

Tutorial 6

CSC 201

Java Programming Concepts

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Chapter 6: Classes and Objects

1. Classes & Objects

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Real Objects

Java Objects

Classes

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A Simple Example: the class Student

What is an Object?

Real Objects

The term **object** in programming is quite close to the real-life meaning of the word. Let us think of some real-life objects.

More formally, we can say that any object has

1- identity: how it is identified, its name, who it belongs to...

2- state : its current status

3- behavior: the actions that the object can do, or that can be done to the object

Java Objects

What about the objects written in our programs? Basically, these objects are used to represent the real-life objects that we just described.

A **Java object** is an object that has all the properties of a real object except one thing, it is not tangible.

Classes:

When defining a new class, you are defining a data type of a specific object that you want to create, with all its properties and methods. For Example, the following is an example of a simple class that can be used to define a student.

```
class Student
{
    String name;
    String id;
    int age;
}
```

Now, we have defined a new type, called Student.

This type has three attributes (we call them instance variables)

- the name of the student (of type String)
- the id of the student (of type String)
- the age of the student (of type int)

Note that we did not create an object yet, we just defined a data type called Student.

Now, take a look at the following statement:

```
Student s1 = new Student();
```

We have just created an object/instance, of type Student. The instance variables of this object are the name, id, and age :

```
s1.name = "Sara";  
s1.id = "2805";  
s1.age = 17;
```

We have given a value to the each of the instance variables of the object s1 that we had created.

Therefore, we cannot access the name, id or age without accessing the object s1 first.

Other Components of a Class

1) The Constructor of a Class

The constructor is a special kind of method that determines how an object is initialized when created. It has no return type, and it must have the same name as the class.

The following is the class Student:

```
class Student
{
    String name;
    String id;
    int age;

    public Student() //default constructor
    {
        name = " ";
        id = " ";
        age = 0;
    }
}
```

The following statement would be used to create an object of this Student class

```
Student s1 = new Student();
```

Note that constructors can also have parameters:

```
class Student
{
    String name;
    String id;
    int age;

    public Student(String n,String i,int a)
    {
        name = n;
        id = i;
        age = a;
    }
}
```

The following statement would be used to create an object of this Student class

```
Student s2 = new Student("Sara","2506",18);
```

Please note that a constructor with no parameters is referred to as the default constructor of the class. Also note that a class can have multiple constructors. The statement where we create the object decides which constructor to call (similar to overloading):

```
Student s1 = new Student(); // will call the default constructor
```

```
Student s2 = new Student("Sara","2506",18); //will call the constructor with the parameters
```

2) Methods of a Class

Why do we need methods in a class/object ?

Recall methods, from [Chapter 6](#)

Methods are used in a class or object to perform some functions needed to describe the behavior of this object/class.

If we want to access the instance variables of a class, we cannot do so directly, therefore we need some methods that will allow us to either give values to these variables or retrieve their values.

The following is a method that accesses the instance variables of the class and sets it with the value sent:

```
class Student
{
    String name;
    String id;
    int age;

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

This would be called in the following manner:

```
Student s1;
s1.setName("Sara");
```


The following is a method that retrieves the data of an object

```
class Student
{
    String name;
    String id;
    int age;
    public String getName()
    {
        return name;
    }
}
```

This would be called in the following manner:

```
Student s1;
String StudentName;
StudentName = s1.getName();
```

Take a look at the following code fragment:

```
class Student
{
    String name;
    String id;
    int age;
    public void DisplayStudentData()
    {
        System.out.println("Name: "+name);
        System.out.println("ID: "+id);
        System.out.println("Age: "+age);
    }
}
```

This method would be called as follows:

```
s1.DisplayStudentData();
```

Our first Class:

Now that we have seen all the different kinds of methods that can be inside a class, take a look at the class **Student**, with some more instance variables and methods.

```
public class Student
{
    String name;
    String id;
    int age;
    double test1,test2,test3;
    double avg;

    //default constructor (no parameters)
    public Student()
    {
        name = " ";
        id = " ";
        age = 0;
        test1 = 0;
        test2 = 0;
    }
}
```

```
//second constructor (three parameters)
public Student(String n,String i,int a)
{
    name =n;
    id = i;
    age = a;
}
public void setName(String n)
{
    name = n;
}
public String getName()
{
    return name;
}
public void setAge(int a)
{
    age = a;
}
public int getAge()
{
    return age;
}
```

```
public void setId(String i)
{
    id = i;
}
public String getId()
{
    return id;
}
```

```
public void setExamScores(double t1, double t2, double t3)
{
    test1 = t1;
    test2 = t2;
    test3 = t3;
}
```

//Other Methods

```
public double getAverage()
{
    avg = (test1 + test2 + test3)/3.0;
    return avg;
}

public void displayStudentData()
{
    System.out.println("Name: "+name);
    System.out.println("Id: "+id);
    System.out.println("Age: "+age);
    System.out.println("Score of test1: "+test1);
    System.out.println("Score of test2: "+test2);
    System.out.println("Score of test3: "+test3);
    System.out.println("Average Score: "+avg);
}
```

```
public static void main(String[] args)
{
    Student s1, s2,
    String sName, sId;
    int sAge;
    double sAvg;
    s1 = new Student(); // created a student s1 with default constructor with no parameters
    s2 = new Student("Sara","2805", 19); //created another student with the constructor parameters
    s1.setName("Ahmed"); // setting the name of student s1
    s1.setId("2104"); //setting the id of student s1
    s1.setExamScores(30, 28.5, 21); //setting the exam scores of student s1
    s1.setAge(18); //setting the age of student s1
    sAvg = s1.getAverage(); //retrieving average of student s1
    s2.setExamScores(30,19.75,21.5); //setting exam scores of student s2
    s2.getAverage(); //retrieving the average of student s2
    System.out.println("Student 1 Data: ");
    s1.displayStudentData(); // displays data of student s1
    System.out.println();
    System.out.println("Student 2 Data: ");
    s2.displayStudentData(); //displays data of student s2
}
}
```