Java Streams: Overview & Benefits

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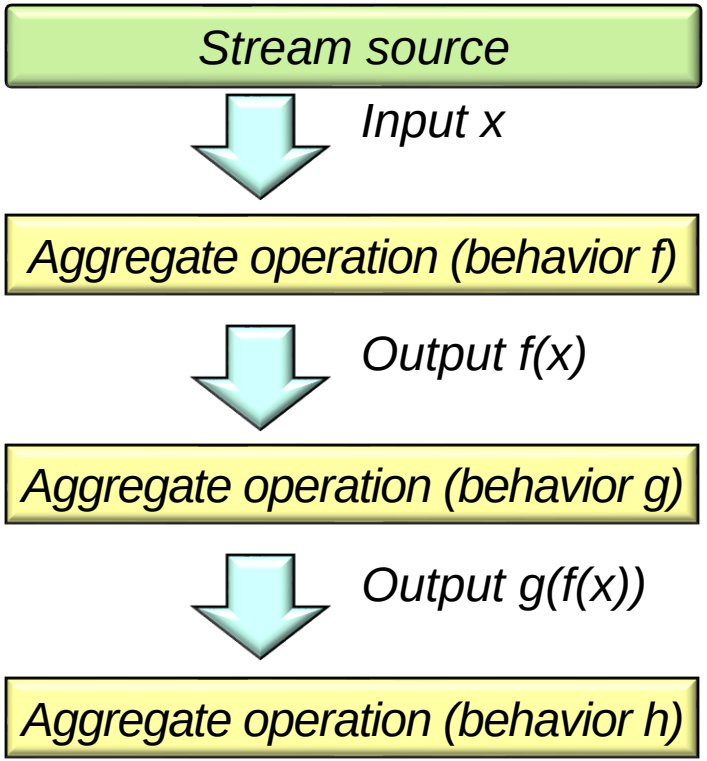
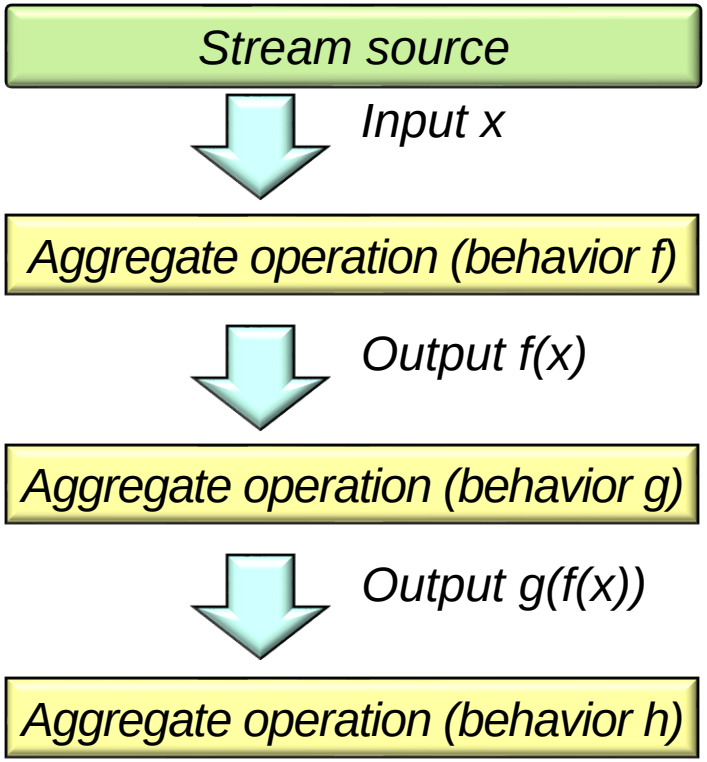
Learning Objectives in this Part of the Lesson

- Understand the structure & functionality of Java streams



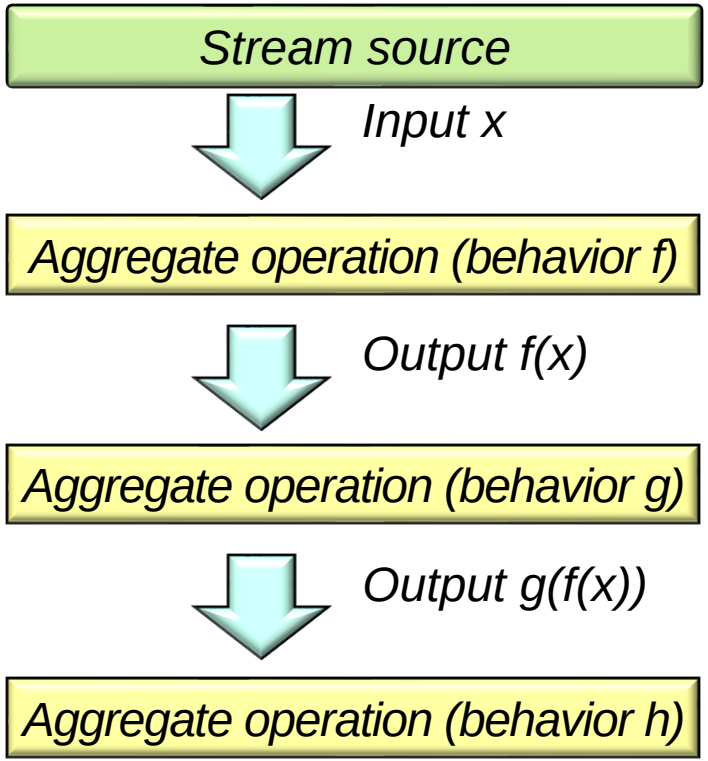
Learning Objectives in this Part of the Lesson

- Understand the structure & functionality of Java streams, e.g.,
  - Fundamentals of streams



Learning Objectives in this Part of the Lesson

- Understand the structure & functionality of Java streams, e.g.,
  - Fundamentals of streams
  - Benefits of streams



Overview of Java Streams

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- Java streams are a framework first introduced into the Java class library in Java 8

What's New in JDK 8

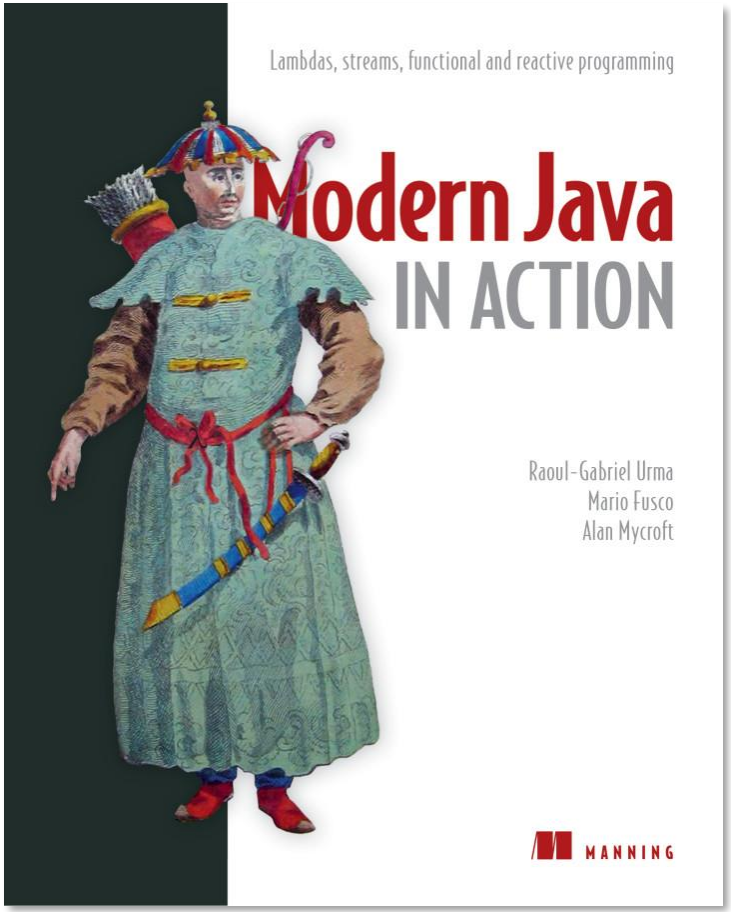
Java Platform, Standard Edition 8 is a major feature release. This document summarizes features and enhancements in Java SE 8 and in JDK 8, Oracle's implementation of Java SE 8. Click the component name for a more detailed description of the enhancements for that component.

- Java Programming Language
  - Lambda Expressions, a new language feature, has been introduced in this release. They enable you to treat functionality as a method argument, or code as data. Lambda expressions let you express instances of single-method interfaces (referred to as functional interfaces) more compactly.
  - Method references provide easy-to-read lambda expressions for methods that already have a name.
  - Default methods enable new functionality to be added to the interfaces of libraries and ensure binary compatibility with code written for older versions of those interfaces.
  - Repeating Annotations provide the ability to apply the same annotation type more than once to the same declaration or type use.
  - Type Annotations provide the ability to apply an annotation anywhere a type is used, not just on a declaration. Used with a pluggable type system, this feature enables improved type checking of your code.
  - Improved type inference.
  - Method parameter reflection.
- Collections
  - Classes in the new `java.util.stream` package provide a Stream API to support functional-style operations on streams of elements. The Stream API is integrated into the Collections API, which enables bulk operations on collections, such as sequential or parallel map-reduce transformations.
  - Performance Improvement for HashMaps with Key Collisions

See docs.oracle.com/javase/tutorial/collections/streams

Overview of Java Streams

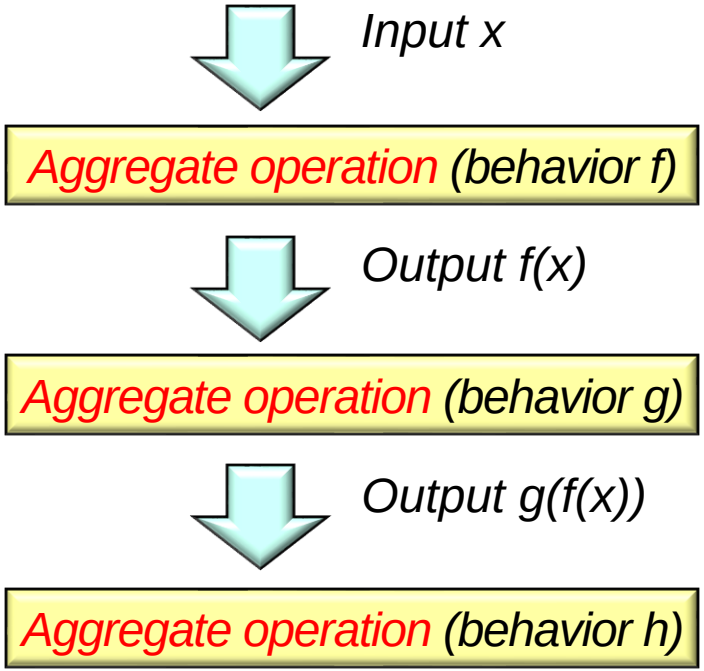
- Java streams are a framework first introduced into the Java class library in Java 8
  - They have continued to evolve a bit in later versions of Java



See www.baeldung.com/java-9-stream-api & blog.codefx.org/java/teeing-collector

Overview of Java Streams

- A stream is a pipeline of aggregate operations that process a sequence of elements (aka, "values" or "data")



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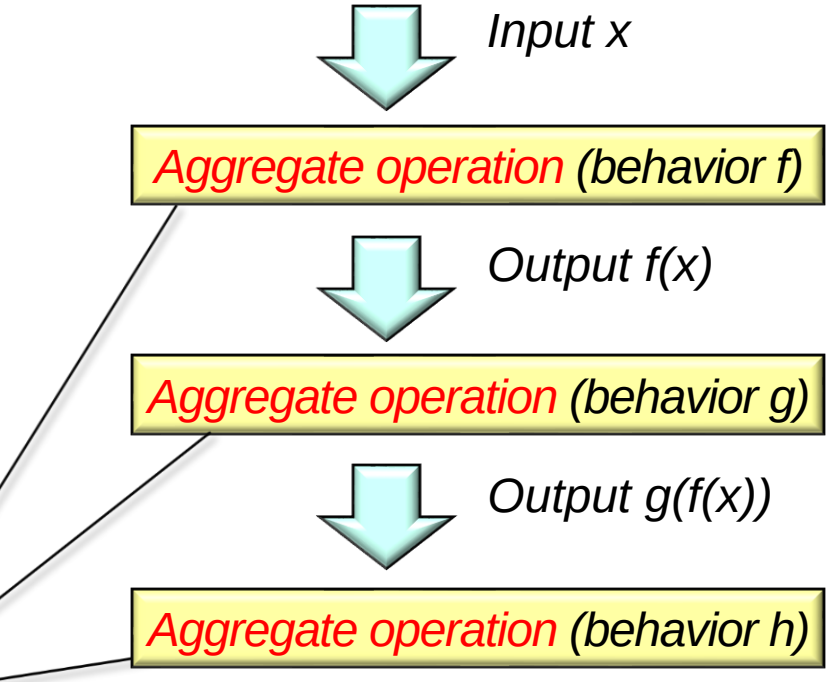

An aggregate operation is a higher-order function that applies a "behavior" param to every element in a stream.

See en.wikipedia.org/wiki/Higher-order_function

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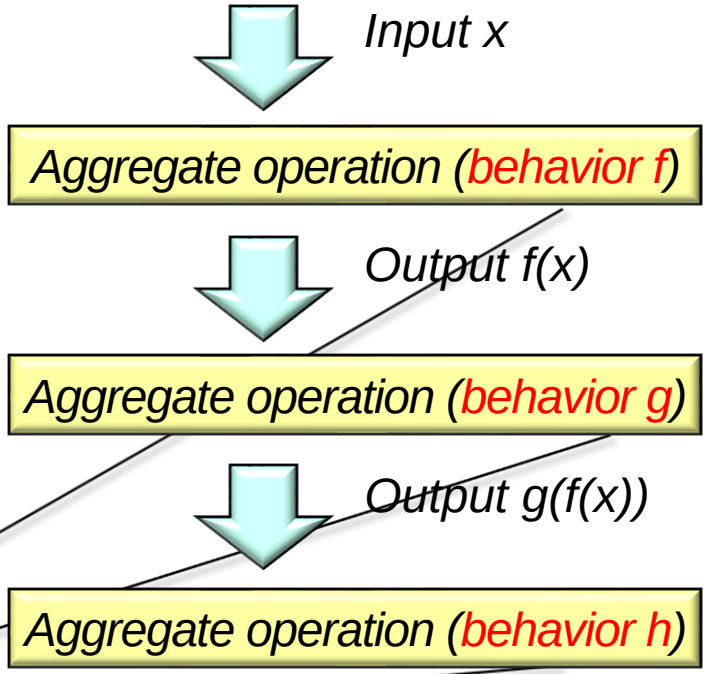

Behavioral parameterization simplifies coping with changing requirements.

See blog.indrek.io/articles/java-8-behavior-parameterization

Overview of Java Streams

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Input x

Aggregate operation (behavior f)

Output f(x)

Aggregate operation (behavior g)

Output g(f(x))

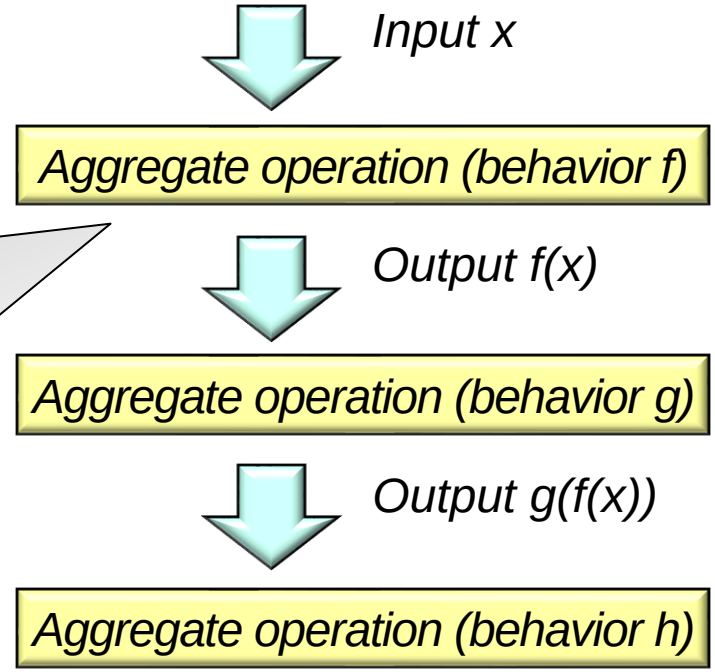
Aggregate operation (behavior h)

A stream is conceptually unbounded, though it's often bounded by practical constraints.

Overview of Java Streams

- We use this stream as a case study example throughout this introduction

```
Stream
   .of("Ophelia","horatio",
       "laertes","Gertrude",
       "Hamlet","fortinbras", ...)
   .filter(s -> toLowerCase
               (s.charAt(0)) == 'h')
   .map(this::capitalize)
   .sorted()
   .forEach(System.out::println);
```



Print each character in Hamlet that starts with 'H' or 'h' in consistently capitalized & sorted order.

See github.com/douglascraigschmidt/LiveLessons/tree/master/Java8/ex12

Benefits of Java Streams

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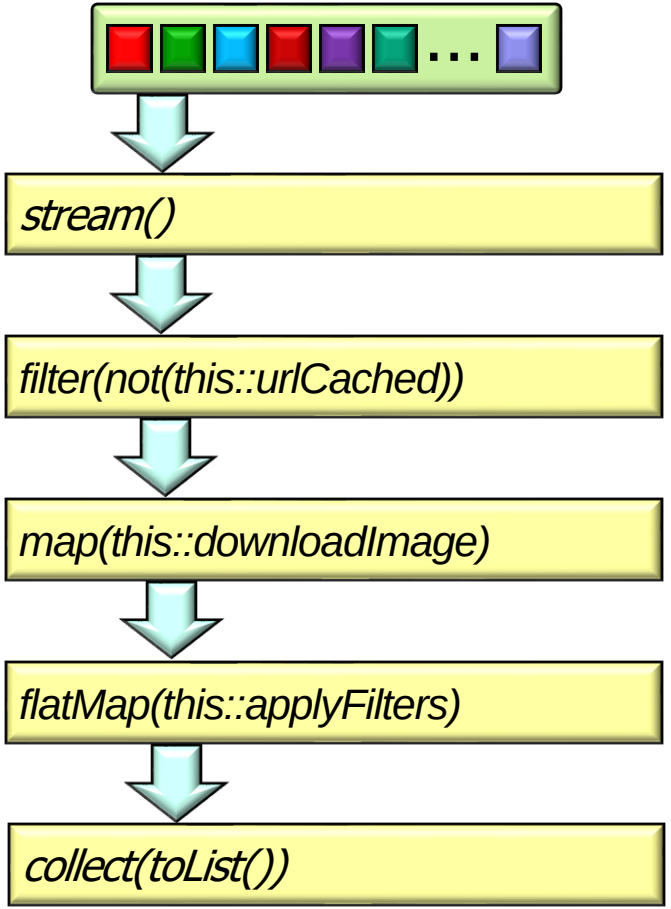
- Java streams provide several key benefits to programs & programmers



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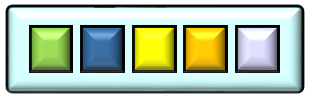
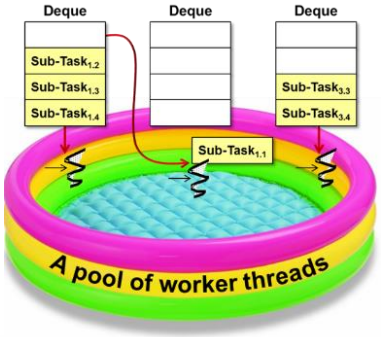
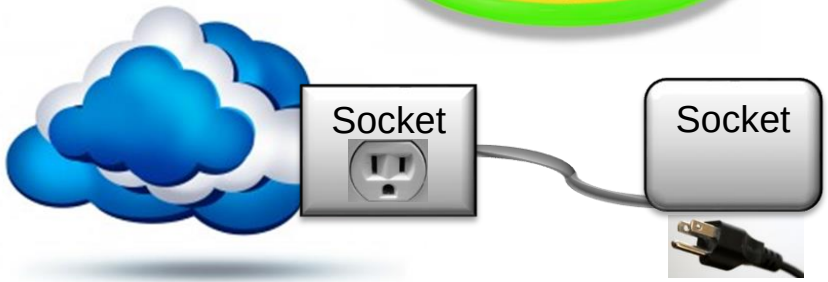
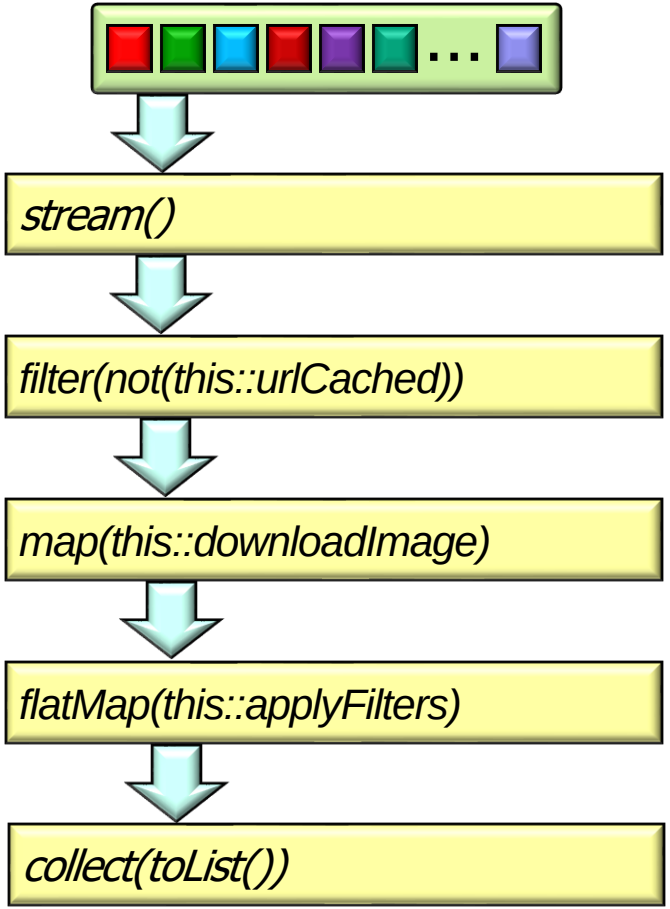




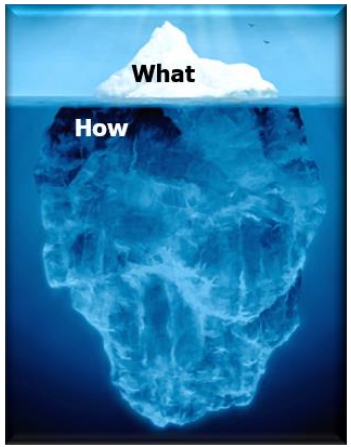


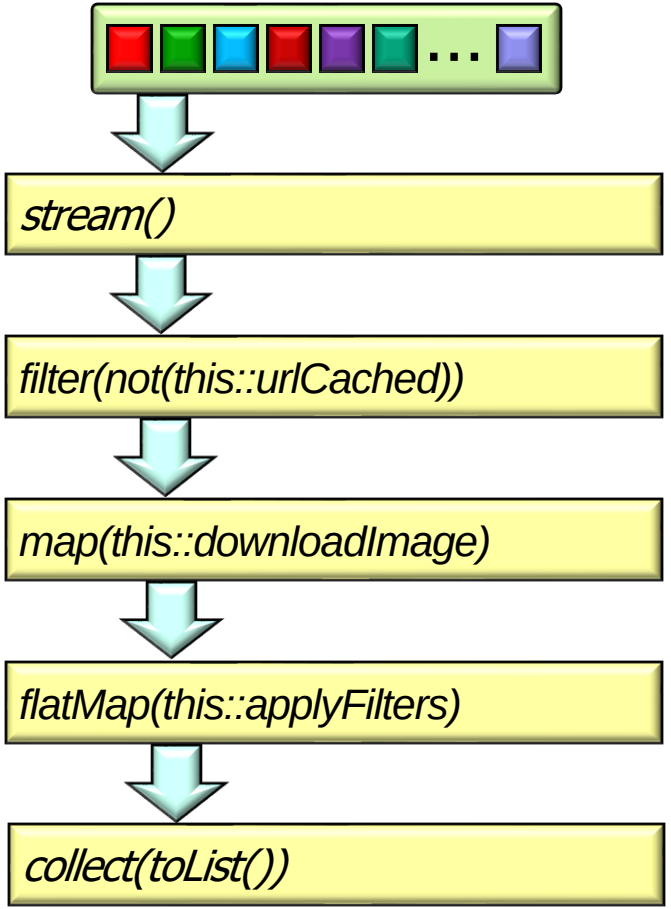


See github.com/douglascraigschmidt/LiveLessons/tree/master/ImageStreamGang

Benefits of Java Streams

- Java streams provide several key benefits to programs & programmers, e.g.
  - **Concise & readable**
    - Declarative paradigm focuses on *what* functions to perform, not *how* to perform them





See en.wikipedia.org/wiki/Declarative_programming

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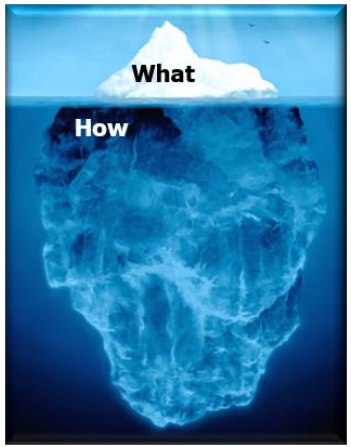
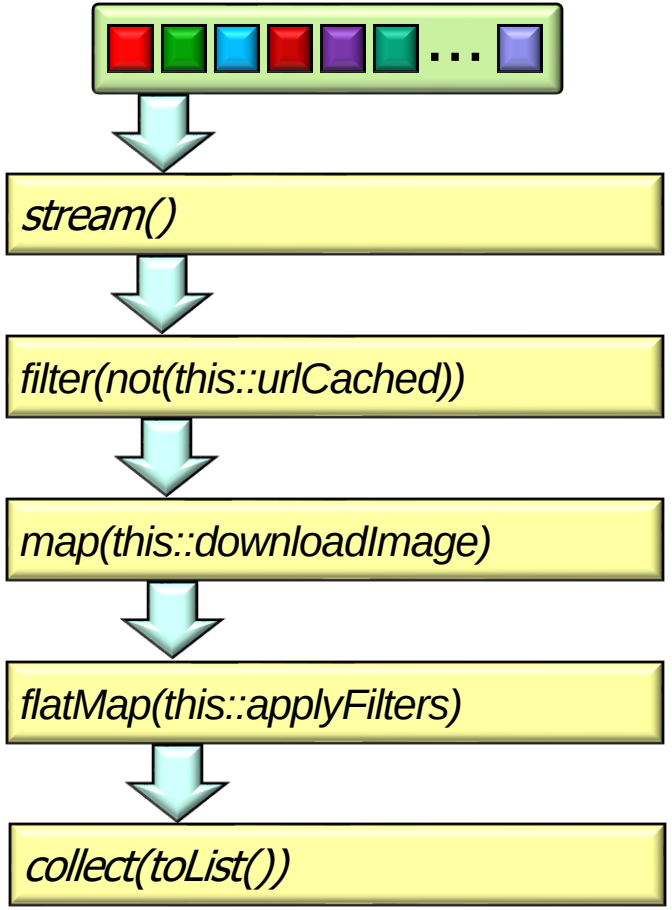


e.g., no Java control-flow operations are applied in this stream



See docs.oracle.com/javase/tutorial/java/nutsandbolts/flow.html

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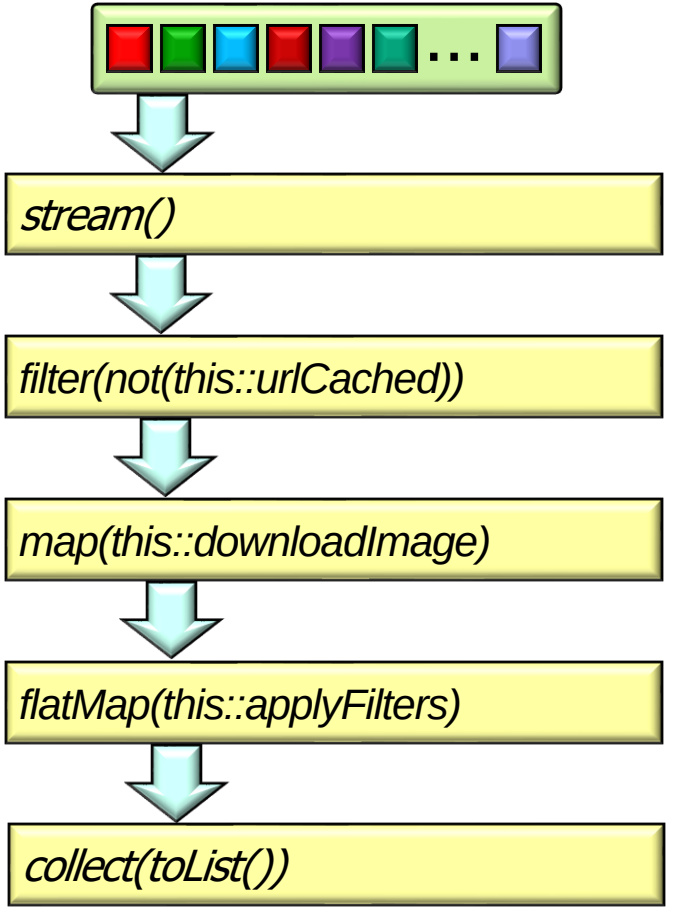
- Java streams provide several key benefits to programs & programmers, e.g.
  - Concise & readable
  - **Flexible & composable**
    - Functions are automatically composed together



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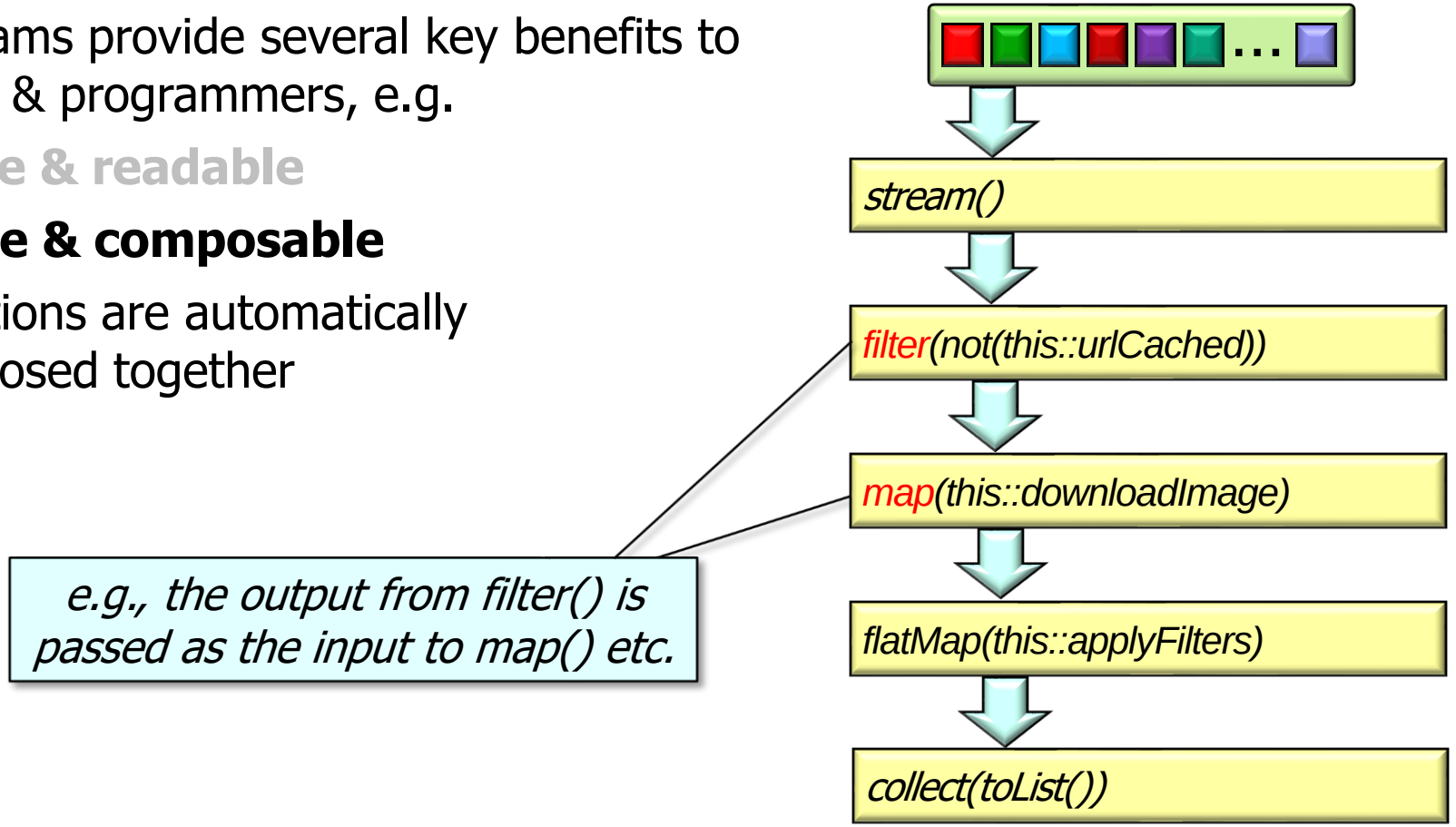

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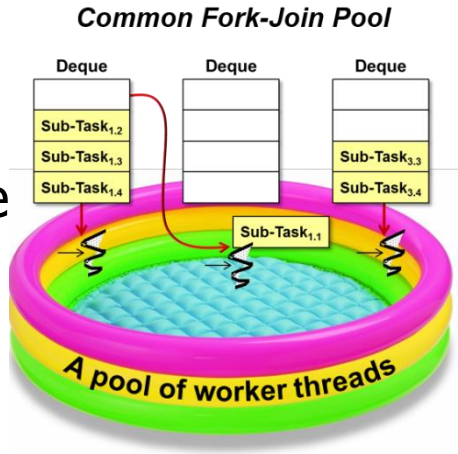
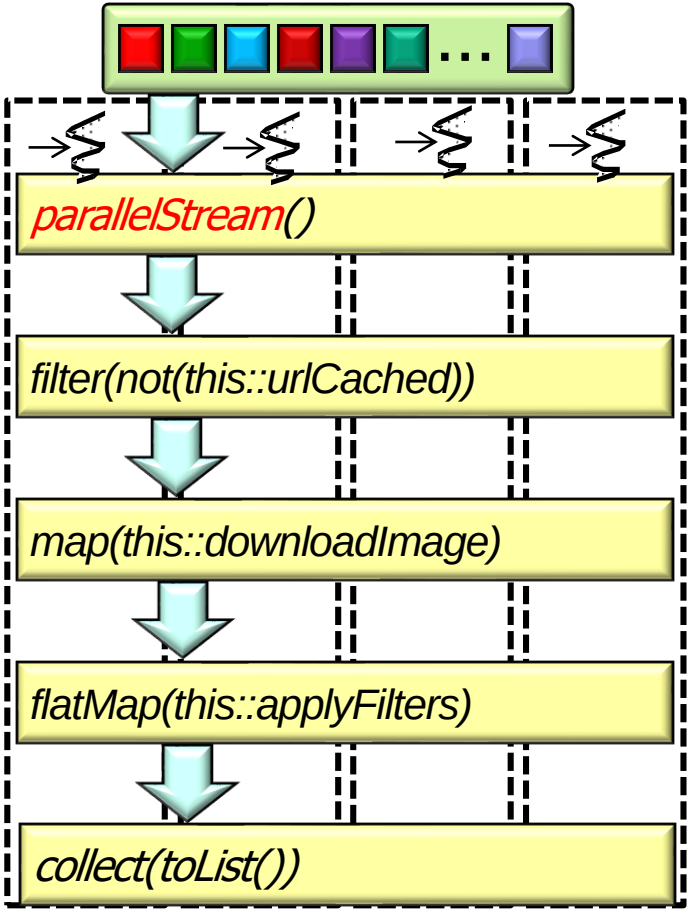
  - **Scalable**
    - Parallelize performance without the need to write any multi-threaded code





See docs.oracle.com/javase/tutorial/collections/streams/parallelism.html

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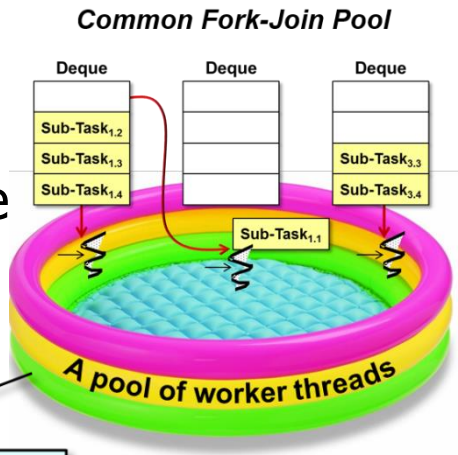
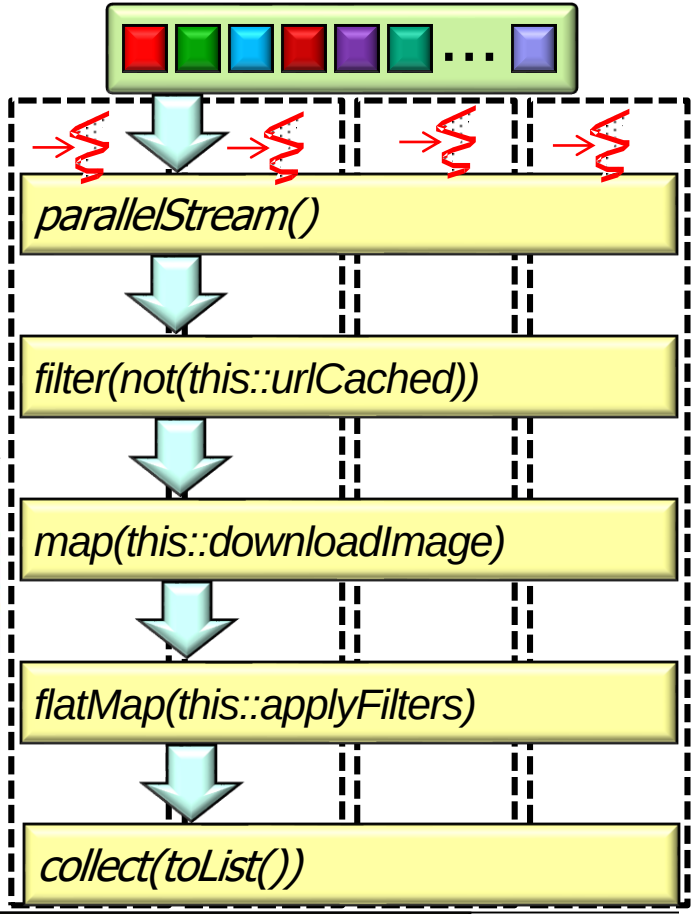


A pool of worker threads is used to process behaviors in parallel



See dzone.com/articles/common-fork-join-pool-and-streams

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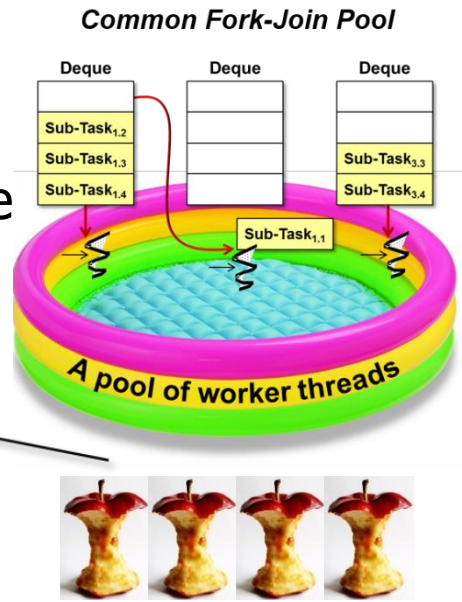
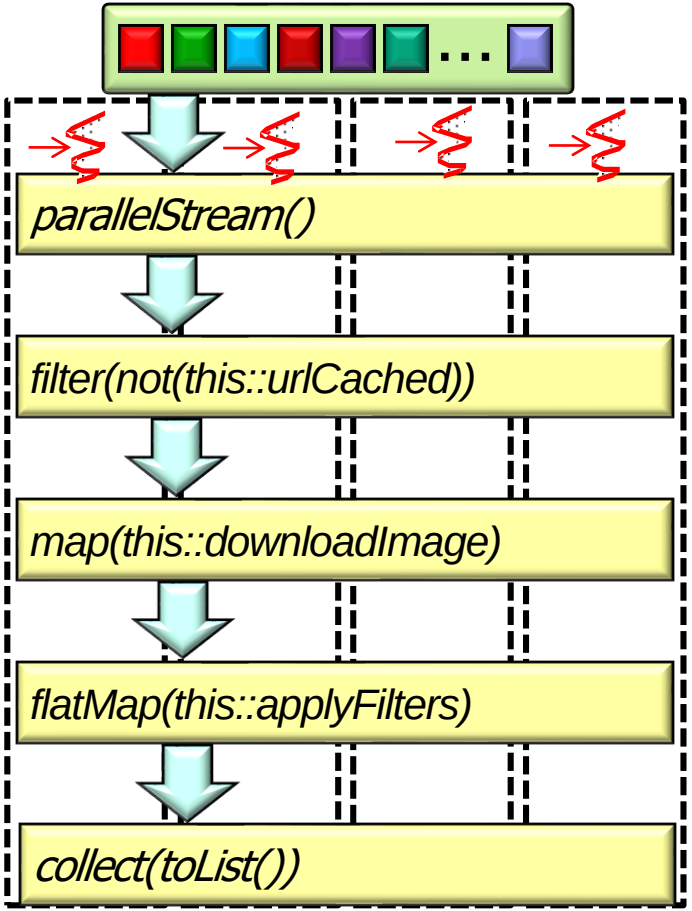


Data mapped automatically to underlying processor cores



See gee.cs.oswego.edu/dl/papers/fj.pdf

End of Java Streams: Overview & Benefits