

Interfaces as Types



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Learning Outcomes:

After doing this exercise, the learner...

- 1. has been confronted with, and has seen, that an interface can be used as the type when declaring a reference; similarly, it can “refer to” any object (“instance”) that is an implementer of the interface.**
- 2. has been confronted with the common novice-programmer error of trying to assign weaker privileges to methods when trying to implement an interface.**

Note:

Feel free to experiment and ask questions to the AllQuestionsForum when you come up against something that confuses you.

To Do:

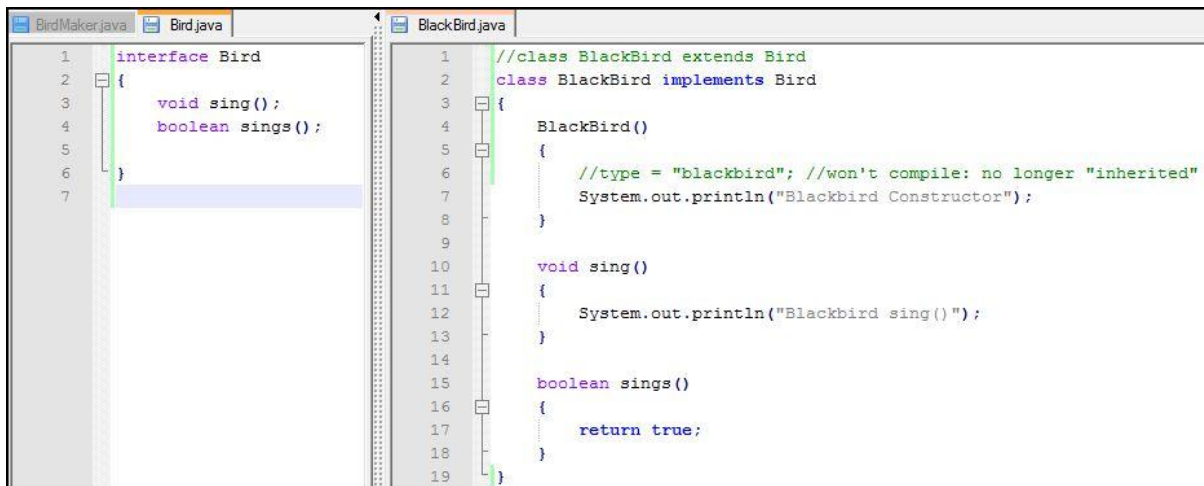
Follow below. Copy and compile the codes yourself and experiment briefly whenever you are curious (oh!, and ask questions).

Interfaces as Types

Part I – Using interfaces as Types

Below, we see a change to the previously shown code where the class `Bird` has been changed to be an interface instead of a class. On the right, we'll see that this required a small change to the `BlackBird` class (see commented lines).

[Note: the data-members `String type` and `String name` (previously declared the `Bird` class) are no-longer declared in the interface `Bird` - so the `BlackBird` constructor could no longer refer to them; i.e. they weren't inherited.]



However, following this minor change – you will see that you can re-compile `Bird`, and `BlackBird` (the changed source-code) and that `BirdMaker` will work without any changes...

Well, nearly! (Try the two compile statements below and observe the error you get). The next page shows how to fix this.

```
G:\example>javac Bird.java

G:\example>javac BirdMaker.java
.\BlackBird.java:15: error: sings() in BlackBird cannot implement
sings() in Bird
    boolean sings()
        ^
    attempting to assign weaker access privileges; was public
.\BlackBird.java:10: error: sing() in BlackBird cannot implement sing()
in Bird
    void sing()
        ^
    attempting to assign weaker access privileges; was public
2 errors

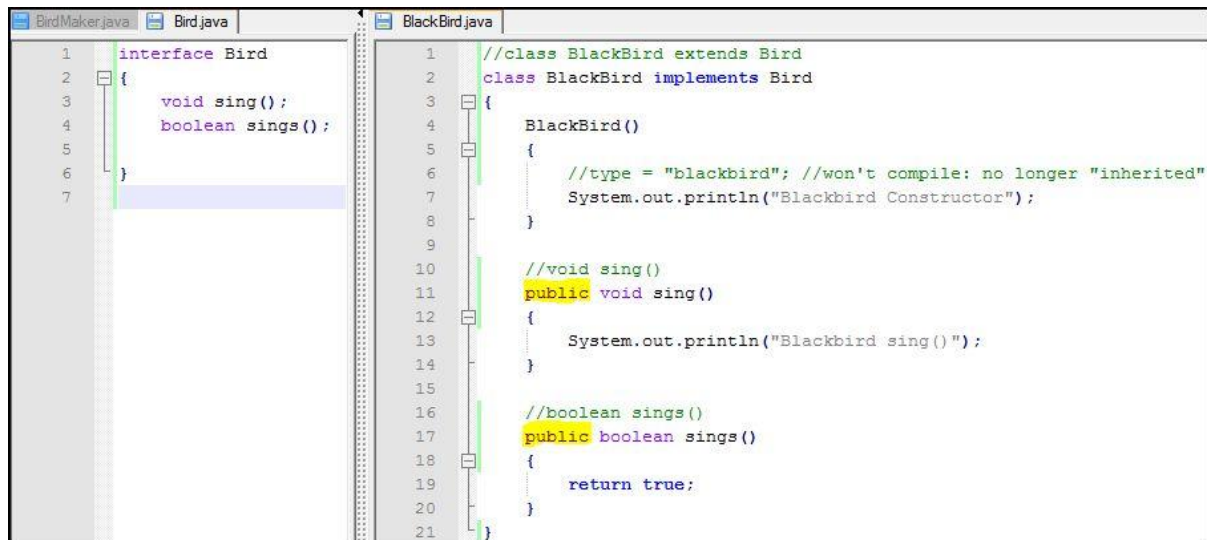
G:\example>
```

Interfaces as Types

The problem above occurred because, in an interface, everything is implicitly public: i.e. even though we wrote: `void sing()` the compiler wrote **public** `void sing()`.

There is a rule in Java that if something is public in a super-class or an interface it has to be public in a sub-class or an implementing class.

So: the following fixes it:



```
1 interface Bird
2 {
3     void sing();
4     boolean sings();
5 }
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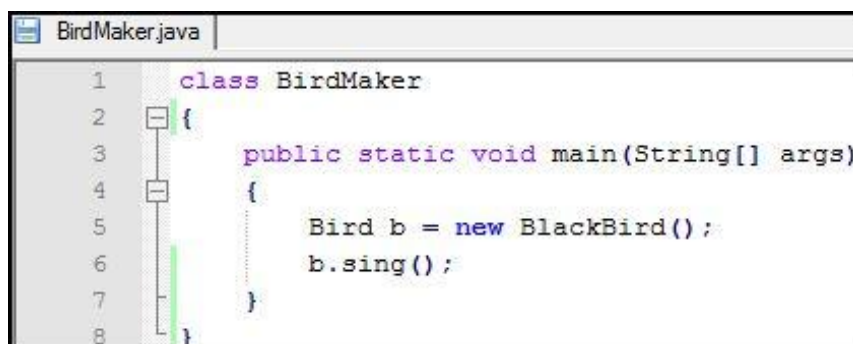
That is, to “implement” an interface’s declared methods – you have to put ‘public’ in the implementing class (as above).

Ok, that done – you save your changes to `BlackBird.java`, go to the compiler, and ...

```
G:\example>javac BlackBird.java
G:\example>
```

It compiles!

Now – will BirdMaker work?



```
1 class BirdMaker
2 {
3     public static void main(String[] args)
4     {
5         Bird b = new BlackBird();
6         b.sing();
7     }
8 }
```

Let’s see...

```
G:\example>java BirdMaker
Blackbird Constructor
Blackbird sing()
```

It does!

Ok. The lesson here is that you can use an interface as the ‘type’ of a reference variable – and this means that it can be assigned to any instance that is an implementer of the type.

Interfaces as Types

With a little thought – this makes sense. If you write a class `BlackBird` and you say:

```
class BlackBird implements Bird{...
```

you are stating that you are going to implement all methods listed in the `Bird` interface. Not only that – if you don't, the compiler won't compile `BlackBird`. So, from once it compiles, it is guaranteed to have a method implementation for

```
public void sing()
```

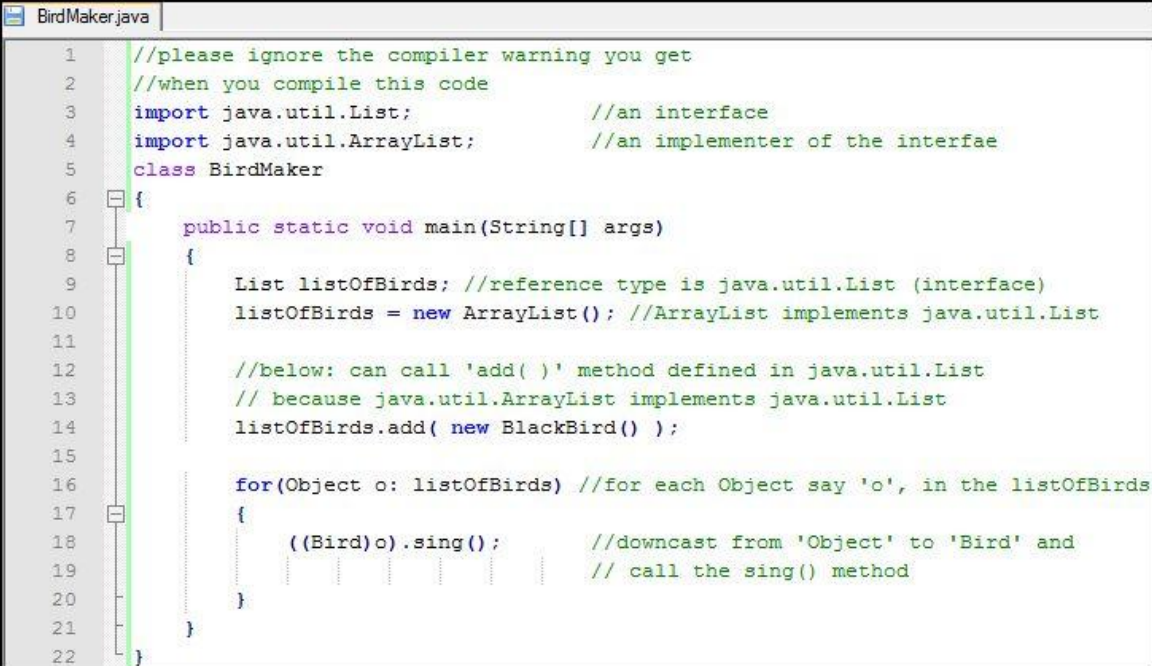
and

```
public boolean sings()
```

and so it makes sense that a reference variable of type `Bird` – can hold an identifier (or loosely-speaking an ~address) to an object-instance that implements the `Bird` interface.

Lesson Applied

See the code below:



```
1 //please ignore the compiler warning you get
2 //when you compile this code
3 import java.util.List;           //an interface
4 import java.util.ArrayList;      //an implementer of the interfae
5 class BirdMaker
6 {
7     public static void main(String[] args)
8     {
9         List listOfBirds; //reference type is java.util.List (interface)
10        listOfBirds = new ArrayList(); //ArrayList implements java.util.List
11
12        //below: can call 'add( )' method defined in java.util.List
13        // because java.util.ArrayList implements java.util.List
14        listOfBirds.add( new BlackBird() );
15
16        for(Object o: listOfBirds) //for each Object say 'o', in the listOfBirds
17        {
18            ((Bird)o).sing(); //downcast from 'Object' to 'Bird' and
19                               // call the sing() method
20        }
21    }
22 }
```

Above at line 9, a reference-variable `listOfBirds` is declared with the type `List` (see import of `java.util.List`) – this is an interface type.

Then at line 10 the reference is assigned a value that “refers to” a newly created `ArrayList` object-instance (see `import java.util.ArrayList;`) – this is a concrete class that implements the `List` interface.

At line 14, the `listOfBirds` reference is used to call the `add(Object o)` method of the concrete `ArrayList` instance which the `listOfBirds` reference-variable is now holding the (~loosely-speaking) address to.

At lines 16 to 20, we loop through the `ArrayList` instances collection of `Bird` objects and use a downcast to access the `sing()` method. [Note: this is a pre-Java-1.5 way of doing this – we should be using `new ArrayList<Bird>()` but for the above example we kept it simple.]

END LAB