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Java: Interface in Depth

"Concept && Coding" YT Video Notes

- What is Interface and How to define
- Why we need Interface
- Methods in Interface
- Fields in an Interface
- Interface Implementation
- Nested Interface
- Difference between Interface and Abstract class.

I

Java8 Interface features :

✓ Default method :

II

Static method

○ Functional Interface and Lambda expression ✎

Java8

Java9 Interface feature:

✓ Private method and
✓ Private Static method

II

What is Interface?

Interface is something which helps 2 system to interact with each other, without one system has to know the details of other.

Or in simple term I can say, it helps to achieve ABSTRACTION.

How to define the interface?

Interface declaration consist of

- Modifiers
- "interface" keyword
- Interface Name
- Comma separated list of parent interfaces
- Body

Only **Public** and **Default** Modifiers are allowed (**Protected** and **private** are not allowed)

```
public interface Bird {  
    .  
    no usages  
    public void fly();  
}
```

```
interface Bird {  
    .  
    no usages  
    public void fly();  
}
```

Comma separated list of parent interfaces (it can extend from **Class**) Example:

```
public interface NonFlyingBirds extends Bird, LivingThings{  
    .  
    no usages  
    public void canRun();  
}
```

Why we need Interface?

1. Abstraction:

Using interface, we can achieve full Abstraction means, we can define WHAT class must do, but not HOW it will do

```
public interface Bird {  
  
    no usages  
    public void fly();  
}
```

```
public class Eagle implements Bird{  
    no usages  
    @Override  
    public void fly() {  
        //the complex process of flying take place here  
    }  
}
```

2. Polymorphism:

- Interface can be used as a Data Type.

- we can not create the object of an interface, but it can hold the reference of all the classes which implements it. And at runtime, it decide which method need to be invoked.

```
public class Main {  
  
    public static void main(String args[]){  
  
        Bird birdObject1 = new Eagle();  
        Bird birdObject2 = new Hen();  
  
        birdObject1.fly();  
        birdObject2.fly();  
    }  
}
```

~~Object~~

```
public interface Bird {  
  
    2 usages 2 implementations  
    public void fly();  
}  
  
public class Eagle implements Bird{  
  
    2 usages  
    @Override  
    public void fly() {  
        System.out.println("Eagle Fly Implementation");  
    }  
}  
  
public class Hen implements Bird{  
  
    2 usages  
    @Override  
    public void fly() {  
        System.out.println("Hen Fly Implementation");  
    }  
}
```

3. Multiple Inheritance:

In Java Multiple inheritance is possible only through Interface only.

Diamond problem:

```
public class Main {  
    public static void main(String args[]){  
        Crocodile obj = new Crocodile();  
        obj.canBreathe();  
    }  
}
```

```
public class WaterAnimal {  
    no usages  
    public boolean canBreathe(){  
        return true;  
    }  
}
```

```
public class LandAnimal {  
    1 usage  
    public boolean canBreathe(){  
        return true;  
    }  
}
```

```
public class Crocodile extends LandAnimal, WaterAnimal{  
}
```

```
public class Main {  
    public static void main(String args[]){  
        Crocodile obj = new Crocodile();  
        obj.canBreathe();  
    }  
}
```

```
public interface LandAnimal {  
    1 usage 1 implementation  
    public boolean canBreathe();  
}
```

```
public interface WaterAnimal {  
    1 usage  
    public boolean canBreathe();  
}
```

```
public class Crocodile implements LandAnimal, WaterAnimal{  
    2 usages  
    @Override  
    public boolean canBreathe() {  
        return true;  
    }  
}
```

Methods in Interface:

- All methods are implicit public only.
- Method can not be declared as final.

```
public interface Bird {  
    1 usage 1 implementation  
    void fly();  
    no usages  
    public void hasBeak();  
}
```

Fields in Interface:

- Fields are public, static and final implicitly (**CONSTANTS**)
- You can not make field private or protected.

```
public interface Bird {  
    no usages  
    int MAX_HEIGHT_IN_FEET = 2000;  
}
```

==

```
public interface Bird {  
    no usages  
    public static final int MAX_HEIGHT_IN_FEET = 2000;  
}
```

Interface Implementation:

- Overriding method can not have more restrict access specifiers.
- Concrete class must override all the methods declared in the interface.
- Abstract classes are not forced to override all the methods.
- A class can implement from multiple interfaces.

```
public interface Bird {  
  
    2 usages 2 implementations  
    public void fly();  
}
```

```
public class Eagle implements Bird{  
    2 usages  
    @Override  
    public void fly() {  
        System.out.println("Eagle Fly Implementation");  
    }  
}
```

```
public class Eagle implements Bird{  
    1 usage  
    @Override  
    protected void fly() {  
  
        //do something  
    }  
}
```

Example of Abstract class implementation of Interface:

```
public interface Bird {  
    no usages 1 implementation  
    public void canFly();  
    no usages 1 implementation  
    public void noOfLegs();  
}
```

```
public abstract class Eagle implements Bird{  
    no usages  
    @Override  
    public void canFly() {  
        //Implementation goes here  
    }  
  
    no usages  
    public abstract void beakLength();  
}
```

```
public class WhiteEagle extends Eagle{  
  
    no usages  
    @Override  
    public void noOfLegs() {  
        //implement interface method  
    }  
  
    no usages  
    @Override  
    public void beakLength() {  
        //implementing abstract class method  
    }  
}
```

Nested Interface:

- Nested Interface declared withing another Interface.
- Nested Interface declared within a Class.

Generally its is used to group, logical related interfacde. And Nested interface

Rules:

- A nested interface declared withing an interface must be public.
- A nested interface declared within a class can have any access modifier.
- When you implement outer interface, inner interface implementation is not required and vice versa.

```
public interface Bird {  
  
    no usages 1 implementation  
    public void canFly();  
  
    no usages  
    public interface NonFlyingBird{  
  
        no usages  
        public void canRun();  
    }  
}
```

```
public class Eagle implements Bird{  
    no usages  
    @Override  
    public void canFly() {  
        //Implementation goes here  
    }  
}  
  
public class Eagle implements Bird.NonFlyingBird{  
    no usages  
    @Override  
    public void canRun() {  
    }  
}  
  
public class Main {  
    public static void main(String args[]){  
        Bird.NonFlyingBird obj = new Eagle();  
        obj.canRun();  
    }  
}  
  
public class Eagle implements Bird, Bird.NonFlyingBird{  
    1 usage  
    @Override  
    public void canRun() {  
    }  
    no usages  
    @Override  
    public void canFly() {  
    }  
}
```

```
public class Bird {  
  
    1 usage  
    ↴     protected interface NonFlyingBird{  
        no usages  
        ↳         public void canRun();  
    }  
  
}
```

```
public class Eagle implements Bird.NonFlyingBird{  
  
    no usages  
    ↴     @Override  
    ↳         public void canRun() {  
  
    }  
}
```

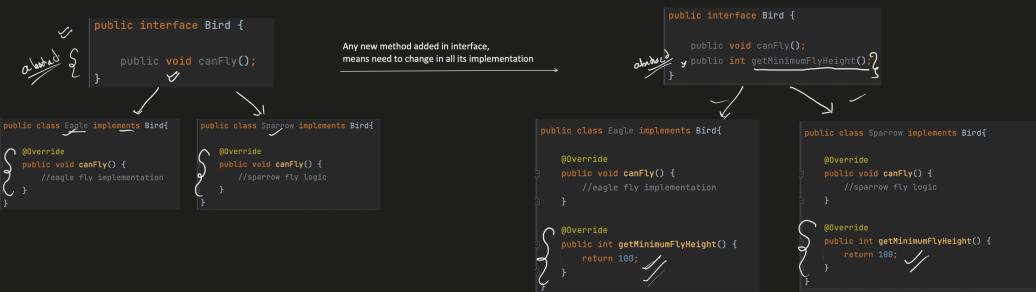
Interface Vs Abstract Class:

S.No.	Abstract Class	Interface
1.	Keyword used here is "abstract"	Keyword used here is "interface"
2.	Child Classes need to use keyword "extends"	Child Classes need to use keyword "implements"
3.	It can have both abstract and non abstract method	It can have only Abstract method (from Java8 onwards it can have default ,static and private method too, where we can provide implementation)
4.	It can Extend from Another class and multiple interfaces	It can only extends from other interfaces
5.	Variables can be static, non static, final , non final etc.	Variable are by default CONSTANTS
6.	Variables and Methods can be private, protected, public, default.	Variable and Methods are by default public (in Java9 , private method is supported)
7.	Multiple Inheritance is not Supported	Multiple Inheritance supported with this in Java
8.	It can provide the implementation of the interface	It can not provide implementation of any other interface or abstract class.
9.	It can have Constructor	It can not have Constructor
10.	To declare the method abstract, we have to use "abstract" keyword and it can be protected, public, default.	No need for any keyword to make method abstract. And by default its public.

JAVA 8 and 9 FEATURES:

1. Default Method(Java8):

- Before Java8, interface can have only Abstract method. And all child classes has to provide abstract method implementation.



Using Default Method:

```
public class Main {  
    public static void main(String args[]){  
        Eagle eagleObj = new Eagle();  
        eagleObj.getMinimumFlyHeight();  
    }  
}
```

```
public interface Bird {  
    public void canFly();  
    default int getMinimumFlyHeight(){  
        return 100;  
    }  
}
```

```
public class Eagle implements Bird{  
    @Override  
    public void canFly() {  
        //eagle fly implementation  
    }  
}
```

```
public class Sparrow implements Bird{  
    @Override  
    public void canFly() {  
        //sparrow fly logic  
    }  
}
```

Why Default method was introduced:

- To add functionality in existing Legacy Interface we need to use Default method. Example stream() method in Collection.



Default and Multiple Inheritance, how to handle:

```
public interface Bird {  
    default boolean canBreathe(){  
        return true;  
    }  
}
```

```
public interface LivingThing {  
    default boolean canBreathe(){  
        return true;  
    }  
}
```

Eagle obj = new Eagle();
obj.canBreathe()

```
public class Eagle implements Bird, LivingThing{  
}
```



```
public class Eagle implements Bird, LivingThing{  
    public boolean canBreathe(){  
        return true;  
    }  
}
```



Interface (default)
↓
Implementation

How to extend interface, that contains Default Method:

1st Way:

```
public class Main {  
    public static void main(String args[]){  
        Eagle eagleObj = new Eagle();  
        eagleObj.canBreathe();  
    }  
}
```

```
public interface LivingThing {  
    default boolean canBreathe(){  
        return true;  
    }  
}
```

```
public interface Bird extends LivingThing{  
}
```

```
public class Eagle implements Bird{  
}
```

Child

Parent

2nd Way:

```
public interface LivingThing {
    default boolean canBreathe() {
        return true;
    }
}
```

Parent

```
public interface Bird extends LivingThing {
    default boolean canBreathe() {
        return true;
    }
}
```

Child

```
public class Eagle implements Bird {
}
```

X

```
public class Eagle implements Bird {
    @Override
    public boolean canBreathe() {
        return true;
    }
}
```

✓

3rd Way:

```
public interface LivingThing {
    default boolean canBreathe() {
        return true;
    }
}
```

Parent Interface

override

```
public interface Bird extends LivingThing {
    default boolean canBreathe() {
        boolean canBreatheOrNot = LivingThing.super.canBreathe();
        // do something else
        return canBreatheOrNot;
    }
}
```

Child Interface

↓

```
public class Eagle implements Bird {
}
```

Java 8

2. Static Method (Java8):

- We can provide the implementation of the method in interface.
- But it can not be overridden by classes which implement the interface.
- We can access it using Interface name itself.
- Its by default public.

```
public interface Bird {  
    static boolean canBreathe() {  
        return true;  
    }  
}
```

```
public class Eagle implements Bird {  
    public void digestiveSystemTestMethod() {  
        Bird.canBreathe();  
        //do something  
    }  
}
```

If you try to override it,
it will just be treated as new method in Eagle class

```
public class Eagle implements Bird {  
    public boolean canBreathe() {  
        System.out.println("in interface");  
        return true;  
    }  
}
```

If you try to add @Override annotation,
it will throw compilation error

```
@Override  
public boolean canBreathe() {  
    System.out.println("in interface");  
    return true;  
}
```

3. Private Method and Private Static method (Java9):

- We can provide the implementation of method but as a private access modifier in interface.
- It brings more readability of the code. For example if multiple default method share some code, that this can help.
- It can be defined as static and non-static.
- From Static method, we can call only private static interface method.
- Private static method, can be called from both static and non static method.
- Private interface method can not be abstract. Means we have to provide the definition.
- It can be used inside of the particular interface only.

```
public interface Bird {  
    void canFly(); //this is equivalent to public abstract void canFly()  
  
    public default void minimumFlyingHeight() {  
        myStaticPublicMethod(); //calling static method  
        myPrivateMethod(); //calling private method  
        myPrivateStaticMethod(); //calling private static method  
    }  
  
    static void myStaticPublicMethod() {  
        myPrivateMethod(); //from static we can call other static method only  
    }  
  
    //private void myPrivateMethod();  
    // private method implementation  
  
    //private static void myPrivateStaticMethod();  
    // private static method implementation  
}
```



↳ Bird
↳ Bird Static

↳ Static Method → Only Static member
(Value of static method)
↳ Non-Static Method → Non-Static