

Collecting Data in Complex Containers Using Collectors



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Agenda



What is a Collector
The Collectors class
Collectors in action

What is a Collector

Reduction in a container

About the Reduction Step

- The reductions we saw were aggregations: sum, max, average, etc...
- A collector is a special type of reduction
- It is a terminal operation, that triggers the computation of the Stream

A First Example

- Let us collect a stream of strings in a list

```
List<String> peopleNames = ... ;  
  
List<String> result = new ArrayList<>() ;  
  
peopleNames.stream()  
    .filter(s -> !s.isEmpty())  
    .forEach(s -> result.add(s)) ;
```

- What is wrong in this pattern?

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- We add elements to an external list
- Which is final... and that cannot be accessed concurrently!

A First Example

- Let us collect a stream of strings in a list

```
List<String> peopleNames = ... ;  
  
List<String> result = new ArrayList<>() ;  
  
peopleNames.stream().parallel()  
    .filter(s -> !s.isEmpty())  
    .forEach(s -> result.add(s)) ;
```

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A First Example

- Let us collect a stream of strings in a list

```
List<String> peopleNames = ... ;  
  
peopleNames.stream()  
    .filter(s -> !s.isEmpty())  
    .collect(Collectors.toList()) ;
```

A First Example

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    peopleNames.stream()  
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peopleNames.stream().parallel()  
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```

Collectors

- This step is called *mutable collection*
- Just because it collects the data in a *mutable* container

The Collectors Class

Ready to use collectors from the JDK

The Collectors Class

- The JDK provides a factory class: `Collectors`
- Collecting data is about gathering data in a mutable container
 - A String (concatenation)
 - A Collection (adding)
 - A HashMap (grouping by a criteria)

We Have Collectors for That

- Collector is the interface that models the collectors
- Collectors is the class factory to build collectors
 - Most collectors can be built through the factory
 - If needed there are other patterns

Collecting a Max

- Pattern:

```
List<Person> people = ... ;

Optional<Person> oldest =
    people.stream()
        .collect(
            Collectors.maxBy(Comparator.comparing(p -> p.getAge()))
        ) ;
```


Collecting an Average

- Pattern :

```
List<Person> people = ... ;

double average =
    people.stream()
        .collect(
            Collectors.averagingDouble(p -> p.getAge())
        ) ;
```

Collecting in a String

- The pattern is:

```
List<Person> people = ... ;  
  
String names =  
    people.stream()  
        .map(p -> p.getName())  
        .collect(Collectors.joining(", ")) ;
```

```
Barbara, Charles, Sharon, Peter
```

Collecting in a Set

- The pattern is:

```
List<Person> people = ... ;  
  
Set<String> names =  
    people.stream()  
        .map(p -> p.getName())  
        .collect(Collectors.toSet()) ;
```

Collecting in a Collection

- The pattern is:

```
List<Person> people = ... ;

TreeSet<String> names =
    people.stream()
        .map(p -> p.getName())
        .collect(Collectors.toCollection(() -> new TreeSet())) ;
```

Collecting in a Map

- Partitioning by a predicate:

```
List<Person> people = ... ;  
  
Map<Boolean, List<Person>> peopleByAge =  
    people.stream()  
        .collect(Collectors.partitioningBy(person -> person.getAge() > 21)) ;
```

Collecting in a Map

- Grouping by a function:

```
List<Person> people = ... ;  
  
Map<Integer, List<Person>> peopleByAge =  
    people.stream()  
        .collect(Collectors.groupingBy(person -> person.getAge())) ;
```

Collecting in a Map

- Grouping and counting:

```
List<Person> people = ... ;

Map<Integer, Long> peopleByAge =
    people.stream()
        .collect(
            Collectors.groupingBy(person -> person.getAge()),
            Collectors.counting()
        ) ;
```

Collecting in a Map

- Grouping and counting:

```
List<Person> people = ... ;

Map<Integer, Long> peopleByAge =
    people.stream()
        .collect(
            Collectors.groupingBy(person -> person.getAge()),
            Collectors.counting() // the « downstream » collector
        ) ;
```


Collecting in a Map

- Grouping and mapping:

```
List<Person> people = ... ;

Map<Integer, List<String>> namesByAge =
    people.stream()
        .collect(
            Collectors.groupingBy(person -> person.getAge()),
            Collectors.mapping(
                person -> person.getName()
            )
        ) ;
```

Collecting in a Map

- Grouping, mapping and collecting in a TreeSet:

```
List<Person> people = ... ;

Map<Integer, TreeSet<String>> namesByAge =
    people.stream()
        .collect(
            Collectors.groupingBy(person -> person.getAge()),
            Collectors.mapping(
                person -> person.getName(),
                Collectors.toCollection(() -> TreeSet())
            )
        )
    ;
```

Collecting in a Map

- Grouping in a TreeMap, mapping and collecting in a TreeSet:

```
List<Person> people = ... ;

TreeMap<Integer, TreeSet<String>> namesByAge =
    people.stream()
        .collect(
            Collectors.groupingBy(person -> person.getAge()),
            () -> new TreeMap(),
            Collectors.mapping(
                person -> person.getName(),
                Collectors.toCollection(() -> TreeSet())
            )
        )
    ;
```

Collecting in an Immutable Map

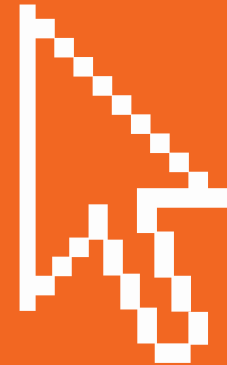
- Collecting in an immutable Map:

```
List<Person> people = ... ;

Map<Integer, List<Person>> peopleByAge =
    people.stream()
        .collect(
            Collectors.collectingAndThen(
                Collectors.groupingBy(person -> person.getAge()),
                Collections::unmodifiableMap
            )
        ) ;
```

Live Coding

The Shakespeare plays Scrabble
example



Live Coding Summary

- How to set up a data processing stream
 - Built on a large set of data
- Collecting the result in a hashmap
 - groupingBy, building histograms
 - Building streams on hashmap entrySet
- Extracting the meaningful information using a postprocessing
 - Sorting streams
 - Getting the first elements

Summary

- Collectors to reduce streams in containers: Strings, Collections, Maps
 - Concatenating strings with separators
 - Building collections: toList, toSet, toCollection
 - Building HashMaps: partitioningBy, groupingBy, downstream collectors
- Collectors in action on the Shakespeare example
 - Complex processing based on the use of histograms
 - Opening streams on hashmap entrySet to postprocess our data
- All of these in parallel!