Java Streams

Richard Warburton

Java Champion, Author and Programmer

@richardwarburto www.monotonic.co.uk

For loops and iterators are a
low level, error prone construct.

Java Streams

A stream is a way of supporting functional-style operations on Collections. In other words aggregate operations that work on sequences of values.

Overview

Introduce Streams in code

Stream Operations

Collectors

Limitations and General features

Live Coding Streams

Intermediate Operations on Streams

Types of Stream Operations

Intermediate

Everything but the last

return `Stream<T>`

`filter()`

Terminal

Last in the Pipeline

return values

`toList()`

```
streamOfProducts.filter(product -> product.getWeight() > 20)
```

Filter

Remove elements from the Stream that don’t match a predicate

```
streamOfProducts.map(Product::getName)
```

Map

Transform elements from one value into another

Skip and limit

```
streamOfProducts
  // Discard next N elements
  .skip(elementsOnPage * pageNumber)
  // Only keep next N elements
  .limit(elementsOnPage)
```

Sorted

```
// Sort Comparable objects with default order
products.map(Product::getName).sorted()

// Sort objects with a specified comparator
Comparator<Product> byName = Comparator.comparing(Product::getName)
products.sorted(byName)
```

```
streamOfShipments.flatMap(shipment -> shipment.getLightVanProducts().stream())
```

FlatMap

Transform elements from one value into zero, one or many values

Terminal Operations on Streams

```
productStream.toList()
```

- Create a List with elements of the Stream
- List is unmodifiable

```
// Object[]
productStream.toArray()
```

- Creates an Object[] Array

```
// Product[]
productStream.toArray(Product[]::new)
```

- Pass a function to create the specific array type
- Normally used with method reference

```
products.anyMatch(
  prod -> prod.getWeight() > 20);

products.noneMatch(
  prod -> prod.getWeight() > 20);

products.allMatch(
  prod -> prod.getWeight() > 20);
```

- **Match family**
- **Terminal Operation**
- **Returns a Boolean**
- **If any / none / all elements match a Predicate**

```
// max (or min) element given a sort order
products.max(Comparator.comparingInt(Product::getWeight))

// Side effecting action for each element
products.forEach(prod -> System.out.println(prod.getName()))

// findFirst (or findAny()) get the element
products.filter(prod -> prod.getName().contains(“Chair”)).findFirst()

// Count number of elements in a stream
products.filter(prod -> prod.getName().contains(“Chair”)).count()
```

```
streamOfProducts.reduce(0, (acc, product) -> acc + product.getWeight())
```

Reduce

Combine elements together using a combining function.

Reduce Example

```
// weights of 35, 25
Stream.of(door, window)
  .reduce(0, (acc, product) -> acc + product.getWeight());
```

```
 0

(0, door) -> 0 + 35 = 35

(35, window) -> 35 + 25 = 60

60
```

Enter the Collector

Performance and Implementation

Primitives vs Boxed Numerics

int
A primitive value
4 bytes

Integer
A boxed, heap allocated object
Needs a pointer
24 bytes on a 64bit JVM

Primitive Streams

```
strings.mapToInt(String::length)
```

```
IntStream.of(1, 2)
```

```
IntStream.range(start, end)
```

Primitive Streams

Performance

Improvement over boxed numeric streams

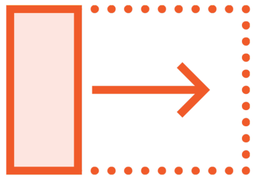
Functionality

Operations like sum() for primitives

Specialised

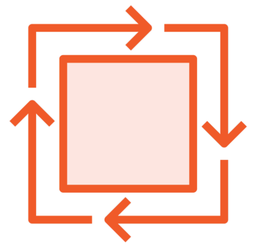
`int`, `long` **and** `double`

Parallel Streams



Streams an be run in a parallel mode

Run on the common fork-join pool of the JVM



Potentially, but not always, a performance improvement

```
collection.parallelStream()
```

```
stream.parallel()
```

- Explicit but Unobtrusive API
- Create from a collection
- Flip an existing stream into parallel mode

Conclusion

Are Streams always better?

Streams	Loops
High Level construct	Low level construct
Optimized framework	Can be faster
General better readability	Readability is subjective
Some corner cases worse	Nicer with checked Exceptions

Beyond Streams

Further Streams Learning Material

Advanced Collectors

Optional API

Summary

Streams are a powerful Abstraction in Java

Can replace many for loops and iterators

Rely heavily upon Lambda Expressions and Method References.

Up Next:
Collection Operations