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02: ♦ Java 8 Streams, lambdas, intermediate vs terminal ops, and lazy loading with simple examples

Posted on [February 24, 2015](#) by [Arulkumaran Kumaraswamipillai](#)

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A **stream** is an infinite sequence of consumable elements (i.e a data structure) for the consumption of an operation or iteration. Any **Collection<T>** can be exposed as a stream. It looks complex, but once you get it, it is very simple. The operations you perform on a stream can either be

1. Intermediate operations like map, filter, sorted, limit, skip, concat, substream, distinct, peek, etc producing another

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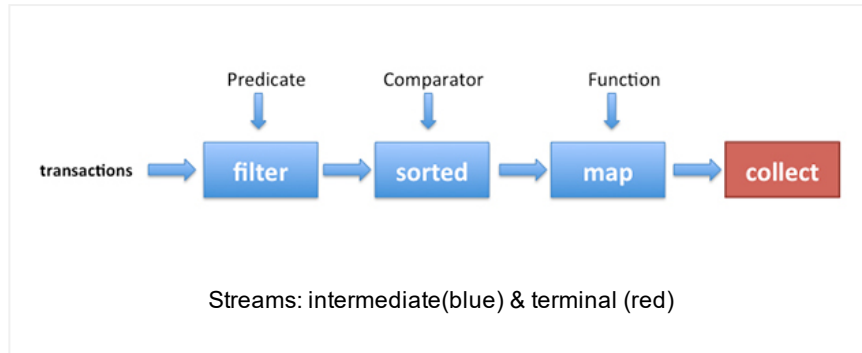
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`java.util.stream.Stream<T>` or a

2. Terminal operations like `forEach`, `reduce`, `collect`, `sum`, `max`, `count`, `matchAny`, `findFirst`, `findAny`, etc producing an object that is not a stream.



Basically, you are building a pipeline as in Unix. In Unix we “pipe” operations, and in Java 8, we stream them.

```
1 ls -l | grep "Dec" | Sort +4n | more
```

The **`stream()`** is a default method added to the **`Collection<T>`** interface in Java 8. The **`stream()`** returns a **`java.util.staream.Stream<T>`** interface with multiple abstract methods like `filter`, `map`, `sorted`, `collect`, etc. The **`DelegatingStream<T>`** is the implementing class.

Intermediate operations are **lazy operations**, which will be executed only after a terminal operation was executed. So when you call `.filter(i -> i % 3 == 0)` the lambda body isn’t being executed at the moment. It will only be executed after a terminal operation was called (**`collect`**, in the example shown below). This is essential to understand from the viewpoint of adding break points in your IDE for debugging purpose.

Go through these examples to get a good handle on the stream concepts.

11 numbers 1 to 10 and an extra 6 are **a)** filtered first for multiples of 3 **b)** filtered for values less than 7 **c)** remove duplicates by adding to a `Set<T>` **d)** print the result.

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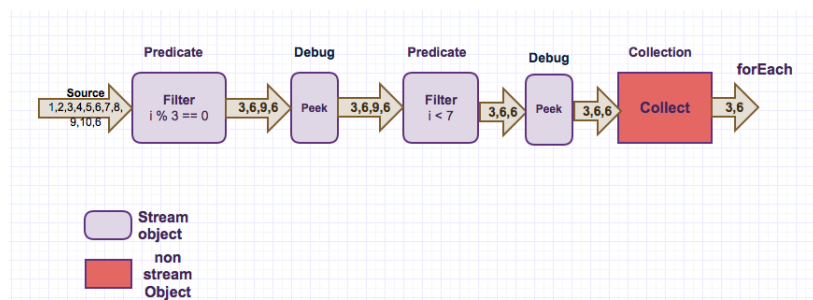
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$i \rightarrow i \% 3 == 0$ is a **lambda expression** used as a predicate to filter only multiples of 3. So,

Q. what is this “lambda expression”?

A. In OOP or imperative programming, $x = x + 5$ makes sense, but in mathematics or **functional programming**, you can't say $x = x + 5$ because if x were to be 2, you can't say that $2 = 2 + 5$. In functional programming you need to say $f(x) \rightarrow x + 5$.



Java 8 Stream

Example 1:

```

1 import java.util.Arrays;
2 import java.util.List;
3 import java.util.stream.Collectors;
4
5 public class Java8LambdaDebug {
6
7     public static void main(String[] args) {
8         List<Integer> list = Arrays.asList(1,2,3
9         list.stream()
10            .filter(i -> i % 3 == 0) //multiples o
11            .peek(i -> System.out.println("Debug p
12            .filter(i -> i < 7)
13            .peek(i -> System.out.println("Debug p
14            .collect(Collectors.toSet()) // remove
15            .forEach(i -> System.out.println("resu
16    }
17 }
18 }
19

```

In the above example, filter and peek are intermediate operations that return a “Stream<T>” object. The “peek” is used for **debugging**. The “collect(...)” is a terminal operation that returns a “Collection<T>” object, which extends

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“Iterable<T>” interface which has the “forEach(…)” method.
Don’t confuse this with the “forEach()” method in the
“java.util.stream.Stream<T>”.

Output:

```

1  Debug pt1: 3
2  Debug pt2: 3
3  Debug pt1: 6
4  Debug pt2: 6
5  Debug pt1: 9
6  Debug pt1: 6
7  Debug pt2: 6
8  result: 3
9  result: 6
10

```

Example 2:

Same as above, let’s introduce another terminal operation
sum().

```

1  import java.util.Arrays;
2  import java.util.List;
3
4  public class Java8LambdaDebug {
5
6      public static void main(String[] args) {
7          List<Integer> list = Arrays.asList(1,2,3
8
9          final int sum = list.stream()
10             .filter(i -> i % 3 == 0) //multiples o
11             .peek(i -> System.out.println("Debug p
12             .filter(i -> i < 7)
13             .peek(i -> System.out.println("Debug p
14             .mapToInt(Integer::intValue)
15             .sum(); //duplicate 6 is included 3+6+
16
17          System.out.println("sum=" + sum);
18      }
19  }
20

```

In the above example, filter, peek, and mapToInt are
intermediate operations that return a “Stream” object. “sum” is
terminal operation that returns a result.

Output:

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```
1 Debug pt1: 3
2 Debug pt2: 3
3 Debug pt1: 6
4 Debug pt2: 6
5 Debug pt1: 9
6 Debug pt1: 6
7 Debug pt2: 6
8 sum=15
9
```

Example 3:

Let's mix "intermediate" and "terminal" operations up.

```
1 import java.util.Arrays;
2 import java.util.List;
3 import java.util.stream.Collectors;
4
5 public class Java8LambdaDebug {
6
7     public static void main(String[] args) {
8         List<Integer> list = Arrays.asList(1,2,3
9
10         final int sum = list.stream()
11             .filter(i -> i % 3 == 0) //multiples o
12             .peek(i -> System.out.println("Debug p
13             .filter(i -> i < 7)
14             .peek(i -> System.out.println("Debug p
15             .collect(Collectors.toSet()) //remove
16             .stream()
17             .mapToInt(Integer::intValue)
18             .sum(); //duplicate is removed 3+6=12
19
20         System.out.println("sum=" + sum);
21     }
22 }
23
24
```

In the above example, `filter(..)`, `peek(..)`, `stream(..)`, and `mapToInt(..)` are intermediate operations that return a "Stream<T>" object. "collect(...)" and "sum()" are terminal operations. Since, "collect" returns a "Collection<T>" terminal object after removing the duplicate value of 6 with the help of `toSet()`, we need to call the `stream()` again to get the "Stream<T>" object back. Finally, "sum()" is a terminal operation.

Output:

```
1 Debug pt1: 3
2 Debug pt2: 3
```

```
3 Debug pt1: 6
4 Debug pt2: 6
5 Debug pt1: 9
6 Debug pt1: 6
7 Debug pt2: 6
8 sum=9
9
```

So, if still having trouble grasping this, have a look at the **Java 8 API docs** for Interfaces `Stream<T>`, `Iterable<T>` and Interface `Collection<E>`. Pay attention to default methods and return objects.

So, now with a little bit of help from the Java 8 API docs, you can perform different combination of operations on a collection of data. You can also debug by placing break points in your IDE like eclipse by keeping in mind that **intermediate ops are lazily evaluated** after a terminal operation. The **peek()** intermediate operation is very handy for debugging as well.

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