Interfaces and Lambda Expressions

Prof. Michele Loreti

Programmazione Avanzata
Corso di Laurea in Informatica (L31)
Scuola di Scienze e Tecnologie
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Java integrates aspects of functional programming in the object-oriented approach.
An interface is a mechanism for spelling out a contract between two parties:

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    public static double average (IntSequence seq, int n)
```

Such sequence can take many forms!
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- test if there is another element in the list;
- get the next element.

These informal descriptions allow us to derive the following interface:

```java
public interface IntSequence {
    boolean hasNext();
    int next();
}
```
Interfaces at work

This interface allow us to implement method `average`:

```java
public static double average(Iterable<Integer> seq, int n) {
    int count = 0;
    double sum = 0;
    while (seq.hasNext() && count < n) {
        count++;
        sum += seq.next();
    }
    return count == 0 ? 0 : sum / count;
}
```
This interface allow us to implement method `average`:

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```

We don’t know the exact implementation of `IntSequence`!
Implementing an Interface

The classes that want to be usable with the `average` method must implement the `IntSequence` interface.
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```java
public class SquareSequence implements IntSequence {

    private int i = 0;

    public boolean hasNext() {
        return true;
    }

    public int next() {
        i++;
        return i * i;
    }
}
```
Example: Fibonacci Sequence

```java
public class FibonacciSequence implements IntSequence {

    private int a = 1;
    private int b = 1;

    public boolean hasNext() {
        return true;
    }

    public int next() {
        int res = a;
        a = b;
        b = res + a;
        return res;
    }
}
```
Example: Digit Sequence

```java
public class DigitSequence implements IntSequence {
    private int number;
    public DigitSequence(int number) {
        this.number = number;
    }
    public boolean hasNext() {
        return this.number != 0;
    }
    public int next() {
        int result = this.number % 10;
        this.number /= 10;
        return result;
    }
    public int rest() {
        return this.number;
    }
}
```
Let us consider the following portion of code:

```java
IntSequence seq = new DigitSequence(19876);
double avg = Util.average(seq, 100);
```
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If *really needed* use `instanceof` to check the correctness of the operation.
Extending Interfaces

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public interface Closeable {
    void close();
}
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**Example:**

```java
public interface Closeable {
    void close();
}

public interface Channel extends Closeable {
    boolean isOpen();
}
```
Implementing Multiple Interfaces

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**Warning:** handle possible clash of names!
Constants

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**Example:**

`SwingConstants.NORTH`
Methods in the Interface

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- static;
- default;
- private methods.
Static Methods

It may be convenient to equip interfaces with static methods (like the factory methods) that provide generic functionalities for a given type.

```java
public interface IntSequence {

    ...

    static IntSequence digitsOf(int n) {
        return new DigitSequence(n);
    }
}
```
Default Methods

Starting from Java 1.9, we can provide a default implementation for any interface method:

```java
public interface IntSequence {
    default boolean hasNext() {
        return true;
    }
    int next();
    ...
}
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The use of default methods is particularly useful for interface evolutions!
Resolving default methods conflict

Let us consider the following interfaces:

```java
public interface Person {
    String getName();
    default int getId() { return 0; }
}
```

```java
public interface Identified {
    default int getId() { return Math.abs(hashCode()); }
}
```

Consider now the class `Employee` defined as follows:

```java
public class Employee implements Person, Identified {
    // ...
}
```
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Consider now the class Employee defined as follows:

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public class Employee implements Person, Identified {
    ...
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There is a conflict that we have to resolve by providing an implementation of getId.
Private methods

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These private methods typically implement utility features and their use should be limited.
Examples...

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- Comparable\(<\text{T}\>\);
- Comparator\(<\text{T}\>\);
- Runnable;
- EventHandler\(<\text{T}\>\).
Lambda Expressions

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\text{(String \ first, String \ second) \rightarrow first.length() - second.length()}
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\[(\text{String } \text{first}, \text{String } \text{second}) \rightarrow \text{first.length()} - \text{second.length()})\]

or a block:

\[(\text{String } \text{first}, \text{String } \text{second}) \rightarrow \{
  \text{int}\ \text{difference} = \text{first.length()} - \text{second.length()};
  \text{if} (\text{difference} < 0) \text{return} \ -1;
  \text{else}\ \text{if} (\text{difference} > 0) \text{return} \ 1;
  \text{else}\ \text{return} \ 0;
\}\]
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We can use a lambda expression (with the appropriate type) when a functional interface is expected:

```java
Arrays.sort(anArray, (x, y) -> x.length() - y.length());
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```

The type of parameters can be inferred!
Method References

Suppose that we want to sort strings regardless of letter case. We could call:

```java
Arrays.sort(strings, (x, y) -> x.compareToIgnoreCase(y));
```

Alternatively, we can pass directly the method reference:

```java
Arrays.sort(strings, String::compareToIgnoreCase);
```

There are many examples of use:

- `list.remove(Objects::isNull)`
- `list.forEach(System.out::println)`
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Method References

There are three variations for method references:

- Class :: instanceMethod
- Class :: staticMethod
- object :: instanceMethod
- Class :: new
Scope of a Lambda Expression

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Example:

```java
public class AClass {
    private int value = 0;

    public void setValue(int value) {
        this.value = value;
    }

    public Function<Integer, Integer> getLambda() {
        return (x) -> this.value + x;
    }
}
```
To be continued...