OOPs Concepts

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Need of OOP

- Impedance mismatch between user of the system & its developer

- Greater Flexibility

- Easy user interface

- Client wants the system to be adaptable & extensible

Characteristics of an Object

Characteristics of an Object

State

Behavior

Identity

Responsibility

State

State: Current values of the parameters

State can be either static or dynamic

Example: CAR

Static state	Dynamic state
Color	Speed
Make	Fuel Level
Model	Tyre pressure

Behavior

Behavior :

How the object behaves or reacts such that its dynamic state may change.

Example: Bank Account

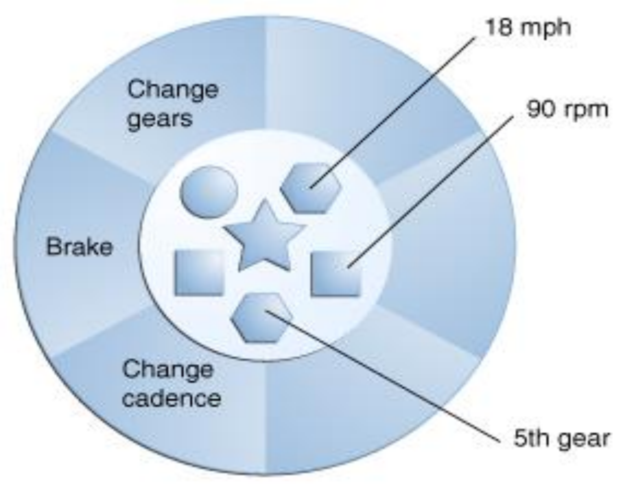
withdraw()

deposit()

It will change the “balance” (i.e. Dynamic state of Account object)

State & Behavior

Representation of static & dynamic state & behavior of a bicycle



Identity

- Identity : That property which uniquely distinguishes the entity from all other entities

Example: Car -- RTO / registration no

Responsibility

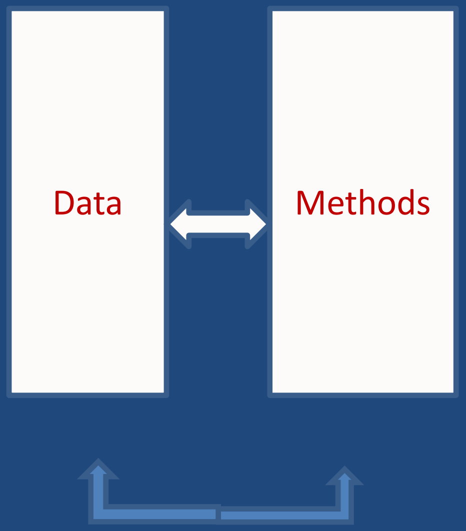
- Responsibility: The very purpose or the role that entity serves in the system

- Example : Bank account : To enable to carry out money transactions

- Car : To take the rider from one place to another

Procedural Vs. OOP

Procedural Languages

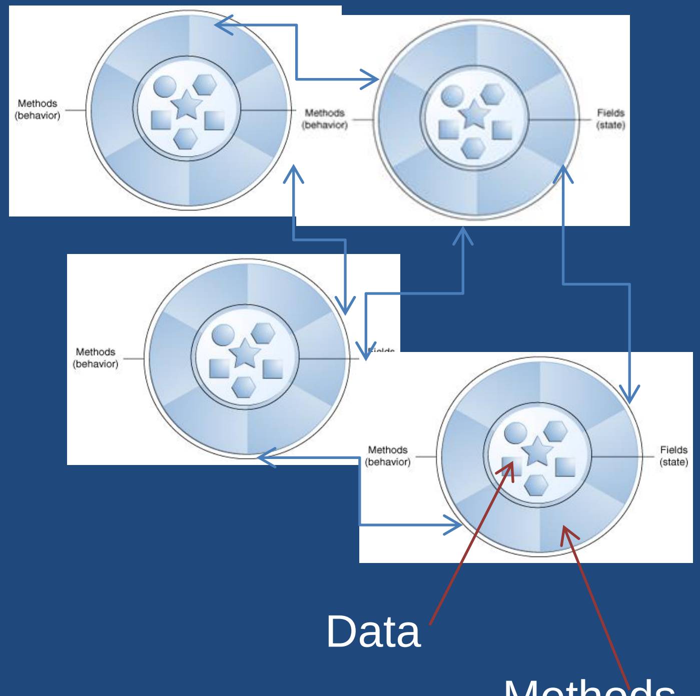


Data

Methods

Separated

Object Oriented Language



Data

Methods

Four Major Pillars

- Abstraction
- Encapsulation
- Inheritance
- Polymorphism

Abstraction

Abstraction:

- Selective negligence
- Process of identifying the key aspects and concentrating on them by ignoring the rest (Ignore that what is insignificant to you)

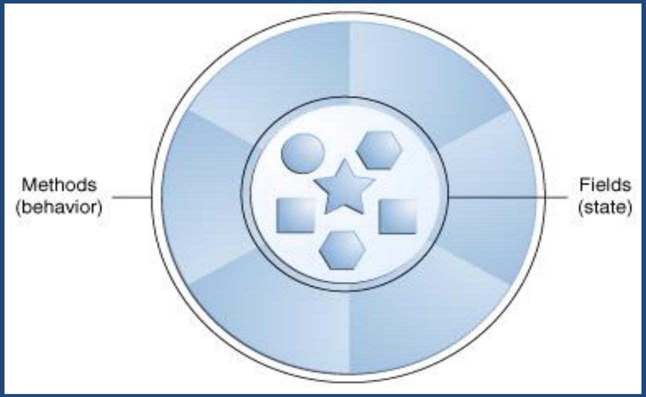
Abstraction of a Person

as an Employee	***as a Patient***	***as a Student***
Name	Name	Name
age	age	age
Educational Qualification	------	------
-------	blood group	------
-------	Medical history	------
-------	--------	batch

- Abstraction of same entity will be different for different users

Encapsulation

- Software objects are conceptually similar to real-world objects they too consist of state and related behavior.
- An object stores its state in *fields* and exposes its behavior through *methods*.
- Methods operate on an object's internal state and serve as the primary mechanism for object-to-object communication.
- Hiding internal state and requiring all interaction to be performed through an object's methods is known as ***data encapsulation*** — a fundamental principle of object-oriented programming.

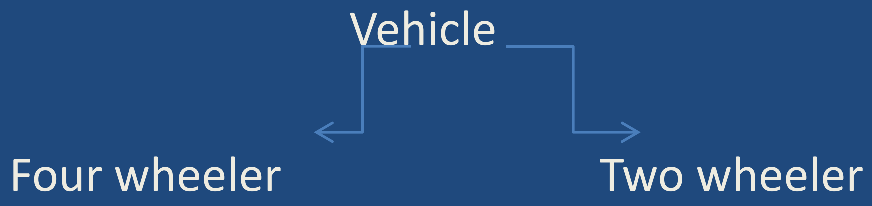


Inheritance

- Inheritance : “*Is-a*” -type of relationship

  Properties of parent are inherited in child.

  Example :



Vehicle

Four wheeler

Two wheeler

a four wheeler is a vehicle.

- Properties of Vehicle are inherited in a four wheeler & a two wheeler. In addition a four wheeler can have its own properties specific to it.

- As we go from parent to child we are moving from generic to specific & from child to parent : From specialization to generalization

Polymorphism

- Polymorphism: One message and different responses

Example: Traffic signal goes Red – single message :- to Stop

car will stop in its own way

scooter will stop in its own way

bicycle will stop in its own way

This type of behavior is called as polymorphic behavior

- In Software Programming, polymorphism is achieved in two ways

method overloading

method overriding

Polymorphism helps in writing more maintainable & extensible code.

Three Minor Pillars

- Strong Typecasting
- Concurrency
- Persistence

Hello World ….

```
class  Greeting
{
    public static void main (String args[])
  {
        System.out.println(“Hello World”);
  }
}
```

- Save this file with name as Greeting.java
- Compile the file using command : javac Greeting.java
- Run it using command: java Greeting

Inheritance

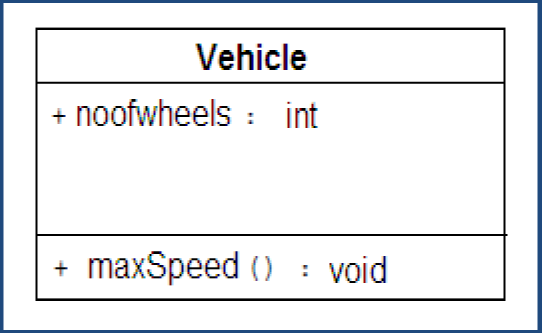
- Inheritance is the capability of a class to use the properties and methods of another class while adding its own functionality.
- Java uses the *extends* keyword to set the relationship between a parent class and a child class.
- Examples: Car extends Vehicle

  Circle extends Shape

Subclassing

The Vehicle class is as follows

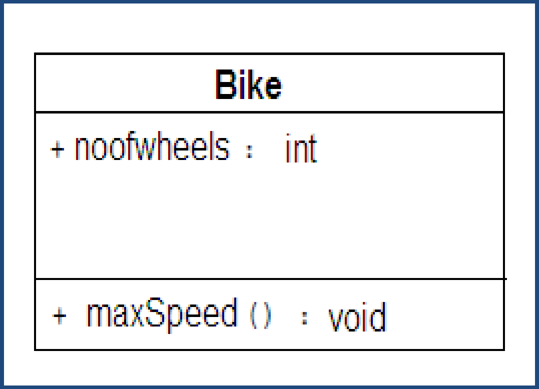
```
public class Vehicle{
public int noofwheels;
public void maxSpeed(){
}
}
```



Subclassing (contd)

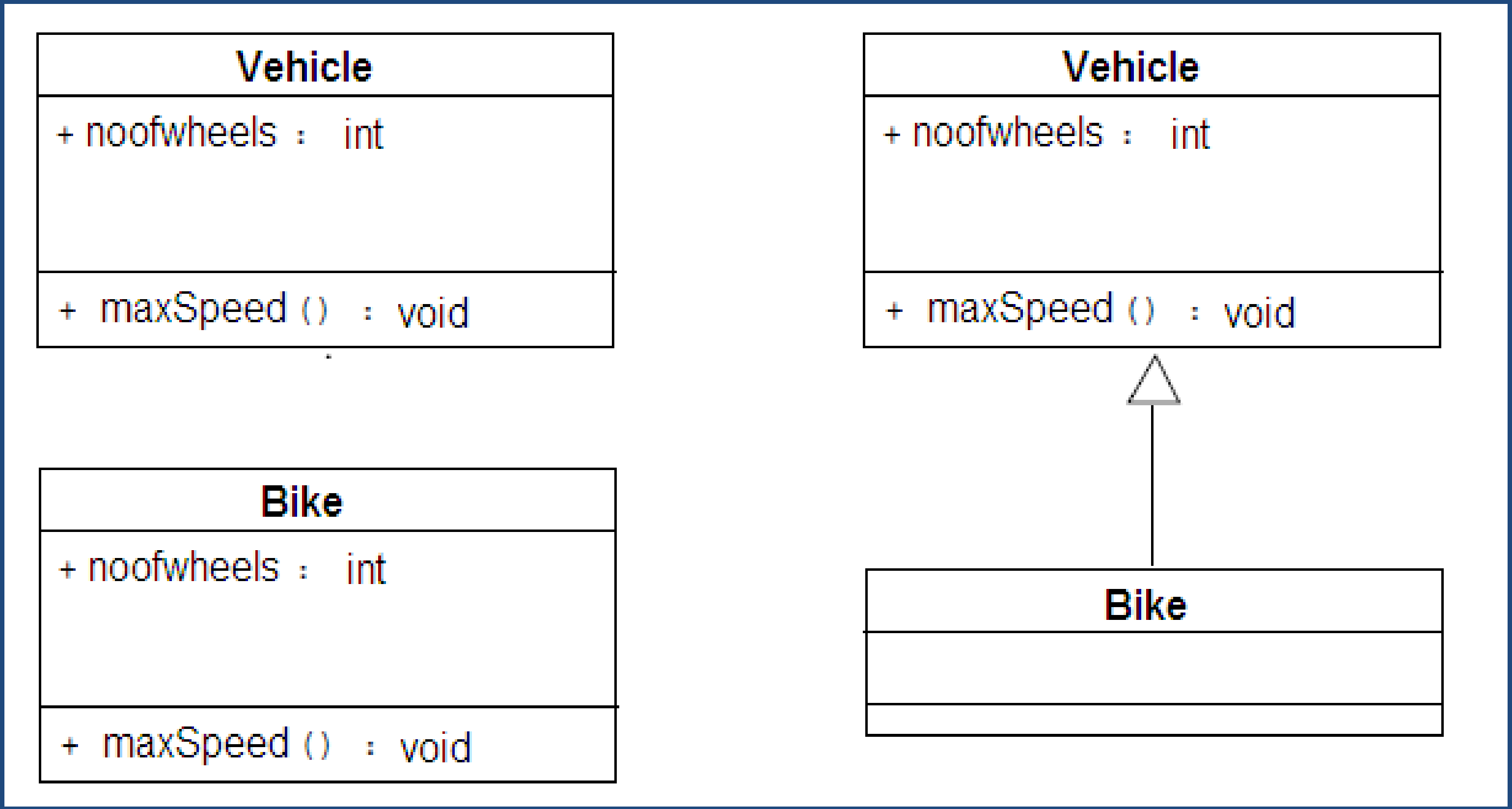
The Bike class is as follows

```
public class Bike{
public int noofwheels;
public void maxSpeed(){
}
}
```



Class Diagram

Class diagram of Vehicle and Bike without and with inheritence



Vehicle

+ noofwheels : int

+ maxSpeed () : void

Bike

+ noofwheels : int

+ maxSpeed () : void

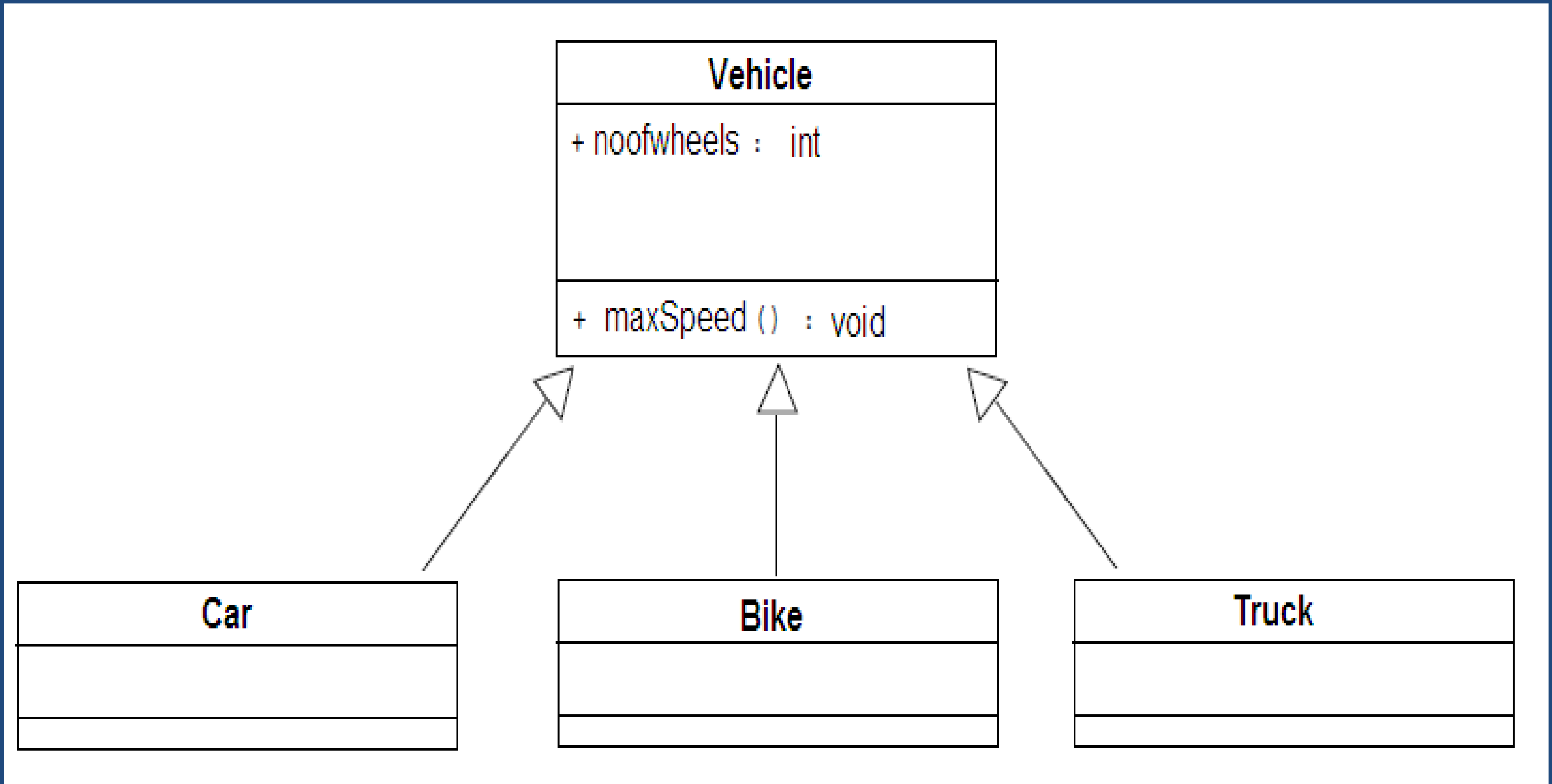
Vehicle

+ noofwheels : int

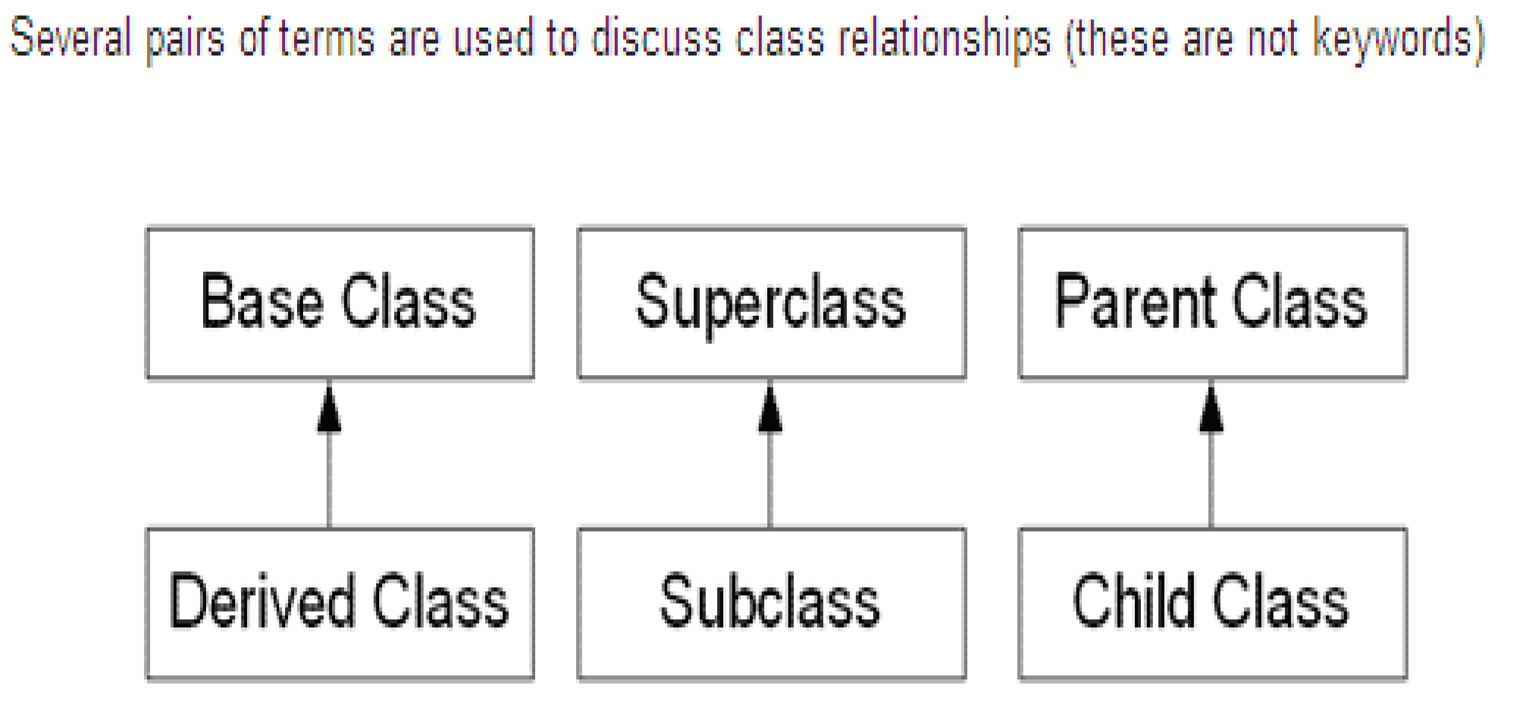
+ maxSpeed () : void

Bike

Single inheritence



Single inheritence (contd)



Several pairs of terms are used to discuss class relationships (these are not keywords)

Base Class

Derived Class

Superclass

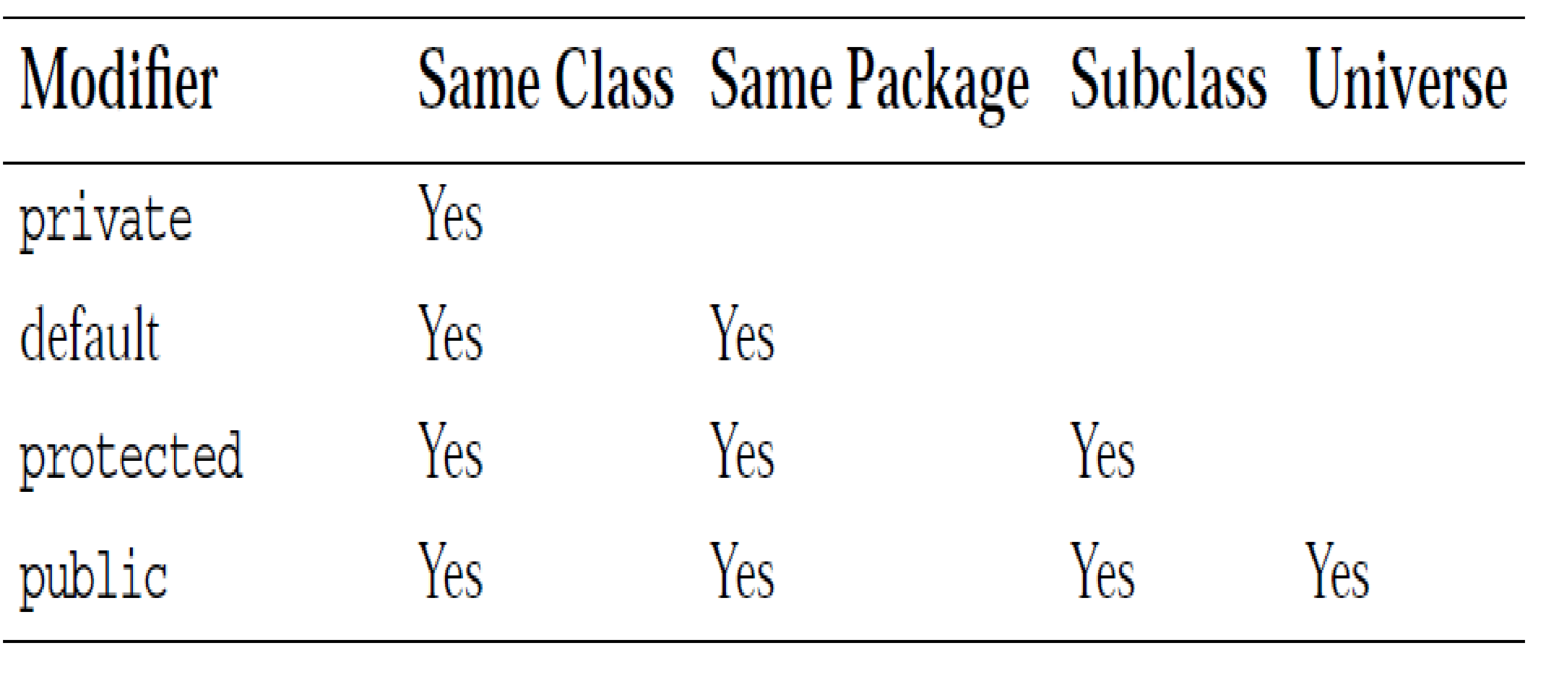
Subclass

Parent Class

Child Class

Access Control

- Access modifiers on class members are:



Modifier	Same Class	Same Package	Subclass	Universe
private	Yes			
default	Yes	Yes		
protected	Yes	Yes	Yes	
public	Yes	Yes	Yes	Yes

Polymorphism

Polymorphism (one message & different responses):

- It involves one method name with no.of different implementations

- The method call is resolved to appropriate method implementation

- Polymorphism can be achieved in two ways:

method overloading

&

method overriding

- Polymorphism helps to design & implement systems which are more easily extensible & maintainable

Types of Polymorphism

The two types of polymorphism :

1) Static Polymorphism also known as Compile time polymorphism

2) Dynamic Polymorphism also known as Run time polymorphism

Static Polymorphism

Function Overloading is an example of static polymorphism

Overloaded methods have same name but different method signatures. (Method signature may vary in 3 ways)

The method call is resolved to suitable method implementation at compile time. (compiler searches for matching function signature)

Static Polymorphism (contd)

Example:

```
public class Mclass
{
     public void add(int x){}
     public void add(int x , int y){}
    public void add(int x, float y){}
    public void add(float  x, int y){}
}
```

Dynamic Polymorphism

Dynamic polymorphism is achieved through method Overriding

Overriding is directly related to Sub -classing

Method is said to be overridden when a subclass modifies the behavior of superclass method to suit its requirement.

The new method definition must have the same method signature (i.e., method name and parameters) and return type should also match.

Dynamic Polymorphism (contd)

Example:

```
class vehicle
{
            public void showSpeedRange()
    { System.out.println(“No range specified”)}
}
class  Car extends vehicle
{
             public void showSpeedRange()
    { System.out.println(“Range: 0-300 ”)}
}
class  Bike extends vehicle
{
             public void showSpeedRange()
     { System.out.println(“Range: 0-120 ”)}
}
```

Dynamic Polymorphism (contd)

```
class SpeedDemo
  {
        public static void main(String args[])
           {
                Vehicle v[] = {  new Car() ,new Bike(),new Car()}
                  for(int i=0; i< v.length; i++)
                       v[i].showSpeedRange();
           }
   }
```

Static data type of v[i] is vehicle & *dynamic data type* is either Car or Bike.

Here Dynamic Data Type will govern the method selection

So its dynamic polymorphism

Super keyword

Super:

- The keyword super is used in a class to refer to its superclass.

- It can refer to both data attributes and methods of super class

- A subclass method may invoke a super class method using the super keyword

Invoking super Class Constructors

When a subclass object is created, constructor gets called in the order from Super to sub.

If there is an explicit call to super class constructor from sub class constructor then that call should be the first statement

```
class Car extends Vehicle
  {
        public Car (int now)
        {
                   super(now);     //--------------- call to super must
                                       be the first statement
         }
 -----
-----}
```

Dynamic Polymorphism (contd)

Example:

```
class Mainclass1{
            public string display(){
            return “hello”;
            }
}
class Mainclass2 extends Mainclass1{
            String s;
  public string display(){
            return (super.display()+s);
            }
}
```