Java Interfaces

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Java_Inter...

Java Interfaces

Interface

- is a way to describe what classes should do,
- without specifying how they should do it.

- NOT a class but a set of requirements
- class - implements an interface

Concept

```
public interface Comparable
{
  int compareTo(Object otherObject);
}
```

- Any class implementing the `Comparable` interface contains a `compareTo` method,
- and this method must take an `Object` parameter and return an integer

Interface declarations

- The declaration consists of a keyword `interface`, its name, and the members
- Similar to classes, interfaces can have three types of members
  - constants (fields)
  - methods
  - nested classes and interfaces

Interface member – constants

- An interface can define named constants, which are `public`, `static` and `final` (these modifiers are omitted by convention) automatically. Interfaces never contain instance fields.
- All the named constants MUST be initialized

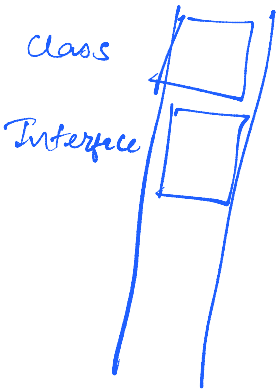
An example interface

```
interface Verbose {
        int SILENT = 0;
        int TERSE = 1;
        int NORMAL = 2;
        int VERBOSE = 3;

        void setVerbosity (int level);
        int getVerbosity();
}
```

Interface member – methods

- They are implicitly `abstract` (omitted by convention). So every method declaration consists of the method header and a semicolon.
- They are implicitly `public` (omitted by convention). No other types of access modifiers are allowed.
- They can't be `final`, nor `static`

{ }



Modifiers of interfaces itself

- An interface can have different modifiers as follows
  - `public/package(default)`
  - `abstract`
    - all interfaces are implicitly `abstract` ← No implementation of methods.
    - omitted by convention

To implement interfaces in a class

To implement interfaces in a class

- Two steps to make a class implement an interface
  1. declare that the class intends to implement the given interface by using the `implements` keyword

     ```
     class Employee implements Comparable { . . . }
     ```

  2. supply definitions for all methods in the interface

     Define access

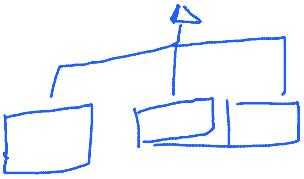
     ```
     public int compareTo(Object otherObject) {
        Employee other = (Employee) otherObject;
        if (salary < other.salary) return -1;
        if (salary > other.salary) return 1;
        return 0; }
     ```

note: in the `Comparable` interface declaration, the method `compareTo()` is `public` implicitly but this modifier is omitted. But in the `Employee` class design, you cannot omit the `public` modifier, otherwise, it will be assumed to have `package` accessibility

To implement interfaces in a class

- If a class leaves any method of the interface undefined, the class becomes `abstract` class and must be declared `abstract`
- A single class can implement multiple interfaces. Just separate the interface names by comma

```
class Employee implements Comparable,
 Cloneable {. . .}
```



Instantiation properties of interfaces

- Interfaces are not classes. You can never use the `new` operator to instantiate an interface.

```
public interface Comparable {
  . . . }
Comparable x = new Comparable( );
```

RHS cannot be an interface

LHS can be an interface

- You can still declare interface variables

```
Comparable x;
```

but they must refer to an object of a class that implements the interface

```
class Employee implements Comparable {
        . . .
}
x = new Employee( );
```

RHS class implementing the interface

Comparable x, y, z . . . .
x = new Employee( );
y = new Student ( );
⋮

} classes implemented comparable interface
Residential Address

Extending interfaces

- Interfaces support multiple inheritance – an interface can extend more than one interface
- Superinterfaces and subinterfaces

Example

Hierarchy.

```
public interface SerializableRunnable extends
java.io.Serializable, Runnable {
        . . .
}
```

Extending interfaces – about constants (1)

- An extended interface inherits all the constants from its superinterfaces
- Take care when the subinterface inherits more than one constants with the same name, or the subinterface and superinterface contain constants with the same name — always use sufficient enough information to refer to the target constants

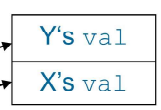
- When an interface inherits two or more constants with the same name
  - In the subinterface, explicitly use the superinterface name to refer to the constant of that superinterface

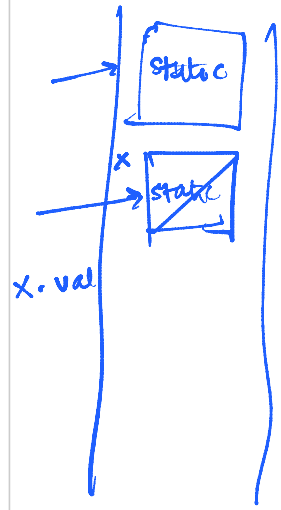
```
interface A {
    int val = 1;
}
interface B {
    int val = 2;
}
interface C extends A, B {
    System.out.println("A.val = "+ A.val);
    System.out.println("B.val = "+ B.val);
}
```

- If a superinterface and a subinterface contain two constants with the same name, then the one belonging to the superinterface is **hidden**
  1. in the subinterface
     - access the subinterface-version constants by directly using its name
     - access the superinterface-version constants by using the superinterface name followed by a dot and then the constant name

E.g

```
interface X {
    int val = 1; }

interface Y extends X{
    int val = 2;
    int sum = val + X.val; }
```





  2. outside the subinterface and the superinterface
     - you can access both of the constants by explicitly giving the interface name.

       E.g. in previous example, use `Y.val` and `Y.sum` to access constants `val` and `sum` of interface `Y`, and use `X.val` to access constant `val` of interface `X`.

- When a superinterface and a subinterface contain two constants with the same name, and a class implements the subinterface
  - the class inherits the subinterface-version constants as its static fields. Their access follow the rule of class's static fields access.

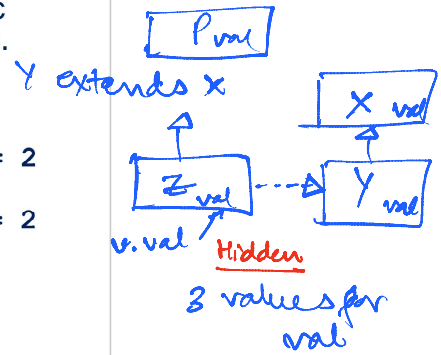
```
E.g    class Z implements Y { }

       //inside the class
       System.out.println("Z.val:"+val);    //Z.val = 2
       //outside the class
       System.out.println("Z.val:"+Z.val); //Z.val = 2
```

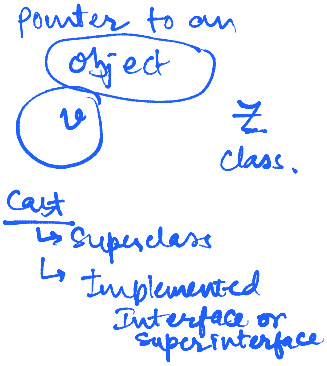
  - object reference can be used to access the constants
    - subinterface-version constants are accessed by using the object reference followed by a dot followed by the constant name
    - superinterface-version constants are accessed by explicit casting

```
E.g.  Z v = new Z( );
      System.out.print( "v.val = " + v.val
                        +", ((Y)v).val = " + ((Y)v).val
                        +", ((X)v).val = " +
   ((X)v).val );
```

output: v.val = 2, ((Y)v).val = 2, ((X)v).val = 1

class overrides

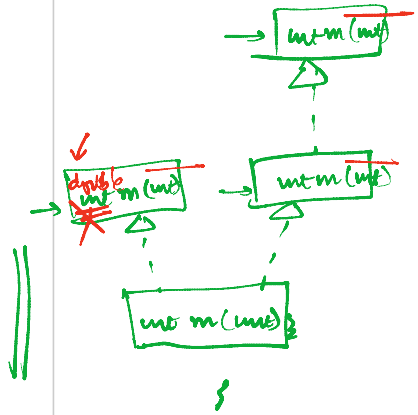




Extending interfaces – about methods

- If a declared method in a subinterface has the same signature as an inherited method and the same return type, then the new declaration *overrides* the inherited method in its superinterface. If the only difference is in the return type, then there will be a compile-time error
- An interface can inherit more than one methods with the same signature and return type. A class can implement different interfaces containing methods with the same signature and return type.
- Overriding in interfaces has **NO** question of ambiguity. The real behavior is ultimately decided by the implementation in the class implementing them. The real issue is whether a single implementation can honor all the contracts implied by that method in different interfaces
- Methods with same name but different parameter lists are `overloaded`

signature (no, int, double) return type



Interface References

Referencing an Interface Variable

intfRef.varName

intfRef.mthName(args)

```
interface A {
  void display(String s);
}

class C1 implements A {
  public void display(String s) {
    System.out.println("C1: " + s);
  }
}

class C2 implements A {
  public void display(String s) {
    System.out.println("C2: " + s);
  }
}

class C3 implements A {
  public void display(String s) {
    System.out.println("C3: " + s);
  }
}
```

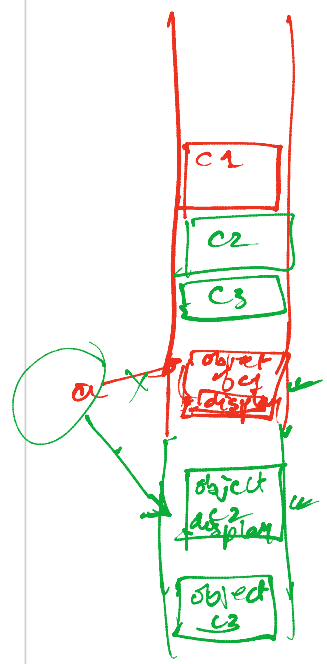
```
class InterfaceReferenceVariable {
 public static void main(String args[]) {
  A a;
  a = new C1();
  a.display("String 1");
  a = new C2();
  a.display("String 2");
  a = new C3();
  a.display("String 3");
 }
}
```

Result :

C1: String 1

C2: String 2

C3: String 3



Marker interfaces

- A marker (tagging) interface has neither methods nor constants, its only purpose is to allow the use of `instanceof` in a type inquiry.

verify type of an object

e instanceof - Employee, Person, M

interface M {
}

Person
Employee implements M
e

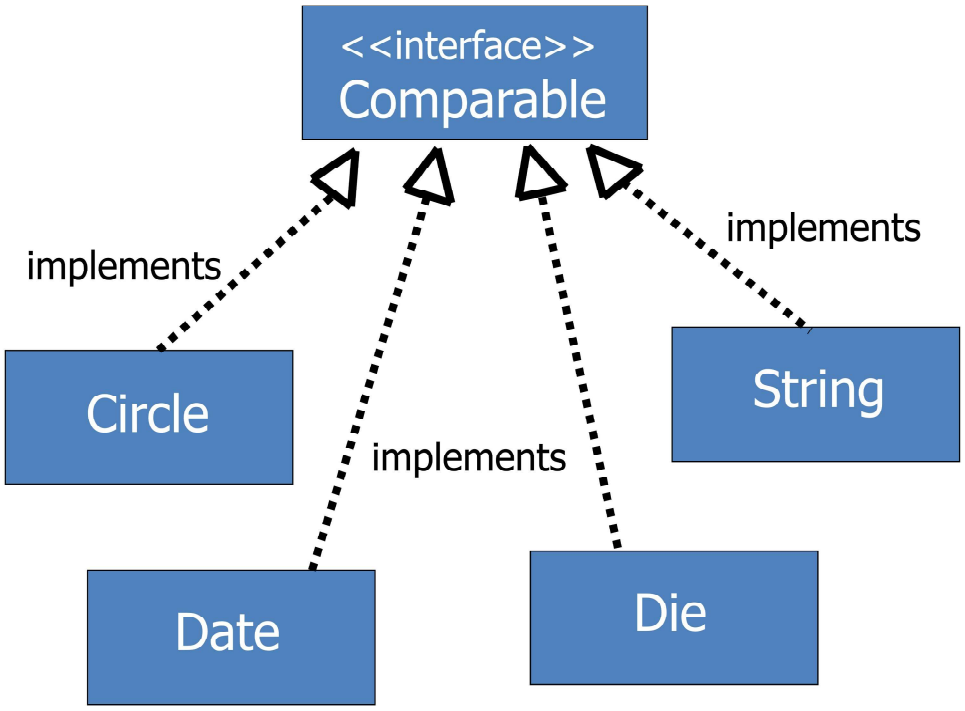
Interfaces and abstract classes

- Why bother introducing two concepts: abstract class and interface?

```
abstract class Comparable  {
   public abstract int compareTo (Object otherObject);
}
class Employee extends Comparable  {
    pulibc int compareTo(Object otherObject) { . . . }
}
-------------------------------------------------------------
public interface Comparable {
    int compareTo (Object otherObject);
}
class Employee implements Comparable  {
    public int compareTo (Object otherObject) { . . . }
}
```

constants
abstract method
{ }

- A class can only extend a single abstract class, but it can implement as many interfaces as it wants
- An abstract class can have a partial implementation, protected parts, static methods and so on, while interfaces are limited to public constants and public methods with no implementation



Comparable interface

```
public interface Comparable {
   public int compareTo( Object o );
}
```

for x, y objects of the same class

x.compareTo(y) < 0 means “x < y”

x.compareTo(y) > 0 means “x > y”

otherwise, “x is neither < nor > y”

- recommended that compareTo() is consistent with equals()
- if o cannot be cast to the same class as x, then generates a ClassCast Exception

```
public class Student implements Comparable
{  private String name;
   public int compareTo( Object o )
   {
        Student other = (Student) o;
        return ((this.name).compareTo(other.name));
   }
}
```

use < & > to compare primitives

invoke compareTo() method to compare objects

remember to have "implements Comparable" on the class header

Mixing inheritance, interfaces

- It is legal for a class to extend a parent and to implement any number of interfaces

```
  public class BankAccount {
  // ...
}

public class NumberedAccount
    extends BankAccount implements
  Comparable {
  private int myNumber;

  public int compareTo(Object o) {
    return myNumber -
  ((BankAccount)o).myNumber;
  }
}
```