Introduction To Object-Oriented Programming

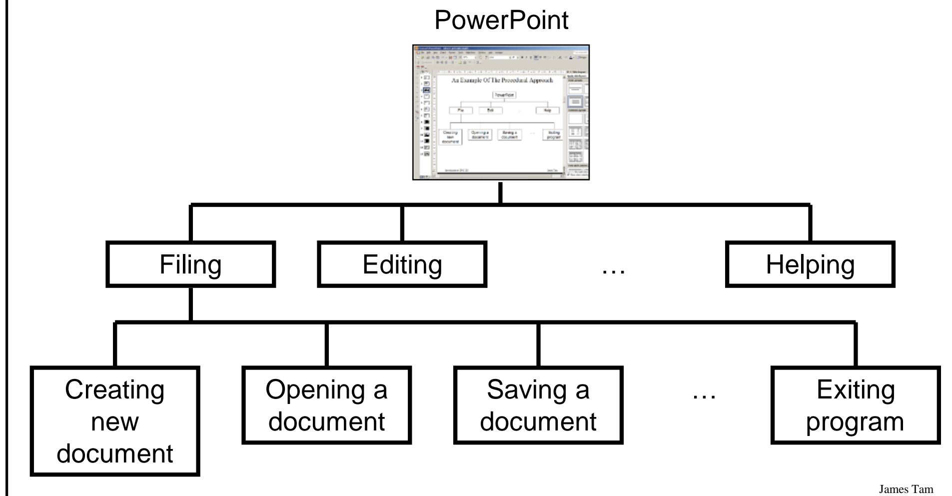
Basic Object-Oriented principles such as encapsulation, overloading as well the object-oriented approach to design.

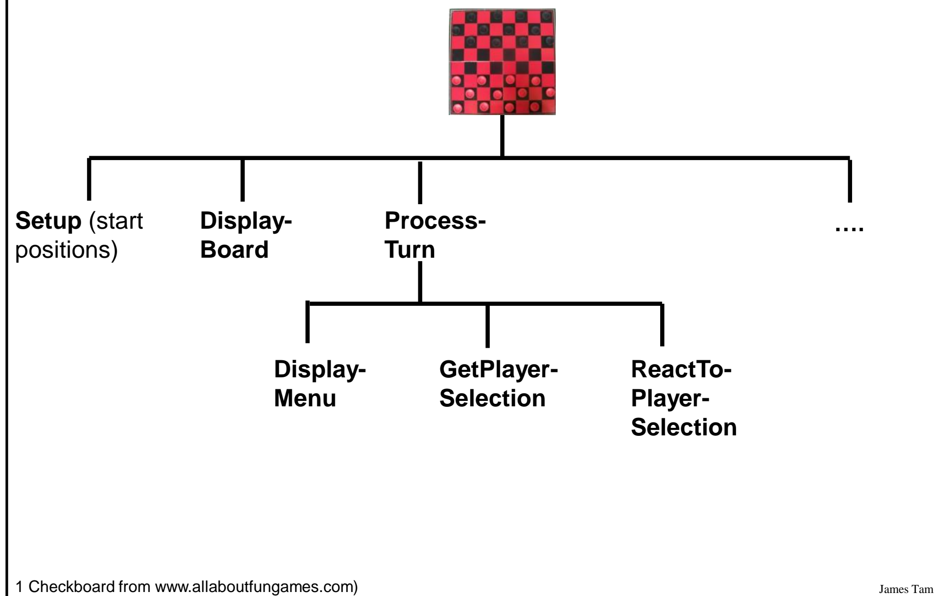
James Tam

Reminder: What You Know

- There are different approaches to writing computer programs.
- They all involve decomposing your programs into parts.
- What is different between the approaches (how the decomposition occurs)/(criteria used for breaking things down")
- There approach to decomposition you have been introduced to thus far:
  - Procedural
  - Object-Oriented (~2 weeks for CPSC 231, not a required topic for CPSC 217)

James Tam


An Example Of The Procedural Approach (Presentation Software)
•Break down the program by what it does (described with actions/verbs)
PowerPoint
Filing
Editing
…
Helping
Creating new document
Opening a document
Saving a document
…
Exiting program
James Tam


An Example Of The Procedural Approach (Simple Game: Checkers)
Setup (start positions)
Display-Board
Process-Turn
….
Display-Menu
GetPlayer-Selection
ReactTo-Player-Selection
1 Checkboard from www.allaboutfungames.com)
James Tam

What You Will Learn

- How to break your program down into objects (**New term: "Object-Oriented programming"**)
- This and related topics comprise most of the remainder of the course

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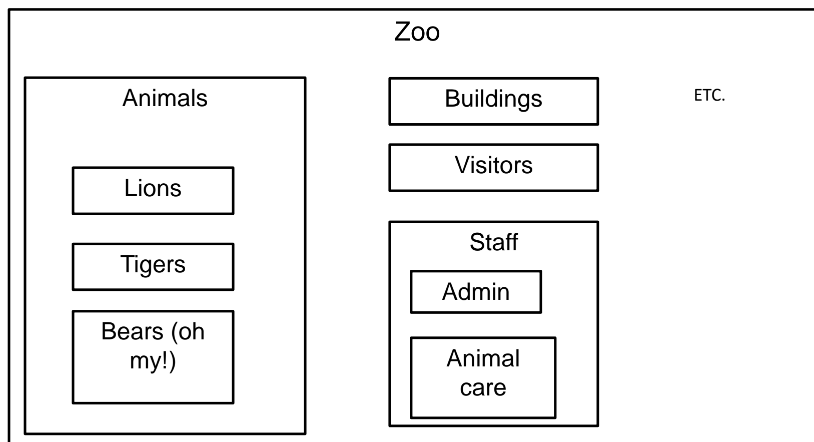
An Example Of The Object-Oriented Approach (Simulation)

- Break down the program into entities (classes, described with *nouns*)



James Tam

Classes

- Each class includes descriptive data.
  - Example (animals):
    - Species
    - Color
    - Length/height
    - Weight
    - Etc.
- Also each class has an associated set of actions
  - Example (animals):
    - Sleeping
    - Eating
    - Excreting
    - Etc.

James Tam

Example Exercise: Basic Real-World Alarm Clock

- What descriptive data is needed?
- What are the possible set of actions?

Image:
Microsoft clipart

James Tam

Additional Resources

- A good description of the terms used in this section (and terms used in some of the later sections).
  http://docs.oracle.com/javase/tutorial/java/concepts/

- A good walk through of the process of designing an object-oriented program, finding the candidate objects e.g., how to use the “find a noun’”approach and some of the pitfalls of this approach.
  http://archive.eiffel.com/doc/manuals/technology/oosc/finding/page.html

James Tam

Types In Computer Programs

- Programming languages typically come with a built in set of types that are known to the translator

```
int num;
// 32 bit whole number (e.g. operations: +, -, *, /, %)

String s = "Hello";
// Unicode character information (e.g. operation:
concatenation)
```

- Unknown types of variables cannot be arbitrarily declared!

```
Person tam;
// What info should be tracked for a Person
// What actions is a Person capable of
// Compiler error!
```

James Tam

A Class Must Be First Defined

- A class is a new type of variable.
- The class definition specifies:
  - What descriptive data is needed?
    - Programming terminology: **attributes** = data (**New definition**)
  - What are the possible set of actions?
    - Programming terminology: **methods** = actions (**new definition**)
    - A method is the Object-Oriented equivalent of a function

James Tam

Defining A Java Class

Format:

```
public class <name of class>
{
    attributes
    methods
}
```

Example (more explanations coming shortly):

```
public class Person
{
    private int age; // Attribute
    public Person() { // Method
        age = in.nextInt();
    }
    public void sayAge() {// Method
        System.out.println("My age is " + age);
    }
}
```

James Tam

What Are Classes

- Class:
  - Specifies the characteristics of an entity but is not an instance of that entity
  - Much like a blue print that specifies the characteristics of a building (height, width, length etc.)

  - This template defines what an instance (example) of this new composite type would consist of but it doesn't create an instance.

James Tam

Creating A Java Object

- Creating a Java object requires the use of the 'new' keyword.
- **Format**:

```
<Class name> <object name> = new <Class name>();
```

- **Example**:

```
Person aPerson = new Person();
```

James Tam

Instantiation

- **New definition**: Instantiation, creating a new instance or example of a class.
- Instances of a class are referred to as *objects*.
- **Format**:

```
<class name> <instance name> = new <class name>();
```

- **Examples**:

```
Person jim = new Person();
Scanner in = new Scanner(System.in);
```

Creates new object

Variable names: 'jim', 'in'

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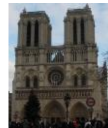
New Concepts: Classes Vs. Objects (2)

- Object:
  - A specific example or instance of a class.
  - Objects have all the attributes specified in the class definition



  - Class definition ~blue print: describes an entity (e.g. building but isn't actually that entity)
  - Object ~building: an actual instance or example of the entity (actual examples of buildings)
  - A blue print is used as a template for a building
  - A class definition is used as a template for an object

Images: James Tam

James Tam

Calling A Method

- Unlike functions methods are associated with a variable.
- Function

```
Def fun():
    print("In fun")

fun()  # Can call fun without any associated variable
```

- Method

```
public class Person {
    public void sayHello() {
        System.out.println("Hi");
    }
}
    // Another part of the program in another method
    Person bob = new Person();
    bob.sayHello();  // sayHello() alone won't work
```

James Tam

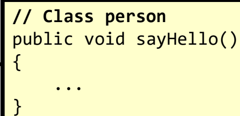
The First Object-Oriented Example

- Program design: each class definition (e.g., `public class <class name>`) must occur its own "dot-java" file).
- Example program consists of two files in the same directory:
  - (From now on your programs must be laid out in a similar fashion):
  - `Driver.java`
  - `Person.java`
  - **Full example**: located in UNIX under: `/home/219/examples/intro_OO/first_helloOO`

James Tam

The Driver Class

```
public class Driver
{
    public static void main(String [] args)
    {
        Person aPerson = new Person();
        aPerson.sayHello();
    }
}
```



I don't wanna say hello.

James Tam

Class Person

```
public class Person
{
    public void sayHello()
    {
        System.out.println("I don't wanna say hello.");
    }
}
```

James Tam

`main()` Method

- Language requirement: There must be a `main()` method - or equivalent – to determine the starting execution point.
- Style requirement: the name of the class that contains `main()` is often referred to as the "`Driver`" class.
  - Makes it easy to identify the starting execution point in a big program.
- Do not create instances of the `Driver`[1]
- For now avoid:
  - Defining attributes for the `Driver`[1]
  - Defining methods for the `Driver` (other than the `main()` method)[1]

1 Details may be provided later in this course

James Tam

Compiling Multiple Classes

- One way (safest) is to compile all code (dot-Java) files when any code changes.
- Example:
  - `javac Driver.java`
  - `javac Person.java`
  - (Alternatively use the 'wildcard'): `javac *.java`

James Tam

Why Are Classes Needed (Java, C++ Etc.)

- Existing composite types (e.g. array is composite because it can be decomposed into array elements) won't be able to model certain types of information
- E.g. For a client we store the following information
  - Name : String
  - Address : String
  - Telephone number: likely a String (if it's a number this will be a problem)
  - Total value of purchases: numeric (this will be a problem, recall that each element of the array must be the same type of information)

```
String [] clientTam = new String[4];    // Can't store numeric
```

James Tam

Why Are Classes Needed (Python List)

- Which field contains what type of information? This isn't immediately clear from looking at the program statements.

```
client = ["xxxxxxxxxxxxxxx",
          "0000000000",
          "xxxxxxxxx",
          0]
```

The parts of a composite list can be accessed via [index] but they cannot be labeled (what do these fields store?)

- Is there any way to specify rules about the type of information to be stored in a field e.g., a data entry error could allow alphabetic information (e.g., 1-800-BUY-NOWW) to be entered in the phone number field.

James Tam

Why Don't All Classes Come Pre-Defined

- Some classes are already pre-defined (included) in a programming language with a list of attributes and methods e.g., `String`
- Why don't more classes come 'built' into the language?
- The needs of the program will dictate what attributes and methods are needed.

James Tam

Defining The Methods Of A Class In Java

Format:

```
<public>1 <return type2> <method name> (<p1 type> <p1 name>, <p2 type> <p2
 name>…)
 {
     <Body of the method>
 }
```

Example:

```
public class Person {
    // Method definition
    public void sayNameAndAge(String name, int age) {
        System.out.print("Name: " + name + "\t");
        System.out.println("Age: " + age);
    }
}
```

1) For now *set the access modifier on all your methods to 'public'* (more on this later).

2) Return types: includes all the built-in 'simple' types such as char, int, double…arrays and classes that have already been defined (as part of Java or third party extras)

James Tam

Parameter Passing: Different Types

Parameter type	Format	Example
Simple types	*<method>*(*<type>* *<name>*)	method(int x, char y) { ... }
Objects	*<method>*(*<class>* *<name>*)	method(Person p) { ... }
Array: 1D	*<method>*(*<type>* []… *<name>*)	method(int [] grades) { ... }
Array: 2D	*<method>*(*<type>* []… *<name>*)	method(Map [][] m) { ... }

When calling a method, only the names of the parameters must be passed e.g., `System.out.println(num);`

James Tam

Return Values: Different Types

Return type	Format	Example
Simple types	*<type>* *<method>*()	int method() { return(0); }

Objects	<class> *<method>*()	Person method() {
		    Person p = new Person();
		    return(p);
		}

Arrays	*<type>*[]... *<method>*()	int [] method() {
		    int [] grades = new
		      int[3];
		    return(grades);
		}

James Tam

What Are Methods

- Possible behaviors or actions for each instance (example) of a class.

Fly()

Walk()
Talk()

Walk()
Talk()

Swim()

Second Example: A Class With Multiple Methods (Driver)

- **Full example**: located in UNIX under:

/home/219/examples/intro_OO/second_multiple_methods

```
public class Driver
{
    public static void main(String [] args)
    {
        Person bart= new Person();
        bart.sayPersonal();
    }
}
```

Second Example: A Class With Multiple Methods (Person)

```
public class Person
{
    public void sayDogAge(int age)
    {
        int dogAge = age * 7;
        System.out.println("My age in dog years: " + dogAge);
    }

    public int sayHumanAge()
    {
        int age = 10;
        System.out.println("My age: " + age);
        return(age);
    }
```

James Tam

Second Example: A Class With Multiple Methods (Person: 2)

```
    public void sayNameAndAge(String name, int age)
    {
        System.out.print("Name: " + name + "\t");
        System.out.println("Age: " + age);
    }

    public void sayPersonal()
    {
        int age = sayHumanAge();
        String name = "Bart";
        sayDogAge(age);
        sayNameAndAge(name,age);
    }
}
```

James Tam

Class Methods: Specifying The Type

- When a method header is specified the **type of the method arguments** must be specified.

```
public void sayNameAndAge(String name, int age)
{
}
```

- When a method is called only the **name of the arguments** (or an unnamed constant need to be passed into the method.
  - Specifying type will produce a syntax error.

```
sayNameAndAge(name,age);   // Names passed
System.out.println(17);    // Unnamed constant 17
```

James Tam

Recall: Classes Also Consist Of Attributes

- Each class includes descriptive data.
  - Example (animals):
    - Species
    - Color
    - Length/height
    - Weight
    - Etc.
- Also each class has an associated set of actions
  - Example (animals):
    - Sleeping
    - Eating
    - Excreting
    - Etc.

James Tam

Defining The Attributes Of A Class In Java

- Attributes can be variable or constant (preceded by the '`final`' keyword), for now stick to the former.
- **Format**:

```
<private>1 <type of the attribute> <name of the attribute>;
```

- **Example**:

```
public class Person
{
    private int age;
}
```

1) Although other options may be possible, *attributes are almost always set to private* (more on this later).

James Tam

New Term: Object State

- Similar to how two variables can contain different data.
- Attributes: Data that describes each instance or example of a class.
- Different objects have the same attributes but the values of those attributes can vary
  - Reminder: The class definition specifies the attributes and methods for *all objects*
- Example: two 'monster' objects each have a health attribute but the current value of their health can differ
- The current value of an object's attribute's determines it's state.

Microsoft cipart

```
Age: 35
Weight: 192
```

```
Age: 50
Weight: 125
```

```
Age: 0.5
Weight: 7
```

James Tam

Accessing Attributes

- Attributes can only accessed only inside the methods of the class where the attribute has been defined (explanations come at the end of this section)

```
public class Person
{
    private int age;
    public void sayAge() {
         System.out.println(age);
    }
}
```

Can only access 'age' within methods of this class

```
public class Driver
{


}
```

Cannot access the age of a Person here (outside of Person)

James Tam

Third Example: Class With Attributes (Driver)

- **Full example**: located in UNIX under:

/home/219/examples/intro_OO/third_attributes

```
public class Driver
{
    public static void main(String [] args)
    {
        Person bart= new Person();
        bart.sayPersonal();
    }
}
```

James Tam

Third Example: Class With Attributes (Person)

```
public class Person
{
    private int age = 10;
    private int dogAge = age * 7;
    private String name = "Bart";

    public void sayDogAge()
    {
        System.out.println("My age in dog years: " +
          dogAge);
    }

    public void sayHumanAge()
    {
        System.out.println("My age: " + age);
    }
```

James Tam

Third Example: Class With Attributes (Person, 2)

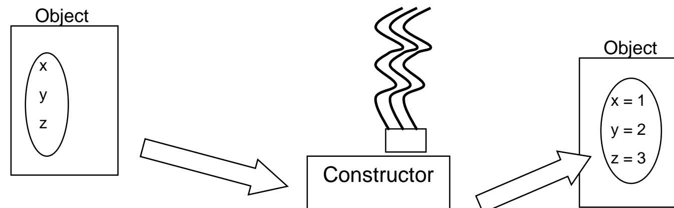
```
    public void sayNameAndAge()
    {
        System.out.print("Name: " + name + "\t");
        System.out.println("Age: " + age);
    }

    public void sayPersonal()
    {
        sayHumanAge();
        sayDogAge();
        sayNameAndAge();
    }
}
```

James Tam

Constructor

- **New term**: A special method to initialize the attributes of an object as the objects are instantiated (created).



- The constructor is automatically invoked whenever an instance of the class is created e.g., `Person aPerson = new Person();`

Call to constructor (creates something 'new')

```
class Person {
    // Constructor
    public Person() {
        …
    }
}
```

- Constructors can take parameters but **never** have a return type.

James Tam

New Term: Default Constructor

- Takes no parameters
- If no constructors are defined for a class then a default constructor comes 'built-into' the Java language.
- e.g.,

```
class Driver {
    main() {
        Person aPerson = new Person();
    }
}

class Person {
    private int age;
}
```

The default constructor (not defined by the author of `Person`) but comes built into the language

James Tam

Calling Methods (Outside The Class)

- You've already done this before with pre-created classes!
- First create an object (previous slides)
- Then call the method for a particular object of that class.
- **Format**:

```
<instance name>.<method name>(<p1 name>, <p2 name>…);
```

- **Examples:**

```
Person jim = new Person();
jim.sayName();  // Jim is a variable of type Person

// Previously covered example, calling Scanner class method
Scanner in = new Scanner(System.in);  // Scanner constructor call
System.out.print("Enter your age: ");
age = in.nextInt();
```

Scanner variable

Calling method

James Tam

Calling Methods: Outside The Class You've Defined

- Calling a method outside the body of the class (i.e., in another class definition)
- The method must be prefaced by a variable which is an object of that class.

```
public class Driver {
    public static void main(String [] args) {
        Person bart = new Person();
        Person lisa = new Person();
        // Incorrect! Who ages?
        becomeOlder();

        // Correct. Happy birthday Bart!
        bart.becomeOlder();
    }
}
```

James Tam

Calling Methods: Inside The Class

- Calling a method inside the body of the class (where the method has been defined)
  - You can just directly refer to the method (or attribute)

```
public class Person {
  private int age;

  public void birthday() {
     becomeOlder();  // access a method
  }

 public void becomeOlder() {
     age++;    // access an attribute
 }
```

James Tam

Fourth Object-Oriented Example

- Learning concepts:
  - Attributes
  - Constructors
  - Accessing class attributes in a class method
- **Location of full example**:
  `/home/219/examples/intro_OO/fourth_attribute_constructor`

James Tam

Class Driver

```
public class Driver
{
    public static void main(String [] args)
    {
        Person jim = new Person();
        jim.sayAge();
    }
}
```

```
public Person() {
    Scanner in = new
    Scanner(System.in);
    System.out.print("Enter age: ");
    age = in.nextInt();
}
```

```
public void sayAge() {
    System.out.println
      ("My age is " + age);
}
```

```
[csc firstOOExample 232 ]> java Driver
Enter age: 123
My age is 123
```

```
[csc firstOOExample 233 ]> java Driver
Enter age: 321
My age is 321
```

James Tam

Class Person

```
public class Person
{
    private int age;
    public Person()
    {
        Scanner in = new Scanner(System.in);
        System.out.print("Enter age: ");
        age = in.nextInt();
    }

    public void sayAge()
    {
        System.out.println("My age is " + age);
    }
}
```

James Tam

Creating An Object

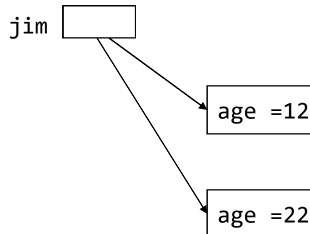
- Two stages (can be combined but don't forget a step)
  - Create a variable that refers to an object e.g., `Person jim;`
  - Create a *new* object e.g., `jim = new Person();`
    - The keyword 'new' calls the constructor to create a new object in memory
  - Observe the following

```
Person jim;

jim = new Person(12);

jim = new Person(22);
```

Jim is a reference to a Person object



Reminder: Methods Vs. Functions

- Both include defining a block of code that be invoked via the name of the method or function (e.g., `print()`)
- **Methods** a block of code that is *defined within a class definition* (Java example):

```
public class Person
{
    public Person() { ... }

    public void sayAge() { ... }
}
```

- Every object that is an instance of this class (e.g., `jim` is an instance of a `Person`) will be able to invoke these methods.

```
Person jim = new Person();
jim.sayAge();
```

Reminder: Methods Vs. Functions (2)

- **Functions** a block of code that is *defined outside or independent of a class* (Python example – it's largely not possible to do this in Java):

```
# Defining method sayBye()
class Person:
    def sayBye(self):
        print("Hosta lavista!")

# Method are called via an object
jim = Person()
jim.sayBye()

# Defining function: sayBye()
def sayBye():
    print("Hosta lavista!")

# Functions are called without creating an object
sayBye()
```

James Tam

Methods Vs. Functions: Summary & Recap

Methods

- The Object-Oriented approach to program decomposition.
- Break the program down into classes.
- Each class will have a number of methods.
- Methods are invoked/called through an instance of a class (an object).

Functions

- The procedural (procedure = function) approach to program decomposition.
- Break the program down into functions.
- Functions can be invoked or called without creating any objects.

James Tam

Fourth Example: Second Look

Calls in Driver.java

```
Person jim = new Person();

jim.sayAge();
```

Person.java

```
public class Person {
    private int age;

    public Person() {
        age = in.nextInt();
    }

    public void sayAge() {
        System.out.println("My age
                       is " + age);
    }
}
```

More is needed:

•What if the attribute 'age' needs to be modified later?

•How can age be accessed but not just via a `print()`?

James Tam

Viewing And Modifying Attributes

1) **New terms: Accessor methods**: '`get()`' method
   - Used to determine the current value of an attribute
   - Example:

```
public int getAge()
{
    return(age);
}
```

2) **New terms: Mutator methods**: '`set()`' method
   - Used to change an attribute (set it to a new value)
   - Example:

```
public void setAge(int anAge)
{
    age = anAge;
}
```

James Tam

Version 2 Of The Fourth Example

- **Location of full example**:
  /home/219/examples/intro_OO/fifth_accesors_mutators

James Tam

Class Person

- Notable differences: constructor is redesigned, getAge() replaces sayAge(), setAge() method added

```
// First version
public class Person
{
    private int age;
    public Person() {
        …
        age = in.nextInt();
    }

    public void sayAge() {
        System.out.println("My age
           is " + age);
    }
}
```

```
// Second version
public class Person
{
    private int age;
    public Person() {
        age = 0;
    }
    public int getAge() {
        return(age);
    }

    public void setAge
       (int anAge){
        age = anAge;
    }
}
```

James Tam

Class Driver

```
public class Driver
{
    public static void main(String [] args)
    {
        Person jim = new Person();
        System.out.println(jim.getAge());
        jim.setAge(21);
        System.out.println(jim.getAge());
    }
}
```

```
0
```

```
21
```

James Tam

Constructors

- Constructors are used to initialize objects (set the attributes) as they are created.
- Different versions of the constructor can be implemented with different initializations e.g., one version sets all attributes to default values while another version sets some attributes to the value of parameters.
- **New term:** method overloading, same method name, different parameter list.

```
public Person(int anAge) {
    age = anAge;
    name = "No-name";
  }
}
```

```
public Person() {
    age = 0;
    name = "No-name";
```

```
// Calling the versions (distinguished by parameter list)
Person p1 = new Person(100);    Person p2 = new Person();
```

James Tam

Example: Multiple Constructors

- **Location of full example**:
  /home/219/examples/intro_OO/sixth_constructor_overloading

James Tam

Class Person

```
public class Person
{
    private int age;
    private String name;

    public Person()
    {
        System.out.println("Person()");
        age = 0;
        name = "No-name";
    }
```

James Tam

Class Person(2)

```
    public Person(int anAge) {
        System.out.println("Person(int)");
        age = anAge;
        name = "No-name";
    }

    public Person(String aName) {
        System.out.println("Person(String)");
        age = 0;
        name = aName;
    }

    public Person(int anAge, String aName) {
        System.out.println("Person(int,String)");
        age = anAge;
        name = aName;
    }
```

James Tam

Class Person (3)

```
    public int getAge() {
        return(age);
    }

    public String getName() {
        return(name);
    }

    public void setAge(int anAge) {
        age = anAge;
    }

    public void setName(String aName) {
        name = aName;
    }
}
```

James Tam

Class Driver

```
Person()
Person(int)
Person(String)
Person(int,String)
```

```
public class Driver {
    public static void main(String [] args) {
        Person jim1 = new Person();  // age, name default
        Person jim2 = new Person(21);   // age=21
        Person jim3 = new Person("jim3");  // name="jim3"
        Person jim4 = new Person(65,"jim4");
        // age=65, name = "jim4"

        System.out.println(jim1.getAge() + " " +
          jim1.getName());
        System.out.println(jim2.getAge() + " " +
          jim2.getName());
        System.out.println(jim3.getAge() + " " +
          jim3.getName());
        System.out.println(jim4.getAge() + " " +
          jim4.getName());
    }
}
```

```
0 No-name
21 No-name
0 jim3
65 jim4
```

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New Terminology: Method Signature

- Method signatures consist of: the type, number and order of the parameters.
- The signature will determine the overloaded method called:

```
Person p1 = new Person();
Person p2 = new Person(25);
```

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Overloading And Good Design

- Overloading: methods that implement similar but not identical tasks.
- Examples include class constructors but this is not the only type of overloaded methods:

```
System.out.println(int)
System.out.println(double)
```

  etc.

  For more details on class `System` see:
  - http://java.sun.com/j2se/1.5.0/docs/api/java/io/PrintStream.html

- Benefit: just call the method with required parameters.

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Method Overloading: Things To Avoid

- Distinguishing methods solely by the order of the parameters.

```
m(int,char);
```

  Vs.

```
m(char,int);
```

- Overloading methods but having an identical implementation.
- Why are these things bad?

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Method Signatures And Program Design

- Unless there is a compelling reason do not change the signature of your methods!

Before:

```
class Foo
{
    void fun()
    {

    }
}
```

After:

```
class Foo
{
    void fun(int num)
    {

    }
}
```

```
public static void main ()
{
    Foo f = new Foo();
    f.fun()
}
```

This change has broken me! ☹

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Graphical Summary Of Classes

- UML (Unified modeling language) class diagram
  - Source "*Fundamentals of Object-Oriented Design in UML*" by Booch, Jacobson, Rumbaugh (Dorset House Publishing: a division of Pearson) 2000
  - UML class diagram provides a quick overview about a class (later you we'll talk about relationships between classes)
- There's many resources on the Safari website:
  - http://proquest.safaribooksonline.com.ezproxy.lib.ucalgary.ca/
  - Example "**Sams Teach Yourself UML in 24 Hours, Third Edition" (concepts)**
  - Hour 3: Working with Object-Orientation
  - Hour 4: Relationships
  - Hour 5: Interfaces (reference for a later section of notes "hierarchies")

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UML Class Diagram

<Name of class>
-<attribute name>: <attribute type>   *+<method name>(p1: p1type; p2 : p2 type..) : <return type>*

Person
-age:int   +getAge():int   +getFriends():Person []   +setAge(anAge:int):void

Note:

1. The type and name of parameters are reversed
2. The return type is last

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Why Bother With UML?

- It combined a number of different approaches and has become the standard notation.
- It's the standard way of specifying the major parts of a software project.
- Graphical summaries can *provide a useful overview* of a program (especially if relationships must be modeled)
  - Just don't over specify details

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Back To The 'Private' Keyword

- It syntactically means this part of the class cannot be accessed outside of the class definition.
  - You should **always** do this for variable attributes, *very rarely do this* for methods (more later).
- Example

```
public class Person {
     private int age;
     public Person() {
         age = 12;   // OK – access allowed here
    }
}
public class Driver {
     public static void main(String [] args) {
         Person aPerson = new Person();
         aPerson.age = 12;  // Syntax error: program won't
                            // compile!
     }
}
```

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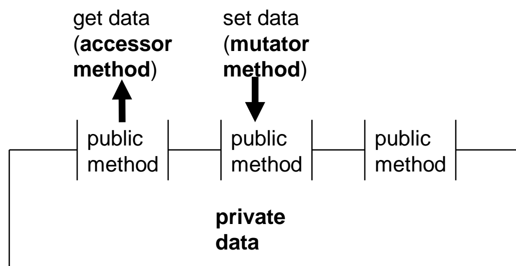
New Term: Encapsulation/Information Hiding

- Protects the inner-workings (data) of a class.
- Only allow access to the core of an object in a controlled fashion (use the *public* parts to access the *private* sections).
  - Typically it means public methods accessing private attributes via accessor and mutator methods.
  - Controlled access to attributes:
    - Can prevent invalid states
    - Reduce runtime errors



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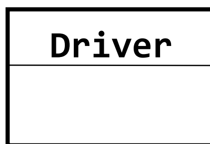
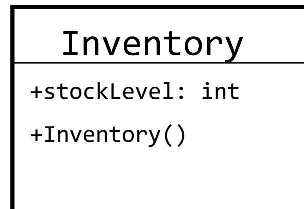
How Does Hiding Information Protect Data?

- Protects the inner-workings (data) of a class
  - e.g., range checking for inventory levels (0 – 100)

- **Location of full example**:
  - /home/219/examples/intro_OO/seventh_no_protection





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Class Inventory

```
public class Inventory
{
    public int stockLevel;

    public Inventory()
    {
        stockLevel = 0;
    }
}
```

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Class Driver

```
public class Driver
{
    public static void main(String [] args)
    {
        Inventory chinook = new Inventory();
        chinook.stockLevel = 10;
        System.out.println("Stock: " + chinook.stockLevel);
        chinook.stockLevel = chinook.stockLevel + 10;
        System.out.println("Stock: " + chinook.stockLevel);
        chinook.stockLevel = chinook.stockLevel + 100;
        System.out.println("Stock: " + chinook.stockLevel);
        chinook.stockLevel = chinook.stockLevel - 1000;
        System.out.println("Stock: " + chinook.stockLevel);
    }
}
```

```
Stock: 10
Stock: 20
Stock: 120
Stock: -880
```

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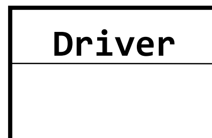
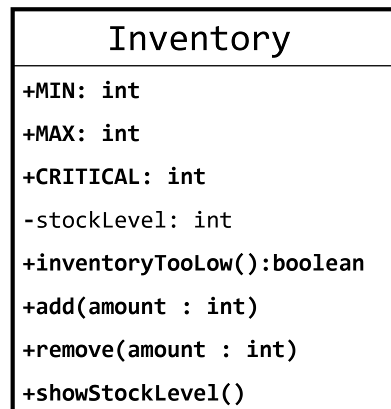
Utilizing Information Hiding: An Example

- **Location of full example**:
  - /home/219/examples/intro_OO/eighth_encapsulation





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Class Inventory

```
public class Inventory
{
    public final int CRITICAL = 10;
    public final int MIN = 0;
    public final int MAX = 100;
    private int stockLevel = 0;

    public boolean inventoryTooLow()
    {
        if (stockLevel < CRITICAL)
             return(true);
        else
             return(false);
    }
```

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Class Inventory (2)

```
    public void add(int amount)
    {
        int temp;
        temp = stockLevel + amount;
        if (temp > MAX)
        {
            System.out.println();
            System.out.print("Adding " + amount +
                             " item will cause stock ");
            System.out.println("to become greater than " + MAX + "
                                units (overstock)");
        }
        else
        {
            stockLevel = temp;
        }
    }
```

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Class Inventory (3)

```
    public void remove(int amount)
    {
        int temp;
       temp = stockLevel - amount;
        if (temp < MIN)
        {
            System.out.print("Removing " + amount +
                             " item will cause stock ");
            System.out.println("to become less than " + MIN + " units
                              (understock)");
        }
              else
        {
            stockLevel = temp;
        }
    }

    public String showStockLevel ()
    { return("Inventory: " + stockLevel); }
}
```

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The Driver Class

```
public class Driver
{
    public static void main (String [] args)
    {
        Inventory chinook = new Inventory();
        chinook.add(10);
        System.out.println(chinook.showStockLevel());
        chinook.add (10);
        System.out.println(chinook.showStockLevel());
        chinook.add (100);
        System.out.println(chinook.showStockLevel());
        chinook.remove (21);
        System.out.println(chinook.showStockLevel());
        // JT: The statement below won't work and for g
        // chinook.stockLevel = -999;
    }
}
```

```
Inventory: 10
Inventory: 20
Inventory: 20
Inventory: 20
```

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Add( ): Try Adding 100 items to 20 items

```
public void add(int amount)
{
    int temp;
    temp = stockLevel + amount;
    if (temp > MAX)
    {
        System.out.println();
        System.out.print("Adding " + amount +
                         " item will cause stock ");
        System.out.println("to become greater than " + MAX +
                           " units (overstock)");
    }
    else
    {
        stockLevel
    }
} // End of method add
```

```
Adding 100 item will cause stock to
become greater than 100 units (overstock)
```

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Remove( ): Try To Remove 21 Items From 20 Items

```
public void remove(int amount)
{
    int temp;
   temp = stockLevel - amount;
    if (temp < MIN)
    {
        System.out.print("Removing " + amount +
                         " item will cause stock ");
        System.out.println("to become less than " + MIN + " units
            (understock)");
    }
          else
    {
        stockLevel = temp;
    }
}

public String showStockLevel ()
{ return("Inventory: " + stockLevel); }
}
```

```
Removing 21 item will cause stock to
become less than 0 units (understock)
```

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New Terms And Definitions

- Object-Oriented programming
- Class
- Object
- Class attributes
- Class methods
- Object state
- Instantiation
- Constructor (and the Default constructor)
- Method
- Function

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New Terms And Definitions (2)

- Accessor method (“get”)
- Mutator method (“set”)
- Method overloading
- Method signature
- Encapsulation/information hiding
- Multiplicity/cardinality

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After This Section You Should Now Know

- How to define classes, instantiate objects and access different part of an object
- What is a constructor and how is it defined and used
- What are accessor and mutator methods and how they can be used in conjunction with encapsulation
- What is method overloading and why is this regarded as good style
- How to represent a class using class diagrams (attributes, methods and access permissions) and the relationships between classes
- What is encapsulation/information-hiding, how is it done and why is it important to write programs that follow this principle

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