Custom Objects and Methods

Object vs. Instance

- What is the difference between the two?

Difference between an Object and an Instance	
Object (Human)	Instance (Lupoli)

Introducing the Theory of Objects

- PROGRAMMER DEFINED data types
- int, double, double, etc… all hold ONE variable's value

Lupoli_name	Lupoli_depart.	Lupoli_title	Lupoli_salary
Mr. Lupoli	Comp. Sci.	Assist. Prof.	-1

```
String Lupoli_name = "Mr. Lupoli";
String Lupoli_department = "Computer Science";
String Lupoli_title = "Assistant Professor";
int Lupoli_salary = -1;
```

- we would have to create a separate variable for each, even though the variables are ALL related!!

EMPLOYEE
name
department
title
salary

- Objects
  - groups related variables into ONE table/object
  - creating your OWN data type/template

- need to only create one TEMPLATE for each person or “instance”

Why use Objects?

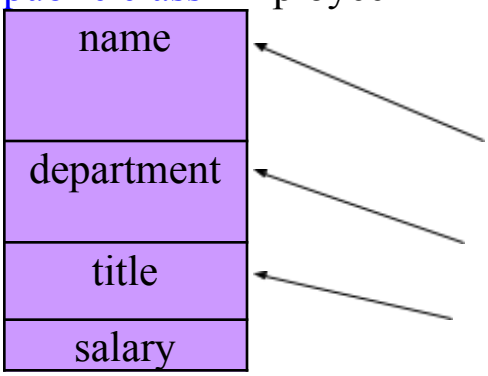
- Java is based in Objects!!!
  - o calls them classes (reserved word)
- basic data types
- good data type to JUST hold data, very basic

Where have you seen the reserved word "class" before?

Syntax and setup

Class Code (Employee.java)

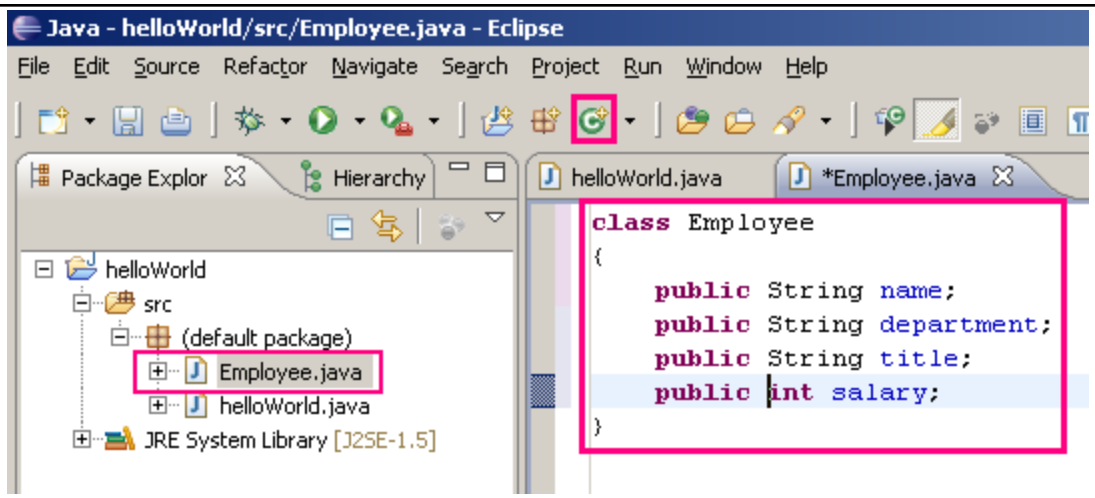
```
public class Employee
{
        public String name;
        public String department;
        public String title;
        public int salary;
}
// Employee literally becomes a data type like int, char, etc…
```



data members

Class setup

AFTER creating your class for the "main", add ***another*** class of whatever object you need.



Inside Employee.java, notice:

1. no main()
2. inside same project (2 files within the SAME project)

In a new project, create the files “Driver.java” and “Employee.java”. (Capitalization matters!!) “Driver” has the main. Copy the code above for Employee.

Eclipse Project Setup

Driver.java	Employee.java

`public class Driver {`
 	
`public static void main(String[] args)`
`{`
 	
`}`
 	
`}`
	`public class Employee`
	`{`
	`public String name;`
	`public String department;`
	`public String title;`
	`public int salary;`
	
	`}`

Creating an instance in the main

- ALL instances are created in the main/DRIVER!!!!!
- Creating an instance is when you create a variable of your new type

First Example of an instance

import // whatever

```
public class Driver {

	public static void main(String[] args) {

		Employee EM001 = new Employee();
		EM001.name = "Mr. Lupoli";
		EM001.department = "Computer Science";
		EM001.title = "Assistant Professor";
		EM001.salary = -1;

		Employee EM002 = new Employee();
		EM002.name = "Steve Thomas";
		EM002.department = "Computer Science";
		EM002.title = "Web Designer";
		EM002.salary = 120000;
	}

}
```

The overall idea – The Big Picture

EMPLOYEE TEMPLATE	EM002	EM001	EM003
name	Mr. Hughes	Mr. L	Jenny
department	C.S.	C.S.	Admin.
title	TA	Assist. Prof.	Site Dir.
salary	-100	-1	100000000

Each of these are an instance of our Employee data type that we created!!

Eclipse Project Setup

Driver.java

```java
public class Driver {

	public static void main(String[] args)
	{

		Employee Lupoli = new Employee();
		// just created a new instance
		Lupoli.name = "Mr. Lupoli";

		// create your own instance!!!


		System.out.println(EM002);
		System.out.println(EM002.name);

	}

}
```

Employee.java

```java
public class Employee
{
	public String name;
	public String department;
	public String title;
	public int salary;

	// what if no public/private in front??
}
```

USE PUBLIC FOR NOW

1. Create 3 ***instances*** using the Employee class, of yourself, your parents, or a friends' info (can be fake info) in JAVA: ***(DO NOT RECREATE THE CLASS!!)***
2. Run the project
3. **Draw** which each would look like:
4. See if you can display the values in your instance. See if you can figure it out.
5. Run the project

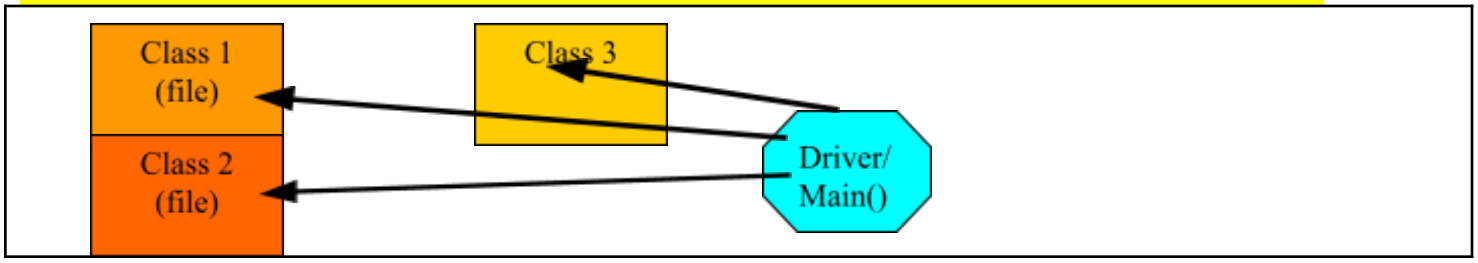
Compiling and naming classes

- There should be ***AT LEAST*** two files now in your projects
  - main/driver
  - class/methods
  - please look BELOW for naming scheme
- remember the name of the file should match the name of the class

Example Files and Setup	
Class File	**Driver File**
Employee.java	**Driver.java**

#import // whatever
 	
class Employee
{
member variables;
…
 	
member methods;
 	
}
	#import // whatever
	
	class Driver
	{
	
	public static void main(…)
	{
	Employee EM003 = new Employee();
	…
	}
	}

ALWAYS COMPILE FROM THE MAIN/DRIVER!!! NO EXCEPTIONS!!



Custom Methods within Objects

- just like helper methods, custom methods can be created for custom Objects
- the code for methods are added below the data members in the class code
- again like helper methods, custom methods require
  - return value
  - name
  - parameters (if necessary)
    - remember, what the method needs in order to work
- methods are also broken down into mutators and accessors
  - mutators CHANGE **the value** data members
  - accessors just RETRIEVE (no change) data members

Object/Class with Methods

```
public class Employee
{
      public String name;
      public String department;
      public String title;
      public int salary;

      // what if no public/private in front??

      public String getName( )    { return name; }
      public String getDepartment( ) { return department; }
      public String getTitle( ) { return title; }
      public int getSalary( ) { return salary; }
      public void setSalary( int newSalary) { salary = newSalary; }
      public String toString( )
      { return name + "\n" + department + "\n" + title + "\n" + salary;}

}
```

Complete Main example using the Class Employee

```
import java.util.Scanner;

public class Driver {

      static Scanner sc = new Scanner(System.in);

      public static void main(String[] args) {

            Employee Heila = new Employee(); // just created a new instance
            Heila.name = "Ms. Heila";
            Heila.department = "Garbage duty";
            Heila.salary = -11111;
            Heila.title = "dumpster cleaner";

            // hard code way of setting her salary
            Heila.setSalary(10);

            // user input way of setting her salary (Scenario #1)
            System.out.println("Please place in Heila's new salary");
            int nS = sc.nextInt();
            Heila.setSalary(nS);

            // user input way of setting her salary (Scenario #2)
            System.out.println("Please place in Heila's new salary");
            Heila.setSalary(sc.nextInt());
      }
}
```

1. In Employee, add and create ALL mutators and accessors!!! (Use the templates above)
   a. ***No toString function yet!!***
2. In the main(), create another instance of your TA!!! I want you to get user input for your TA's values.
3. Display those values at the end of the main().
4. WHY DOESN'T NAME, DEPARTMENT, and SALARY need to be declared, OR an INSTANCE in front WITHIN the functions??
5. Identify a parameter in ANY of the mutator functions.
6. Identify the return type of the method getSalary()?
7. Identify the following about the above object's methods

name of method	return type	parameter (if any)	what does it do?
getName()	String		

What is overloading??

- methods that share the exact method name, but different parameters, and possibility different NUMBER of parameters

Overloaded Example

```
public class Example {

      public void getMethod(int score) // Method #1
      {
            System.out.println( "Method #1" );
            System.out.println( score );
      }

      public void getMethod (char grade) // Method #2
      {
            System.out.println( "Method #2" );
            System.out.println( grade );
      }

      public void getMethod (double average) // Method #3
      {
            System.out.println( "Method #3" );
            System.out.println( average );
      }

      public static void main(String [] args )
      {
            Example ex = new Example();

            ex.getMethod(98); // What method # will be called??
            ex.getMethod(12.3); // What method # will be called??
            ex.getMethod('F'); // What method # will be called??
      }
}
```

The ToString Function

- overloads the String function “toString”
- created by the programmer
- used to display the instance and all of it’s values
- function is added to the class
- NOTICE no “”toString()” behind the instance!!
    - called automatically when System.out.println(String) is called

ToString Function Example

Code

```
    public String toString()
    {
     return getfirstName() + ", " + getlastName() + "\n " + getAge();
    }
```

Called

```
public class Driver
{
     public static void main(String[] args)
     {
          Employee adjunct = new Employee("Shawn", "Lupoli", 21);
          Employee dean = new Employee("Jack", "McLaughlin", 75);
          Employee professor = new Employee("Super", "Mario", 81);

          System.out.println(adjunct);
     }

}
```

Output

```
Shawn Lupoli
21
```

Go ahead and add the “toString” method to Employee. Have it return their name and salary only. Within the main(), have ONE of your instances printed.

Access modifiers (public and private)

- encapsulation is the concept of determining what items of data should be EASILY accessible or HARD to get to
  - access from the main/driver
- there are two types (actually more, but later)
- public
  - **methods** and **variables** that ***CAN*** be accessed by the class AND main()
- private
  - **methods** and **variables** that ***CAN NOT*** be access by the main, but CAN BE from INSIDE the class
- Strategy, what would ***YOU*** want people to be able to see?
- It is safer to be private

Bank Account	Automobile
Long int/String account_number	Mileage (int)
Double interest rate	Vin# (String)
Double balance	Model (String)
String account_type	Make (String)
Long int routing_number	Year (int)
Int/String SSN	Brake_type (String) ABS, standard…
DATE Open date	Drive_tran (Boolean) automatic,..
String bank_name	Plate # (String)
Boolean current	Horsepower (int)
	Max_speed (String/Int)
	NumOfWindows
	NumOfDoors

Look at all data members, as a group, decide on which are public or private

Notice: From here out all data members will be PRIVATE in my notes

Encapsulation – Class setup

- We are using a method to change the values, NOT changing them directly!!
- Need a method to return the actual value

What the class code should look like

```
class Employee
{
      private String name;
      private String department;
      private String title;
      private int salary;

      // mutators
      public void setName(String newName) { name = newName; } // set name
      public void setDepartment(String newDP){department = newDP;}// sets department
      public void setTitle(String newTitle) { title = newTitle; } // sets title
      public void setSalary( int newSalary) { salary = newSalary; } // sets salary

      // accessors
      private String getName( )     { return name; } // retrieves salary
      public  String getDepartment( ) { return department; }// retrieves department
      public  String getTitle( ) { return title; }// retrieves title
      public int getSalary( ) { return salary; }// retrieves salary

      // toString
      public  String toString( ) { return name + "\n" + department + "\n" + title + "\n" + salary;}
}
```

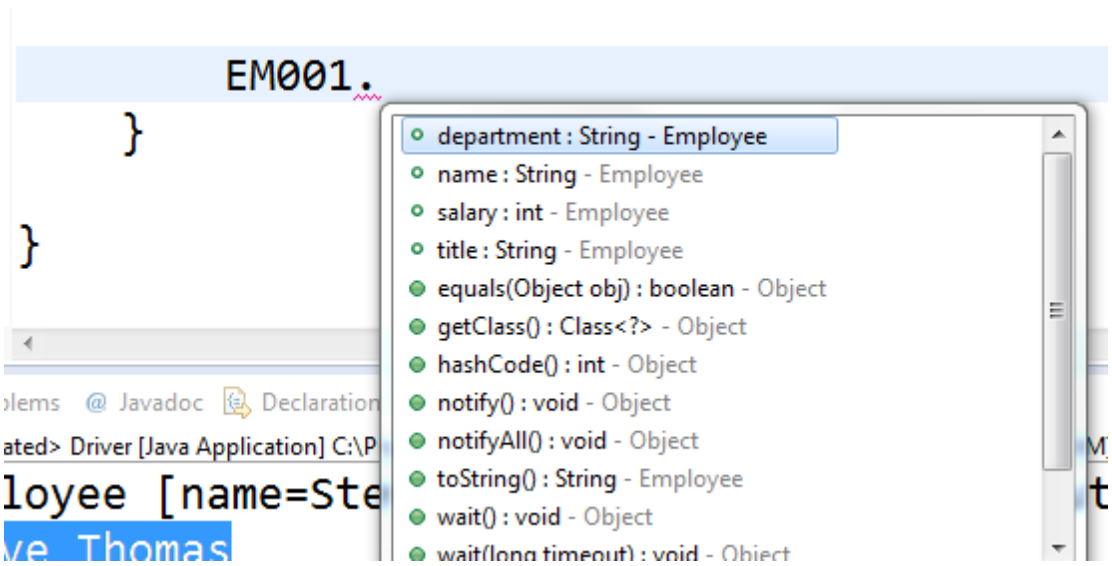
Ravi.setSalary(10); ~~Ravi.salary = 10;~~

Proving Encapsulation works

- Now that data member are private, I SHOULD NOT have direct access
- I have to call functions in order to change them
  - They can validate data, validate the user, etc…

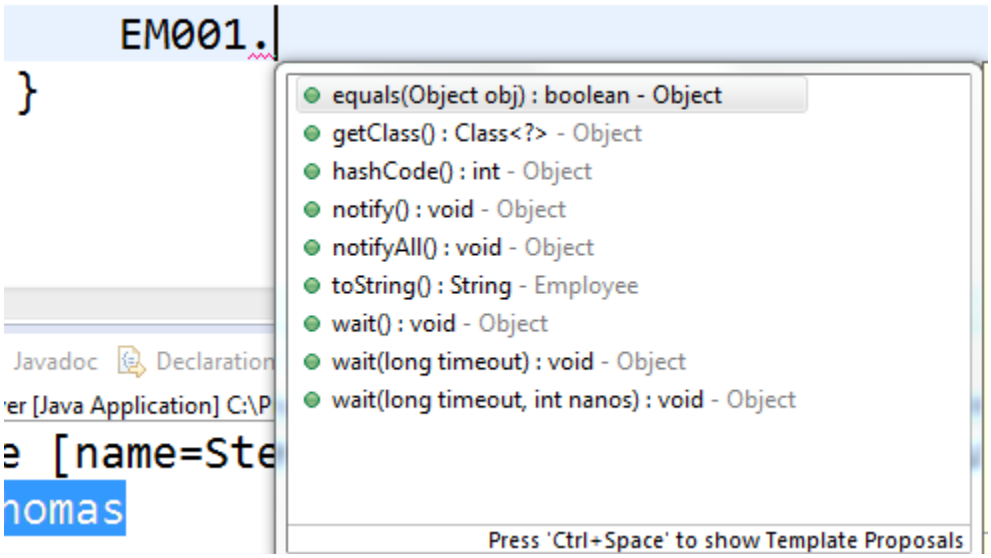
Data members were *public*

```
public class Employee {

    public String name;
    public String department;
    public String title;
    public int salary;
}
```



Data members are *private*

```
public class Employee {

    private String name;
    private String department;
    private String title;
    private int salary;
}
```



Encapsulation – Instance (main) setup

- remember
  - an instance is created in the main/driver
  - instance values are set/returned in the driver

In the main()

…

```
Employee EM001 = new Employee();
EM001.setName("Mr. Lupoli");
EM001.setDepartment("Computer Science");
EM001.setTitle("Assistant Professor");
EM001.setSalary(-1);
System.out.println(EM001);  // uses toString method in class
```

// what do you think the LAST line will print?

1. Change all of your data members in Employee to PRIVATE.
2. Delete all instances created in the main().
3. Create 2 ***instances*** using the Employee class, of yourself, and a friends' info (can be fake info) using the **new** structure: ***(DO NOT RECREATE THE CLASS!!)***

Creating non-setter/getter methods

- You CAN create your own!!
- Needs to be completed in these steps
  1. Create the function WITHIN the class
  2. Call the function WITHIN the driver

Custom Object Methods

Class

```
class Employee
{
	private String name;
	private String department;
	private String title;
	private int salary;

	// mutators
	public void setName(String newName)
	{
		name = newName;
	} // set name
	public void setDepartment(String newDP){department = newDP;}// sets department
	public void setTitle(String newTitle) { title = newTitle; } // sets title
	public void setSalary( int newSalary) { salary = newSalary; } // sets salary
	public void setSalaryRaise(double percentage)
	{
		salary += salary * percentage;
	}

	// accessors
	private String getName( )	{ return name; } // retrieves salary
	public  String getDepartment( ) { return department; }// retrieves department
	public  String getTitle( ) { return title; }// retrieves title
	public int getSalary( ) { return salary; }// retrieves salary

	// toString
	public  String toString( ) { return name + "\n" + department + "\n" + title + "\n"
+ salary;}

}
```

Driver

```java
public class Driver {

    public static void main(String[] args) {

        Employee EM001 = new Employee();
        EM001.setName("Mr. Lupoli");
        EM001.setDepartment("Computer Science");
        EM001.setTitle("Assistant Professor");
        EM001.setSalary(100);
        System.out.println(EM001);

        EM001.setSalaryRaise(0.02);
        // let's see if the raise stuck!!
        System.out.println(EM001);
    }
}
```

What can you put into a method??

- Anything you have already learned!!
  - Loops
  - Arrays
  - If-else
  - Variables
  - Etc…

See how a method works (Mechanics)

- code literally makes a jump in the program
- function then returns back to where it was called

Method Mechanics

Employee Class

```
class Employee
{
private String name;
private String department;
private String title;
private int salary;

// mutators
public void setName(String newName)
{
        name = newName; ❷
} // set name❸
```

Employee Driver

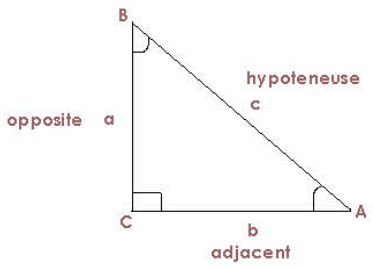
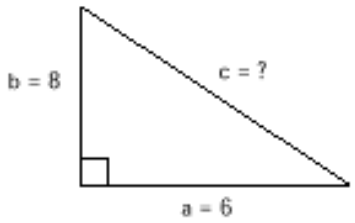
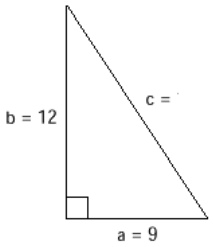
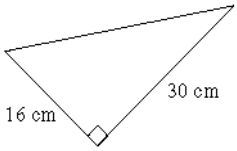
```
import java.util.Random;
import java.util.Scanner;

public class helloWorld
{
        static Scanner sc = new Scanner(System.in);
         public static void main(String[] args)
         {
                Employee EM001 = new Employee();
                EM001.setName("Mr. L"); ❶

         }
}
```

Parameters

- ***what does a method need for it to work?***
  - Example, finding the hypotenuse of a right triangle needs:
    - side A length
    - side B length
- need to ***pass*** both values into the function if you wish to find the hypotenuse
- the parameter list can be reused over and over again with DIFFERENT values
  - called aliases

Review of Hypotenuse and triangles

$c^2 = a^2 + b^2$ (c being the hypotenuse)

			
	$6^2 + 8^2 = c^2$ $36 + 64 = c^2$ $100 = c^2$ $c = \sqrt{100}$ $c = 10$		

Hypotenuse function using parameters

The function

```
public double getHypotenuse(int a, int b)
{
      return Math.sqrt(a* a + b * b);
}
```

What datatype will this function return?
What variables are parameters?

The call to that function

```
Triangle example = new Triangle();

double answer1 = example.getHypotenuse(8,6);
double answer2 = example.getHypotenuse(9, 12);
double answer3 = example.getHypotenuse(16,30);

// Please notice that "a" and "b" are reused and given new values EACH time!!
```

Receiving parameters from the user

```
// user input values
System.out.println( "give 2 values for a right triangle");
int x = sc.nextInt();
int y = sc.nextInt();

double answer4 = example.getHypotenuse(x,y);
// Please notice that "a" and "b" are reused and given new values EVEN HERE!!
```

Why will x and y work??

Methods with Parameters in Employee

- fitting an example of a custom function with multiple parameters and an Employee
- remember that methods, can access values from the instance (member variables) not just from parameters

Member functions with parameters

```
public void printPayCheck(double hours, double taxPercentage)
{
      System.out.println("----------- You should receive in your check --------");
      double pay = hours * wage * (1.00-(taxPercentage/100));
      System.out.println("" + fmt.format(pay));
}
// wage was a member from the class
// hours and taxPercentage were values passed in as parameters
```

```
Employee e = new Employee("John Adams", "Boston, MA", 2, 2400.00);
e.setWage(12.50);
e.printPayCheck(35, 33);
```

Alias

- values given temporary name ***<u>HAVE TO SHARE THE</u>*** same data type
- items and functions asks for:
  - how many? (parameters)
  - what type are each?
    - THEY DO NOT ASK FOR A NAME!!!

public double getHypotenuse(int a, int b)
{
return Math.sqrt(a* a + b * b);
}
	// how many parameters does the function need to work?
	// what TYPES does it need

public void function(int x, double y, char z)
{
…
}
	// how many parameters does the function need to work?
	// what TYPES does it need

public char function (int x, int y, double z)
{
…
}
	// how many parameters does the function need to work?
	// what TYPES does it need

public void function (double x, double y, char z)
{
…
}
	// how many parameters does the function need to work?
	// what TYPES does it need

public double function (int x, double y, char []z)
{
…
}
	// how many parameters does the function need to work?
	// what TYPES does it need