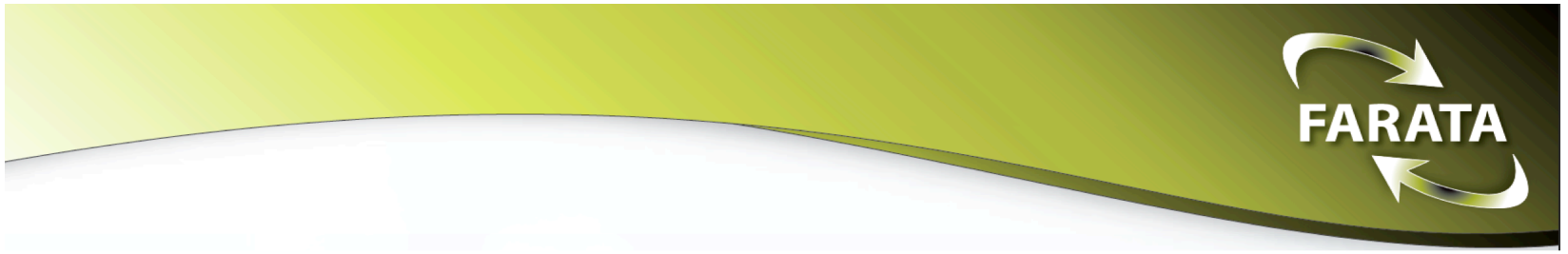


Java Programming
Unit 2

Intro to Object-Oriented Programming

Classes, methods, properties

- Java is an object-oriented language - its constructs represent objects from the real world.

- Each Java program has at least one class that knows how to do certain actions or has properties.

- Classes in Java may have methods (similar to functions) and properties (a.k.a. attributes or fields).

The Class Car

```
class Car{
   String color;
   int numberOfDoors;

   void startEngine() {
     // Some code goes here
   }
   void stopEngine () {
       int tempCounter=0;
     // Some code goes here
   }
}
```

Fields represent some attributes (properties) of a car – number of doors or color.

numberOfDoors is a variable of type `int` – to store integers; color can hold a string of characters (text)

Local variables are declared inside methods,
Fields (a.k.a. member variables) - outside

Single-line comments start with //
Multi-line comments go between /* and */

Methods describe what our car can do:
stop and start the engine.

This class has no main() method. What does it mean?

How many cars can you create?

- A class definition is a blueprint from which you can create one or more instances of the class Car.

- These two instances are created with the new operator:

```
Car car1 = new Car();
Car car2 = new Car();
```

Where do you write this code?

Let's do it in the `main()` method of another class

- Now the variables car1 and car2 represent these instances:

```
car1.color="blue";
car2.color="red";
```

A class TestCar with the method main()

```
class TestCar{

     public static void main(String[] args){

         Car  car1 = new Car();        // creating one instance
         Car  car2 = new Car();       // creating another instance

          car1.color="blue";
          car2.color="red";

          // Printing a message on the system console
           System.out.println("The cars have been painted ");
     }
 }
```

Walkthrough 1

- Create a new Eclipse Java project called OOP
- Write a class Car using the sample code above
- Write a class TestCar that creates two instances of the class Car, changes their colors and prints the message about it.
- Run the class TestCar. Observe the message in the view Console.

Inheritance – James Bond Car

In object-oriented languages the term *inheritance* means an ability to define a new class based on an existing one.

```
class JamesBondCar extends Car{

   int currentSubmergeDepth;
   boolean isGunOnBoard=true;
   final String MANUFACTURER;

   void submerge() {
      currentSubmergeDepth = 50;
     // Some code goes here
   }

   void surface() {
     // Some code goes here
   }
}
```

```
class JamesBondCar extends Car{

// …

}
```

The class JamesBondCar has everything that the class Car has *plus something else*.

In this example, it defines:
- three more attributes

- two more methods.

Variable and constants

Java is statically typed language

```
int currentSubmergeDepth;          // an integer variable
boolean isGunOnBoard=true;         // a boolean variable
final String MANUFACTURER="GAZ";   // a final text variable (a.k.a. constant)
```

First declare a variable, then use it. You can assign and change the value of the variable many times:

```
currentSubmergeDepth = 25;
…
currentSubmergeDepth = 30;
```

You can assign the value to a final variable **only once** and can't change it afterward.

```
MANUFACTURER = "Toyota";
```

Read more on variable types in Lesson 3 of the textbook.

Yet another example: class Tax

```
class Tax {

    double grossIncome;
    String state;
    int  dependents;

   public double calcTax() {

                return 234.55;
    }


}
```

To calculate taxes, you can declare a class Tax that will have some properties to store the values, required for calculations.

Then add methods that implement required functionality (*behavior*).

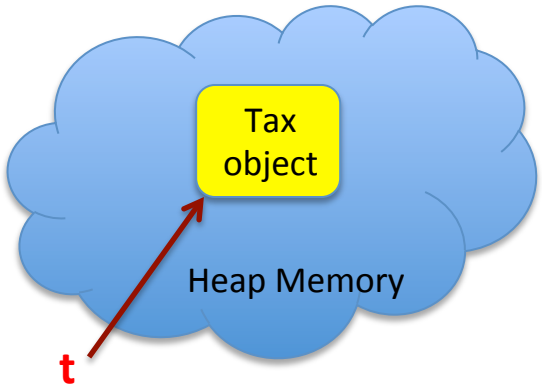
The keyword double in the method signature means that the method calcTax() will return a the result of calculations as a double presicion value.

Testing the class Tax

Let's create a class TestText with the main() method, which will instantiate Tax and call its method calcTax().

```
class TestTax{

    public static void main(String[] args){

        Tax   t = new Tax(); // creating an instance of Tax

        t.grossIncome= 50000;  // assigning the values
        t.dependents= 2;
        t.state= "NJ";

        double yourTax = t.calcTax(); //calculating tax

       // Printing the result
       System.out.println("Your tax is " + yourTax);
    }
}
```

Note the use of the variable **t**, which knows the address of the instance of the class Tax in memory.



if-statement

Sometimes you need to change the flow of the code execution. You can do it with the if-statement:

```
if (totalOrderPrice <= 200){
        System.out.println("You'll get a 20% discount");
 }
else if (totalOrderPrice > 200 && totalOrderPrice <300){
        System.out.println("You'll get 25% discount");
}
else {
        System.out.println("You'll get 30% discount");
}
```

Walkthrough 2

- Add two more classes to the OOP project: Tax and TestTax.
- Run the TestTax and observe that it always prints 234.55 as calculated text
- Modify the code of the calcTax() method to print the tax as 6% of of gross income if it was up to $50000 and 8% otherwise.
- Run the TestTax program and see if the tax is properly calculated. Change the value of grossIncome and re-run the program.

switch-statement

The switch statement is an alternative to if. The case label in the switch condition (taxCode) is evaluated and the program goes to one of the following case clauses:

```
int taxCode=someObject.getTaxCode(grossIncome);

switch (taxCode){
   case 0:
     System.out.println("Tax Exempt");
     break;
   case 1:
     System.out.println("Low Tax Bracket");
     break;
   case 2:
     System.out.println("High Tax Bracket");
     break;
   default:
     System.out.println("Wrong Tax Bracket");
}
//some other code goes here
```

Don't forget about the break statements to avoid the fall through situation.

Java 7 allows using String type in the switch statement:

```
switch (taxCategory){
  case "rich":
     …
    break;
  case "poor":
    …
}
```

Method Arguments

External data can be provided to a method in the form of *arguments* (a.k.a. *parameters*).

In the method signature declare the data type and the name of each argument.
For example, the method calcLoanPayment() has 3 arguments:

```
int calcLoanPayment(int amount, int numberOfMonths, String state){

   // Your code goes here

}
```

You can call this method passing the values for the payment calculations as arguments:

calcLoanPayment(20000, 60, “NY”);

This method call will cause compilation error if there’s no methods with 2 arguments:

calcLoanPayment(20000, 60);

Another example of inheritance

The subclass NJTax defines a new method adjustForStudents():

```
class NJTax extends Tax{

    double adjustForStudents (double stateTax){
       double adjustedTax = stateTax – 500;
       return adjustedTax;
    }
}
```

The TestTax can instantiate NJTax and use methods and fields from both *super* and *subclasses*:

```
NJTax  t= new NJTax();

double yourTax = t.calcTax();
double totalTax = t.adjustForStudents (yourTax);
```

Method overriding

If a subclass has the method with the same name and argument list, it will *override* (suppress) the corresponding method of its ancestor.

Method overriding comes handy in the following situations:

- The source code of the super class is not available, but you still need to change its functionality.

- The original version of the method is still valid in some cases, and you want to keep it as is.

Walkthrough 3

- Add to the OOP project the class NJTax that will have the calcTax() method with the same signature as in Tax
- Add the code to NJTax.calcTax() method to print the tax as 10% of of gross income if it was up to $50000 and 13% otherwise.
- Run existing TestTax and observe that your changes didn't have any effect on the calculate tax. Why?
- Change the code of the TestTax to instantiate NJTax instead of Tax.
- Run the TestTax program again and observe that now the new percentage is properly applied. You are using the *overriden* version of the method calcTax().

Method Overloading

Method overloading means having a class with more than one method having the same name but different argument lists.

```
class Financial{
  …
  int calcLoanPayment(int amount, int numberOfMonths){
     // by default, calculate for New York state
     calcLoanPayment(amount, numberOfMonths, "NY");
  }

   int calcLoanPayment(int amount, int numberOfMonths,
                                   String state){

      // Your code for calculating loan payments goes here

   }
…
}
```

A method can be overloaded not only in the same class but in a descendant too.

Constructors are special methods

When a program creates an instance of a class using new, Java invokes the class's *constructor* — a special method that is called only once :
Tax t = new Tax(40000, "CA",4);

- Constructors are called when the class is being instantiated.
- They must have the same name as the class.
- They can't return a value and you don't use void as a return type.

```
class Tax {
    double grossIncome; // class variables
    String state;
    int dependents;

    // Constructor
    Tax (double gi, String st, int depen){
       grossIncome = gi;  // class variable initialization
       state = st;
       dependents=depen;
    }
}
```

Homework

1.Study the lessons 3 and 4 from the textbook and do the assignment from the Try It sections of these lessons.

2. From now on use the following Java SE 7 documentation:

http://download.oracle.com/javase/**7**/docs/

Additional Reading

Overriding vs. hiding:
http://www.coderanch.com/how-to/java/OverridingVsHiding

Eclipse Debugging tutorial by Lars Vogel:
http://www.vogella.com/articles/EclipseDebugging/article.html