CS2832: Modular Software Development

OOP Concepts

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Object Oriented Programming Concepts

1. Encapsulation

2. Inheritance

3. Abstraction

4. Polymorphism

1. Encapsulation

Encapsulation

- Encapsulation hides the implementation details
  -> Data hiding

Encapsulation Benefits

- Ensures that structural changes remain local:
  - Changing the class internals does not affect any code outside of the class
  - Changing methods' implementation does not reflect the clients using them
- Encapsulation allows adding some logic when accessing client's data
  - E.g. validation on modifying a property value
- Hiding implementation details reduces complexity -> easier maintenance
- Fields can be made read-only or write-only

Modifiers

Access Modifiers

public

protected

default

private

Non-Access Modifiers

final

abstract

static

strictfp

synchronize

native

transit

Volatile

Access Modifiers

- Specifies the accessibility or scope of a field, method, constructor, or class.
- We can change the access level of fields, constructors, methods, and class by applying the access modifier on it.

Access Modifiers	**Class**	**Package**	**Subclass**		**Global**
			Same Package	Different Package	
Public	Yes	Yes	Yes	Yes	Yes
Protected	Yes	Yes	Yes	Yes	No
Default	Yes	Yes	Yes	No	No
Private	Yes	No	No	No	No

Example 1

```
class A{
   private void display(){
        System.out.println("Inside display method");
   }
}

class B{
   public static void main(String args[]){
          A obj = new A();
          //trying to access private method of 
another class
          obj.display();
   }
}
```

```
error: display() has private access in A 
        obj.display();
```

Example 2

```
package p1;

//Class A is having Default access modifier
class A{
    void display(){
           System.out.println("Inside display method");
    }
}

//Java program to illustrate error while using class from
different package with default modifier
package p2;
import p1.*;

//This class is having default access modifier
class B{
    public static void main(String args[]){
          //accessing class Geek from package p1
          A obj = new A();
          obj.display();
    }
}
```

Compile time error

Example 3

```
package p1;

public class A{
   protected void display(){
        System.out.println("Inside display method");
   }
}

package p2;
import p1.*; //importing all classes in package p1

//Class B is subclass of A
class B extends A{
   public static void main(String args[])
   {
       B obj = new B();
       obj.display();
   }
}
```

```
Inside display method
```

Example 4

```
package p1;
public class A{
   public void display(){
          System.out.println("Inside display method");
   }
}

package p2;
import p1.*;
class B{
    public static void main(String args[]){
          A obj = new A;
          obj.display();
    }
}
```

```
Inside display method
```

Encapsulation - Example

Let's see the simple example of encapsulation that has only one field with its setter and getter methods.

Student.java

```
//A fully encapsulated class.
package A;
public class Student{
    //private data member
    private String name;
    //getter method for name
    public String getName(){
        return name;
    }
    //setter method for name
    public void setName(String name){
        this.name=name
    }
}
```

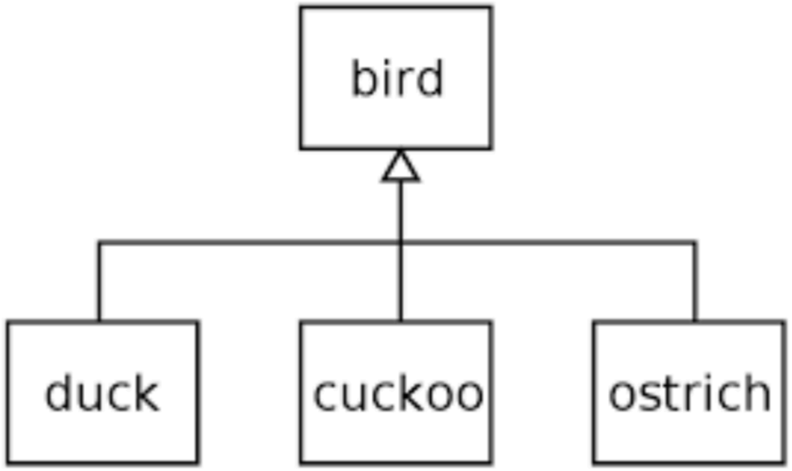
Test.java

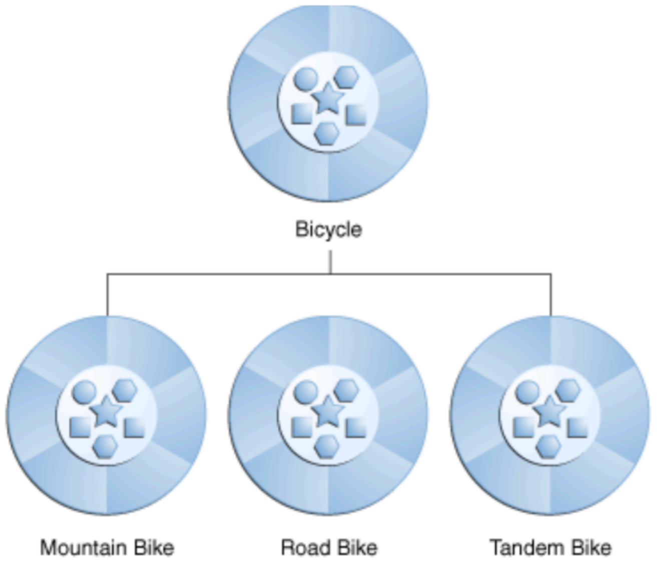
```
//A Java class to test the encapsulated class.
package A;
class Test{
    public static void main(String[] args){
        //creating instance of the encapsulated class
        Student s=new Student();
        //setting value in the name member
        s.setName(“John Doe”);
        //getting value of the name member
        System.out.println(s.getName());
    }
}
```

Output: John Doe

2. Inheritance

Inheritance





Inheritance

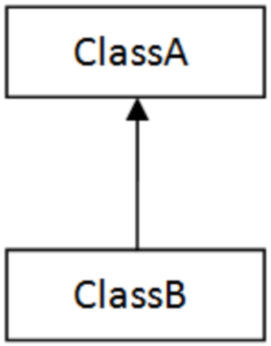
- The process by which one class acquires the properties (data members) and functionalities (methods) of another class is called **inheritance**.
- The aim of inheritance is to provide the reusability of code so that a class has to write only the unique features and rest of the common properties and functionalities can be extended from another class.

- **Child Class:**
  - The class that extends the features of another class is known as child class, sub class or derived class.
- **Parent Class:**
  - The class whose properties and functionalities are used(inherited) by another class is known as parent class, super class or Base class.

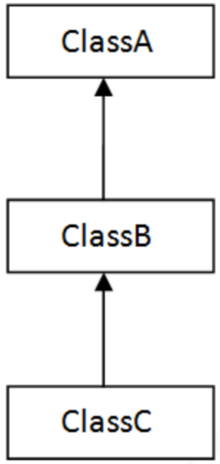
Inheritance - Example

```
class Employee{
    float salary=40000;

    int calc(int OT){
            return salary + OT*500;
    }
}
class Programmer extends Employee{
    int bonus=10000;

    public static void main(String args[]){
           Programmer p=new Programmer();
           System.out.println("Programmer salary:”+p.calc());
           System.out.println("Bonus of Programmer:"+p.bonus);

    }
}
```

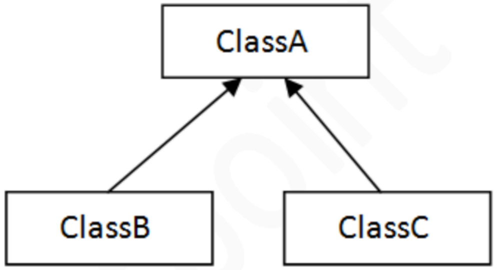
Types of Inheritance



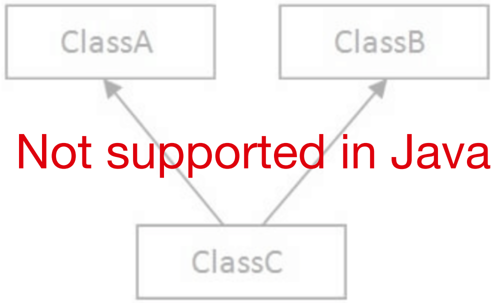
1) Single



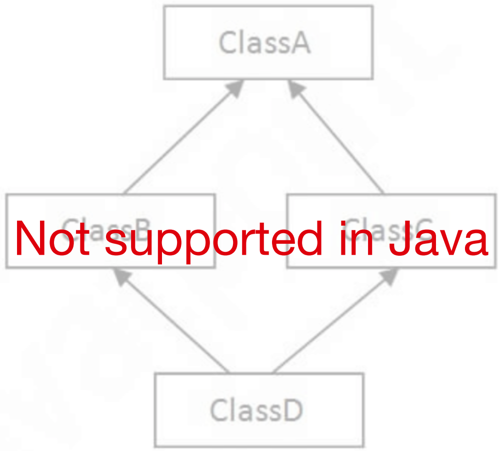
2) Multilevel



3) Hierarchical



4) Multiple



5) Hybrid

Subclass

- A subclass inherits all of the default (same package only), protected and public members of its parent
- **Fields (attributes)**
  - The inherited fields can be used directly, just like any other fields.
  - Can declare a field in the subclass with the same name as the one in the super-class, thus hiding it (not recommended).
  - Can declare new fields in the subclass that are not in the super class.

Subclass

- **Methods**
  - Inherited methods can be used directly as they are
  - Can have a new instance method in the subclass that has the same signature as the one in the super class, thus overriding it.
  - Can have a new static method in the subclass that has the same signature as the one in the super class, thus hiding it.
  - Can declare new methods that are not in the super class.
- Can write a constructor that invokes the constructor of the super class
  - Implicitly
  - By using the keyword super

3. Abstraction

Abstraction

- Abstraction – we know what an object does and how to use it, but not how it does what it does
    - Ignoring irrelevant features, properties, or functions and emphasizing the relevant ones to a given project
- **Abstract Class**
    - An abstract class is a class that is declared abstract
    - Abstract classes can not be instantiated, but can be sub-classed
    - Abstract classes are used only as super classes in inheritance hierarchies
    - Abstract class are used to share a common design

Abstract Methods

- If you want a class to contain a particular method but you want the actual implementation of that method to be determined by child classes
- Can be included ONLY in an abstract class
- Any child class must either override the abstract method or declare itself abstract

Abstract Class

- Parent class contains the common functionality of a collection of child classes
- But the parent class itself is too abstract to be used on its own
- Impose what should be there but not how it should be done
- When an abstract class is sub-classed, all of the abstract methods in its parent class must be implemented
- However, if it does not, then the subclass must also be declared abstract

```
public abstract class Animal {
     //declare fields
     //declare non - abstract methods
     public abstract void makeNoise();
 }
```

4. Polymorphism

Polymorphism

- The ability of an object to take on many forms
- Subclasses of a class can define their own unique behaviors and yet share some of the same functionality of the parent class
- In Java polymorphism is divided into two types:
    1. Compile time Polymorphism
    2. Runtime Polymorphism

Compile time Polymorphism

- This type of polymorphism is achieved by function overloading
    - Same method name
    - Different Parameters

```
class Dog {
    public void Bark(){
        System.out.println(”Woof”);
    }

    public void Bark(String sound){
        System.out.println(sound);
    }
}
```

Run time Polymorphism

- This type of polymorphism is achieved by function overriding
    - Same method name
    - Same Parameters

```
class Dog {
    public void Bark(){
        System.out.println(”Woof”);
    }
}

class Hound extends Dog {
    public void Sniff(){
        System.out.println(”Sniff”);
    }

    public void Bark(){
        System.out.println(”Woof”);
    }
}
```

Questions?

Thank You