Understanding Java Streams
Common Aggregate Operations

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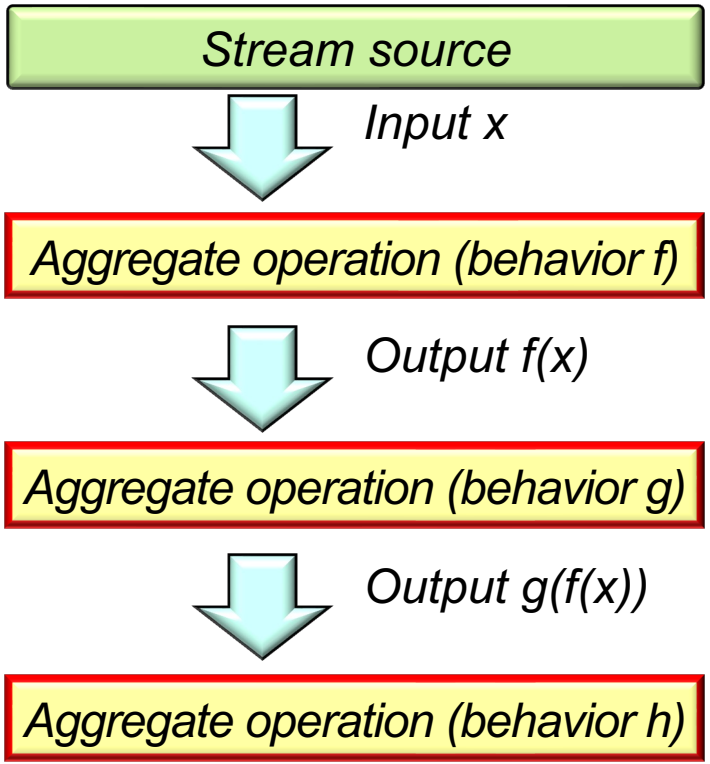
Learning Objectives in this Part of the Lesson

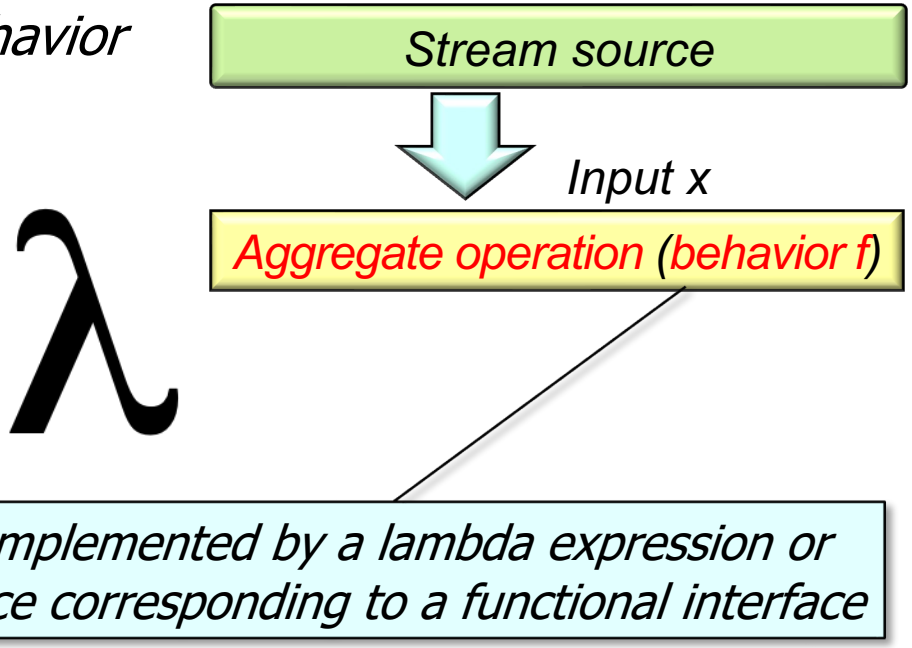
- Understand Java streams structure & functionality, e.g.
  - Fundamentals of streams
  - Three streams phases
  - Operations that create a stream
  - Aggregate operations in a stream



Java Streams
Aggregate Operations

Java Streams Aggregate Operations

- An aggregate operation performs a *behavior* on elements in a stream



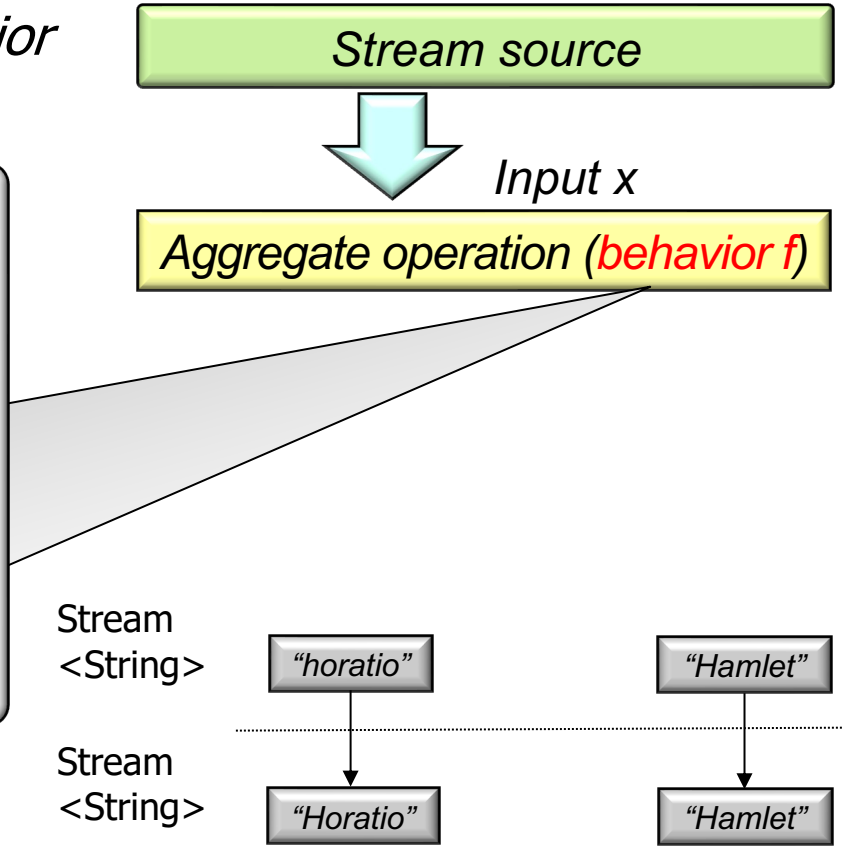
See blog.indrek.io/articles/java-8-behavior-parameterization

Java Streams Aggregate Operations

- An aggregate operation performs a *behavior* on elements in a stream

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

Method reference



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

Java Streams Aggregate Operations

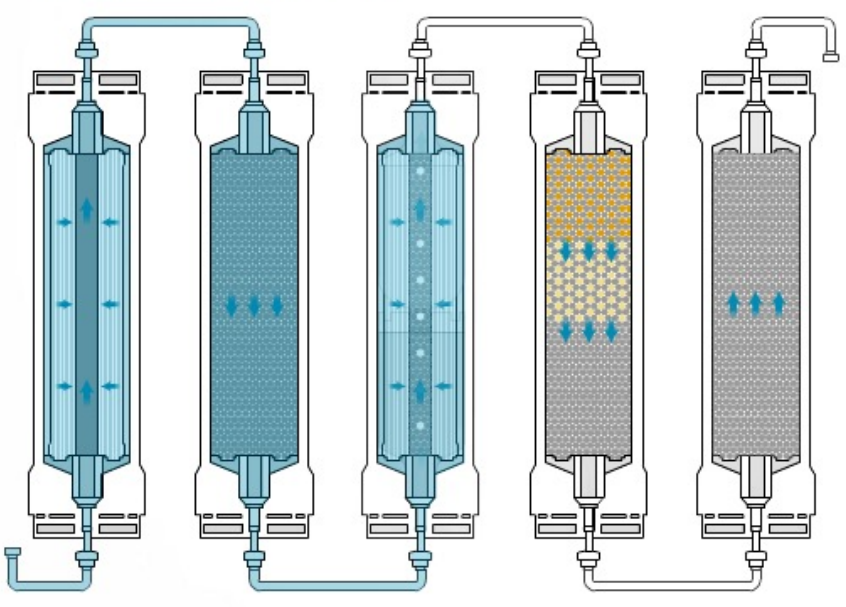
- An aggregate operation performs a *behavior* on elements in a stream
  - Some aggregate operations perform behaviors on all elements in a stream

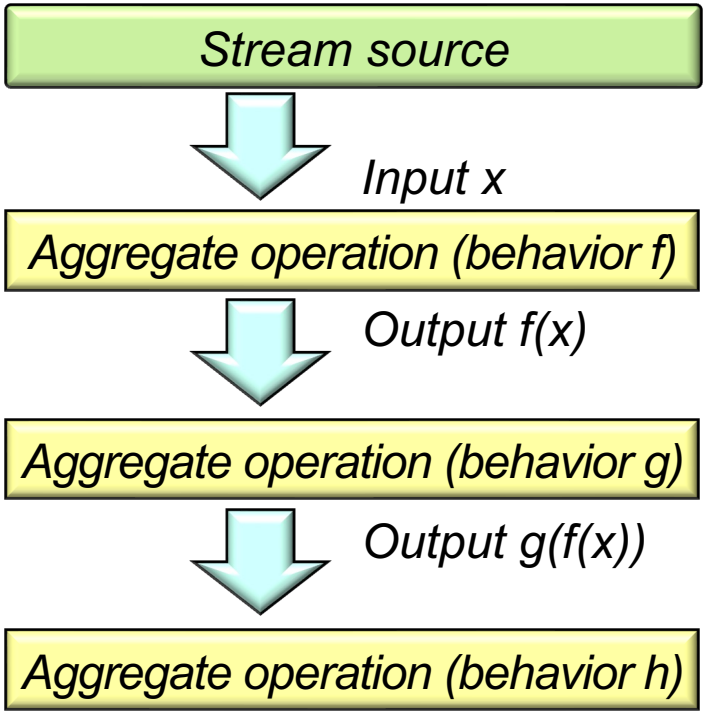
Java Streams Aggregate Operations

- An aggregate operation performs a *behavior* on elements in a stream
  - Some aggregate operations perform behaviors on all elements in a stream
  - Other aggregate operations perform behaviors on some elements in a stream

Java Streams Aggregate Operations

- Aggregate operations can be composed to form a pipeline of processing phases

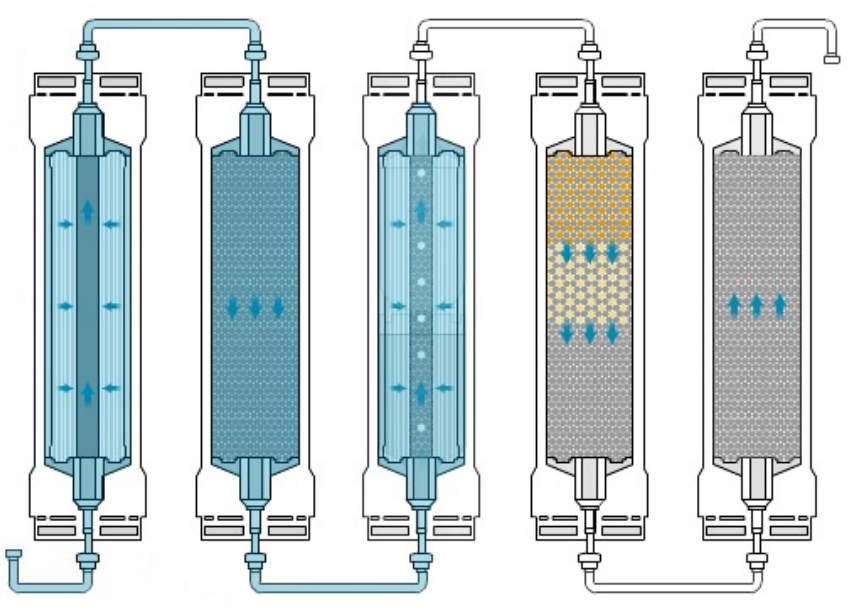


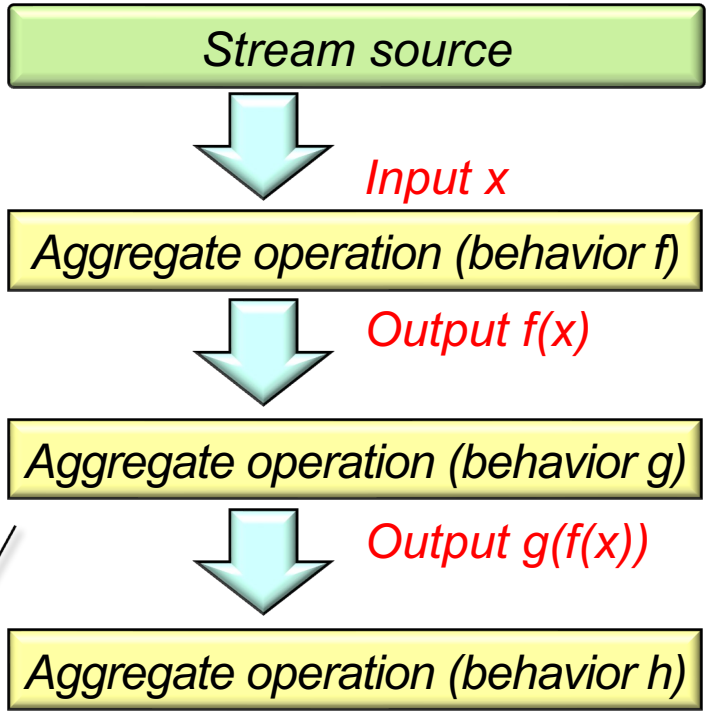


See en.wikipedia.org/wiki/Pipeline_(software)

Java Streams Aggregate Operations

- Aggregate operations can be composed to form a pipeline of processing phases





The output of one aggregate operation can be input into the next one in the stream.

Java Streams Aggregate Operations

- Aggregate operations can be composed to form a pipeline of processing phases

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   .sorted()
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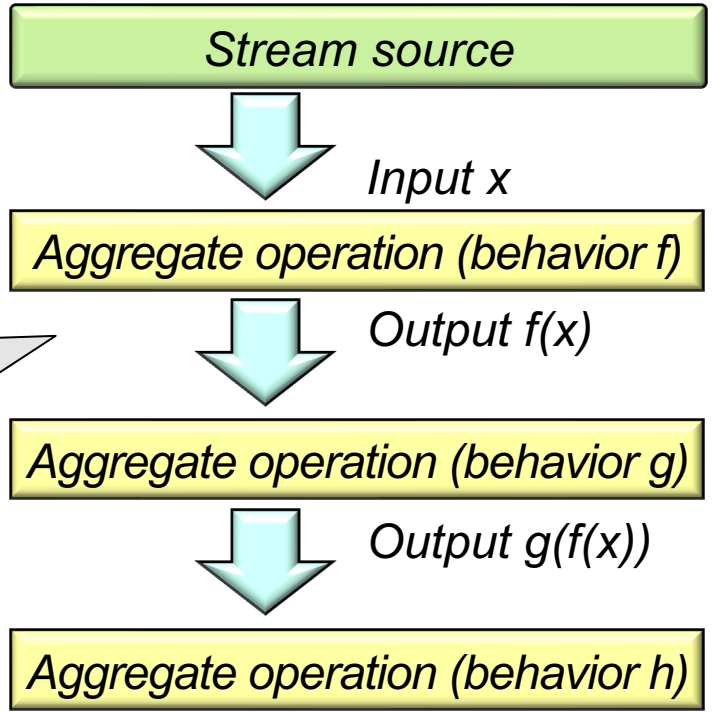

Java streams supports pipelining of aggregate operations via "fluent interfaces".

See en.wikipedia.org/wiki/Fluent_interface

Java Streams Aggregate Operations

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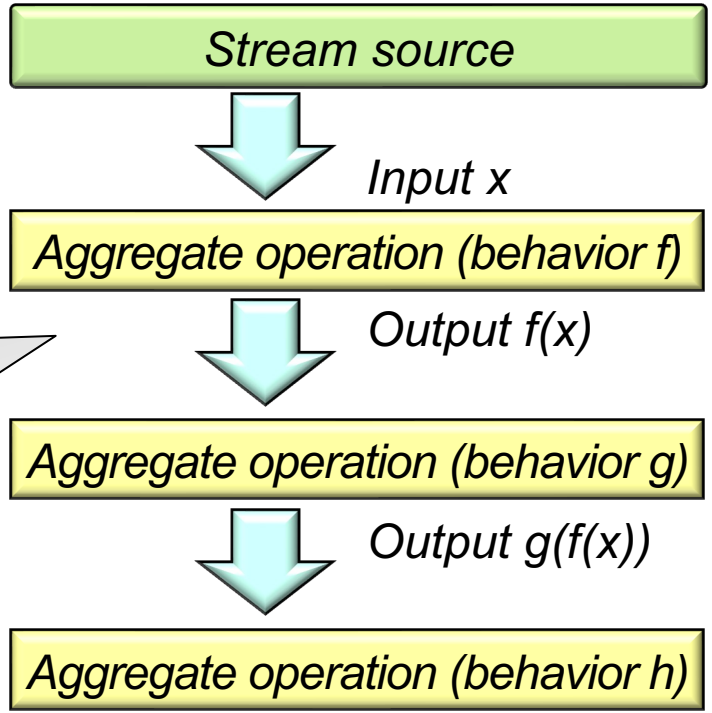

A factory method that creates a stream from an array of elements

See upcoming lessons on "*Stream Creation Operations*"

Java Streams Aggregate Operations

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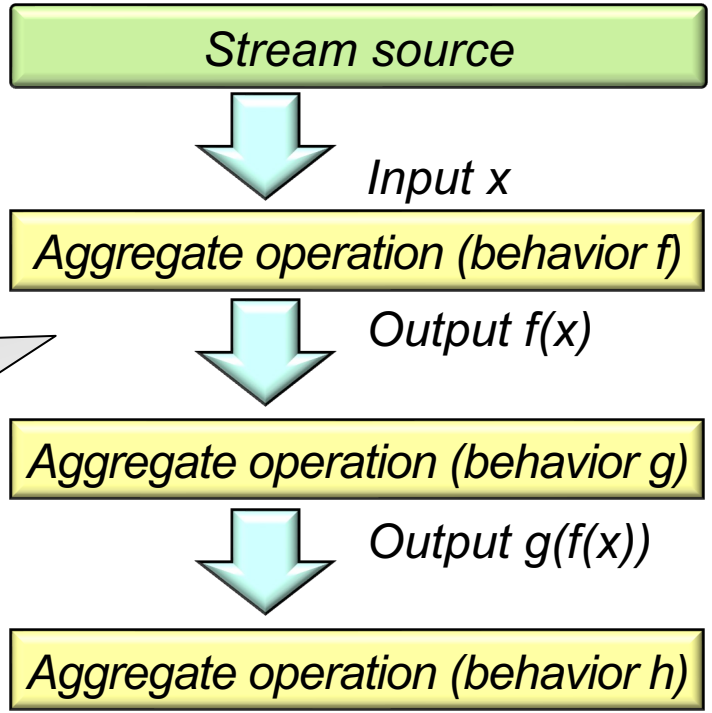

An aggregate operation that returns a stream containing only elements matching the predicate

See upcoming lessons on "*Stream Intermediate Operations*"

Java Streams Aggregate Operations

- Aggregate operations can be composed to form a pipeline of processing phases

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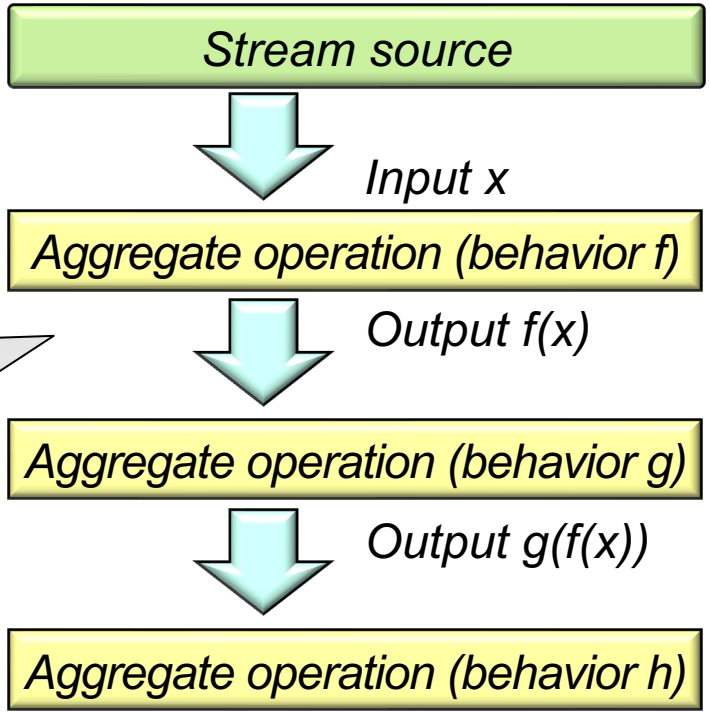

An aggregate operation that returns a stream consisting of results of applying a function to elements of this stream

See upcoming lessons on "*Stream Intermediate Operations*"

Java Streams Aggregate Operations

- Aggregate operations can be composed to form a pipeline of processing phases

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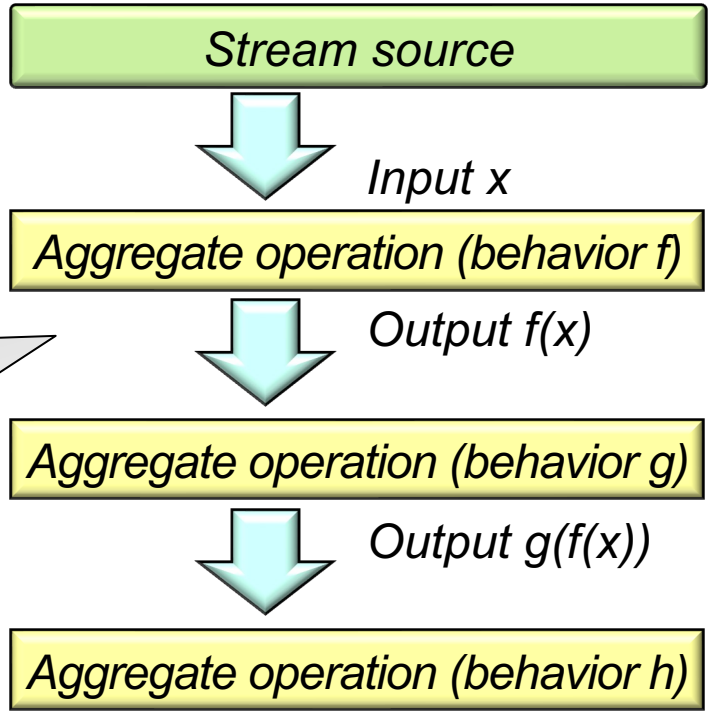

An aggregate operation that returns a stream consisting of results sorted in the natural order

See docs.oracle.com/javase/8/docs/api/java/util/stream/Stream.html#sorted

Java Streams Aggregate Operations

- Aggregate operations can be composed to form a pipeline of processing phases

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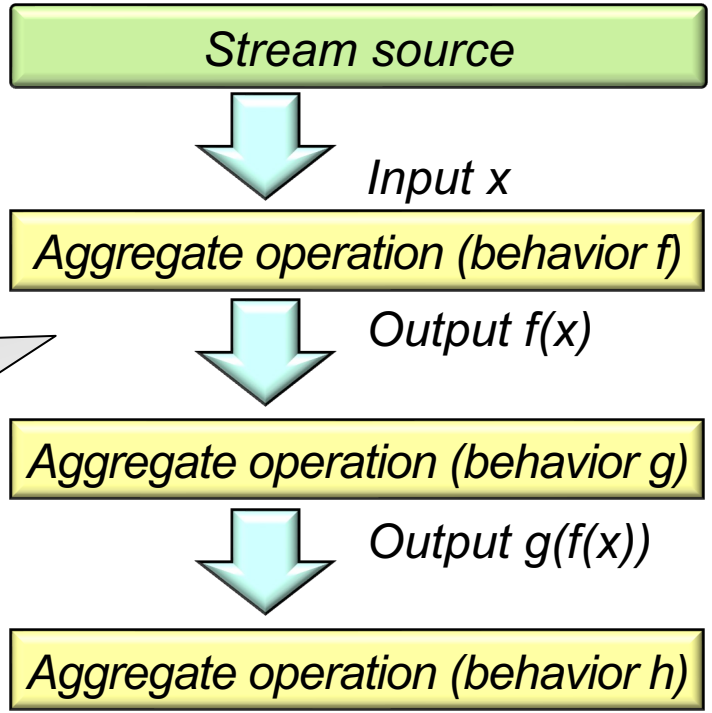

An aggregate operation that performs an action on each element of the stream

See upcoming lessons on "*Stream Terminal Operations*"

Java Streams Aggregate Operations

- Java streams iterate internally (& invisibly) between aggregate operations

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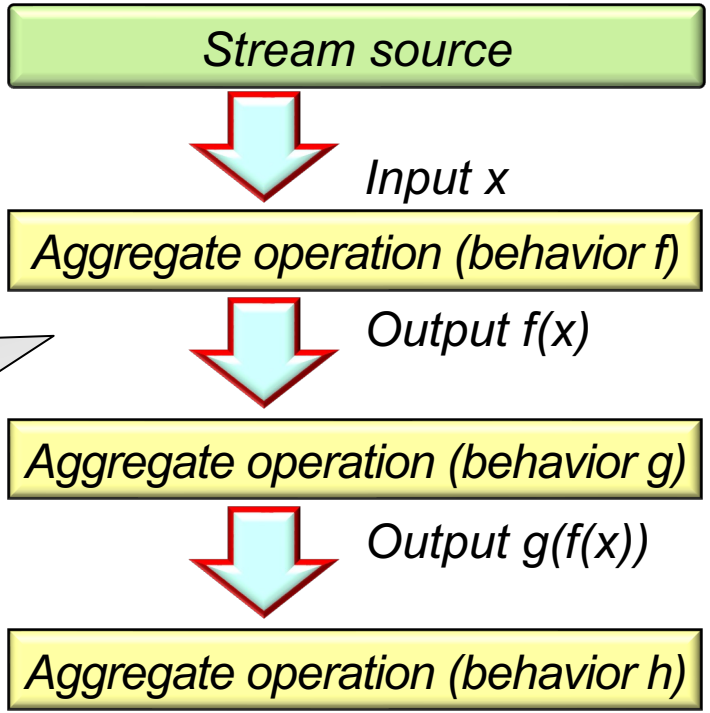

Internal iteration enhances opportunities for transparent optimization & incurs fewer accidental complexities

See www.javabrahman.com/java-8/java-8-internal-iterators-vs-external-iterators

Java Streams Aggregate Operations

- In contrast, collections are iterated explicitly using loops and/or iterators.

```
List<String> l = new LinkedList<>
   (List.of("horatio", "laertes", "Hamlet", ...));

for (int i = 0; i < l.size();)
  if (toLowerCase(l.get(i).charAt(0)) != 'h')
    l.remove(i);
  else {
    l.set(i, capitalize(l.get(i))); i++;
  }

Collections.sort(l);

for (String s : l) System.out.println(s);
```

Explicit control constructs yield more opportunities for accidental complexities & are hard to optimize

See upcoming lessons on "*External vs. Internal Iterators in Java*"

End of Understanding Java Streams Common Aggregate Operations