Class

- A class is a **template** that specifies the **attributes** and **behavior** of things or objects.
- A class is a **blueprint** or **prototype** from which objects are created.
- A class is the implementation of an **abstract data type** (ADT). It defines attributes and methods which implement the data structure and operations of the ADT, respectively.

  Syntax:

```
class classname
{
Datatype variable1;
Datatype variable2;
// ...
Datatype variableN;

return_type   methodname1(parameter-list)
{
        // body of method
}

return_type   methodname2(parameter-list)
{
        // body of method
}

        return_type   methodnameN(parameter-list)
        {
                // body of method
        }
    }
```

  - A class is declared by use of the **class** keyword.
  - The **data**, or **variables**, defined within a class are called **instance** variables because each instance of the class (that is, each object of the class) contains its **own copy** of these variables. Thus, the data of one object is **separate** and **unique** from the data of another.
  - The actual code contained within **methods**.
  - The **methods** and **variables** defined within a class are called members of the class.

Methods

Syntax:

```
return_type   method_name(parameter-list)
{
    // body of method
}
```

- Here, **return_type** specifies the type of data **returned** by the method. This can be any **valid** type. If the method does not **return** a value, its return type must be **void**.

- The name of the method is specified by **method_name**. This can be any legal **identifier** other than those already used by other member within the **current scope**. The **parameter-list** is a sequence of **type and identifier** pairs separated by **commas**.
- Parameters are essentially variables that **receive** the value of the **arguments** passed to the method when it is called. If the method has no parameters, then the parameter list will be **empty.**

Return value

- Method that have a **return type** other than **void** return a value to the calling **method** using the following form of the return statement:

Syntax:

return value;

- Here, **value** is the value returned.

Example:

```
class  Box
{
        double width = 1;
        double height = 2;
        double depth = 3;

        double volume()
        {
            return  (width * height * depth);
        }
}
```

Method Call

Syntax:

var_name = **object_name.**method_name(parameter-list);

Example:

vol = b1.volume();

- In above example, **b1** is an object and when **volume( )** is called, it is put on the right side of an **assignment** statement. On the left is a **variable,** in this case **vol**, that will receive the value returned by **volume( )**.

Declaring Object

- To obtain an **object** of class, **first** you must declare a **variable** of the **class type**. This variable does not define an object. Instead, it is simply a variable that can **refer** to an **object**.
- **Second**, you must obtain an **actual** copy of the object and **assign** it to that variable. You can do this using the **new** operator.
- The **new** operator dynamically allocates (that is, allocates at run time) memory for an object and returns a **reference** to it. This **reference** is an **address** in memory of the object allocated by **new**.

Syntax:

Step - 1 : class_name class_var;
Step - 2: class_var = new class_name( );

- Here, **class_var** is a variable of the class type being created. The **class_name** is the name of the class that is being instantiated.

Assigning Object Reference Variables

- **Object reference** variables acts differently than you might expect when an assignment takes place.

Example:

```
Box  b1 = new Box();
Box  b2 = b1;
```

- Here, **b1** and **b2** will both refer to the **same** object. The assignment of **b1** to **b2** did not allocate any memory of the original object.
- It simply makes **b2** refer to the same object as **b1** does. Thus, any changes made to the object through **b2** will affect the object to which **b1** is referring, since they are the same **object.**

Example:

```
class Box
{
        double width = 1.0;
        double height = 2.0;
        double depth = 3.0;

        void volume()
        {
                System.out.print("Volume is ");
                System.out.println(width * height * depth);
        }
}
class BoxDemo
{
        public static void main(String args[])
        {
                Box b1 ;                    // declare reference to object
                b1 = new Box()              // allocate a Box object
                //Box b1 = new Box();       We can also combine above two statement.
                b1.volume();
        }
}
```

Output:

```
Volume is 6.0
```

Visibility Controls of JAVA

- Java provides a number of **access modifiers** to set access levels for **classes**, **variables**, **methods** and **constructors**. The four access levels are:
  1) **Package/friendly (default) -**Visible to the **package**. **No modifiers are needed**.
  2) **Private** - Visible to the **class** only.
  3) **Public**- Visible to the **class** as well as **outside the class**.
  4) **Protected**- Visible to the **package** and all **subClasses**.

Default Access Modifier – No Keyword

- **Default** access modifier means no need to declare an access modifier for a **class**, **field**, **method** etc.
- A variable or method declared without any access control modifier is **available to any other class in the same package**. The **default** modifier cannot be used for methods in an **interface** because the methods in an interface are by default **public**.

  Example:

```
String  str = "Hi";
void a()
{
        System.out.println(str);
}
```

Private Access Modifier – private

- Methods, Variables and Constructors that are declared **private** can only be accessed within the **declared class itself**.
- Private access modifier is the most **restrictive access level**. **Class** and **interfaces** cannot be **private**.
- Variables that are declared private can be accessed outside the class if **public getter** methods are present in the **class**.
- Using the private modifier, an object **encapsulates** itself and **hides** data from the outside world.

  Example:

```
class  A
{
        private String s1 = "Hello";
        public String getName()
        {
                return  this.s1;
        }
}
```

  - Here, **s1** variable of **A** class is private, so there's no way for other classes to retrieve. So, to make this variable available to the outside world, we defined public methods: **getName()**, which returns the value of **s1**.

Public Access Modifier - public

- The **public** keyword is an access specifier, which allows the programmer to control the visibility of class members.
- When a class member is preceded by **public**, then that member may be accessed by code **outside the class**.
- A class, method, constructor, interface etc declared public can be accessed from any other class.
- Therefore, methods or blocks declared inside a public class can be accessed from any class belonging to the Java world.
- However, if the public class we are trying to access is in a different package, and then the public class still need to be **imported**. Because of class inheritance, all public methods and variables of a class are inherited by its **subClasses**.

  Example:

```
public static void main(String[] args)
{
    // ...
}
```

- The **main( )** method of an application needs to be **public**. Otherwise, it could not be called by a **Java interpreter** (such as java) to run the class.

Protected Access Modifier – Protected

- Variables, methods and constructors which are declared **protected** in a super class can be accessed only by the **subClasses** in other package or any class within the package of the protected members' class.
- The protected access modifier cannot be applied to **class** and **interfaces**. **Methods** can be declared **protected**, however **methods** in a **interface** cannot be declared **protected**.
- Protected access gives chance to the subClass to use the helper method or variable, while prevents a non-related class from trying to use it.

  Example:

```
package p1;
class A
{
    float f1;
    protected int i1;
}

// note that class B belongs to the same package as class A
package p1;
class B
{
    public void getData()
    {
        // create an instance of class A
```

```
                A  a1 = new A();
                a1.f1 = 19;
                a1.i1 = 12;
            }
        }
```

- In above example, class **A** and **B** are in same package **p1**. Class **A** has **i1** variable which is declared as protected. So, it can be accessed through entire package and all its subclasses. Thus, in **getData()** method of class **B** we can access variable **f1** as well as **i1.**

this Keyword

- Sometimes a method will need to refer to the object that invoked it.
- To allow this, Java defines the **this** keyword. Keyword **this** can be used inside any method or constructor of class to refer to the current object.
- It means, **this** is always a reference to the object on which the method was invoked.
- **this** keyword can be very useful in case of Variable Hiding.
- You can use **this** anywhere a reference to an object of the current class' type is permitted.
- We cannot create two **Instance/Local** variables with same name. But it is legal to create one instance variable & one local variable or method parameter with same name.
- **Local Variable** will hide the instance variable which is called Variable Hiding.

Example:

```
class A
{
int v = 5;
public static void main(String args[])
{
        A a1 = new A();
        a1.method(20);
        a1.method();
}
void method(int variable)
{
        int  v = 10;
        System.out.println("Value of Instance variable :" + this.v);
        System.out.println("Value of Local variable :" + v);
}
void method()
{
        int v = 40;
        System.out.println("Value of Instance variable :" + this.v);
        System.out.println("Value of Local variable :" + v);
    }
}
```

Output:

```
Value of Instance variable :5
Value of Local variable :10
```

Value of Instance variable :5
Value of Local variable :40

static Keyword

- When a member is declared **static**, it can be accessed before any objects of its class are created, and without reference to any object.
- You can declare both methods and variables to be **static**. The most common example of a **static** member is **main( )**.
- **main( )** is declared as **static** because it must be called before any objects exist.
- When objects of its class are declared, no copy of a **static** variable is made. Instead, all instances of the class share the same **static** variable.
- **Methods** declared as **static** have several restrictions:
  1) They can only call other **static** methods.
  2) They must only access **static** data.
  3) They cannot refer to **this** or **super** in any way.

Example:

```
class staticDemo
{
        static int count=0;      //will get memory only once and retain its value

        staticDemo()
        {
                count++;
                System.out.println(count);
        }
        static
        {
                System.out.println("Static block initialized...");
        }
        static void display()
        {
                System.out.println("Static method call…");
        }
        public static void main(String args[])
        {
                staticDemo s1=new staticDemo();
                staticDemo s2=new staticDemo();
                staticDemo s3=new staticDemo();
                display();
        }
}
```

Output:

```
Static block initialized...
1
```

```
2
3
Static method call...
```

- If you wish to call a **static** method from outside its class, you can do so using the following general form:

  classname.method( );

- Here, **classname** is the name of the class in which the **static** method is declared. No need to call static method through object of that class.

final Keyword

- A **variable** can be declared as **final**. You cannot change the value of final variable. It means, final variable act as **constant** and value of that variable can never be changed.
- If you declared any **method** as **final** then you cannot **override** it.
- If you declared any **class** as **final** then you cannot **inherit** it.

Example:

```
class finalDemo
{
        final int b = 100;
        void  m1()
        {
                b = 200;   /* Error generate because we cannot change the value of
                              final variable*/
        }
        public static void main(String args[])
        {
                finalDemo f1 = new finalDemo();
                f1.m1();
        }
}
```

Output:

```
Compile Time Error
```

Method Overloading

- If class have multiple methods with **same name** but **different parameters** is known as **Method Overloading**.
- Method overloading is also known as **compile time (static) polymorphism**.
- The same method name will be used with **different number of parameters and parameters of different type**.
- Overloading of methods with **different return types is not allowed**.
- Compiler identifies which method should be called among all the methods have same name using the **type** and **number of arguments**.
- However, the two functions with the same name must differ in at least one of the following,

1) The number of parameters
2) The data type of parameters
3) The order of parameter

Example:

```
class overloadingDemo
{
        void  sum(int a,int b)
        {
            System.out.println("Sum of (a+b) is:: "+(a+b));
        }
        void  sum(int a,int b,int c)
        {
            System.out.println("Sum of (a+b+c) is:: "+(a+b+c));
        }
        void  sum(double a,double b)
        {
            System.out.println("Sum of double (a+b) is:: "+(a+b));
        }
        public static void main(String args[])
        {
                overloadingDemo o1 = new overloadingDemo();
                o1.sum(10,10);          // call method1
                o1.sum(10,10,10);       // call method2
                o1.sum(10.5,10.5);      // call method3
        }
}
```

Output:

```
Sum of (a+b) is:: 20
Sum of (a+b+c) is:: 30
Sum of double (a+b) is:: 21.0
```

Constructor

- Constructor is special type of method that is used to initialize the object.
- It is invoked at the time of object creation.
- **There are two rules to define constructor as given below:**
  1) Constructor name must be same as its class name.
  2) Constructor must not have return type.
- Return type of class constructor is the **class type itself**.
- **There are two type of constructor :**
  1) Default Constructor
  2) Parameterized constructor

Default Constructor

- A constructor that has **no parameter** is known as **default constructor**.
- If we don't explicitly declare a constructor for any class, the compiler creates a default constructor for that class.

Example:

```
class A
{
        A()                 //Default constructor
        {
                System.out.println("Default constructor called..");
        }
        public static void main(String args[])
        {
                A a = new A();
        }
}
```

Output:

```
Default constructor called..
```

Parameterized Constructor

- A constructor that has parameters is known as **parameterized constructor**.
- It is used to provide different values to the distinct objects.
- It is required to pass parameters on creation of objects.
- If we define only parameterized constructors, then we cannot create an object with **default constructor**. This is because compiler will not create default constructor. You need to create default constructor explicitly.

Example:

```
class A
{
        int a;
        String s1;
        A(int b,String s2)        //Parameterized constructor
        {
                b = a;
                s2 = s1;
        }
        void display()
        {
                System.out.println("Value of parameterized constructor is :: "+a+" and
"+b);
        }
        public static void main(String args[])
        {
                A a = new A(10,"Hello");
```

```
                a.display();
            }
        }
```

Output:

Value of parameterized constructor is :: 10 and Hello

Copy Constructor

- A copy constructor is a constructor that takes only **one parameter** which is the same type as the class in which the copy constructor is defined.
- A copy constructor is used to create another **object** that is a copy of the object that it takes as a parameter. But, the newly created copy is totally **independent** of the original object.
- It is **independent** in the sense that the copy is located at different address in memory than the original.

Overloading Constructor

- Constructor overloading in java allows to **more than one constructor** inside one Class.
- It is not much different than **method overloading**. In Constructor overloading you have multiple constructors with **different signature** with only difference that constructor doesn't have **return type**.
- These types of constructor known as **overloaded constructor**.

Passing object as a parameter

- If you want to construct a new object, thatis initially the same as some existing object. To do this, you must define a constructor that takes an object of its class as a parameter.

Example:

```
class Box
{
        double width;
        double height;
        double depth;
        // It takes an object of type Box. Copy constructor
        Box(Box ob)
        {
                // pass object to constructor
                width = ob.width;
                height = ob.height;
                depth = ob.depth;
        }
        // Parameterized constructor
        Box(double w, double h, double d)
        {
                width = w;
                height = h;
                depth = d;
```

```
}
// Default constructor
Box()
{
        width = -1; // use -1 to indicate
        height = -1; // an uninitialized
        depth = -1; // box
}
// constructor used when cube is created
Box(double len)
{
        width = height = depth = len;
}
// compute and return volume
double volume()
{
        return width * height * depth;
}
}
class DemoAllCons
{
public static void main(String args[])
{
        Box mybox1 = new Box(10, 20, 15);
        Box mybox2 = new Box();
        Box mycube = new Box(7);
        Box myclone = new Box(mybox1); // create copy of mybox1
        double vol;
        // get volume of first box
        vol = mybox1.volume();
        System.out.println("Volume of mybox1 is " + vol);
        // get volume of second box
        vol = mybox2.volume();
        System.out.println("Volume of mybox2 is " + vol);
        // get volume of cube
        vol = mycube.volume();
        System.out.println("Volume of cube is " + vol);
        // get volume of clone
        vol = myclone.volume();
        System.out.println("Volume of clone is " + vol);
    }
}
```

Output:

```
Volume of mybox1 is 3000.0
Volume of mybox2 is -1.0
Volume of cube is 343.0
Volume of clone is 3000.0
```