Understand Java Parallel Streams Internals:
Combining Results (Part 1)

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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
  - Partition a data source into “chunks”
  - Process chunks in parallel via the common fork-join pool
  - Configure the Java parallel stream common fork-join pool
- Perform a reduction to combine partial results into a single result

See developer.ibm.com/languages/java/articles/j-java-streams-3-brian-goetz
Combining Results in a Parallel Stream
Combining Results in a Parallel Stream

- After the common fork-join pool finishes processing chunks their partial results are combined into a final result.

This discussion assumes a non-concurrent collector (other discussions follow).
Combining Results in a Parallel Stream

• After the common fork-join pool finishes processing chunks their partial results are combined into a final result
  • join() occurs in a single thread at each level
    • i.e., the “parent”
Combining Results in a Parallel Stream

- After the common fork-join pool finishes processing chunks their partial results are combined into a final result.
- `join()` occurs in a single thread at each level.
  - i.e., the “parent”

As a result, there’s typically no need for synchronizers during the joining.
Combining Results in a Parallel Stream

- Different terminal operations combine partial results in different ways.

Understanding these differences is particularly important for parallel streams.
Combining Results in a Parallel Stream

- Different terminal operations combine partial results in different ways, e.g.
  - reduce() creates a new immutable value

See docs.oracle.com/javase/tutorial/essential/concurrency/immutable.html
Combining Results in a Parallel Stream

- Different terminal operations combine partial results in different ways, e.g.
  - `reduce()` creates a new immutable value

```java
long factorial(long n) {
    return LongStream.
        rangeClosed(1, n)
        .parallel()
        .reduce(1, (a, b) -> a * b,
                 (a, b) -> a * b);
}
```

Combining Results in a Parallel Stream

- Different terminal operations combine partial results in different ways, e.g.
  - `reduce()` creates a new immutable value

```
long factorial(long n) {
    return LongStream.rangeClosed(1, n)
        .parallel()
        .reduce(1, (a, b) -> a * b);
}
```

See [github.com/douglascraigtschmidt/LiveLessons/tree/master/Java8/ex16](github.com/douglascraigtschmidt/LiveLessons/tree/master/Java8/ex16)
Combining Results in a Parallel Stream

• Different terminal operations combine partial results in different ways, e.g.
  • reduce() creates a new immutable value

```java
long factorial(long n) {
    return LongStream
        .rangeClosed(1, n)
        .parallel()
        .reduce(1, (a, b) -> a * b);
}
```

reduce() combines two immutable values (e.g., long) & produces a new one
Combining Results in a Parallel Stream

- Different terminal operations combine partial results in different ways, e.g.
  - `reduce()` creates a new immutable value
  - `collect()` mutates an existing value

See greenteapress.com/thinkapjava/html/thinkjava011.html
Combining Results in a Parallel Stream

- Different terminal operations combine partial results in different ways, e.g.
  - `reduce()` creates a new immutable value
  - `collect()` mutates an existing value

```
Set<CharSequence> uniqueWords =
   getInput(sSHAKESPEARE, "\s+")
   .parallelStream()
   ...
   .collect(toCollection(TreeSet::new));

See github.com/douglascraigschmidt/LiveLessons/tree/master/Java8/ex14
```
Combining Results in a Parallel Stream

• Different terminal operations combine partial results in different ways, e.g.
  • `reduce()` creates a new immutable value
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```java
Set<CharSequence> uniqueWords = getInput(sSHAKESPEARE, "\"s+")
    .parallelStream()
    ...
    .collect(toCollection(TreeSet::new));
```

`collect()` mutates a container to accumulate the result it’s producing
Combining Results in a Parallel Stream

- Different terminal operations combine partial results in different ways, e.g.
  - `reduce()` creates a new immutable value
  - `collect()` mutates an existing value

```java
Set<CharSequence> uniqueWords =
    getInput(sSHAKESPEARE, "\s+")
    .parallelStream()
    ...
    .collect(ConcurrentHashSetCollector.toSet());
```

Concurrent collectors (covered later) are different than non-concurrent collectors
End of Understand Java
Parallel Streams Internals: Combining Results (Part 1)