OOP Concept

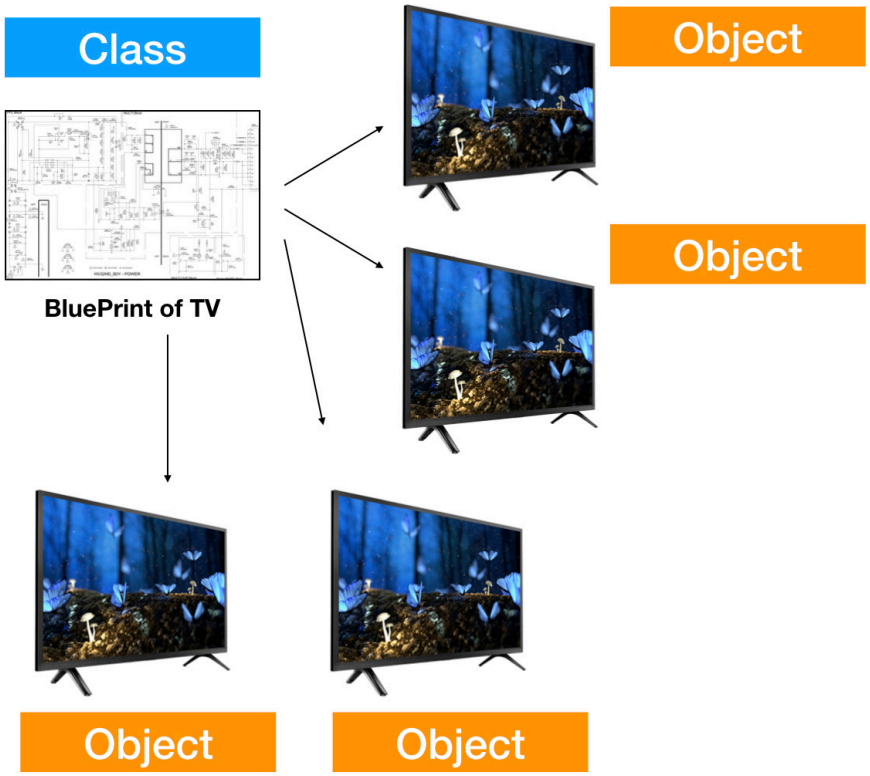
OOP(Object Oriented Programming) Concept
Created by: Alan Kay
First OOP based programming: Simula
First famous OOP based programming: C++
Java's OOP comes from C++
Java is more Object Oriented and Secure than C++
Java is C++ without the guns, clubs and knives. (by- James Gosling)

OOP's Concepts

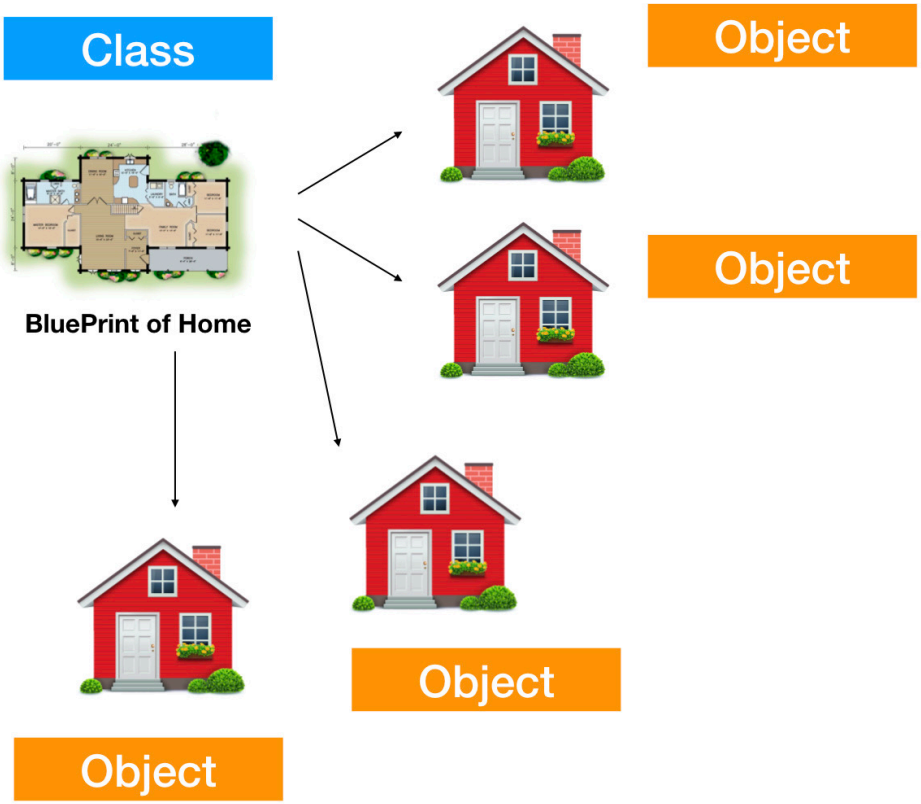
- Class
- Object
- Encapsulation
- Abstraction
- Inheritance
- Polymorphism

Class and Object

Class is a blueprint of the object.
Object is a physical entity.

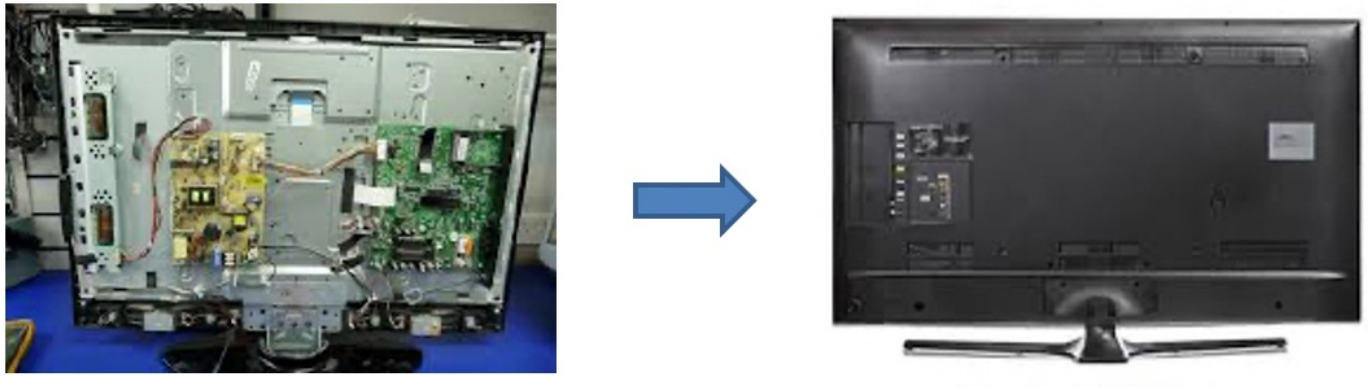


Class and Object



Encapsulation

Binding/Wrapping the component together to make them secure is known as **Encapsulation.**



Abstraction

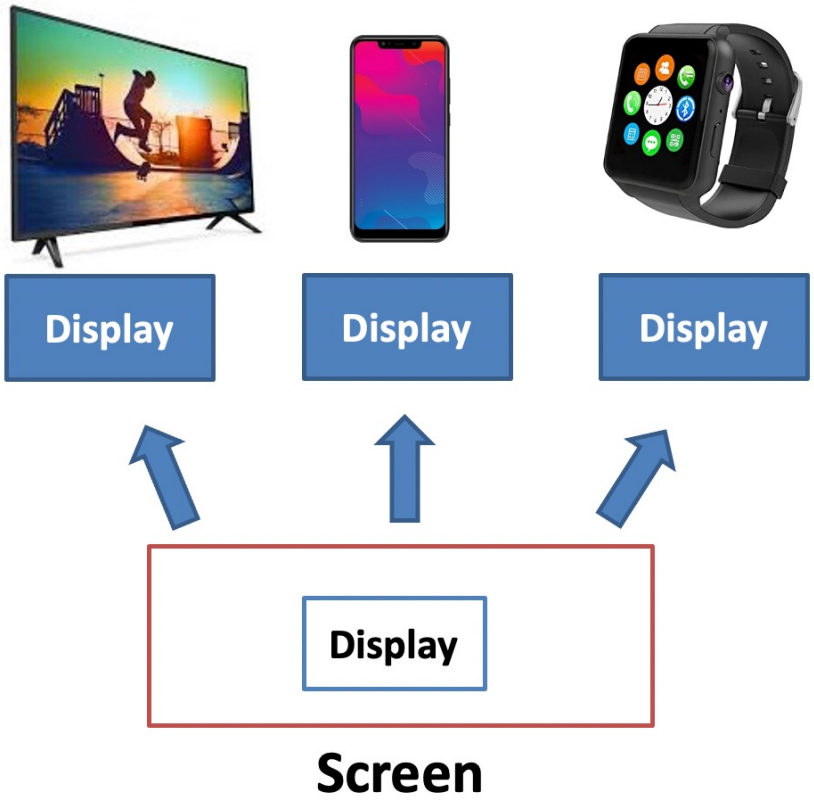
Hiding the complex working(Complexity) by providing the functionality is known as **Abstraction.**

Inheritance

Using the old design to creating new design is known as **Inheritance.**

Polymorphism

Having multiple functionalities with same name but different way of working is known as **Polymorphism.**



Object Anatomy


```
class Employee{
    String name;
    int salary;
    String cname;
}
```

Static Keyword

static keyword can be used inside the class as:

- **Static variable**
- **Static method**
- **Static block**
- **Static nested class**

Static Variable

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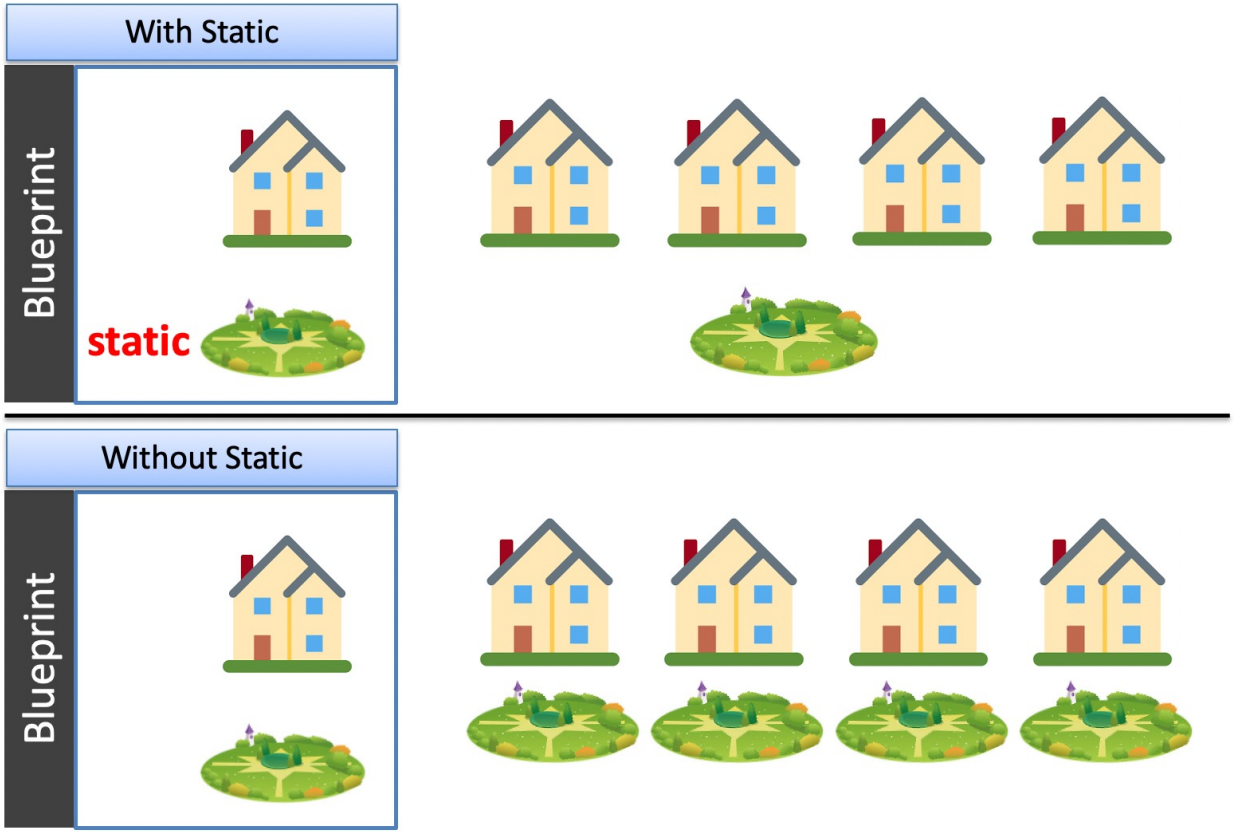
A common member for every object of a class.



Static Variable

- **Can be accessed via Class-Name and Reference-name.**
- **Allocated when the class loads in memory.**

```
class Employee{
        String name;
        int salary;
        static String cname;
}
```

Static Method

- **Can be accessed via Class-Name and Reference-name.**
- **Allocated when the class loads in memory.**
- **Can access static member but can not access non-static member of that class.**

```
class A{
        static void methodName(){
        //body
        }
}
```

Static Block

- **Automatically executes when the class loads in memory.**
- **Only executes once.**
- **Can access static member but can not access non-static member of that class.**
- **Mostly used for initializing the static variable.**

```
class A{
        static {
          //body
        }
}
```

Static vs Non-Static Member

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Static member	Non-Static member
• Also known as Class Member. • Common for Every Object of the class. • Can be accessed via Class name and Reference variable-name /instance. • Allocated when class loads in memory. • Can be accessed from static and non-static context both.	• Also known as Instance Member. • Individual for Every Object of the class. • Can be accessed via Reference variable-name /instance only. • Allocated when object created in memory. • Can be accessed from a non-static context only.

Constructor

A special method in a class that is executed automatically when an object of the class created.

```
class A{
        A(){
          System.out.println(”Hi A”);
        }
}
```

A a1=new A();
A a2=new A();
A a3=new A();

Constructor vs Method

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Constructor	Method
• Special method in a class. • Name must be same as class name. • Can not declare return type (even, void not allowed). • Invoked implicitly with object construction. • Mostly used to initialize the object of the class.	• Normal method in a class. • Name is the choice of programmer. • Can declare return type or void. • Invoked explicitly by programmer's choice. • Used to do anything that programmer needs.

Types of Constructor

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Non-Parameterized	Parameterized

class **A**{
A(){
//body
}
}
	class **A**{
	A(int x){
	//body
	}
	}

Constructor Overloading

```
class A{
        A(){
          //body
        }
        A(int x){
          //body
        }
}
```

Constructor Chaining

```
class A{
        A(){
          //body
        }
        A(int x){
          this();
          //body
        }
}
```

Constructor Chaining Rules

- **Can not chain more than one constructor in a constructor.**
- **Constructor chaining statement must be the first statement.**
- **Recursive constructor chaining is not allowed.**

Initialize Block

- **A special block in a class that is executed automatically before constructor when an object of the class created.**
- **This block having no name that's why also known as anonymous block of the class.**

```
class A{
        A(){
          //body
        }
        {
          //body
        }
}
```

Inheritance

Mechanism of creating new class from old one is called Inheritance.

```
class A{
        //members
}
```

Super/Parent/Base class

```
class B extends A{
        //members
}
```

Sub/Child/Derived class

Types of Inheritance

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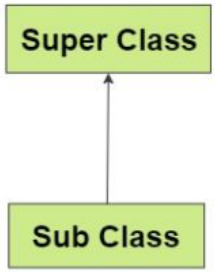
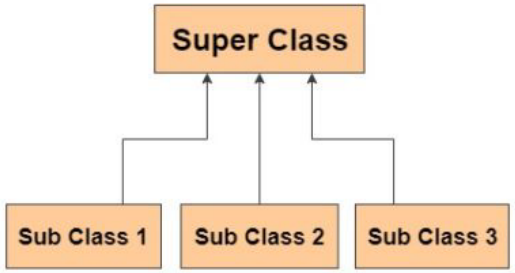
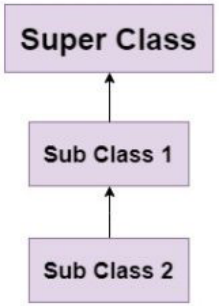
Single Inheritance



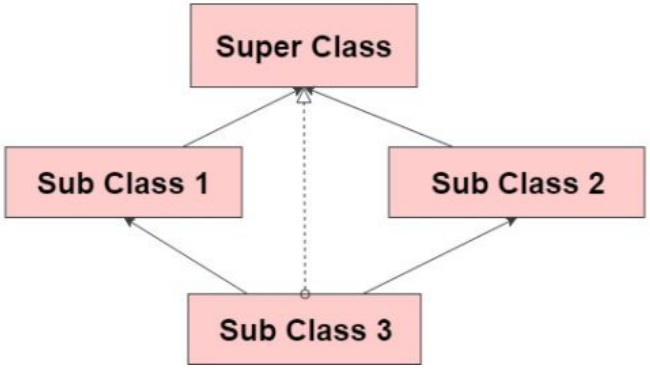
Hierarchial Inheritance



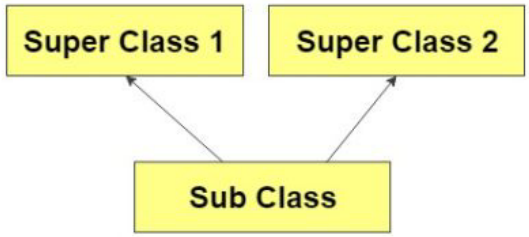
MultiLevel Inheritance



Hybrid Inheritance

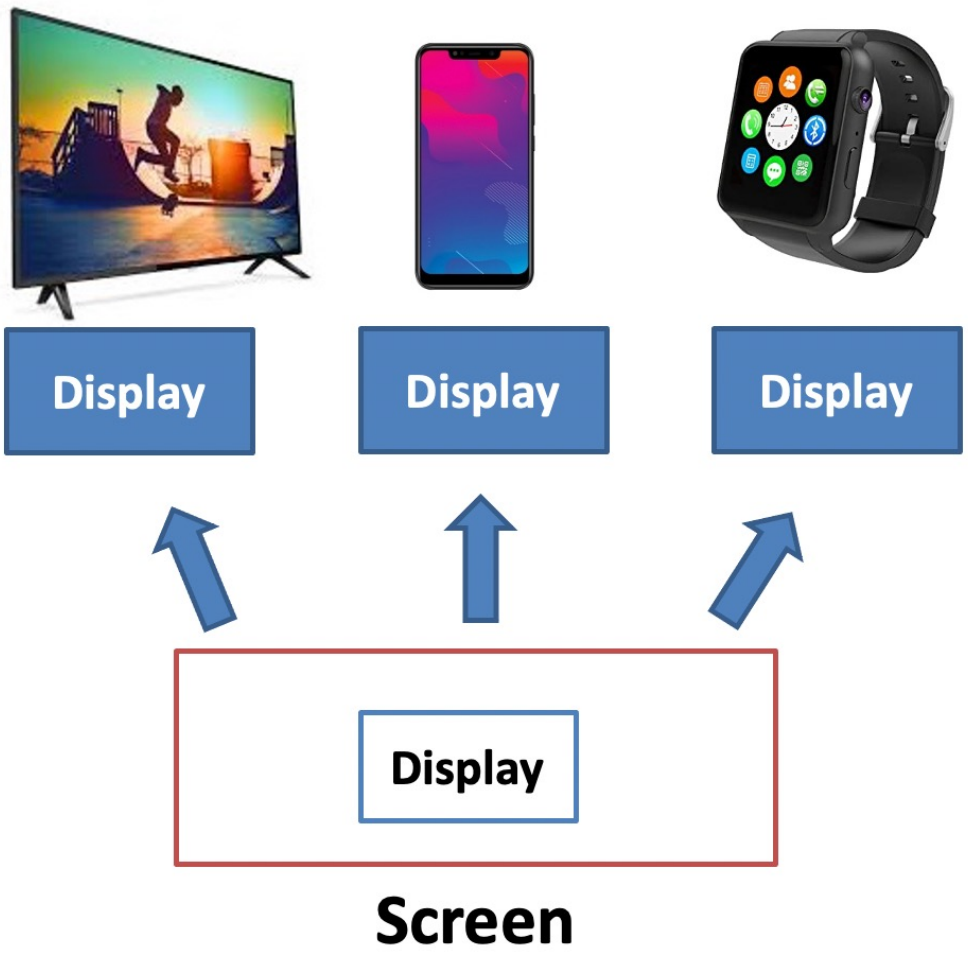


Multiple Inhertance

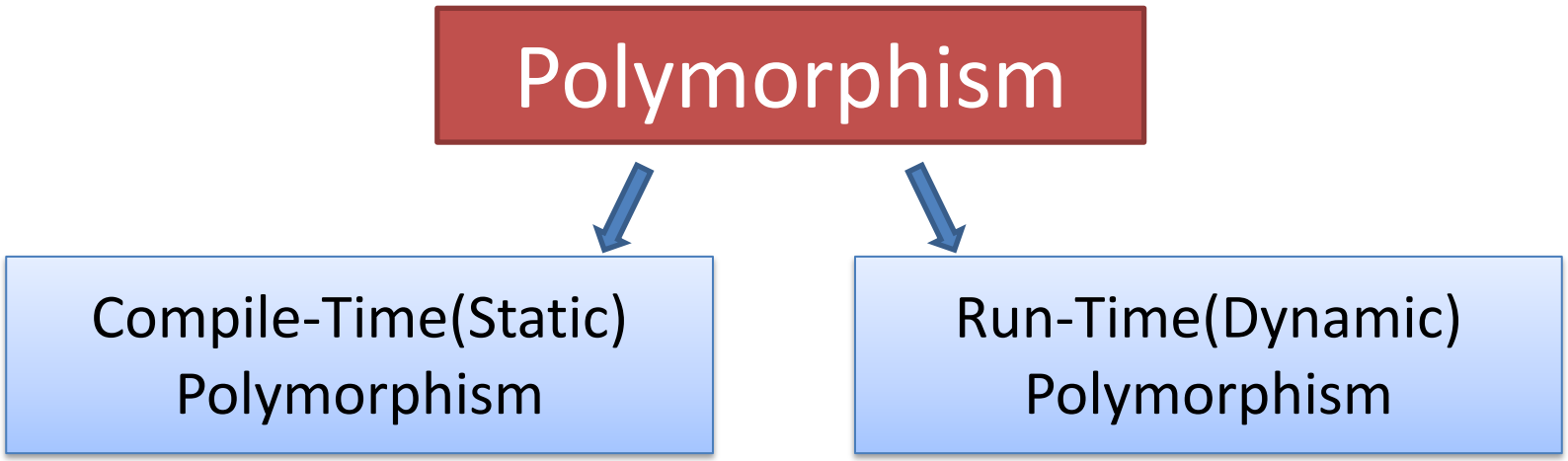


In Java classes Multiple Inheritance is NOT supported.

Polymorphism



Types of Polymorphism



Rules of Method Overloading

- **Method name must be same.**
- **Method argument must be different.**
- **Method return type can be same or different.**
- **Inheritance is optional.**
- **Method can be static or non-static.**

Compile-Time Polymorphism

- **Compile-Time Polymorphism = Method Overloading.**
- **Having multiple methods with same name in a class is known as compile-time polymorphism.**

```
class Addition{
        void add(int x,int y){
          //body
        }
        void add(String x,String y){
          //body
        }
}
```

Rules of Method Overriding

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- **Method name must be same.**
- **Method argument must be same.**
- **Method return type must be same or covariant.**
- **Inheritance is compulsory.**
- **Access modifier must be same or strong.**
- **Method must be non-static.**

Rules of Method Hiding

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- **Method name must be same.**
- **Method argument must be same.**
- **Method return type must be same or covariant.**
- **Inheritance is compulsory.**
- **Access modifier must be same or strong.**
- **Method must be static.**

Type Casting

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Non-Primitive TypeCasting

```
class Super{
    void m1(){ }
}
```

```
class Sub extends Super{
    void m2(){ }
}
```

```
Sub x=new Sub();
Super y=x; [ upcasting ]
Sub z=y ; [ compile error ]
Sub z=(Sub)y; [ downcasting ]

Super y=new Sub() ; [ upcasting ]
Super y=(Super)new Sub(); [ upcasting ]
Sub x=new Super() ; [ compile error ]
Sub x=(Sub)new Super() ; [ ClassCastException ]
```

Primitive TypeCasting

```
int x=10;
double y=x; [ upcasting ]
int z=y ; [ compile error ]
int z=(int)y; [ downcasting ]
```

Run-Time Polymorphism

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- **Run-Time Polymorphism = Method Overriding + Non-primitive Upcasting**
- **Having multiple methods with same signature in different classes and calling them from the super-class reference is known as run-time polymorphism.**

Without Run-Time Polymorphism

```
public class  Circle{
 private double a;
 public void area(){
     a=3.14 X 5 X 5 ;
   }
 public void show(){
     SOP("Circle's Area: "+a) ;
   }
}
```

```
public class  Rectangle{
 private double  v;
 public void m1 (){
     v=10 X 7 ;
   }
 public void m2(){
  SOP("Rectangle's Area: "+v) ;
   }
}
```

```
public class  Triangle{
 private double  ar;
 public void calculate(){
     a= 15 X 8 / 4;
   }
 public void display(){
   SOP("Triangle's Area: "+ar) ;
   }
}
```

```
public class Test{
   PSVM(String [] s){
     Circle  c=new Circle();
      c.area();
      c.show();
      Rectangle  r=new Rectangle();
      r.m1();
      r.m2();
      Triangle  t=new Triangle();
      t.calculate();
      t.display();
   }
}
```

With Run-Time Polymorphism

```
public class  Circle extends  Shape{
 private double a;
 public void findArea(){
     a=3.14 X 5 X 5 ;
   }
 public void printArea(){
     SOP("Circle's Area: "+a) ;
   }
}
```

```
public class  Rectangle extends  Shape{
 private double  v;
 public void findArea(){
     v=10 X 7 ;
   }
 public void printArea(){
  SOP("Rectangle's Area: "+v) ;
   }
}
```

```
public class  Triangle extends  Shape{
 private double  ar;
 public void findArea(){
     a= 15 X 8 / 2;
   }
 public void printArea(){
   SOP("Triangle's Area: "+ar) ;
   }
}
```

```
public class  Shape{
   public void findArea(){

   }
   public void printArea(){

    }
}
```

```
public class Test{
   PSVM(String [] s){
      Shape s;
      s=new Circle();
      s. findArea();
      s. printArea();
      s=new Rectangle();
      s. findArea();
      s. printArea();
      s=new Triangle();
      s. findArea();
      s. printArea();
   }
}
```

Abstract Class

```
public class  Circle extends  Shape{
 private double a;
 public void findArea(){
     a=3.14 X 5 X 5 ;
   }
 public void printArea(){
     SOP("Circle's Area: "+a) ;
   }
}
```

```
public class  Rectangle extends  Shape{
 private double  v;
 public void findArea(){
     v=10 X 7 ;
   }
 public void printArea(){
  SOP("Rectangle's Area: "+v) ;
   }
}
```

```
public class  Triangle extends  Shape{
 private double  ar;
 public void findArea(){
     a= 15 X 8 / 2;
   }
 public void printArea(){
   SOP("Triangle's Area: "+ar) ;
   }
}
```

```
abstract public class  Shape{
   public void findArea(){

   }
   public void printArea(){

    }
}
```

```
public class Test{
   PSVM(String [] s){
      Shape s= new Shape() ;
      s=new Circle();
      s. findArea();
      s. printArea();
      s=new Rectangle();
      s. findArea();
      s. printArea();
      s=new Triangle();
      s. findArea();
      s. printArea();
   }
}
```

Abstract Class

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- **A class that can not be instantiated.**
- **A class that is used to access its sub-classes only.**
- **A class that is used to achieve Run-time polymorphism.**

Abstract Method

```
public class  Circle extends  Shape{
 private double a;
 public void findArea(){
     a=3.14 X 5 X 5 ;
   }
 public void printArea(){
     SOP("Circle's Area: "+a) ;
   }
}
```

```
public class  Rectangle extends  Shape{
 private double  v;
 public void findArea(){
     v=10 X 7 ;
   }
 public void printArea(){
  SOP("Rectangle's Area: "+v) ;
   }
}
```

```
public class  Triangle extends  Shape{
 private double  ar;
 public void findArea(){
     a= 15 X 8 / 2;
   }
 public void printArea(){
   SOP("Triangle's Area: "+ar) ;
   }
}
```

```
abstract public class  Shape{
 abstract public void findArea() ;
 abstract public void printArea() ;
}
```

```
public class Test{
   PSVM(String [] s){
      Shape s= ~~new Shape()~~ ;
      s=new Circle();
      s. findArea();
      s. printArea();
      s=new Rectangle();
      s. findArea();
      s. printArea();
      s=new Triangle();
      s. findArea();
      s. printArea();
   }
}
```

Abstract Method

- **A method without body.**
- **A method that must be overridden in its non-abstract sub-class.**

Interface

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```
public class  A {
 public void show(){
   SOP("Hello A") ;
   }
}
```

```
abstract public interface  Shape{
 abstract public void findArea() ;
 abstract public void printArea() ;
}
```

```
public class  Rectangle extends A implements Shape{
 private double  v;
 public void findArea(){
     v=10 X 7 ;
   }
 public void printArea(){
  SOP("Rectangle's Area: "+v) ;
  show();
   }
}
```

```
public class  Triangle implements  Shape{
 private double  ar;
 public void findArea(){
     a= 15 X 8 / 2;
   }
 public void printArea(){
   SOP("Triangle's Area: "+ar) ;
   }
}
```

```
public class Test{
   PSVM(String [] s){
      Shape s= new Shape() ;
      s=new Circle();
      s. findArea();
      s. printArea();
      s=new Rectangle();
      s. findArea();
      s. printArea();
      s=new Triangle();
      s. findArea();
      s. printArea();
   }
}
```

Interface vs Abstract Class

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Interface	Abstract class
• It is 100% abstract class by default. • Supports multiple inheritance. • Does not support constructor. • Method in interface is by default abstract and public. • Variable in interface is by default public, static and final. • To inherit an interface in class, we use **implements** keyword and To inherit an interface in interface, we use **extends** keyword. • From Java-8, **default method** and **static method** are allowed in the . • From Java-9, **private** method is also allowed in the interface.	• It can be 100% abstract or not. • Does not supports multiple inheritance. • Supports constructor. • Method in abstract class is not by default abstract and public. • Variable in abstract class is not by default public, static and final. • To inherit an abstract class, we use **extends** keyword.

Final keyword

- **Final class** (A class that can not be Inherited)
- **Final method** (A method that can not be overridden)
- **Final variable** (A variable, who's value can not be changed)

final class

```
final class A{
        //members
}
```

final method

```
class A{
        final void method(){
        //body
        }
}
```

final variable

```
class A{
        final  int x=10;
         void method(){
                final  int z=20;
        }
}
```

Blank Final Variable

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Allowed

```
class Test{
   final int a;
   Test(){
    a=10;
    }
}
```

```
class Test{
   final int a;
   {
    a=10;
    }
}
```

```
class Test{
   static final int a;
   static {
    a=10;
    }
}
```

Not Allowed

```
class Test{
   final int a;
   Test(){
    a=10;
    }
    {
     a=10;
    }
}
```

```
class Test{
   static final int a;
   Test(){
    a=10;
    }
}
```

```
class Test{
   final int a;
   static{
    a=10;
    }
}
```

Nested Class

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- **Non-static nested class**
- **Static nested class**
- **Local nested class**
- **Anonymous nested class**

Non-Static Nested Class

```
class A{
        void m1(){
            B b=new B();
            SOP(b.z);
            b.m();
        }
        class B{
            int z;
            void m(){
                SOP("hi B");
            }
        }
}
```

```
class Demo{
        PSVM(){
            A a=new A();
            A.B b=a.new B();
            SOP(b.z);
            b.m();
        }
}
```

Static Nested Class

```
class A{
        void m1(){
            B b=new B();
            SOP(b.z);
            b.m();
        }
        static class B{
            int z;
            void m(){
                SOP("hi B");
            }
        }
}
```

```
class Demo{
        PSVM(){
            A.B b=new A.B();
            SOP(b.z);
            b.m();
        }
}
```

Local Nested Class

```
class A{
        void m1(){
            class B{
                int z;
                void m(){
                    SOP("hi B");
                }
            }
            B b=new B();
            SOP(b.z);
            b.m();
        }
        void m2(){
            // B b=new B(); //error
        }
}
```

```
class Demo{
        PSVM(){
            A a=new A();
            a.m1();
        }
}
```

Anonymous Nested Class

```
class A{
        void m1(){
            SOP( “Hi A”);
        }
}
```

```
class Demo{
        PSVM(){
            A a=new A() {
                    void m1(){
                        SOP( “Hi INCAPP”);
                    }
            } ;
            a.m1();
        }
}
```

Package

- **Used to avoid the naming confliction of classes in a project**
- **Used to categorized the classes.**

Access Modifiers

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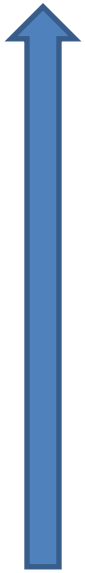
Most Accessible



public: accessible all over the enclosing project.

protected: accessible inside the enclosing package and inside the sub-class of any package of the enclosing project.

Default(package private): accessible only inside the enclosing package .

private: accessible inside the enclosing class.

Less Accessible

protected keyword

Protected member is accessible inside the enclosing package and inside the sub-class of any package of the enclosing project.

package **p2**

```
import p1.A;
public class B{
    public void m(){
        A a= new A();
        SOP(a.x); //error
    }
}
```

```
import p1.A;
public class C extends A{
    public void m(){
        SOP(x);
    }
}
```

package **p1**

```
public class A{
    protected int x=10;
}
```

```
public class B{
    public void m(){
        A a= new A();
        SOP(a.x);
    }
}
```

```
public class C extends A{
    public void m(){
        SOP(x);
    }
}
```

Sub-Packages

Package inside the package known as Sub-Package or Nested Package.

package **p3**

```
import p2.B; // Error
import p1.p2.B;
public class D{
    public void m(){
        B b=new B();
        SOP( b.y );
    }
}
```

package **p1**

```
import p2.B; // Error
import p1.p2.B;
public class A{
    public void m(){
        B b=new B();
        SOP( b.y );
    }
}
```

package **p1.p2**

```
public class B{
    public int y=20;
}
```

import static

import static is used to directly import static-member of the class.

package **p2**

```
import  static p1.A.y;
import  static p1.A.m2;
public class  D{
      PSVM(){
            m2();
            SOP( y );
      }
}
```

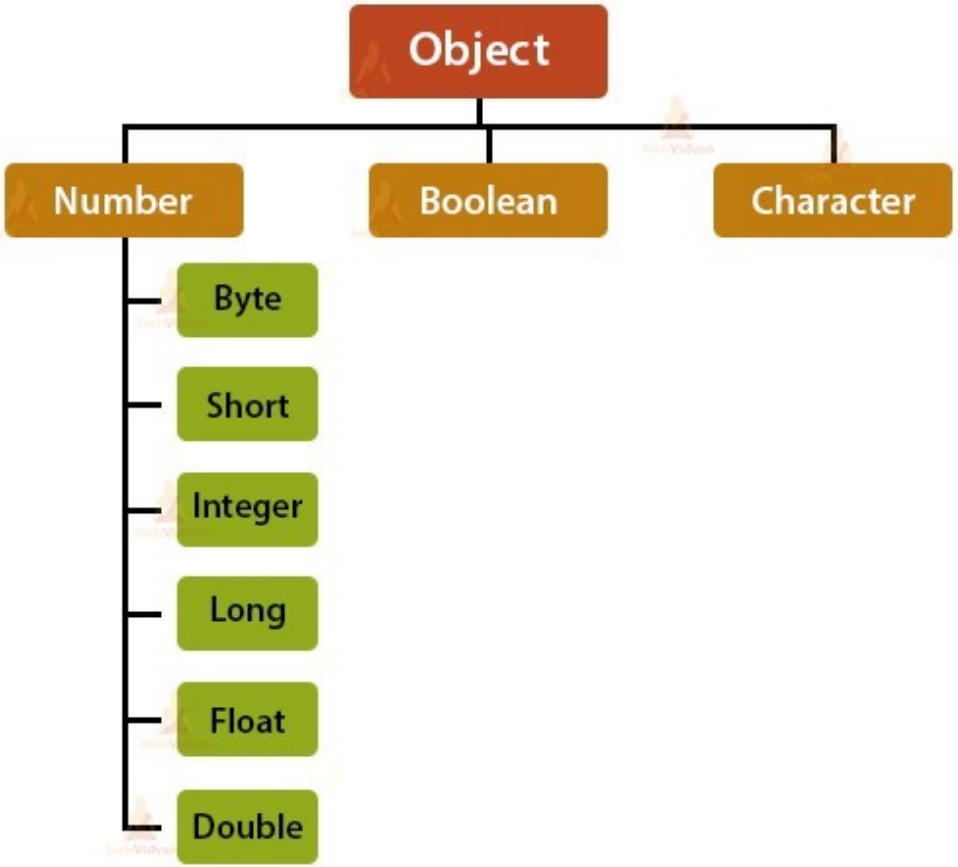
package **p1**

```
public class  A{
      public int x=10;
      static int y=20;
      public void m1(){
        //body
      }
      static public void m2(){
        //body
      }

}
```

Wrapper Classes

Wrapper classes used to use primitive data types (int, double, char, etc..) as objects.



Boxing/Unboxing/Autoboxing

- **Boxing:**

  We **Box** or **Wrap** an '**int**' value in an Integer object.

```
Integer  obj=new Integer(3);
```

- **Unboxing:**

  We **Unbox** or **Unwrap** an '**int**' value from an Integer object.

```
int  a= obj.intValue( );
```

- Java does **autoboxing/unboxing** as necessary, so we do not have to explicitly do it in our code.

```
Integer  obj=3 ;
```

```
int  a= obj ;
```

Parsing

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```
String x="25";
int y=Integer.parseInt(x);
double z=Double.parseDouble(x);
System.out.println(y);
System.out.println(z);
```