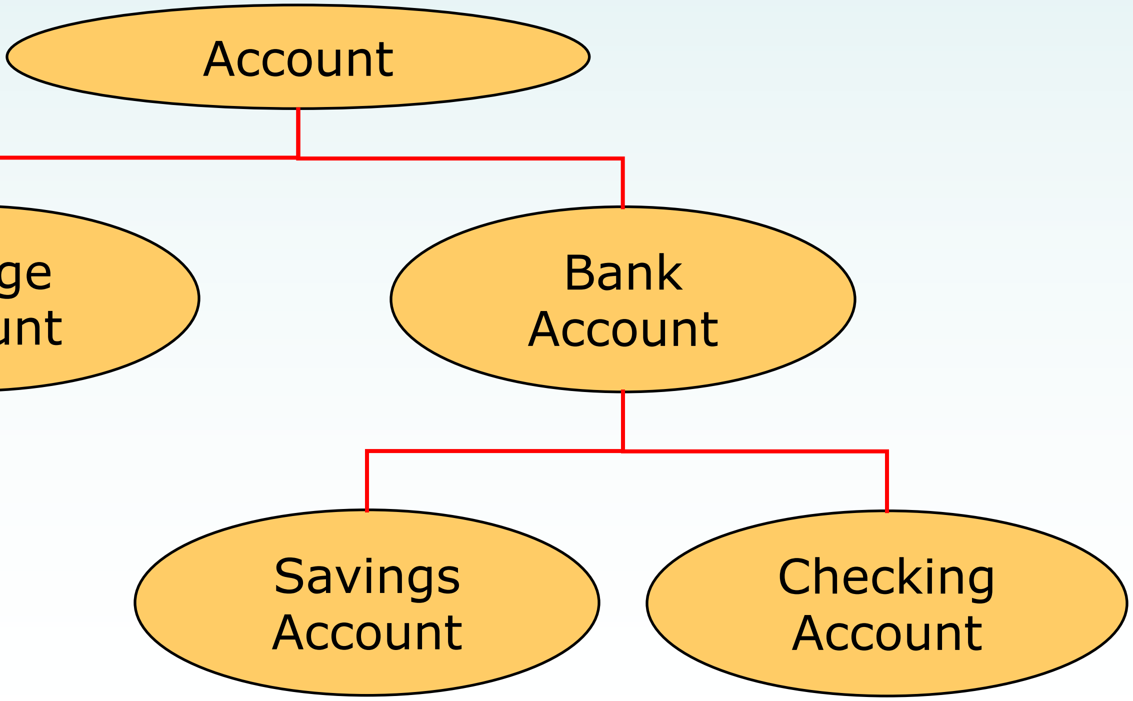


Objects and Classes



Inheritance

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



Summary

- Chapter 1 focused on:
  - components of a computer
  - how those components interact
  - how computers store and manipulate information
  - computer networks
  - the Internet and the World Wide Web
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  - an introduction to Java
  - an overview of object-oriented concepts