Java & JEE Training

Day 9 – OOP with Java Contd.

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Day 9 Agenda

- ✓ Review of last class concepts
- ✓ Types of Inheritance and a look at Aggregation
- ✓ Polymorphism
  - ✓ Method overloading
  - ✓ Method overriding

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Inheritance in Java, and Aggregation

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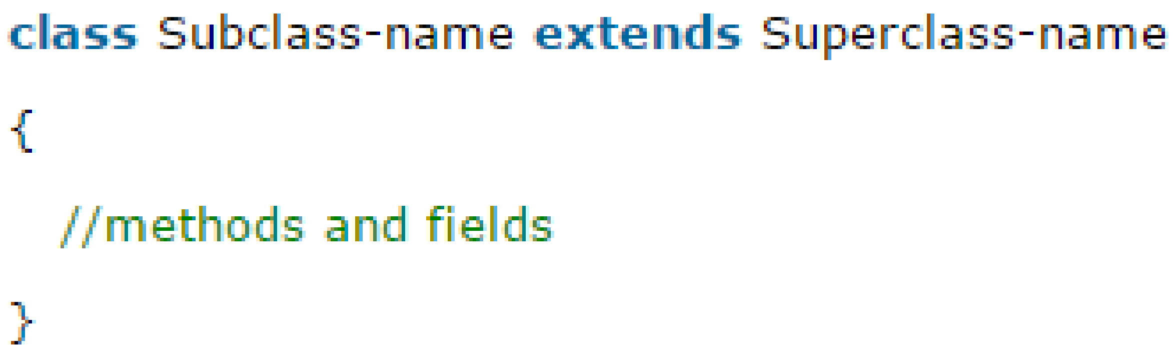
Inheritance in Java

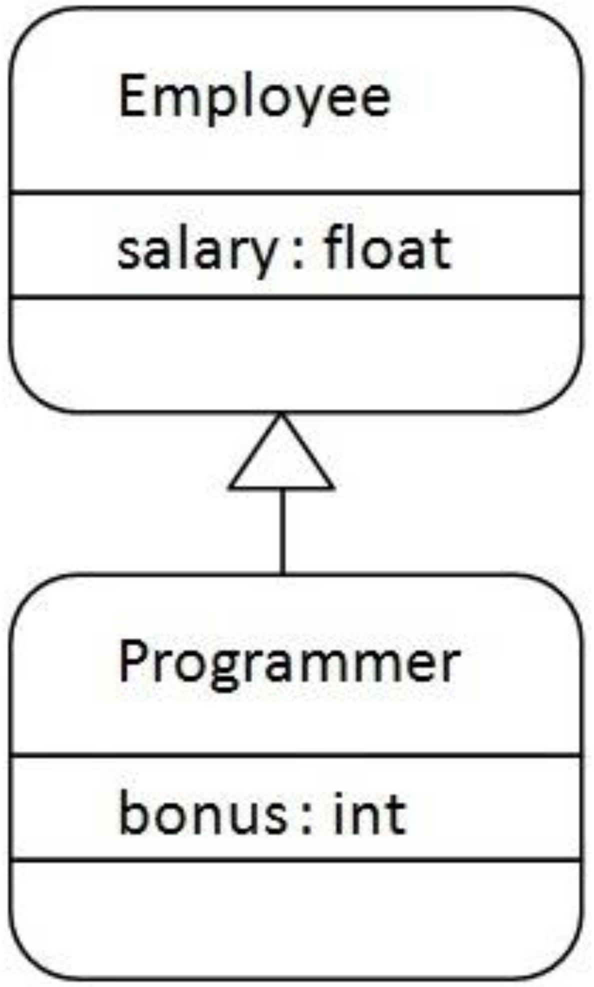
- a mechanism in which one object acquires all the properties and behaviours of parent object.
- Inheritance represents the **IS-A relationship**, also known as *parent-child* relationship.

- Why use inheritance in java
  - For Method Overriding (so runtime polymorphism can be achieved).
  - For Code Reusability.

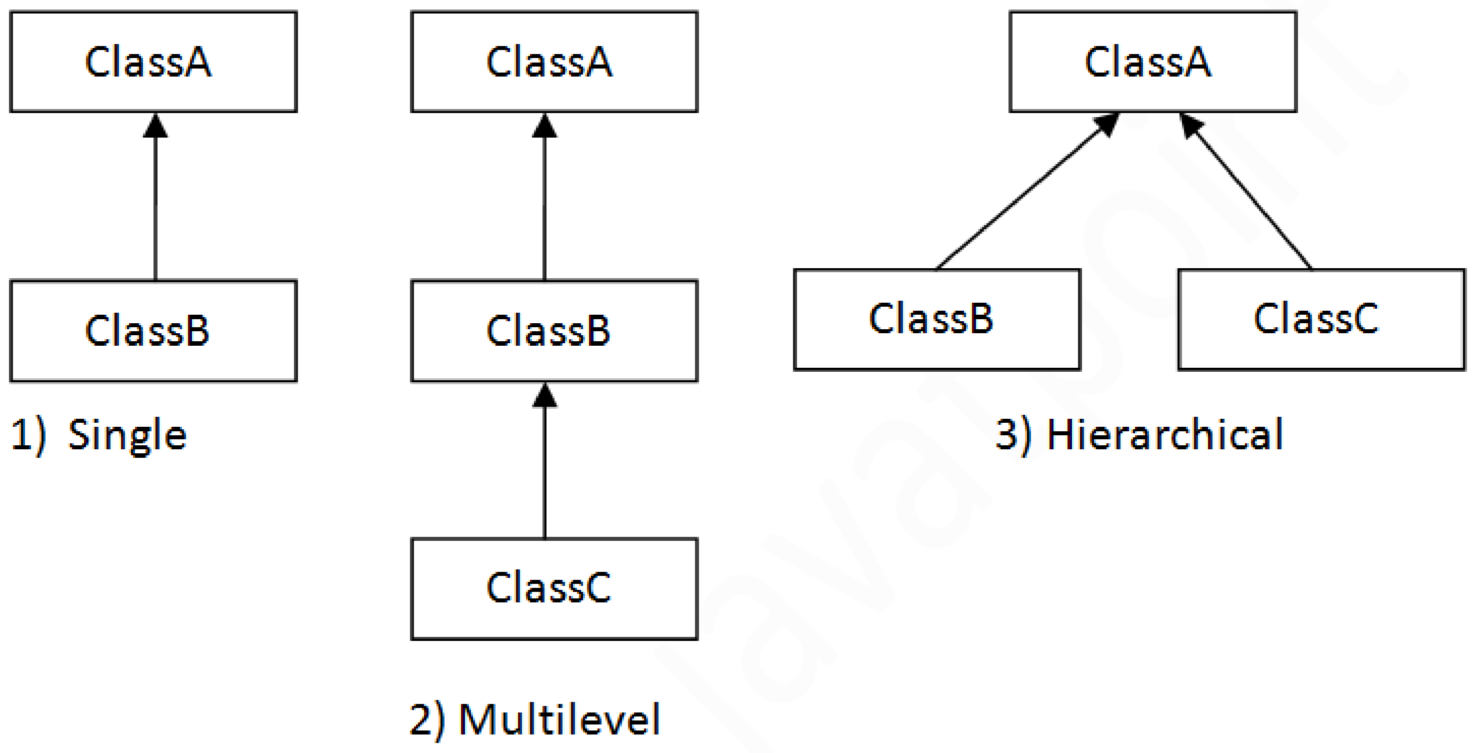


```
class Subclass-name extends Superclass-name
{
   //methods and fields
}
```

Inheritance in Java

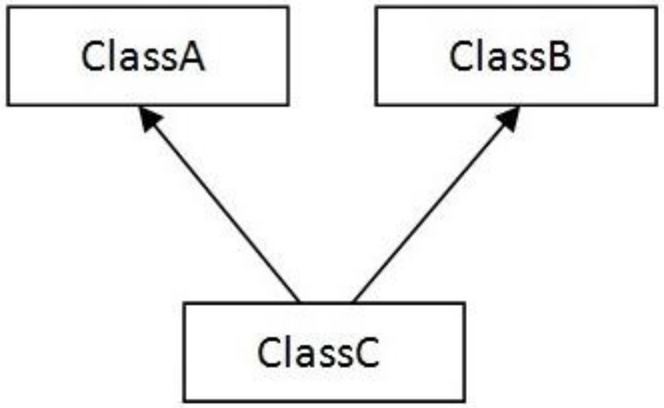


Types of Inheritance

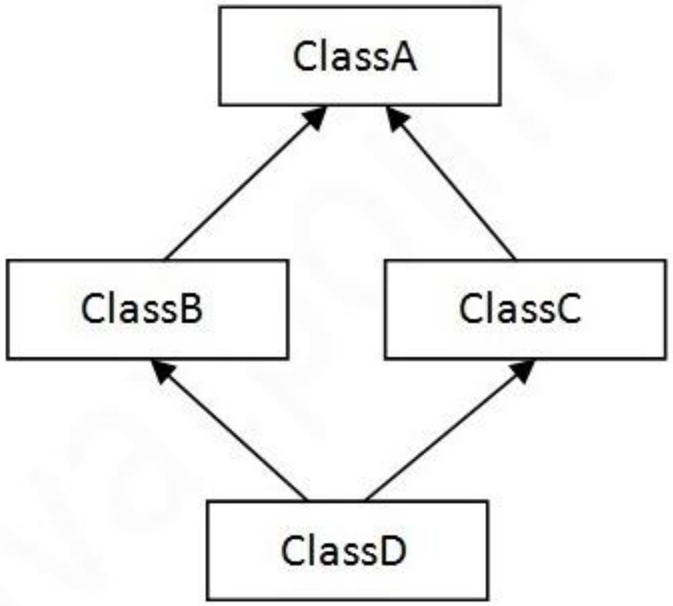


Inheritance Not Supported in Java

- When a class extends multiple classes i.e. known as multiple inheritance.



4) Multiple



5) Hybrid

Why multiple inheritance not supported in Java?

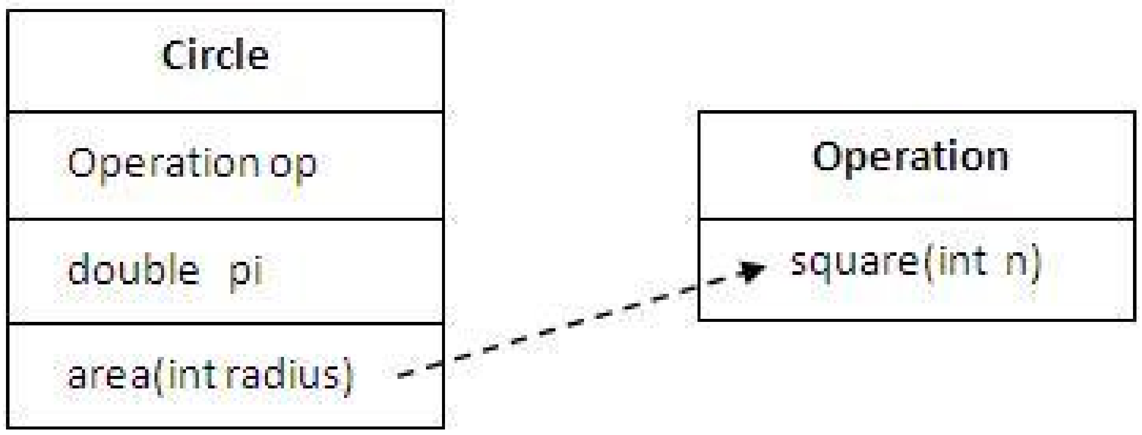
```
class A{
       void msg(){System.out.println("Hello");}
}
class B{
       void msg(){System.out.println("Welcome");}
}
class C extends A,B{//suppose if it were

 public static void main(String args[]){
   C obj=new C();
   obj.msg();//Now which msg() method would be invoked? Compile-time error
}
}
```

Aggregation in Java

- If a class have an entity reference, it is known as Aggregation.
- Aggregation represents HAS-A relationship.

- Why use Aggregation?
  - For Code Reusability.



Aggregation in Java

```
class Operation{
 int square(int n){
  return n*n;
 }
}

class Circle{
 Operation op;//aggregation
 double pi=3.14;

 double area(int radius){
   op=new Operation();
   int rsquare=op.square(radius);//code reusability (i.e. delegates the method call).
   return pi*rsquare;
 }

 public static void main(String args[]){
   Circle c=new Circle();
   double result=c.area(5);
   System.out.println(result);
 }
}
```

Example: Employee HAS-A Address

- Demo

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Method Overriding in Java, and a re-look into Method Overloading

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Method Overriding in Java

- If subclass (child class) has the same method as declared in the parent class, it is known as **method overriding in java**.
- If subclass provides the specific implementation of the method that has been provided by one of its parent class, it is known as method overriding.
- Method overriding is used to provide specific implementation of a method that is already provided by its super class.
- Method overriding is used for runtime polymorphism

- Rules:
  - method must have same name as in the parent class
  - method must have same parameter as in the parent class.
  - must be IS-A relationship (inheritance).

Example of Method Overriding

```
class Vehicle{
        void run(){System.out.println("Vehicle is running");}
}
class Bike2 extends Vehicle{
        void run(){System.out.println("Bike is running safely");}

        public static void main(String args[]){
                Bike2 obj = new Bike2();
                obj.run();
}
```

Point to ponder.. Can we override static methods in Java? Why?

Think… (This is one of the exercises for today)

Method Overloading vs Method Overriding

No.	Method Overloading	Method Overriding
1)	Method overloading is used *to increase the readability* of the program.	Method overriding is used *to provide the specific implementation* of the method that is already provided by its super class.
2)	Method overloading can be performed *within class*.	Method overriding occurs *in two classes* that have IS-A (inheritance) relationship.
3)	In case of method overloading, *parameter must be different*.	In case of method overriding, *parameter must be same*.
4)	Method overloading is the example of *compile time polymorphism*.	Method overriding is the example of *run time polymorphism*.
5)	In Java, method overloading can't be performed by changing return type of the method only. *Return type can be same or different* in method overloading. But you must have to change the parameter.	*Return type must be same or covariant* in method overriding.

super keyword in Java

- The **super** keyword in Java is a reference variable that is used to refer immediate parent class object.
- Usage of super Keyword
    - super is used to refer immediate parent class instance variable.
    - super() is used to invoke immediate parent class constructor.
    - super is used to invoke immediate parent class method.

super used to refer immediate parent class instance variable

```
class Vehicle{
  int speed=50;
}
class Bike3 extends Vehicle{
  int speed=100;
  void display(){
   System.out.println(speed);//will print speed of Bike
   System.out.println(super.speed);//will print speed of Vehicle
  }
  public static void main(String args[]){
   Bike3 b=new Bike3();
   b.display();
}
}
```

super is used to invoke parent class constructor

```
class Vehicle{
  Vehicle(){System.out.println("Vehicle is created");}
}

class Bike5 extends Vehicle{
  Bike5(){
   super();//will invoke parent class constructor
   System.out.println("Bike is created");
  }
  public static void main(String args[]){
   Bike5 b=new Bike5();

  }
}
```

super can be used to invoke parent class method

```
class Person{
   void message(){System.out.println("welcome");}
}

class Student16 extends Person{
   void message(){System.out.println("welcome to java");}

   void display(){
      message();//will invoke current class message() method
      super.message();//will invoke parent class message() method
   }

   public static void main(String args[]){
      Student16 s=new Student16();
      s.display();
   }
}
```

super not required here

```
class Person{
        void message(){System.out.println("welcome");}
}

class Student17 extends Person{

   void display(){
        message();//will invoke parent class message() method
   }

   public static void main(String args[]){
      Student17 s=new Student17();
      s.display();
   }
}
```

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final keyword

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final keyword in Java

- final keyword applied to

  - Variable: stops value change
  - Methods: stops overriding
  - Class: stops inheritance

final variable

final variable once assigned a value can never be changed.

```
class Bike9{
 final int speedlimit=90;//final variable
 void run(){
  speedlimit=400;  //compile-time error
 }
 public static void main(String args[]){
 Bike9 obj=new  Bike9();
 obj.run();
 }
}//end of class
```

final method – cannot override

```
class Bike{
  final void run(){System.out.println("running");}
}

class Honda extends Bike{
   void run(){System.out.println("running safely with 100kmph");}
     //compile-time error
   public static void main(String args[]){
      Honda honda = new Honda();
      honda.run();
   }
}
```

final class – cannot extend

```
final class Bike{}

class Honda1 extends Bike{  //compile-time error
  void run(){System.out.println("running safely with 100kmph");}


  public static void main(String args[]){
     Honda1 honda= new Honda();
     honda.run();
  }
}
```

Blank final variables must be initialized only in constructor

```
class Bike10{
  final int speedlimit; // blank final variable

  Bike10(){
       speedlimit=70;  // initialized in constructor
       System.out.println(speedlimit);
  }

  public static void main(String args[]){
        new Bike10();
 }
}
```

final parameter example

```
class Bike11{
  int cube(final int n){
   n=n+2; //can't be changed as n is final
   n*n*n;
  }
  public static void main(String args[]){
    Bike11 b=new Bike11();
    b.cube(5);
 }
}
```

Point to ponder…Can constructors be declared final?

Think… (Exercise for today)

Java Runtime Polymorphism – Example of Upcasting

```
class Animal{
            void eat(){System.out.println("eating");}
}

class Dog extends Animal{
            void eat(){System.out.println("eating fruits");}
}

class BabyDog extends Dog{
         void eat(){System.out.println("drinking milk");}

         public static void main(String args[]){
              Animal a1,a2,a3;
              a1=new Animal();
              a2=new Dog();
              a3=new BabyDog();

              a1.eat();
              a2.eat();
              a3.eat();
         }
}
```

Static and dynamic binding

Static Binding: Type of object determined at Compile time.

```
class Dog{
 private void eat(){System.out.println("dog is eating...");}

 public static void main(String args[]){
  Dog d1=new Dog();
  d1.eat();
 }
}
```

Dynamic Binding: Type of object determined at run time

```
class Animal{
 void eat(){System.out.println("animal is eating...");}
}

class Dog extends Animal{
 void eat(){System.out.println("dog is eating...");}

 public static void main(String args[]){
  Animal a=new Dog();
  a.eat();
 }
}
```

instanceof operator

- used to test whether the object is an instance of the specified type (class or subclass or interface).

```
class Simple1{
 public static void main(String args[]){
      Simple1 s=new Simple1();
      System.out.println(s instanceof Simple1);//true
 }
}


class Animal{}
class Dog1 extends Animal{//Dog inherits Animal

 public static void main(String args[]){
 Dog1 d=new Dog1();
 System.out.println(d instanceof Animal);//true
 }
}
```

instanceof operator

```
class Dog2{
 public static void main(String args[]){
      Dog2 d=null;
      System.out.println(d instanceof Dog2);//false
 }
}
```

Downcasting

Dog d=**new** Animal();//Compilation error

Dog d=(Dog)new Animal();
//Compiles successfully but ClassCastException could be thrown at runtime