Java Parallel Stream Internals: Combining Results (Part 1)

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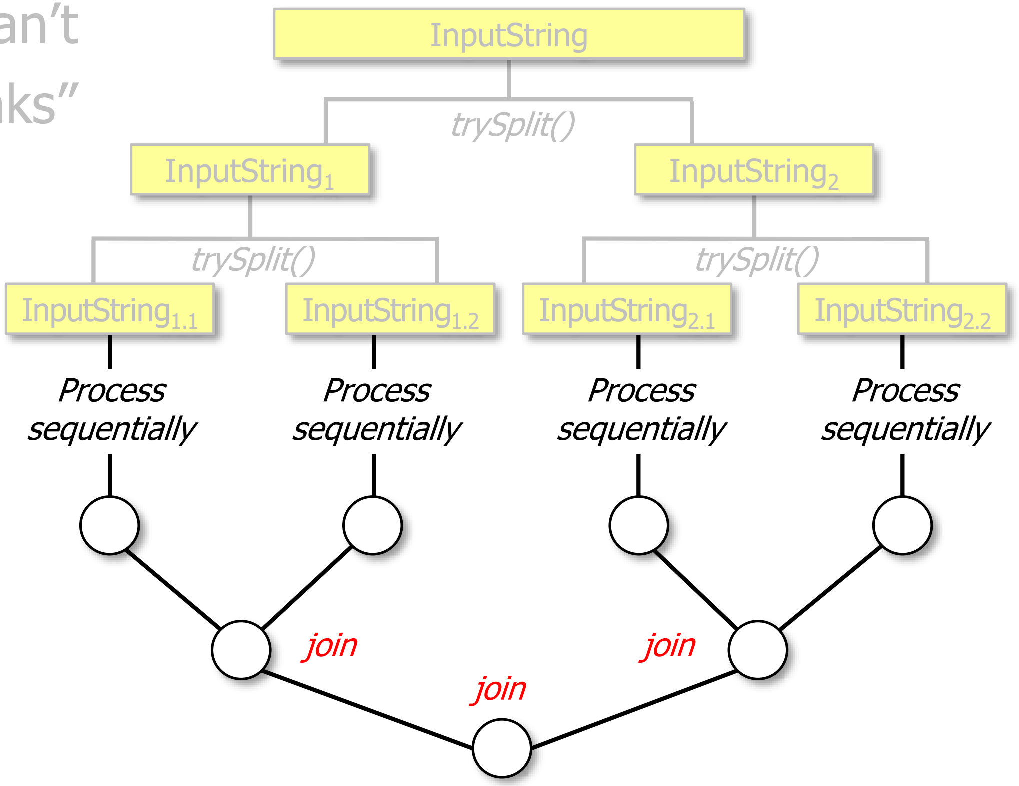
Learning Objectives in this Part of the Lesson

- 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

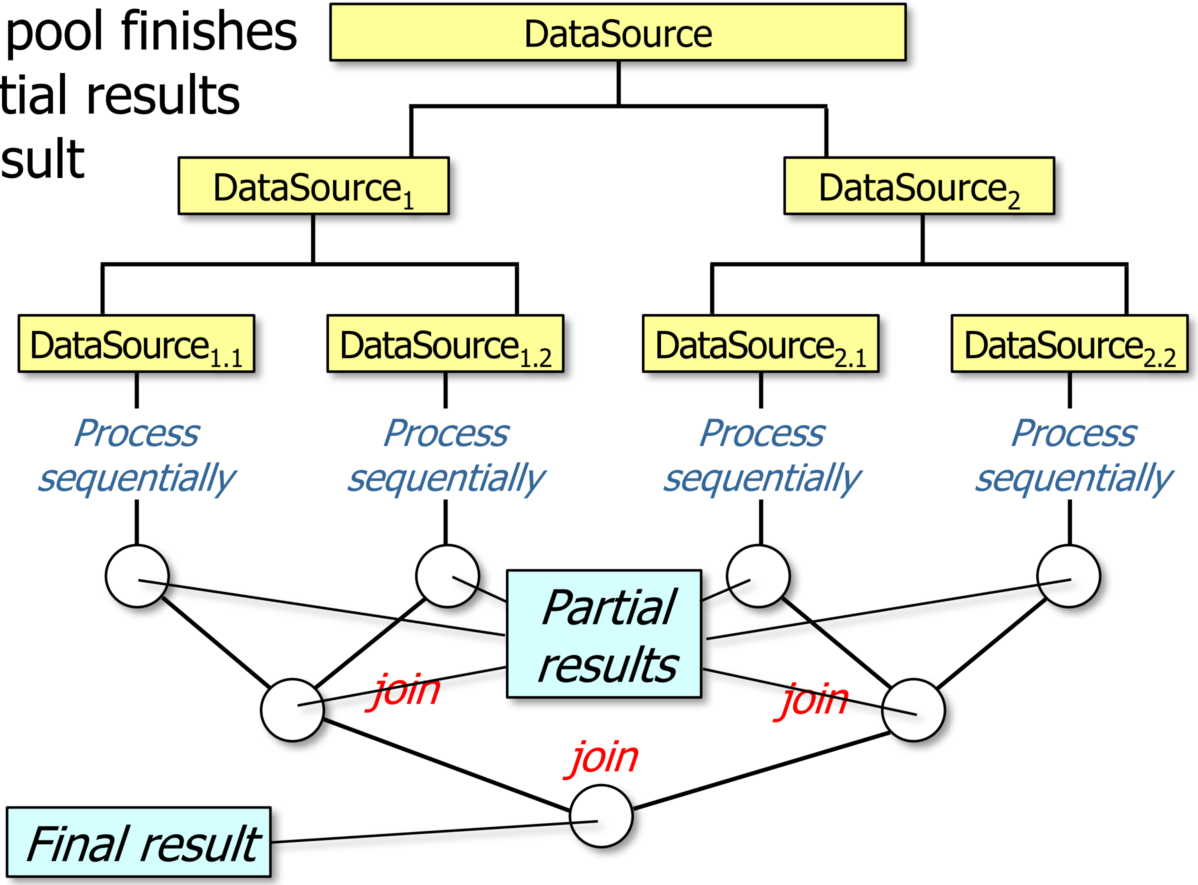


See www.ibm.com/developerworks/library/j-java-streams-3-brian-goetz

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

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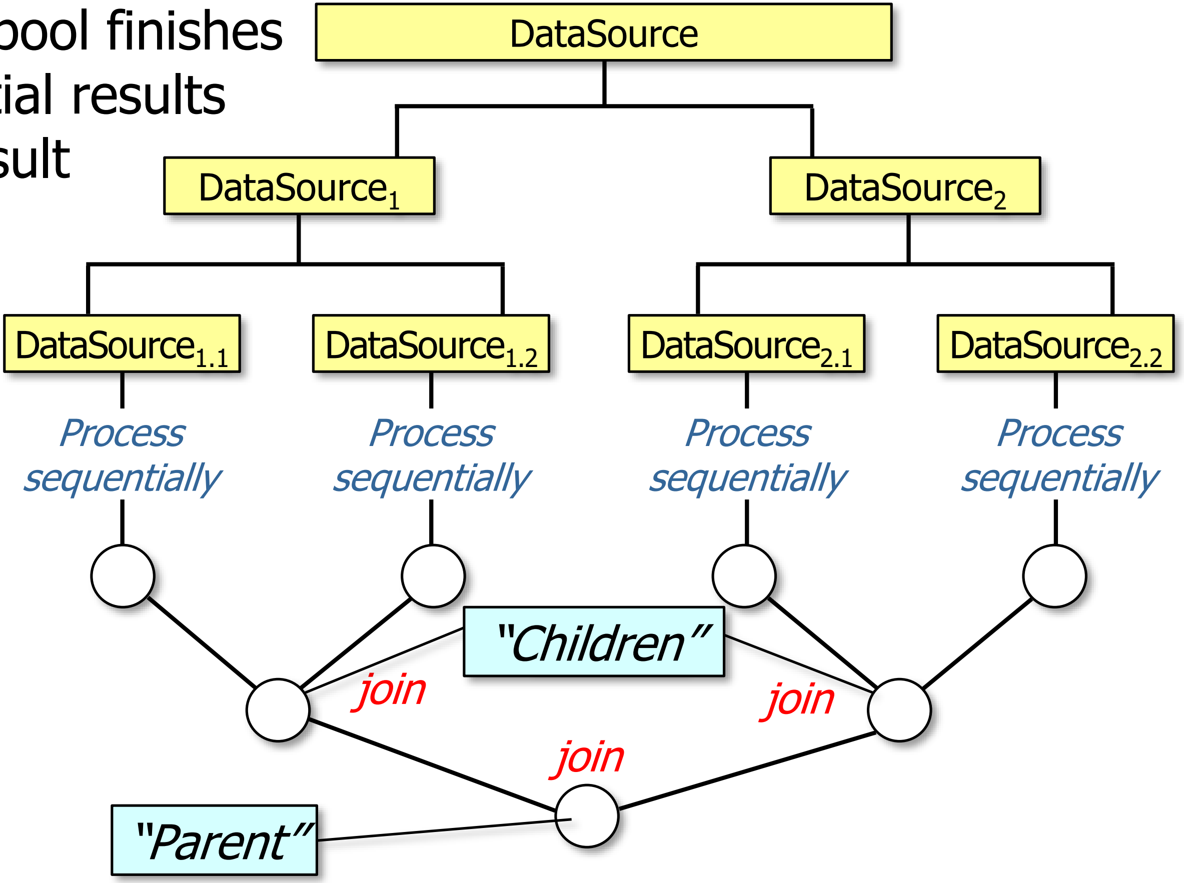
  - join() occurs in a single thread at each level
    - i.e., the "parent"



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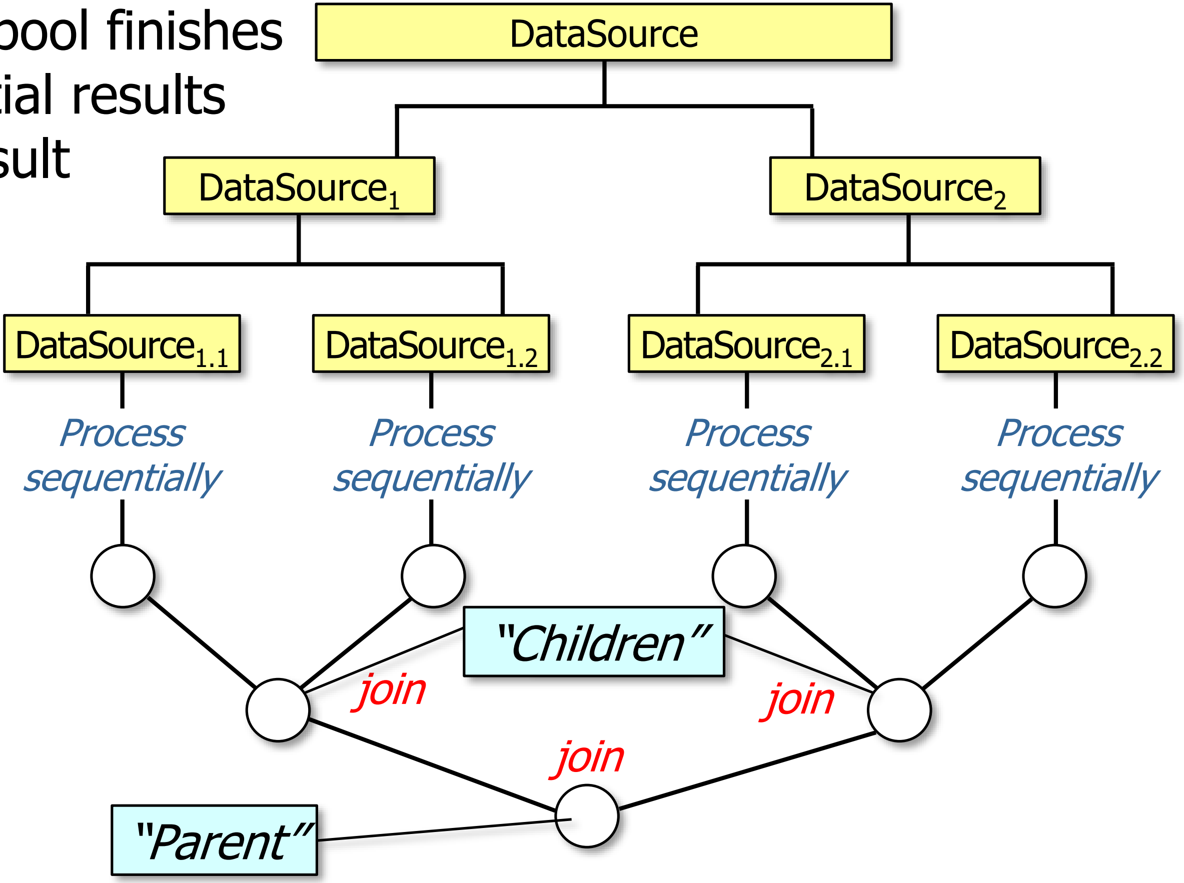
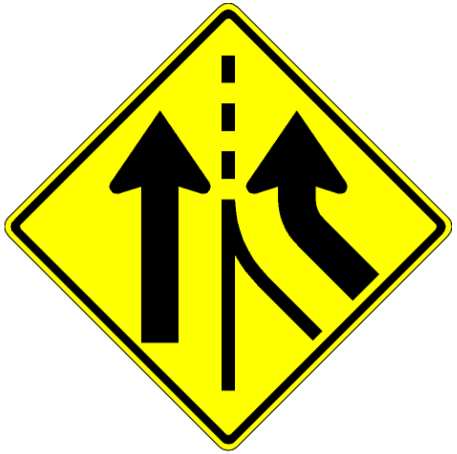


As a result, there's typically no need for synchronizers during the joining

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

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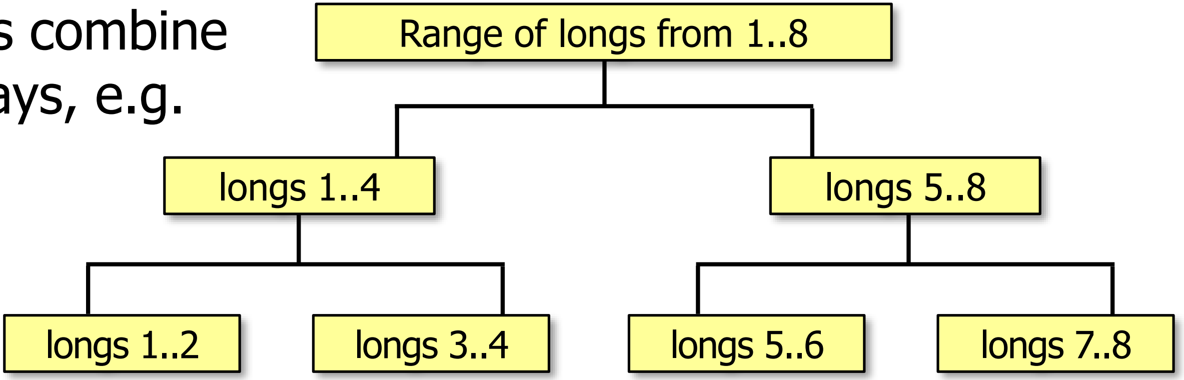

```
long factorial(long n) {
  return LongStream
    .rangeClosed(1, n)
    .parallel()
    .reduce(1, (a, b) -> a * b,
                (a, b) -> a * b);
}
```

Generate a range of longs from 1..8 in parallel

See github.com/douglascraigschmidt/LiveLessons/tree/master/Java8/ex16

Combining Results in a Parallel Stream

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Multiply pair-wise values

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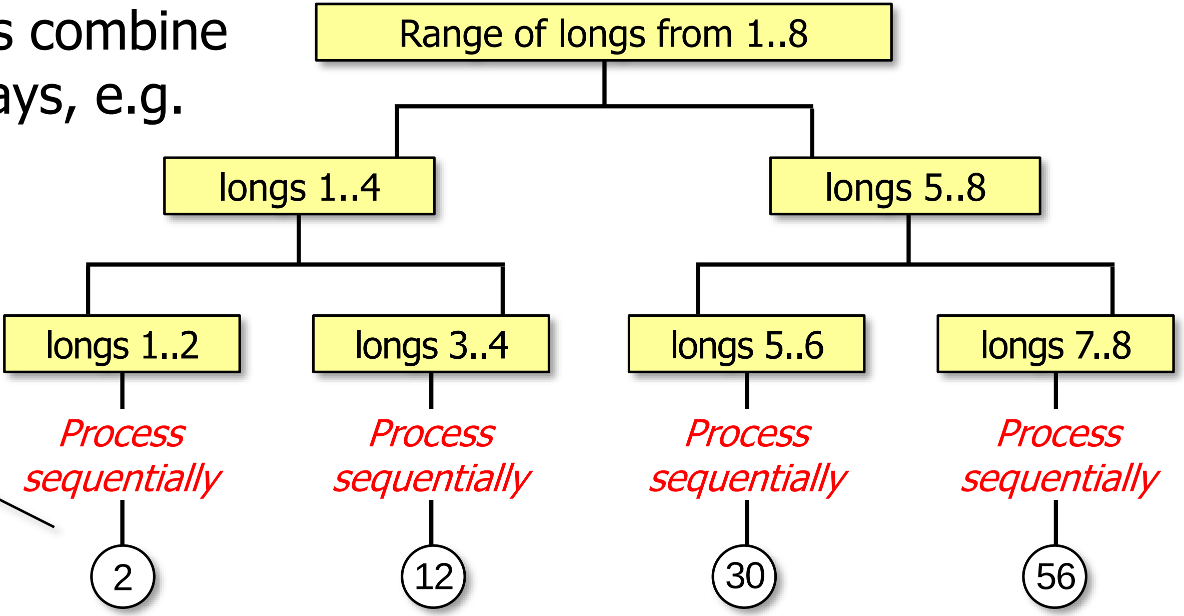

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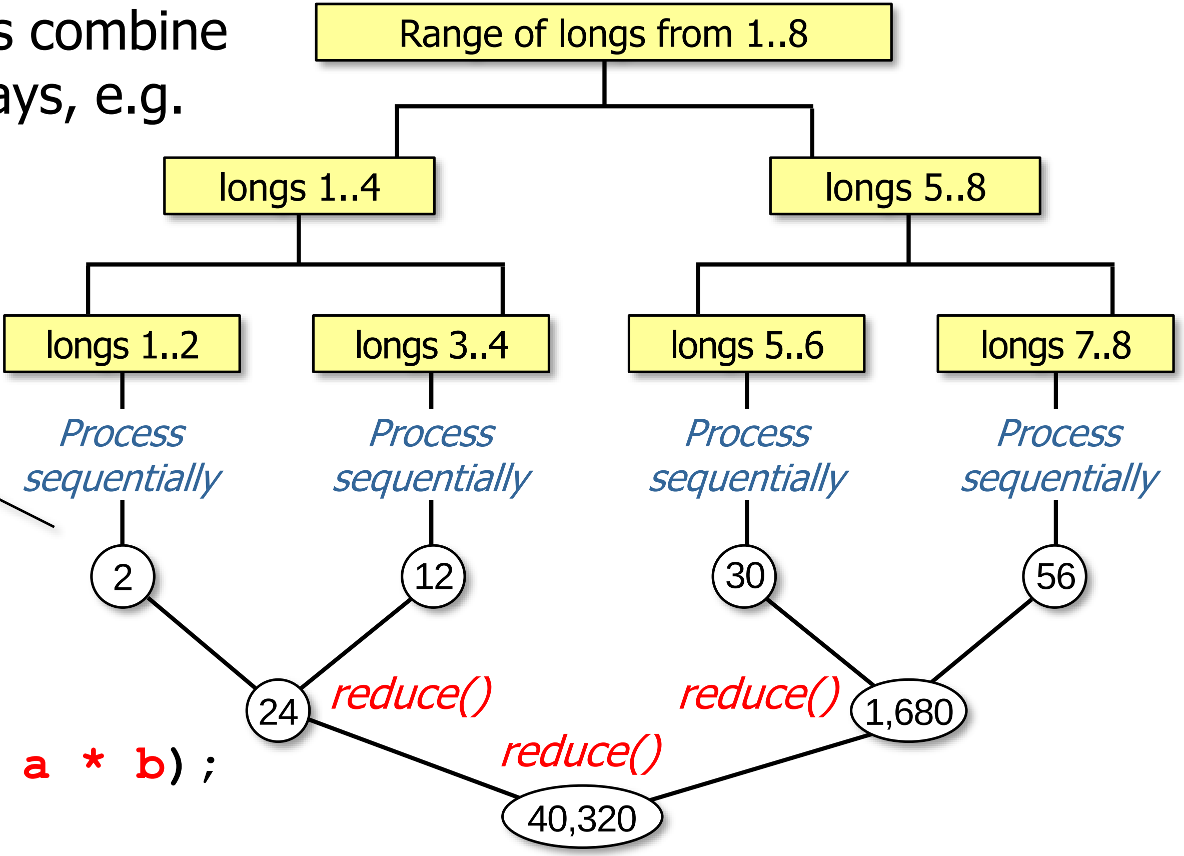

reduce() combines two immutable values (e.g., long) & produces a new one

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

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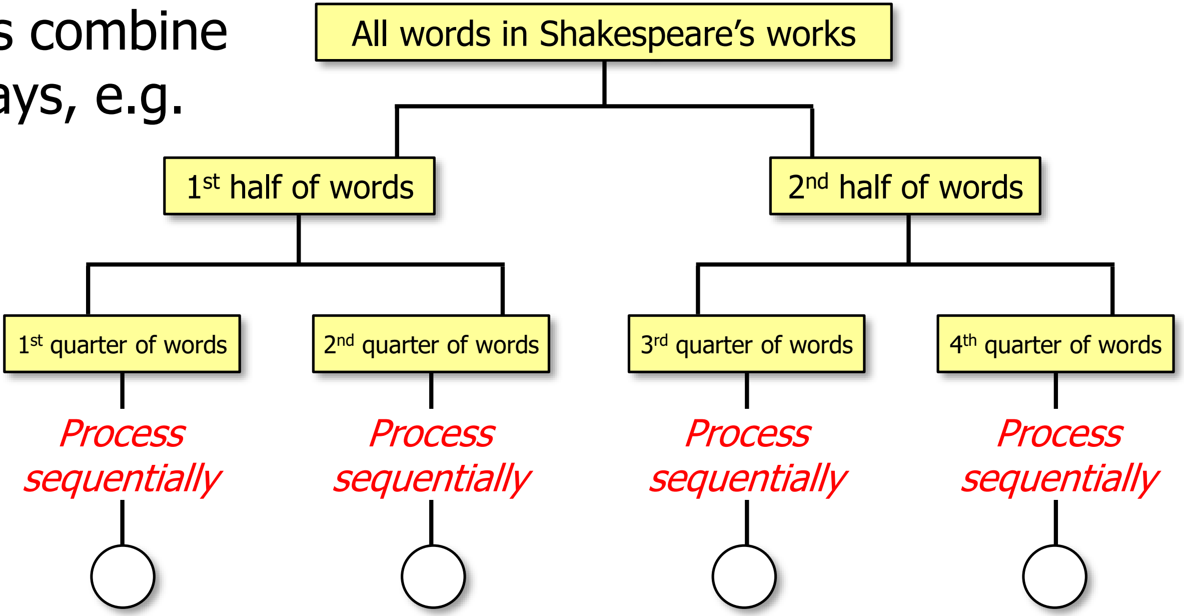
```
Set<CharSequence>
      uniqueWords =
  getInput(sSHAKESPEARE,
           "\\s+")
  .parallelStream()
  ...
  .collect(toCollection(TreeSet::new));
```



See github.com/douglascraigschmidt/LiveLessons/tree/master/Java8/ex14

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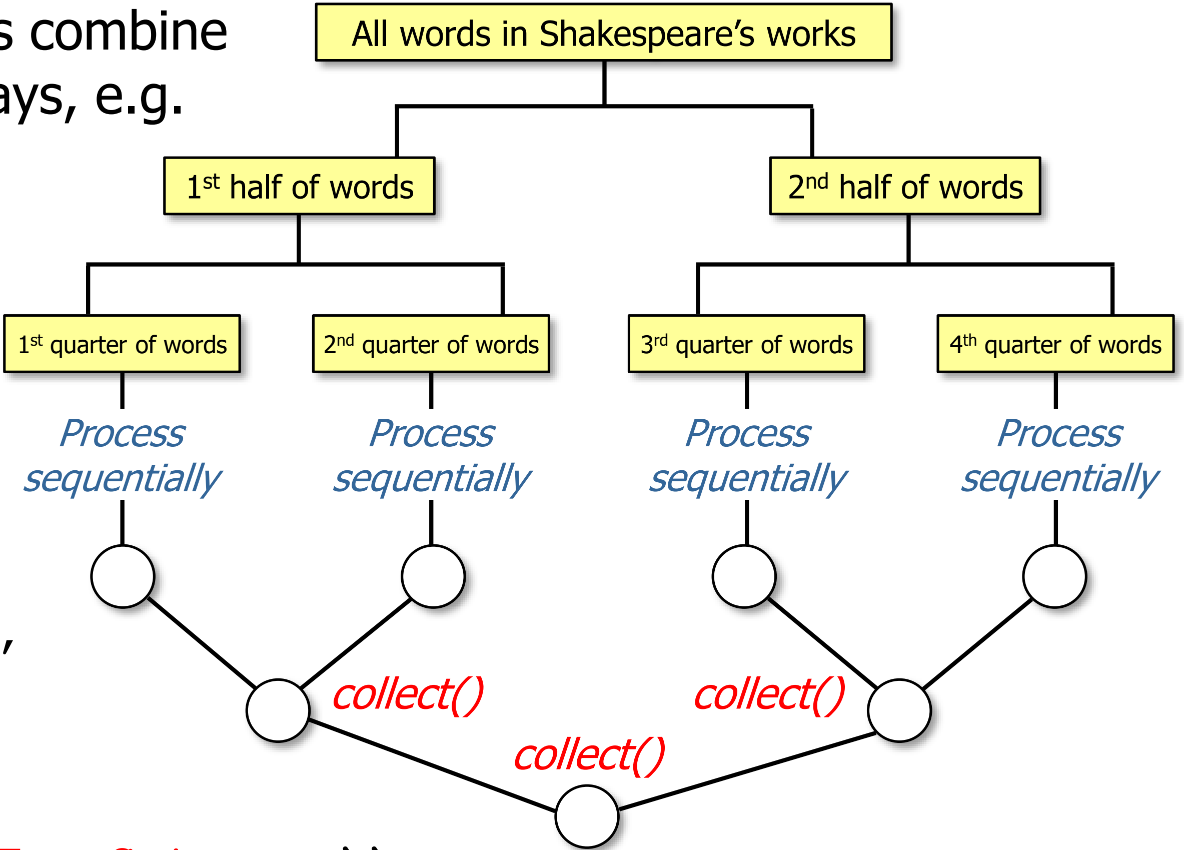

collect() mutates a container to accumulate the result it's producing

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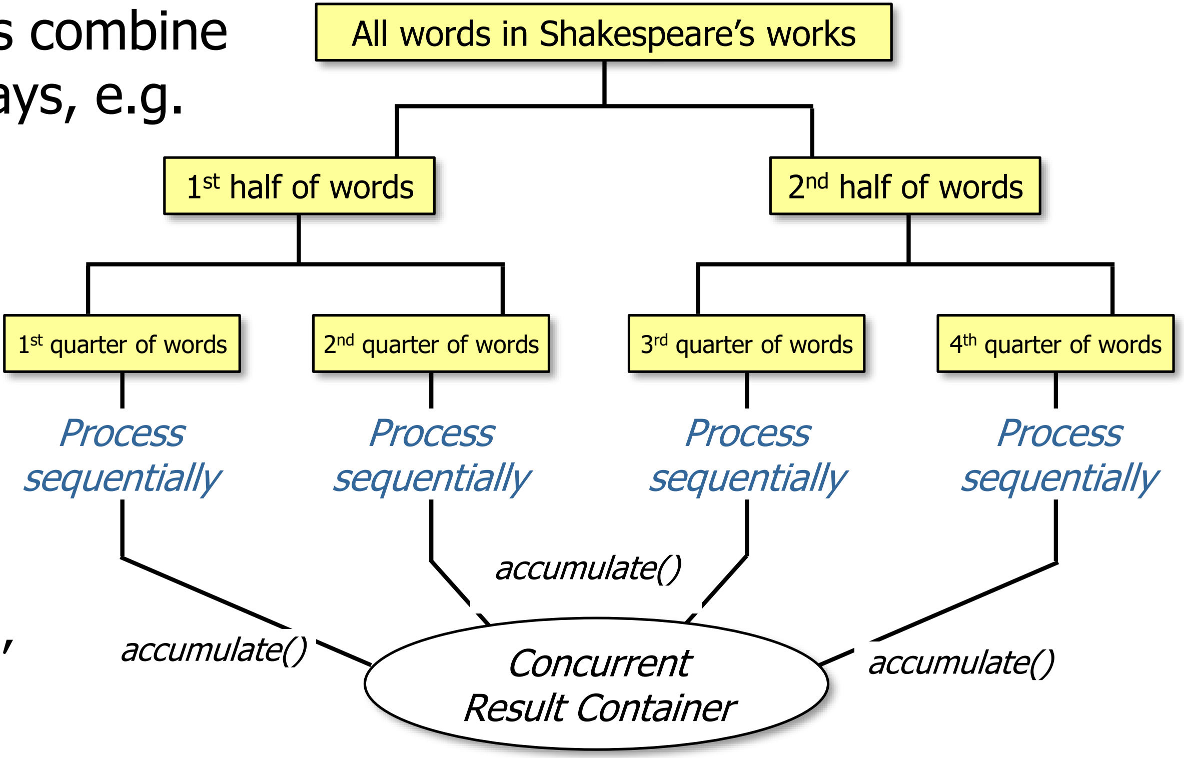
```
Set<CharSequence>
      uniqueWords =
  getInput(sSHAKESPEARE),
            "\\s+")
  .parallelStream()
  ...
  .collect(ConcurrentHashSetCollector.toSet());
```



Concurrent collectors (covered later) are different than non-concurrent collectors

End of Java Parallel Stream Internals: Combining Results (Part 1)