Java Parallel Streams Internals:
Splitting, Combining, & Pooling

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Learning Objectives in this Part of the Lesson

- Understand parallel stream internals, e.g.
- Know what can change & what can’t
- Splitting, combining, & pooling mechanisms

```java
public interface ManagedBlocker {
    boolean block() throws InterruptedException;
    boolean isReleasable();
}
```

```java
public interface Spliterator<T> {
    boolean tryAdvance(Consumer<? super T> action);
    Spliterator<T> trySplit();
    long estimateSize();
    int characteristics();
}
```

```java
final class Collectors {
    ...
    public static <T> Collector<T, ?, List<T>> toList() { ... }

    public static <T> Collector<T, ?, Set<T>> toSet() { ... }
    ...
}
```

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```
Parallel Stream Splitting, Combining, & Pooling Mechanisms
Parallel Stream Splitting, Combining, & Pooling Mechanisms

- A parallel stream’s splitting, combining & pooling mechanisms are often invisible

Stream factory operation ()

Input $x$

Intermediate operation (behavior $f$)

Output $f(x)$

Intermediate operation (behavior $g$)

Output $g(f(x))$

Terminal operation (behavior $h$)
- A parallel stream’s splitting, combining, & pooling mechanisms are often invisible
- All Java collections have predefined spliterators that create parallel streams

```java
interface Collection<E> {
    ...
    default Spliterator<E> spliterator() {
        return Spliterators.spliterator(this, 0);
    }

    default Stream<E> parallelStream() {
        return StreamSupport.stream(spliterator(), true);
    }
    ...
}
```

See [docs.oracle.com/javase/8/docs/api/java/util/Collection.html](http://docs.oracle.com/javase/8/docs/api/java/util/Collection.html)
Parallel Stream Splitting, Combining, & Pooling Mechanisms

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See [docs.oracle.com/javase/8/docs/api/java/util/Spliterator.html](docs.oracle.com/javase/8/docs/api/java/util/Spliterator.html)
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    ...
}
```

See [blog.logentries.com/2015/10/java-8-introduction-to-parallelism-and-spliterator](blog.logentries.com/2015/10/java-8-introduction-to-parallelism-and-spliterator)
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Java also predefines collector factory methods in the Collectors utility class

```
final class Collectors {
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        toList() { ... }
    public static <T> Collector<T, ?, Set<T>>
        toSet() { ... }
    ...
}
```

See docs.oracle.com/javase/8/docs/api/java/util/stream/Collectors.html
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```

These non-concurrent collectors can work seamlessly with parallel streams
A parallel stream’s splitting, combining, & pooling mechanisms are often invisible

- All Java collections have predefined spliterators that create parallel streams
- Java also predefines collector factory methods in the Collectors utility class
- The common fork-join pool is used to run intermediate operations on chunks of data

See www.baeldung.com/java-fork-join
Parallel Stream Splitting, Combining, & Pooling Mechanisms

• However, parallel streams programmers can also customize these mechanisms

See upcoming lessons on "Java Parallel Stream Internals"
• However, parallel streams programmers can also customize these mechanisms

interface Spliterator<T> {
    boolean tryAdvance
        (Consumer<? Super T> action);
    Spliterator<T> trySplit();
    void forEachRemaining
        (Consumer<? Super T> action);
    long estimateSize();
    int characteristics();
}

An interface used to traverse & partition elements of a source.

See docs.oracle.com/javase/8/docs/api/java/util/Spliterator.html
Parallel Stream Splitting, Combining, & Pooling Mechanisms

- However, parallel streams programmers can also customize these mechanisms

```
interface Spliterator<T> {
    boolean tryAdvance
        (Consumer<? Super T> action);
    Spliterator<T> trySplit();
    void forEachRemaining
        (Consumer<? Super T> action);
    long estimateSize();
    int characteristics();
}
```

The streams framework uses this method to process elements in sequential and parallel streams.

See earlier lesson on “Java Streams: Applying Spliterators”
Parallel Stream Splitting, Combining, & Pooling Mechanisms

• However, parallel streams programmers can also customize these mechanisms

```java
interface Spliterator<T> {
    boolean tryAdvance
        (Consumer<? Super T> action);
    Spliterator<T> trySplit();
    void forEachRemaining
        (Consumer<? Super T> action);
    long estimateSize();
    int characteristics();
}
```

The streams framework uses this method to partition elements in a parallel stream.

See upcoming lesson on “Java Parallel Streams Internals: Partitioning”
Parallel Stream Splitting, Combining, & Pooling Mechanisms

- However, parallel streams programmers can also customize these mechanisms

interface Collector<T,A,R> {
    Supplier<A> supplier();
    BiConsumer<A, T> accumulator();
    BinaryOperator<A> combiner();
    Function<A, R> finisher();
    Set<Collector.Characteristics> characteristics();
    ...
}

A framework that accumulates input elements into a concurrent and/or non-concurrent mutable result containers.

See docs.oracle.com/javase/8/docs/api/java/util/stream/Collector.html
Parallel Stream Splitting, Combining, & Pooling Mechanisms

- However, parallel streams programmers can also customize these mechanisms

```java
public interface ManagedBlocker {
    boolean block() throws InterruptedException;
    boolean isReleasable();
}
```

This interface provides managed parallelism for tasks running in the common fork-join pool.

End of Java Parallel Stream Internals: Splitting, Combining, & Pooling