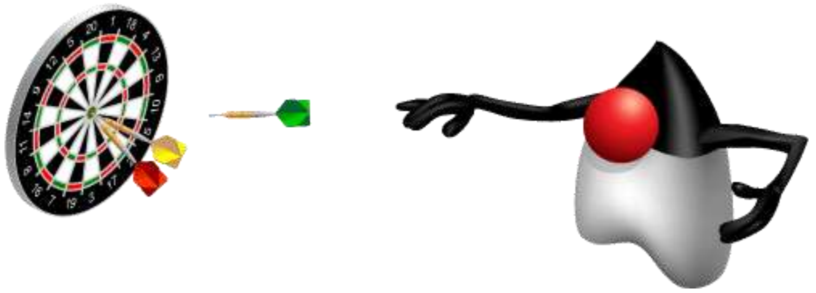
Using Interfaces

Objectives

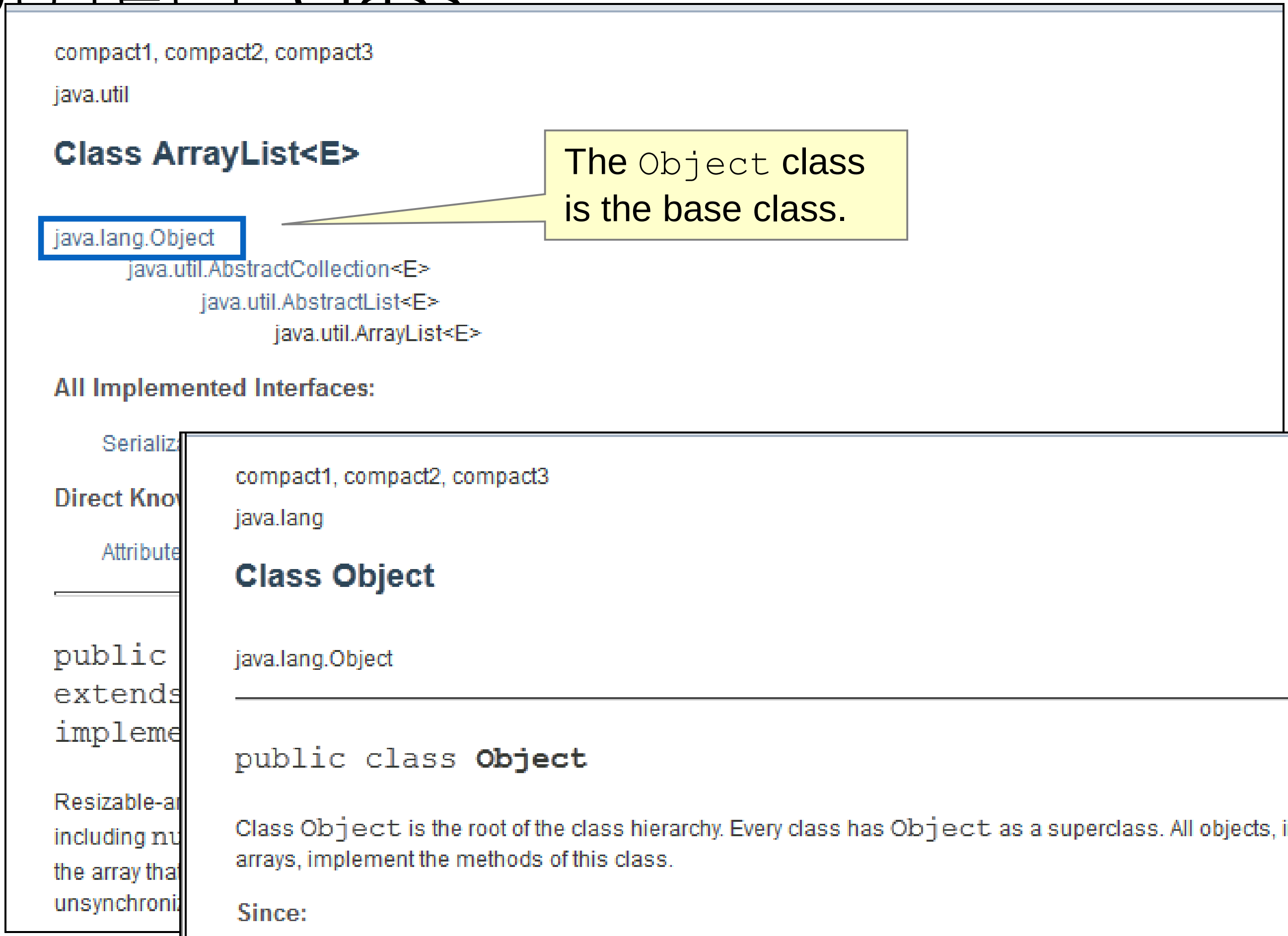
- After completing this lesson, you should be able to:
  - Override the `toString` method of the `Object` class
  - Implement an interface in a class
  - Cast to an interface reference to allow access to an object method
  - Write a simple lambda expression that consumes a `Predicate`



Topics

- Polymorphism in the JDK foundation classes
- Using interfaces
- Using the `List` interface
- Introducing lambda expressions

The Object Class



compact1, compact2, compact3

java.util

Class ArrayList<E>

java.lang.Object
    java.util.AbstractCollection<E>
        java.util.AbstractList<E>
            java.util.ArrayList<E>

All Implemented Interfaces:

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Attribute

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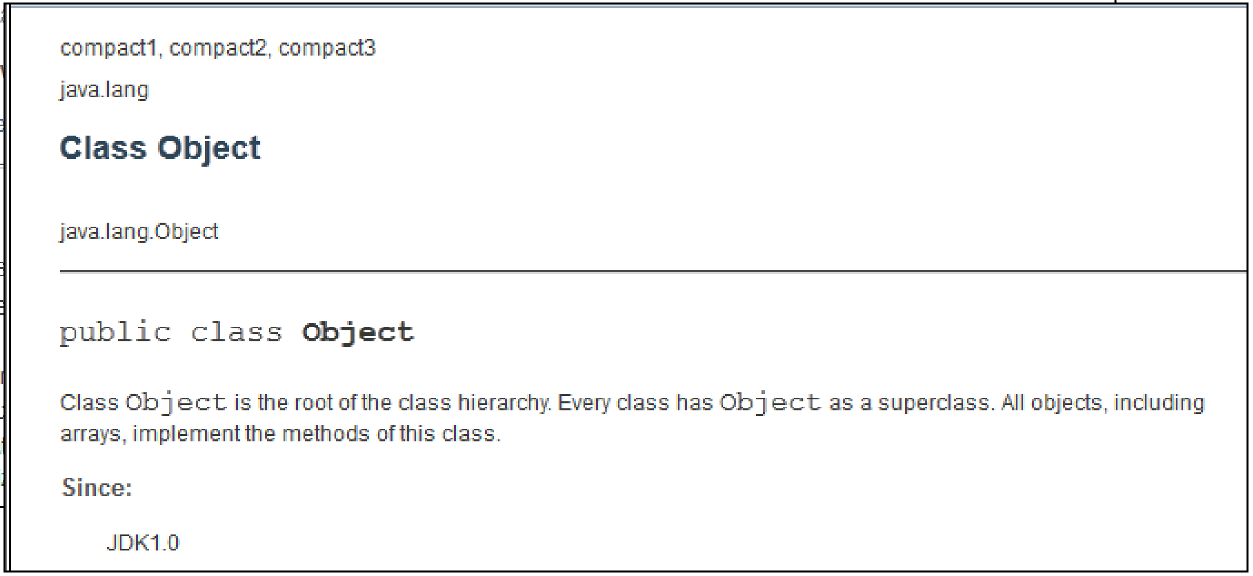
The `Object` class is the base class.



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java.lang

Class Object

java.lang.Object

```
public class Object
```

Class `Object` is the root of the class hierarchy. Every class has `Object` as a superclass. All objects, including arrays, implement the methods of this class.

Since:

JDK1.0

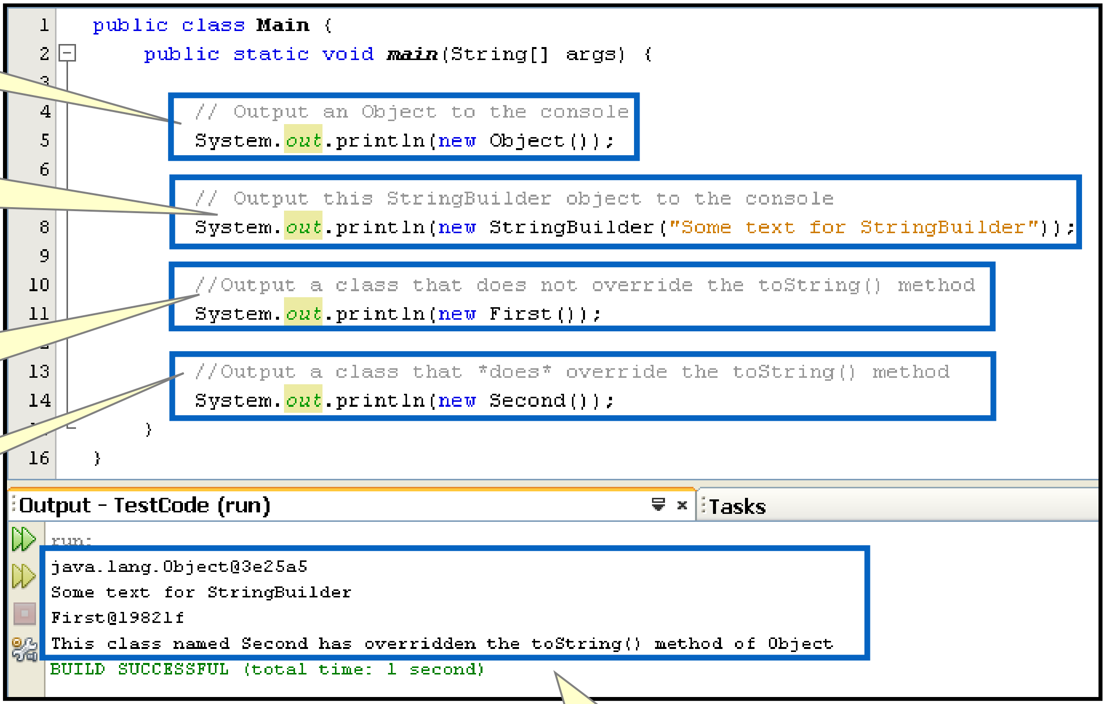
Calling the `toString` Method

Object's `toString` method is used.

StringBuilder overrides Object's `toString` method.

First inherits Object's `toString` method.

Second overrides Object's `toString` method.



```
public class Main {
    public static void main(String[] args) {

        // Output an Object to the console
        System.out.println(new Object());

        // Output this StringBuilder object to the console
        System.out.println(new StringBuilder("Some text for StringBuilder"));

        //Output a class that does not override the toString() method
        System.out.println(new First());

        //Output a class that *does* override the toString() method
        System.out.println(new Second());
    }
}
```

```
run:
java.lang.Object@3e25a5
Some text for StringBuilder
First@19821f
This class named Second has overridden the toString() method of Object
BUILD SUCCESSFUL (total time: 1 second)
```

The output for the calls to the `toString` method of each object

Overriding `toString` in Your Classes

Shirt class example

```
public String toString(){
  return "This shirt is a " + desc + ";"
      + " price: " + getPrice() + ","
      + " color: " + getColor(getColorCode());
}
```

Output of `System.out.println(shirt):`

- Without overriding `toString`

```
examples.Shirt@73d16e93
```

- After overriding `toString` as shown above

```
This shirt is a T Shirt; price: 29.99, color: Green
```

Topics

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- Using interfaces
- Using the `List` interface
- Introducing lambda expressions

The Multiple Inheritance Dilemma

- Can I inherit from *two* different classes? I want to use methods from both classes.
  - Class Red:

    ```
      public void print()  {System.out.print("I am Red");}
    ```
  - Class Blue:

    ```
     public void print() {System.out.print("I am Blue");}
    ```

```
public class Purple extends Red, Blue{
  public void printStuff() {
     print();  }
}
```

Which implementation of `print()` will occur?

The Java Interface

- An interface is similar to an abstract class, except that:
  - Methods are implicitly abstract (except default methods)
  - A class does not *extend* it, but *implements* it
  - A class may implement more than one interface
- All abstract methods from the interface must be implemented by the class.

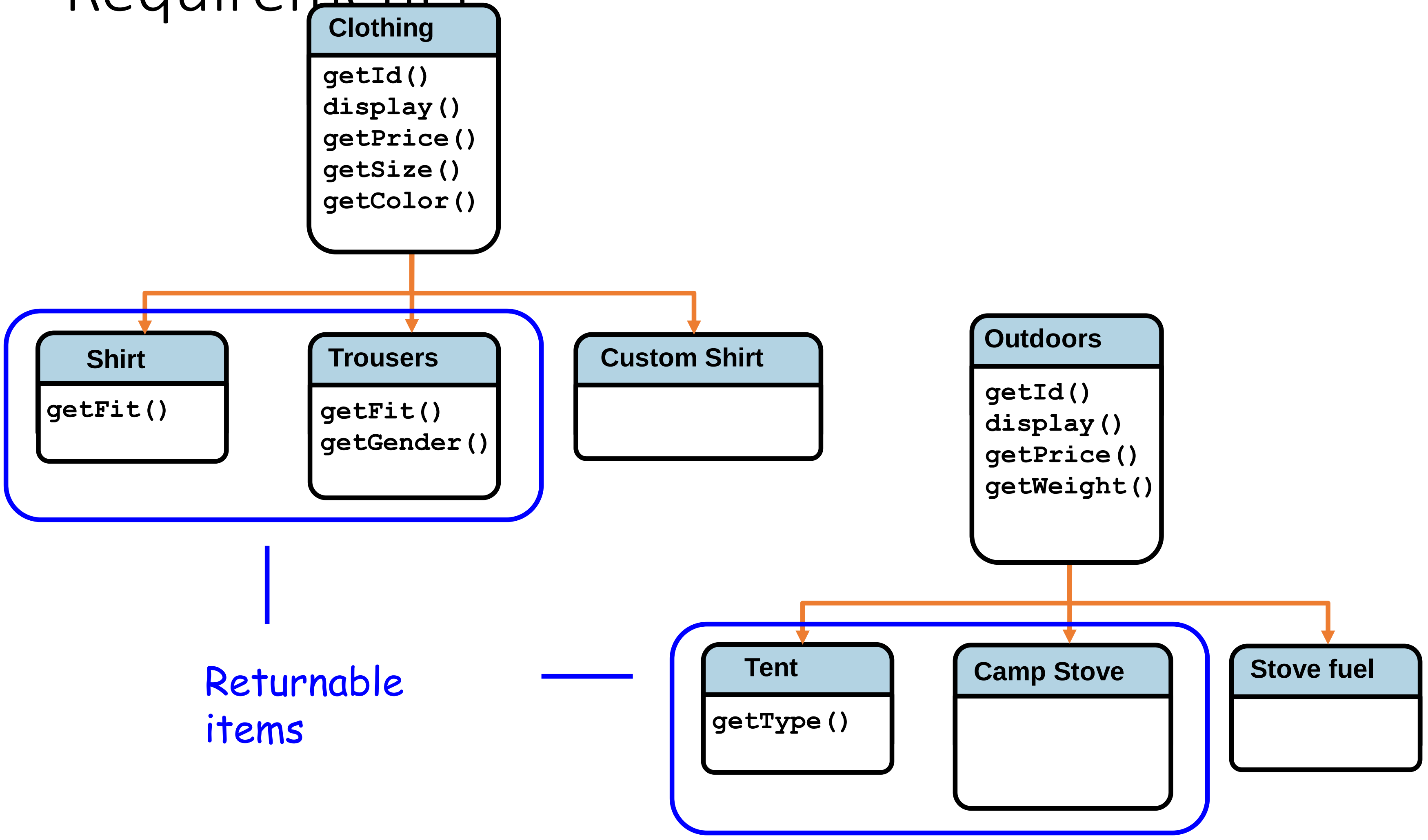
```java
public interface Printable {
    public void print();
}
```

Implicitly abstract

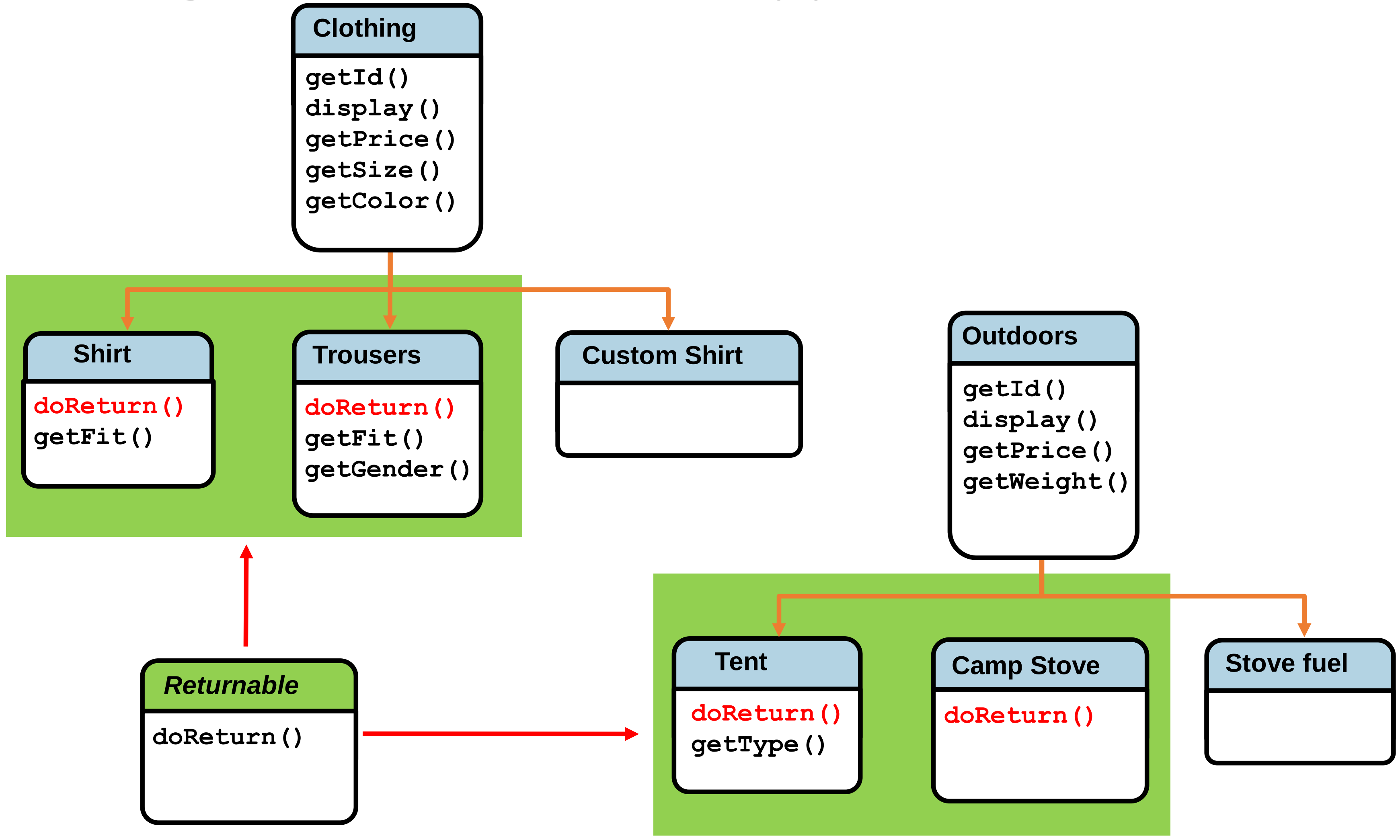
```java
public class Shirt implements Printable {
        ...
        public void print(){
                System.out.println("Shirt description");
        }
}
```

Implements the `print()` method.

Multiple Hierarchies with Overlapping Requirements



Using Interfaces in Your Application



Implementing the `Returnable` Interface

`Returnable` interface

```
public interface Returnable {
  public String doReturn();
}
```

Implicitly abstract method

`Shirt` class

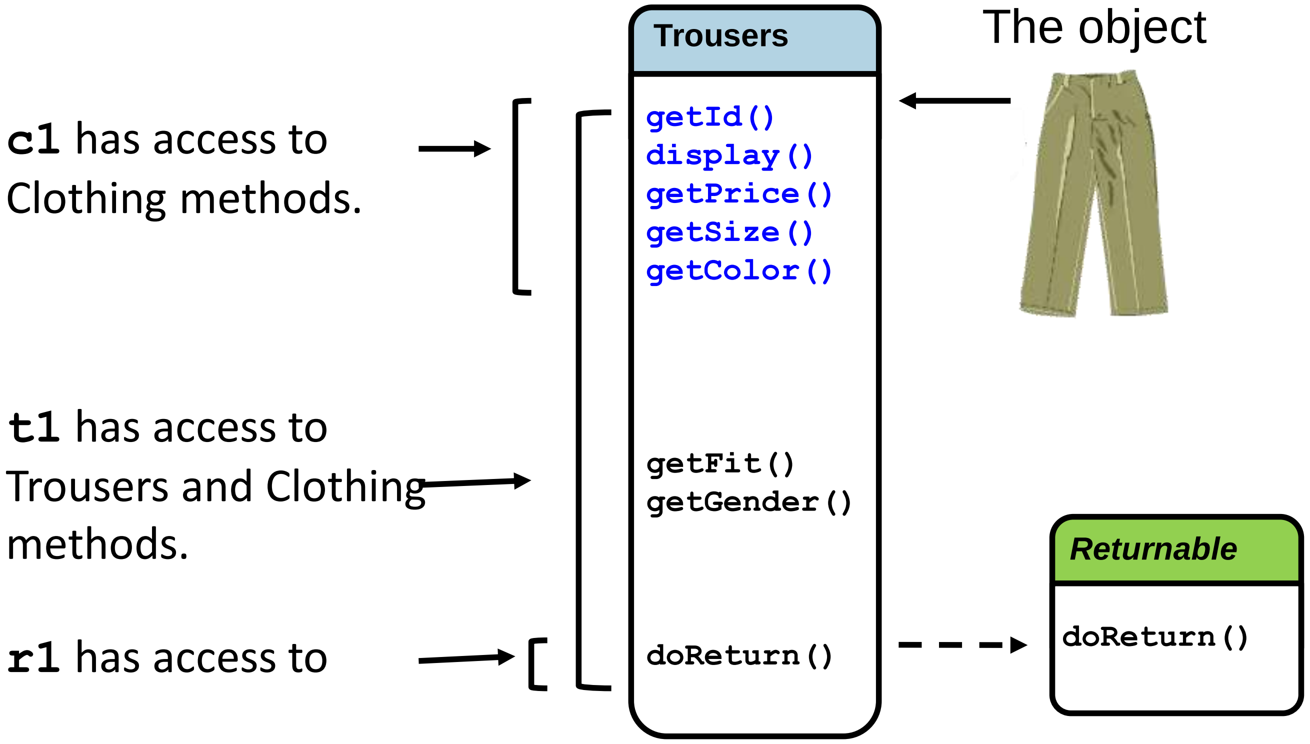
Now, Shirt 'is a' Returnable.

```
public class Shirt extends Clothing implements Returnable {
  public Shirt(int itemID, String description, char colorCode,
                      double price, char fit) {
      super(itemID, description, colorCode, price);
      this.fit = fit;
   }
public String doReturn() {
    // See notes below
     return "Suit returns must be within 3 days";
 }
...< other methods not shown > ...         } // end of class
```

Shirt implements the method declared in Returnable.

Access to Object Methods from Interface

```
Clothing c1 = new Trousers();
Trousers t1 = new Trousers();
Returnable r1 = new Trousers();
```



Casting an Interface Reference

```
Clothing c1 = new Trousers();
Trousers t1 = new Trousers();
Returnable r1 = new Trousers();
```

- The `Returnable` interface does not know about `Trousers` methods:
- Use **casting** to access methods defined outside the interface.

```
r1.getFit()                    //Not allowed
```

- Use `instanceof` to avoid inappropriate casts.

```
((Trousers)r1).getFit();
```

```
if(r1 instanceof Trousers) {
      ((Trousers)r1).getFit();
}
```

Quiz

- Which methods of an object can be accessed via an interface that it implements?
  a. All the methods implemented in the object's class
  b. All the methods implemented in the object's superclass
  c. The methods declared in the interface

Quiz

- How can you change the reference type of an object?
  a. By calling `getReference`
  b. By casting
  c. By declaring a new reference and assigning the object

Topics

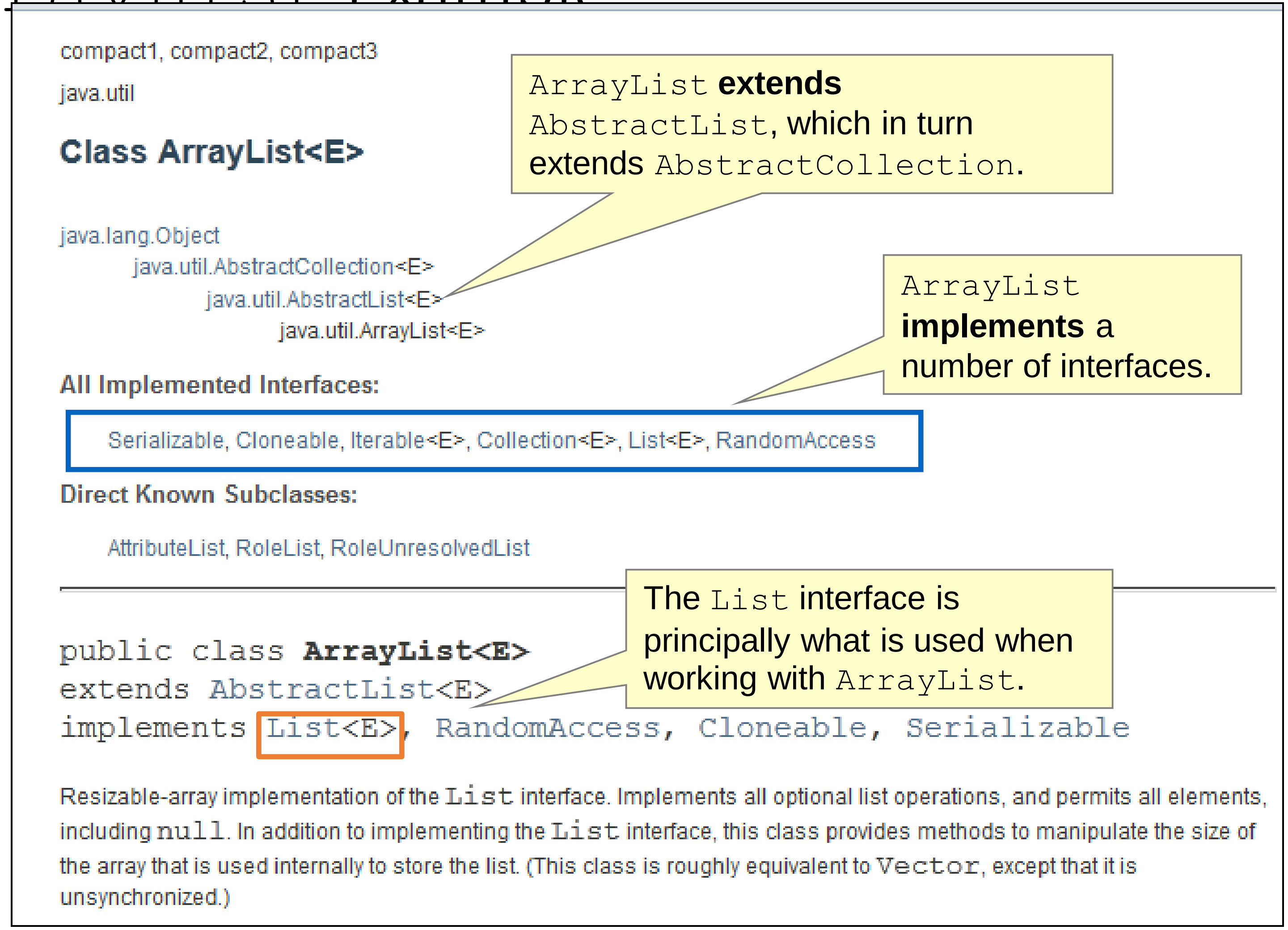
- Polymorphism in the JDK foundation classes
- Using Interfaces
- Using the `List` interface
- Introducing lambda expressions

The Collections Framework

The collections framework is located in the `java.util` package. The framework is helpful when working with lists or collections of objects. It contains:

- Interfaces
- Abstract classes
- Concrete classes (Example: `ArrayList`)

ArrayList Example



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java.util

Class ArrayList<E>

java.lang.Object
    java.util.AbstractCollection<E>
        java.util.AbstractList<E>
            java.util.ArrayList<E>

All Implemented Interfaces:

Serializable, Cloneable, Iterable<E>, Collection<E>, List<E>, RandomAccess

Direct Known Subclasses:

AttributeList, RoleList, RoleUnresolvedList

```
public class ArrayList<E>
extends AbstractList<E>
implements List<E>, RandomAccess, Cloneable, Serializable
```

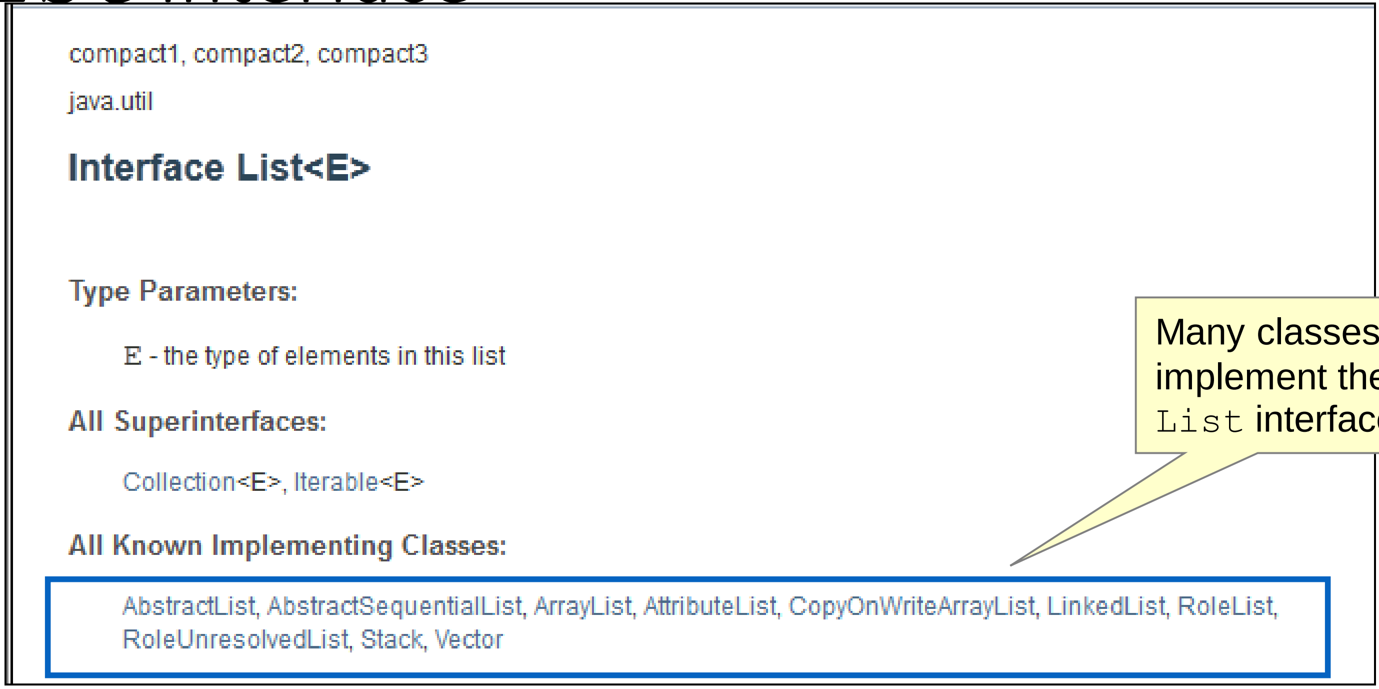
Resizable-array implementation of the `List` interface. Implements all optional list operations, and permits all elements, including `null`. In addition to implementing the `List` interface, this class provides methods to manipulate the size of the array that is used internally to store the list. (This class is roughly equivalent to `Vector`, except that it is unsynchronized.)

`ArrayList` **extends** `AbstractList`, which in turn extends `AbstractCollection`.

`ArrayList` **implements** a number of interfaces.

The `List` interface is principally what is used when working with `ArrayList`.

List Interface



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java.util

Interface List<E>

Type Parameters:

E - the type of elements in this list

All Superinterfaces:

Collection<E>, Iterable<E>

All Known Implementing Classes:

AbstractList, AbstractSequentialList, ArrayList, AttributeList, CopyOnWriteArrayList, LinkedList, RoleList, RoleUnresolvedList, Stack, Vector

Many classes implement the `List` interface.

- All of these object types can be assigned to a `List` variable:

```
ArrayList<String> words = new ArrayList();
List<String> mylist = words;
```

Example: `Arrays.asList`

- The `java.util.Arrays` class has many static utility methods that are helpful in working with arrays.
  - Converting an array to a `List`:

```
String[] nums = {"one","two","three"};
List<String> myList = Arrays.asList(nums);
```

List objects can be of many different types. What if you need to invoke a method belonging to `ArrayList`?

```
mylist.replaceAll()

mylist.removeIf()
```

This works! `replaceAll` comes from List.

Error! `removeIf` comes from Collection (superclass of ArrayList).

Example: `Arrays.asList`

- Converting an array to an `ArrayList`:

```
String[] nums = {"one","two","three"};
List<String> myList = Arrays.asList(nums);
ArrayList<String> myArrayList = new ArrayList(myList);
```

Shortcut:

```
String[] nums = {"one","two","three"};
ArrayList<String> myArrayList =
      new ArrayList(Arrays.asList(nums));
```

Summary

- In this lesson, you should have learned the following:
  - Polymorphism provides the following benefits:
    - Different classes have the same methods.
    - Method implementations can be unique for each class.
  - Interfaces provide the following benefits:
    - You can link classes in different object hierarchies by their common behavior.
    - An object that implements an interface can be assigned to a reference of the interface type.
  - Lambda expressions allow you to pass a method call as the argument to another method.