The Java Streams reduce() Terminal Operation (Part 2)

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 common terminal operations, e.g.
  - forEach()
  - collect()
  - reduce()
    - Know what reduce() does
    - Recognize interesting variants of collect() & reduce()

```
void runCollectReduce() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .reduce(0L,
              Long::sum);
```

We showcase reduce() using the Hamlet program

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

Learning Objectives in this Part of the Lesson

- Understand common terminal operations, e.g.
  - forEach()
  - collect()
  - reduce()
    - Know what reduce() does
    - Recognize interesting variants of collect() & reduce()
      - Also know how to replace reduce() with sum()

```
void runCollectReduce2() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .mapToLong
         (Long::longValue)
      .sum();
```

Interesting Variants of collect() & reduce()

Interesting Variants of collect() & reduce()

- Thus far we've used reduce() to return a primitive value

```
void runCollectReduce() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .reduce(0L,
              Long::sum);
```

See earlier lesson on "*The Java Stream reduce() Terminal Operation (Part 1)*"

Interesting Variants of collect() & reduce()

- However, collect() can also be used to return a primitive value

```
void runCollectReduce3() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .collect
         (summingLong
            (Long::longValue));
```

See earlier lesson on "*Java Streams: the collect() Terminal Operation*"

Interesting Variants of collect() & reduce()

- However, collect() can also be used to return a primitive value

```
void runCollectReduce3() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .collect
        (summingLong
          (Long::longValue));
```

Trigger the stream processing.

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

Interesting Variants of collect() & reduce()

- However, collect() can also be used to return a primitive value

```
void runCollectReduce3() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .collect
        (summingLong
          (Long::longValue));
```

Return a collector that produces the sum of a long-value function applied to input elements.

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

Interesting Variants of collect() & reduce()

- Likewise, reduce() can be used to return a non-primitive value

```
void streamReduceConcat
        (boolean parallel) {
  ...
  Stream<String> stringStream =
    allWords.stream();

  ...

  String words = stringStream
    .reduce("",
            (x, y) -> x + y);
```

See github.com/douglascraigschmidt/LiveLessons/tree/master/Java8/ex17

Interesting Variants of collect() & reduce()

- Likewise, reduce() can be used to return a non-primitive value

```
void streamReduceConcat
        (boolean parallel) {
...
Stream<String> stringStream =
  allStrings.stream();

...

String words = stringStream
  .reduce("",
          (x, y) -> x + y);
```

Create a stream of all the String objects in a List

Interesting Variants of collect() & reduce()

- Likewise, reduce() can be used to return a non-primitive value

```
void streamReduceConcat
        (boolean parallel) {
  ...
  Stream<String> stringStream =
    allWords.stream();

  ...

  String words = stringStream
    .reduce("",
            (x, y) -> x + y);
```

reduce() creates an immutable String object containing all concatenated words in a stream

See javarevisited.blogspot.com/2015/01/3-examples-to-concatenate-string-in-java.html

Interesting Variants of collect() & reduce()

- Likewise, reduce() can be used to return a non-primitive value

```
void streamReduceConcat
        (boolean parallel) {
  ...
  Stream<String> stringStream =
    allWords.stream();

  ...

  String words = stringStream
    .reduce("",
            (x, y) -> x + y);
```

However, this code is inefficient due to string concatenation overhead!!

See upcoming lesson on "*Java Parallel Stream Internals: Combining Results (Part 2)*"

Interesting Variants of collect() & reduce()

- The joining() Collector can be used to alleviate the overhead of Java String concatenation

```
void streamCollectJoining
        (boolean parallel) {
  ...
  Stream<String> stringStream =
    allWords.stream();

  ...

  String words = stringStream
    .collect(Collectors
             .joining());
```

Efficiently concatenate Java String objects

See upcoming lesson on "*Java Parallel Stream Internals: Combining Results (Part 2)*"

Interesting Variants of collect() & reduce()

- reduce() can also return a stream!

```
generateOuterStream
   (Options.instance().iterations())

.map(ex35::innerStream)

.reduce(Stream::concat)
.orElse(Stream.empty())

.collect(Collectors.toList());
```

reduce() returns a stream that is then processed via collect()!

See github.com/douglascraigschmidt/LiveLessons/tree/master/Java8/ex35

Replacing reduce() with sum()

Replacing reduce() with sum()

- The sum() terminal operation can replace reduce() for streams of primitive values

```
void runCollectReduce2() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .mapToLong(Long::longValue)
      .sum();
```

See docs.oracle.com/javase/8/docs/api/java/util/stream/LongStream.html#sum

Replacing reduce() with sum()

- The sum() terminal operation can replace reduce() for streams of primitive values

```
void runCollectReduce2() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .mapToLong(Long::longValue)
      .sum();
```

Convert the map into a stream of long values.

Replacing reduce() with sum()

- The sum() terminal operation can replace reduce() for streams of primitive values

```
void runCollectReduce2() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .mapToLong(Long::longValue)
      .sum();
```

Map the stream of Long objects into a stream of long primitives.

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

Replacing reduce() with sum()

- The sum() terminal operation can replace reduce() for streams of primitive values

```
void runCollectReduce2() {
  Map<String, Long>
    matchingCharactersMap =
      ...

  long sumOfNameLengths =
    matchingCharactersMap
      .values()
      .stream()
      .mapToLong(Long::longValue)
      .sum();
```

Sum the stream of long primitives into a single result.

See docs.oracle.com/javase/8/docs/api/java/util/stream/LongStream.html#sum

End of the Java Streams reduce() Terminal Operation (Part 2)