Java Revisited

CS212:Data Structure

Today

•Object Oriented Programming (OOP): What, Why, How?
•Analyzing and Designing OO Programs (Objects & Classes)
•Java Syntax, Java Program Skeleton
•Analyzing and Designing a Program
•Preparing Classes.

OOP: What?

- Thinking of Objects!
- What is the form of “Things” in the world?
- Define an Object!!

It’s a thing that have a status and can perform functions

OOP: What?

- An approach to the solution of problems in which all computations are performed in the context of objects.
    - The objects are instances of classes, which:
        - are data abstractions
        - contain procedural abstractions that operate on the objects
    - A running program can be seen as a collection of objects collaborating to perform a given task

OOP: Why?

- Object-Oriented Programming consists of 3 primary ideas:
  - Data Abstraction and Encapsulation
    - Operations on the data are considered to be part of the data type
    - We can understand and use a data type without knowing all of its implementation details
      - Neither how the data is represented nor how the operations are implemented
      - We just need to know the interface (or method headers) – how to "communicate" with the object
      - Compare to functional abstraction with methods

OOP: Why?

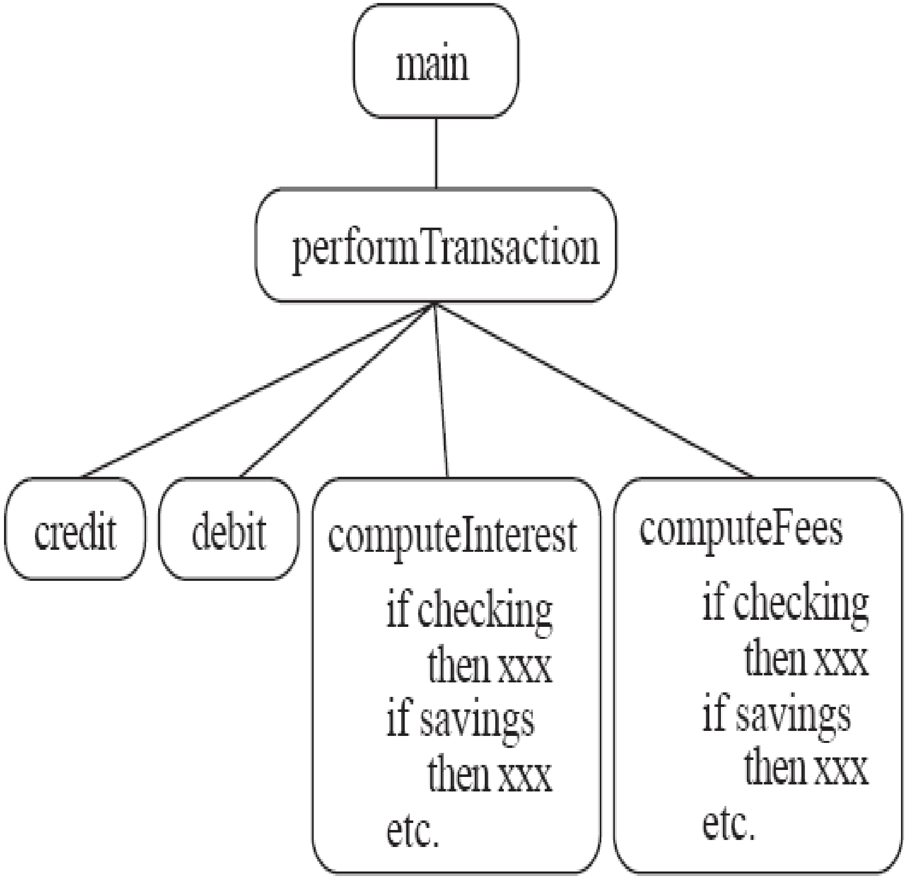
- Inheritance
  - Properties of a data type can be passed down to a sub-type – we can build new types from old ones
  - We can build class hierarchies with many levels of inheritance
- Polymorphism
  - Operations used with a variable are based on the class of the object being accessed, not the class of the variable
  - Parent type and sub-type objects can be accessed in a consistent way

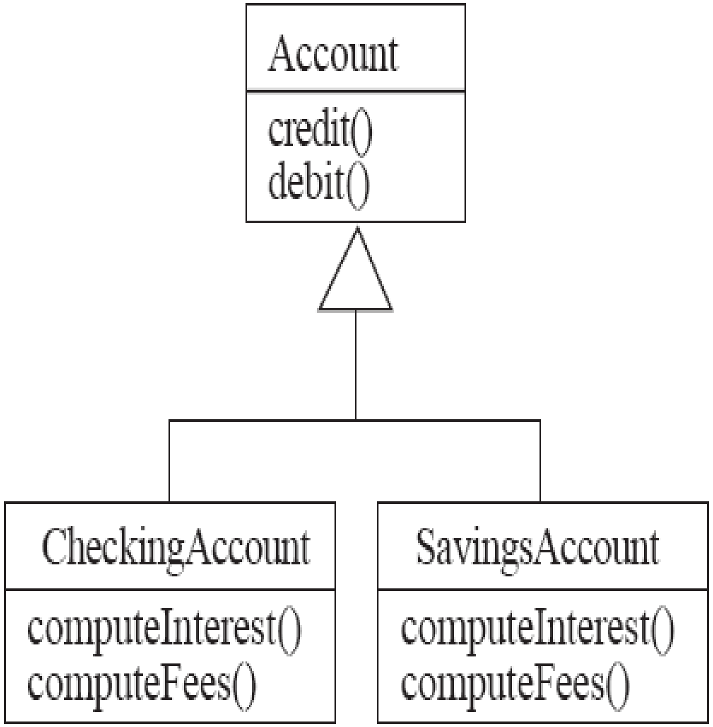
OOP vs. Procedural Programming

- Procedural paradigm:
  - Software is organized around the notion of *procedures*
  - *Procedural abstraction*
    - Works as long as the data is simple
  - *Adding data abstractions*
    - Groups together the pieces of data that describe some entity
    - Helps reduce the system’s complexity.
      - Such as *Records* and *structures*

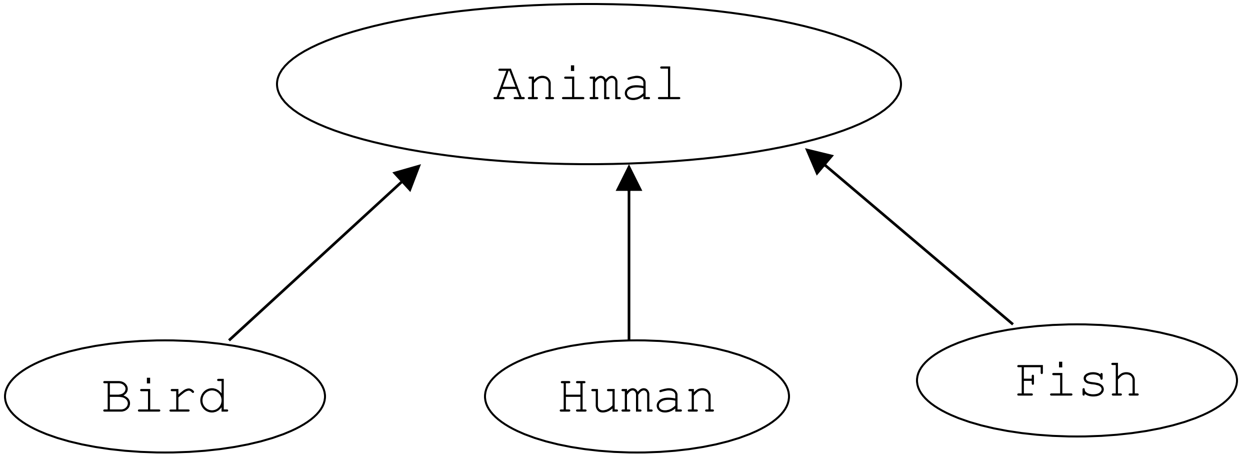
- Object oriented paradigm:
  - Organizing procedural abstractions in the context of data abstractions

OOP vs. Procedural Programming



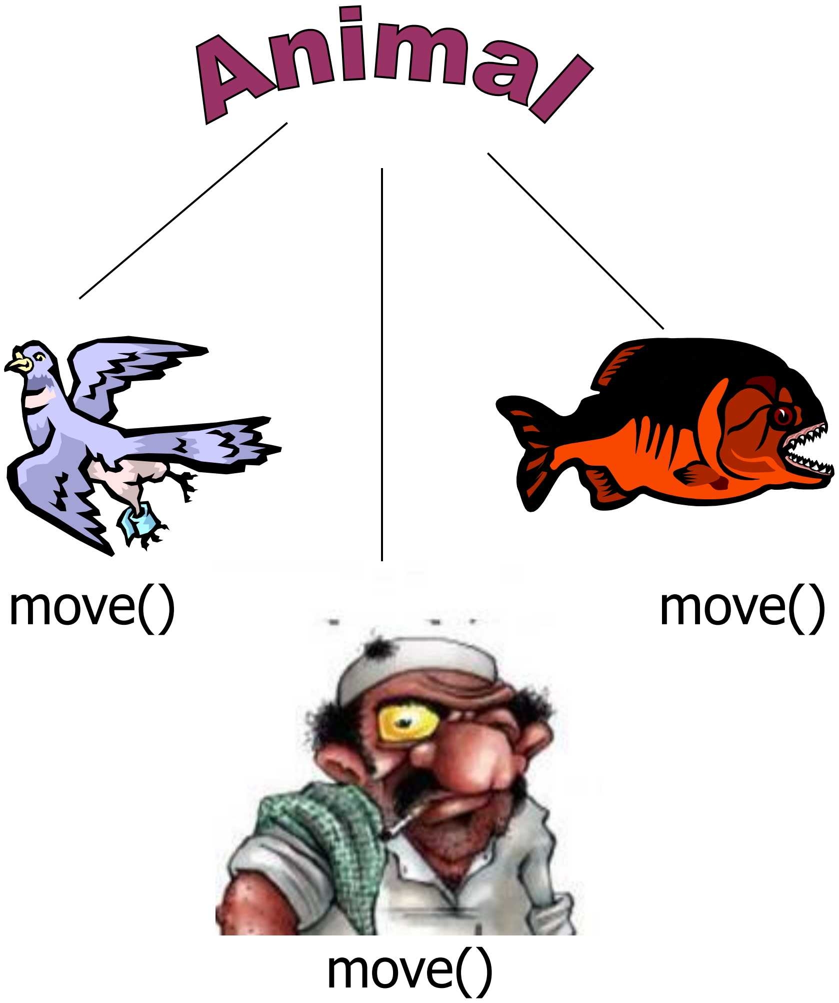


OOP: Inheritance



- Bird, Human and Fish are all Animals
- However, an Animal is not necessarily a Bird, Human or Fish

OOP: Polymorphism



Animal

move()

move()

move()

Analysis & Design and OOP

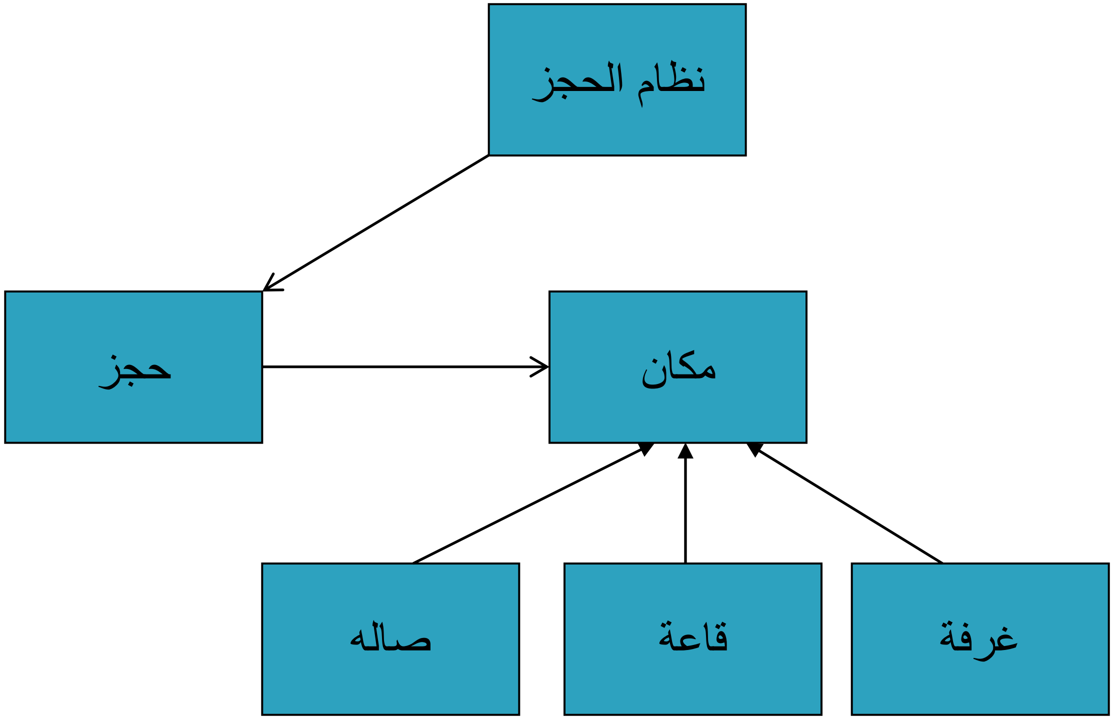
- How To Define Objects in a Program?
- How dose objects interact?
- Classes What are they?
- Skeleton of a class

Finding Objects

- Objects = nouns
- Functions to be encapsulated

فندق به عدد من الغرف السكنية المخصصه للإيجار اليومي و صالات أفراح و قاعات إجتمات كلها تؤجر بالساعة المطلوب إعداد برنامج للحجز للفندق بحيث يعرض للمستخدم الغرف أو القاعات المتوفره و يمكن المستخدم من حجز أحدها

Objects interaction



Classes

- A class:
  - A unit of abstraction in an object oriented (OO) program
  - Represents similar objects
    - Its *instances*
  - A kind of software module
    - Describes its instances' structure (properties)
    - Contains *methods* to implement their behavior

Class Structure

- Two Main Sections
  - Variables: can be a simple data type or another Class
    - Represent the State of the Class
    - Define Data represented in an Class
    - Associations
  - Operations :A procedural abstraction used to implement the behaviour of a class.

Skelton of a Class

```
class Name {
        // Attributes
        Type Name;

        Constructor {
        }

        Setter {
        }
        Getter{
        }
        Operations{
        }
}
```

What is Java?

- Java is a programming language created by James Gosling from Sun Microsystems in 1991. The first public available version of Java (Java 1.0) was released 1995.
- The target of the Java programming language was that a program can be written once and then runs on multiple operating systems.
- The Java programming language consists out of a Java compiler, the Java virtual machines, and the Java class libraries.
- The Java virtual machine is a software implementation of a computer that executes programs like a real machine.
- The Java virtual machine is written specifically for a specific operating system.

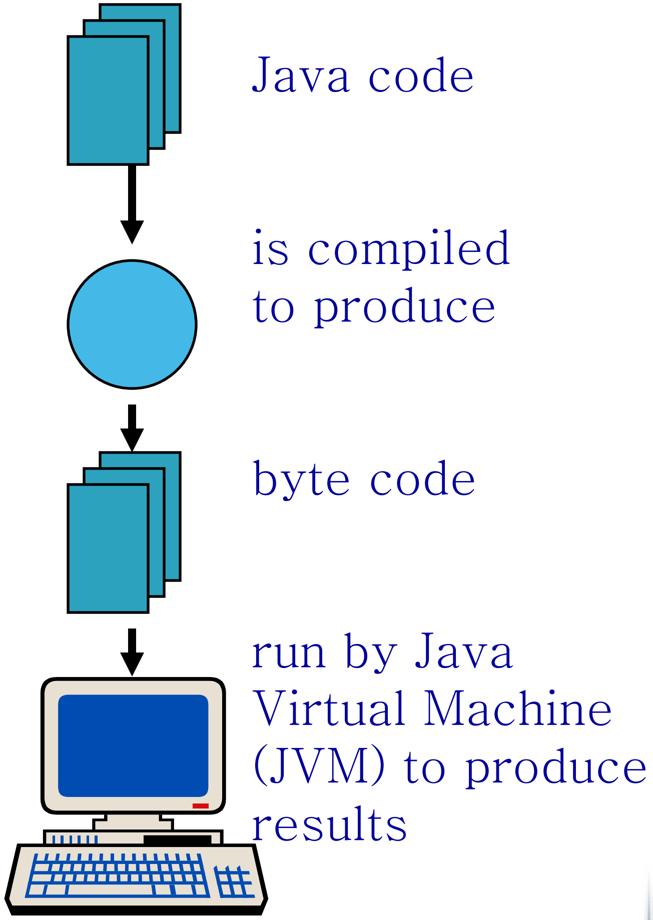
Why Java?

- Java tries to deliver the promise of „Write once, run everywhere“
- Characteristics:
  - Platform independent
  - Object-orientated programming language
  - Strongly-typed programming language
  - Interpreted and compiled language
  - Automatic memory management
  - Single inheriance

- The Java programming language is actively developed via the Java Community Process (JCP)
- Watchout: Java is case-sensitive!!!

Architecture of Java Applications

- Java applications are written as text files
- The java compiler creates platform independent code which is called bytecode.
- Bytecode can be executed by the java runtime environment.
- The Java virtual machine is a program which knows how to run the bytecode on the operating system the JRE is installed upon.
- The JRE translates the bytecode into native code, e.g. the native code for Linux is different then the native code for Windows.



How Dose It Look?

```
public class Hello  {
          public static void main(String args[])
          {
                    System.out.println("Hello World”);
           }
}    /* end of program */
```

Java Rules

- name of class is same as name of file (which has .java extension)
- body of class surrounded by { }
- this class has one method called main
  - all Java applications must have a main method in one of the classes
  - execution starts here
  - body of method within { }
- all other statements end with semicolon ;

Java Rules

- keywords appear in **bold**
  - reserved by Java for predefined purpose
  - don’t use them for your own variable, attribute or method names!
- **public**
  - visibility could be **private**
- **static**
  - the main method belongs to the Hello class, and not an instance (object) of the class
- **void**
  - method does not return a value

Variables and data types

String name=“ALi”;

- name is a variable of type String
- we have to declare variables before we use them
- unlike C, variables can be declared anywhere within block
- use meaningful names   numberOfBricks
- start with lower case
- capitalise first letter of subsequent words

Data types

- int 4 byte integer (whole number)
  - range –2147483648 to +2147483648
- float 4 byte floating point number
  - decimal points, numbers outside range of int
- double 8 byte floating point number
  - 15 decimal digits (float has 7) so bigger precision and range
- char 2 byte letter
- String string of letters
- boolean true or false (not 1 or 0)

System output

- Java provides print methods in the class System.out (don’t need to import)
- println(name);
  - prints out what is stored in *name*, then goes to a new line
- print(name);
  - prints out what is stored in *name,* but does not start a new line
- print("My name is " + name);
  - put text in quotes
  - use + to print more than one item

Methods in Java

- methods break down large problems into smaller ones
- your program may call the same method many times
  - saves writing and maintaining same code
- methods take parameters
  - information needed to do their job
- methods can return a value
  - must specify type of value returned

Example method

signature

```
public static int addNums(int num1, int
  num2)
{
        int answer = num1 + num2;
        return answer;
}
```

body

Method signature

visibility [static] returnType methodName(parameterList)

- visibility:
  - public
    - accessible to other objects and classes
  - protected
    - accessible to classes which inherit from this one
  - private
- static keyword:
  - use when method belongs to class as whole
    - not object of the class

Method signature

visibility [static] returnType methodName(parameterList)

- return type:
  - specifies type of information returned
  - can be a simple type
    - **int, float, double, char,** String, **boolean**
  - or a class
  - if nothing returned, use keyword **void**
- method name:
  - use meaningful name which describes what method does!

Method signature

- parameter list:
  - information needed by method
  - pairs of *type name*
  - examples:

    addNums(**int** num1, **int** num2)

    drawPerson(**boolean** isBald, String name, **int** numEarrings)
  - use empty brackets if method has no parameters

    printHeadings()

Method body

- use curly brackets to enclose method body
- all your code goes in here
  - write it so the method does what you intended
- last line should return a value of appropriate type
  - must match type in method header
  - nothing is executed after **return** statement
  - if method returns **void,** can omit **return** statement
    - method will automatically return at closing }

Calling a method

- methods will not run unless called from elsewhere
  - a statement in main() method could call another method
  - this method could call a third method .....
- class methods are called with the form:

  ClassName.methodName(parameters);
  - omit ClassName if called in same class
- method name and parameters must match the method signature
- if the method returns a value, it can be stored in a variable or passed to another method

Calling methods

```
public static void main(String args[])
{
    int input;
    input = Console.readInt("Number? ");
    System.out.print("Your number plus 3 is ");
    System.out.println(addNums(input, 3));
}
```

Extending Classes

- Inheritance in Java is implemented by extending a class

```
public class NewClass extends OldClass
{
   ...
```

  - We then continue the definition of NewClass as normal
  - However, implicit in NewClass are all data and operations associated with OldClass
    - Even though we don’t see them in the definition

ToDo

- Read Chapter 1 of the Textbook.
- Install eclipse or any java editor you fancy.
- Start programming …