# Overview of Java Streams


Douglas C. Schmidt
d.schmidt@vanderbilt.edu
www.dre.vanderbilt.edu/~schmidt

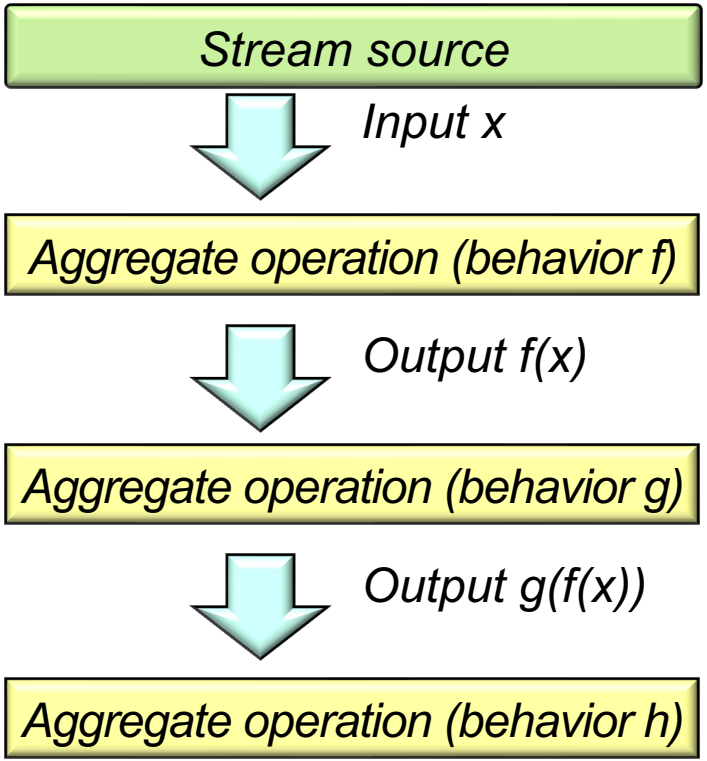
Professor of Computer Science

Institute for Software
Integrated Systems

Vanderbilt University
Nashville, Tennessee, USA

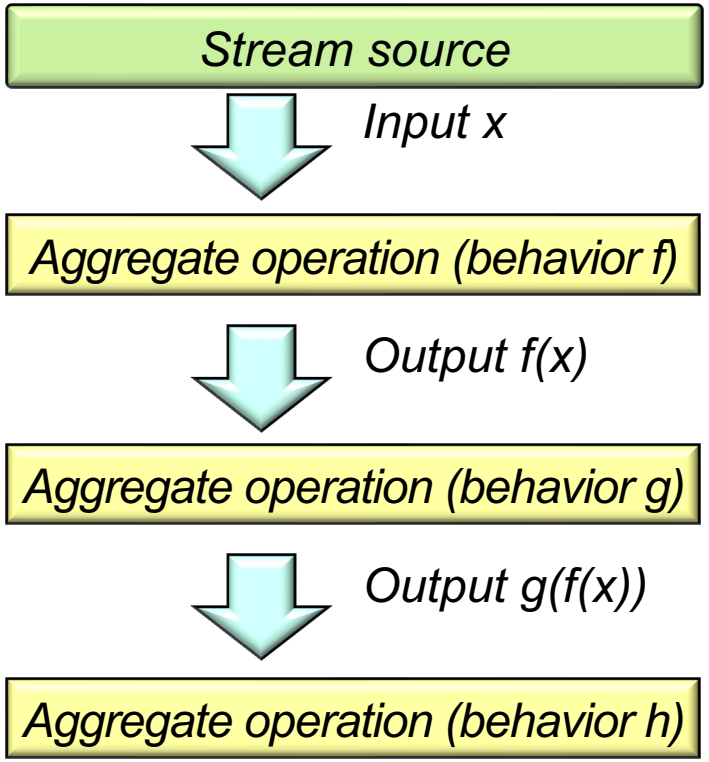

# Learning Objectives in this Part of the Lesson

- Understand Java streams structure & functionality



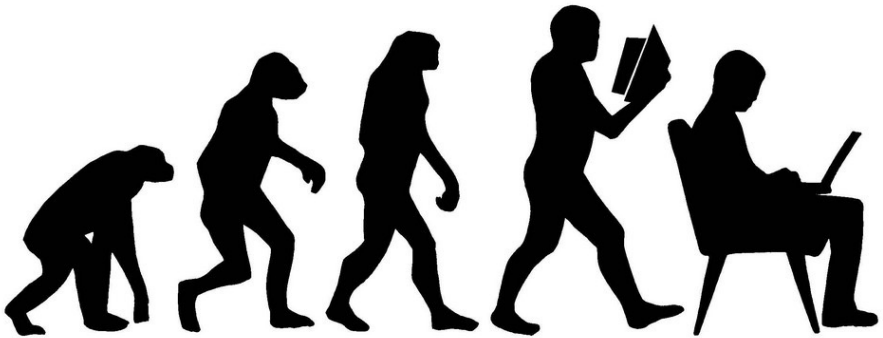
# Learning Objectives in this Part of the Lesson

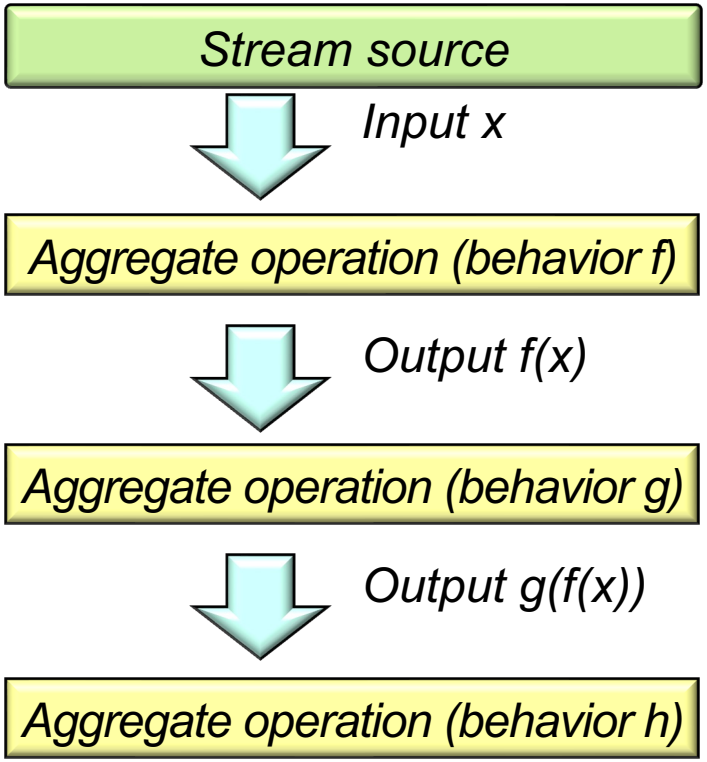
- Understand Java streams structure & functionality, e.g.
  - Fundamentals of streams



# Learning Objectives in this Part of the Lesson

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

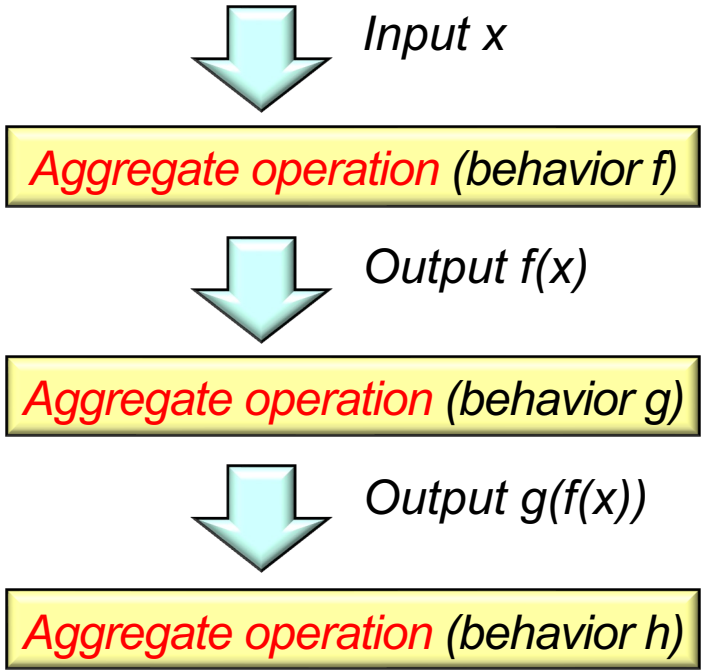
Java Platform, Standard Edition 8 is a major feature release. This document summarizes features and enhancements in Java SE 8 and in JDK 8, Oracle's implementation of Java SE 8. Click the component name for a more detailed description of the enhancements for that component.

- 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

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

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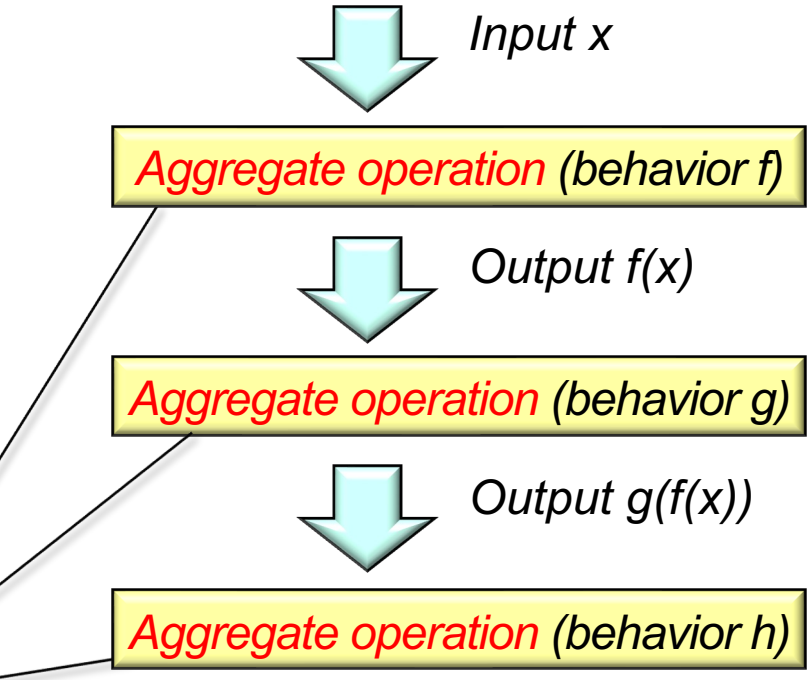


*An aggregate operation is a higher-order function that applies a "behavior" param to every element in a stream.*

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

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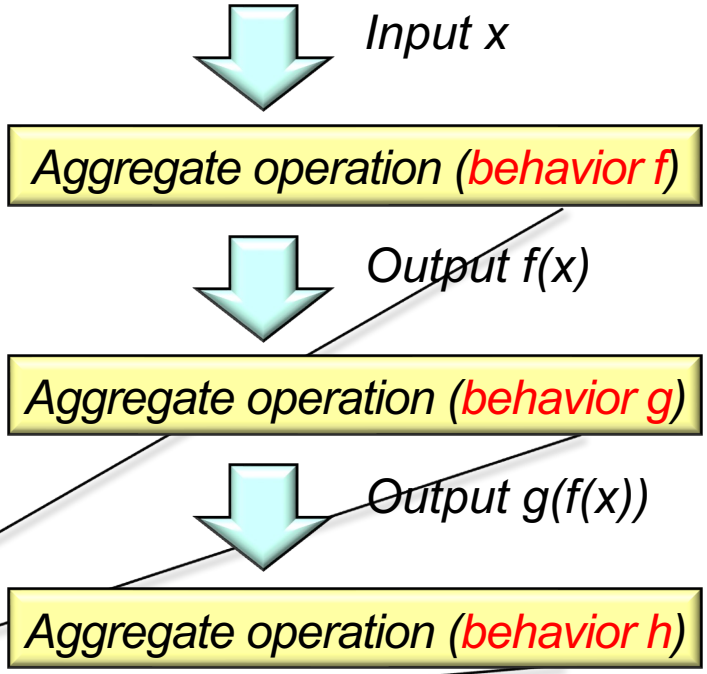


*Behavior parameterization simplifies coping with changing requirements.*

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

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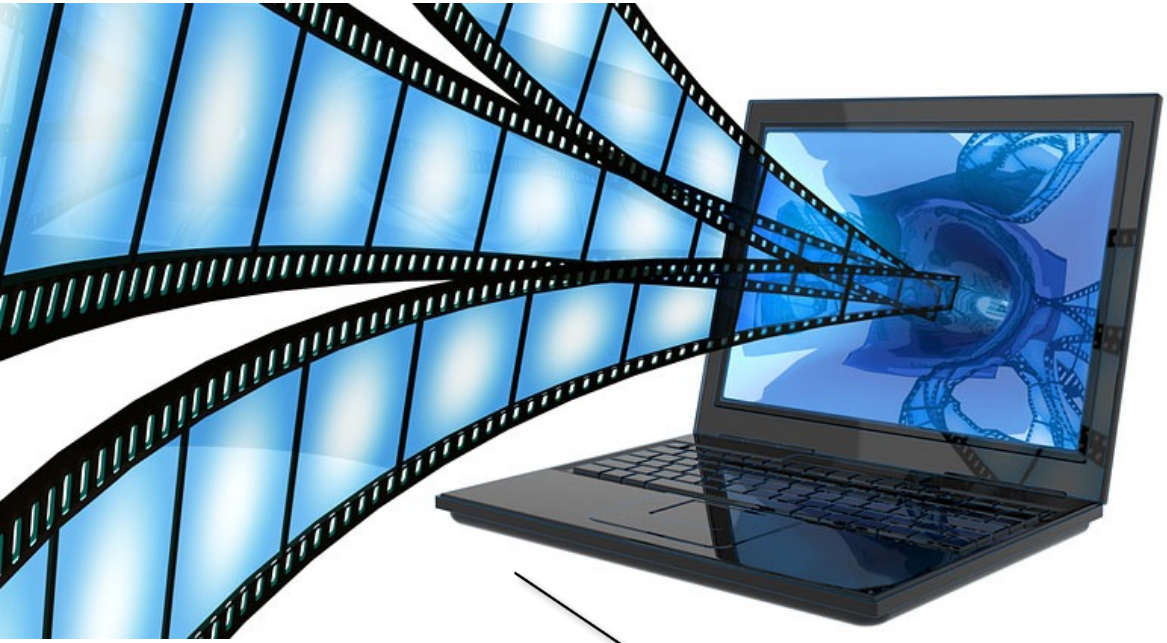


*Input x*

*Aggregate operation (behavior f)*

*Output f(x)*

*Aggregate operation (behavior g)*

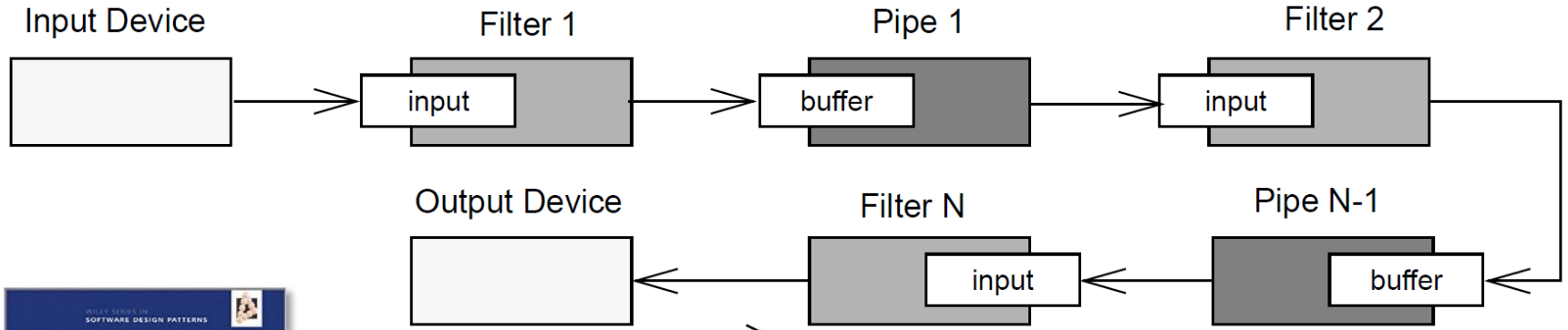
*Output g(f(x))*

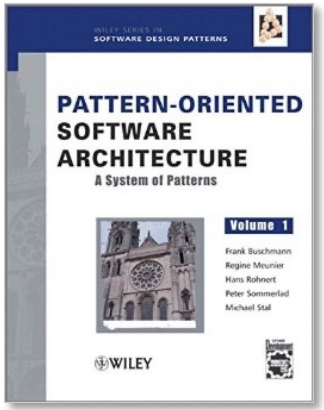
*Aggregate operation (behavior h)*

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

# Overview of Java Streams

- A Java stream is an implementation of the POSA1 *Pipes & Filters* pattern



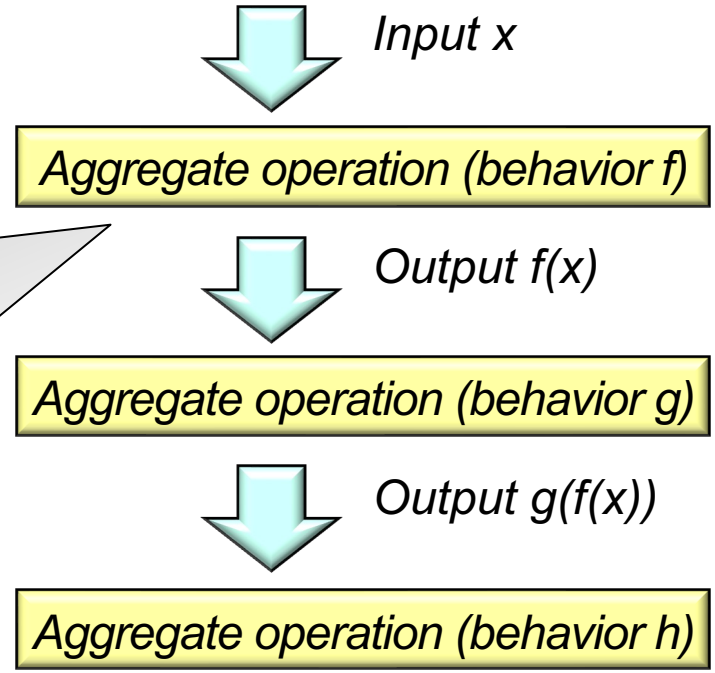

*Divide an app's tasks into multiple self-contained data processing steps & connect these steps via intermediate data buffers to form a data processing pipeline*

See hillside.net/plop/2011/papers/B-10-Hanmer.pdf

# 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);
```



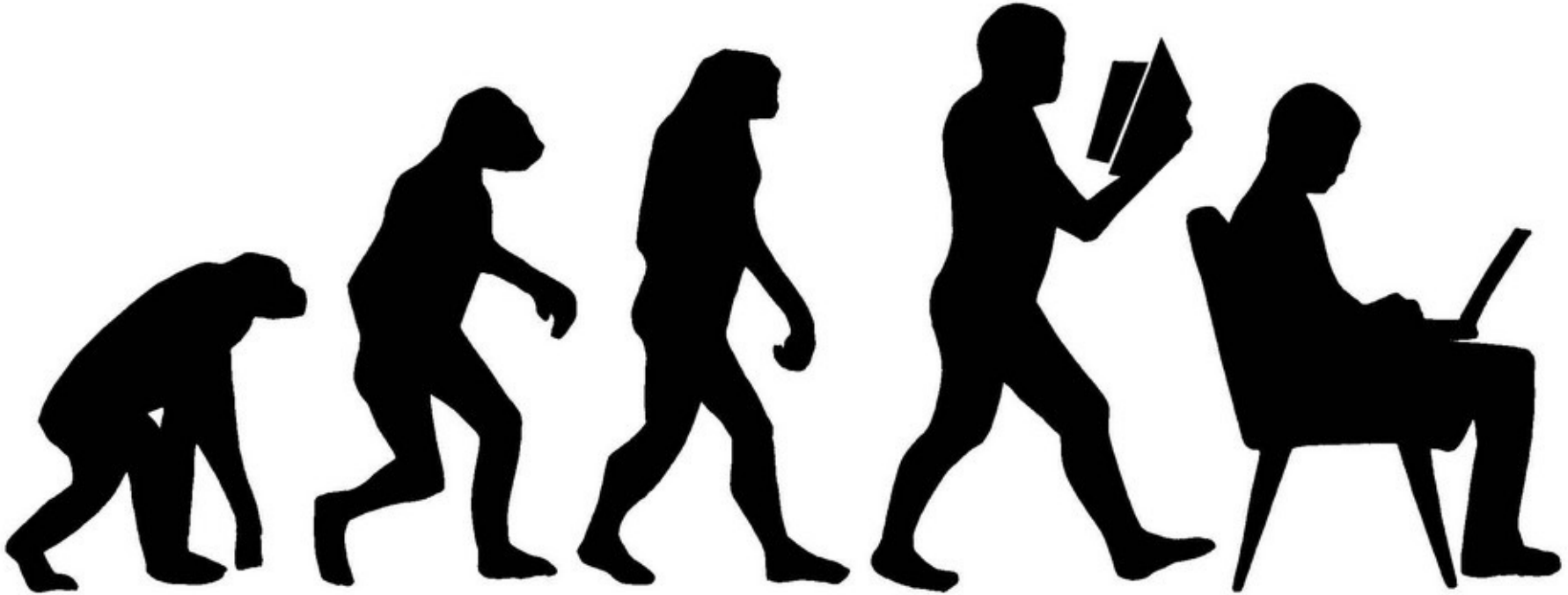

*Print each character in Hamlet that starts with 'H' or 'h' in consistently capitalized & sorted order.*

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

# The Evolution of Java Streams

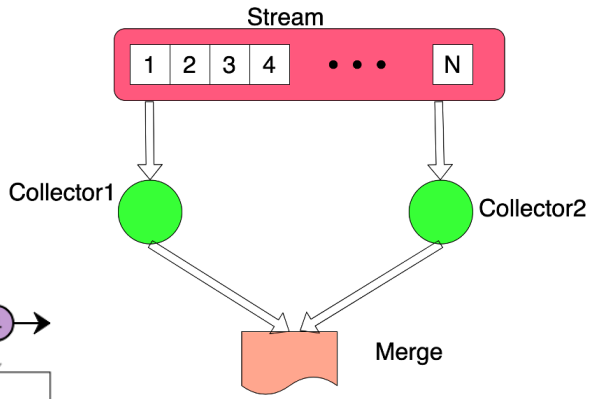
# The Evolution of Java Streams

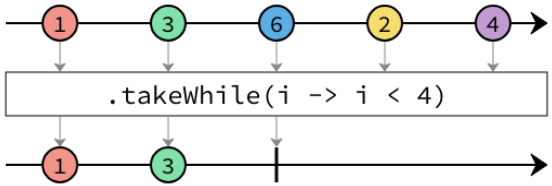
- Java streams have evolved a bit over time

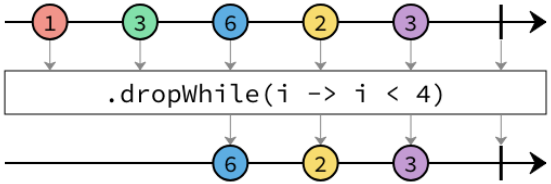


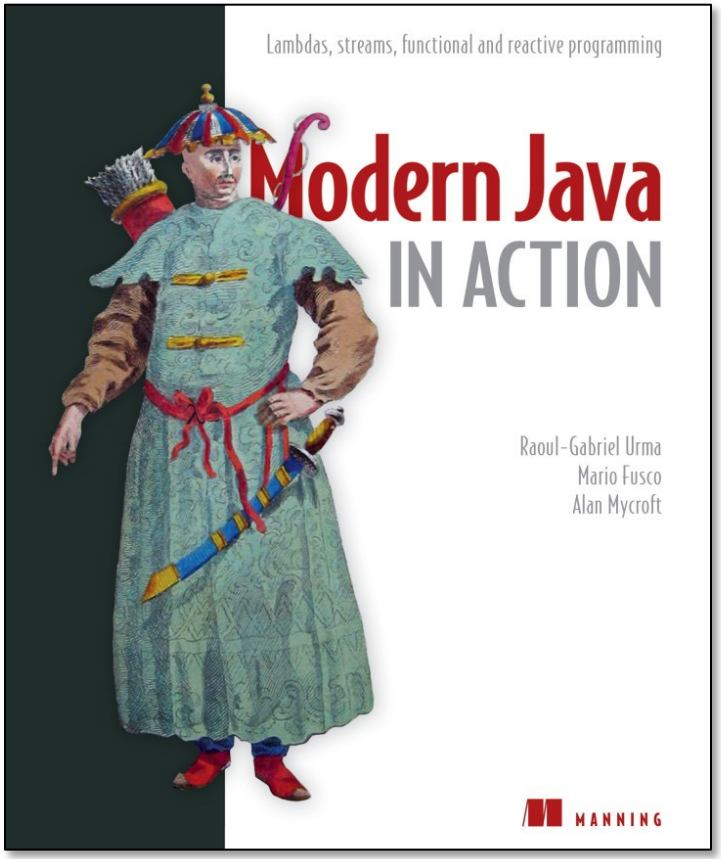
# The Evolution of Java Streams

- Java streams have evolved a bit over time, e.g.
  - Later versions of Java added some new operations




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

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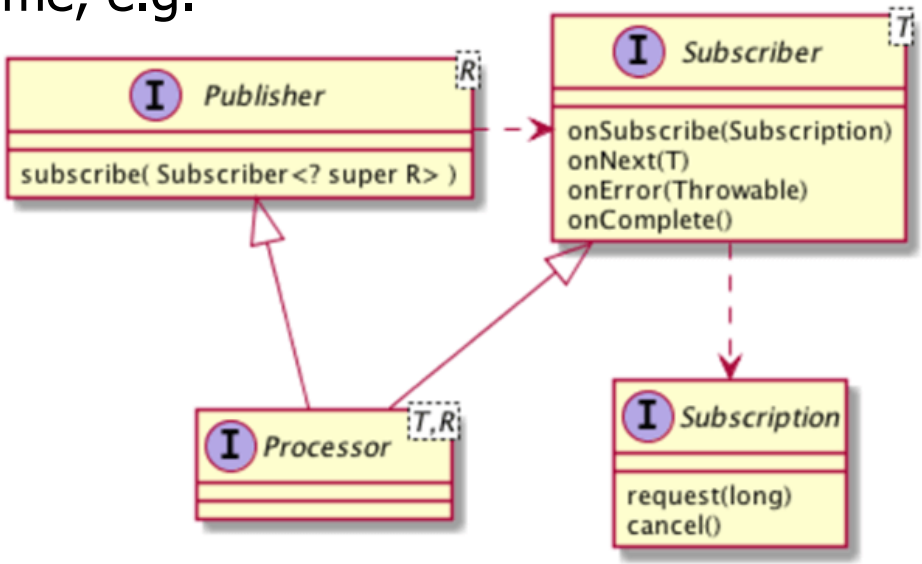
- Java streams have evolved a bit over time, e.g.
  - Later versions of Java added some new operations
  - Java 9 also added a new API that implements the reactive streams specification




See www.reactive-streams.org

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- Java streams have evolved a bit over time, e.g.
  - Later versions of Java added some new operations
  - Java 9 also added a new API that implements the reactive streams specification
    - Reactive streams frameworks are covered later in this course

Project Reactor

See upcoming lessons on RxJava & Project Reactor

# End of Overview of Java Streams