

Java Streams: Implementing Pre-defined Non-Concurrent Collectors

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Learning Objectives in this Part of the Lesson

- Understand the structure & functionality of non-concurrent collectors for sequential streams
- Know the API for non-concurrent collectors
- Recognize how pre-defined non-concurrent collectors are implemented in the JDK

Class Collectors

```
java.lang.Object  
    java.util.stream.Collectors
```

```
public final class Collectors  
    extends Object
```

Implementations of `Collector` that implement various useful reduction operations, such as accumulating elements into collections, summarizing elements according to various criteria, etc.

The following are examples of using the predefined collectors to perform common mutable reduction tasks:

How Pre-defined Non-Concurrent Collectors are Implemented

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The following are examples of using the predefined collectors to perform common mutable reduction tasks:

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

How Pre-defined Non-Concurrent Collectors are Implemented

- Collectors is a utility class whose factory methods create collectors for common collection types
- A utility class is final, has only static methods, no (non-static) state, & a private constructor

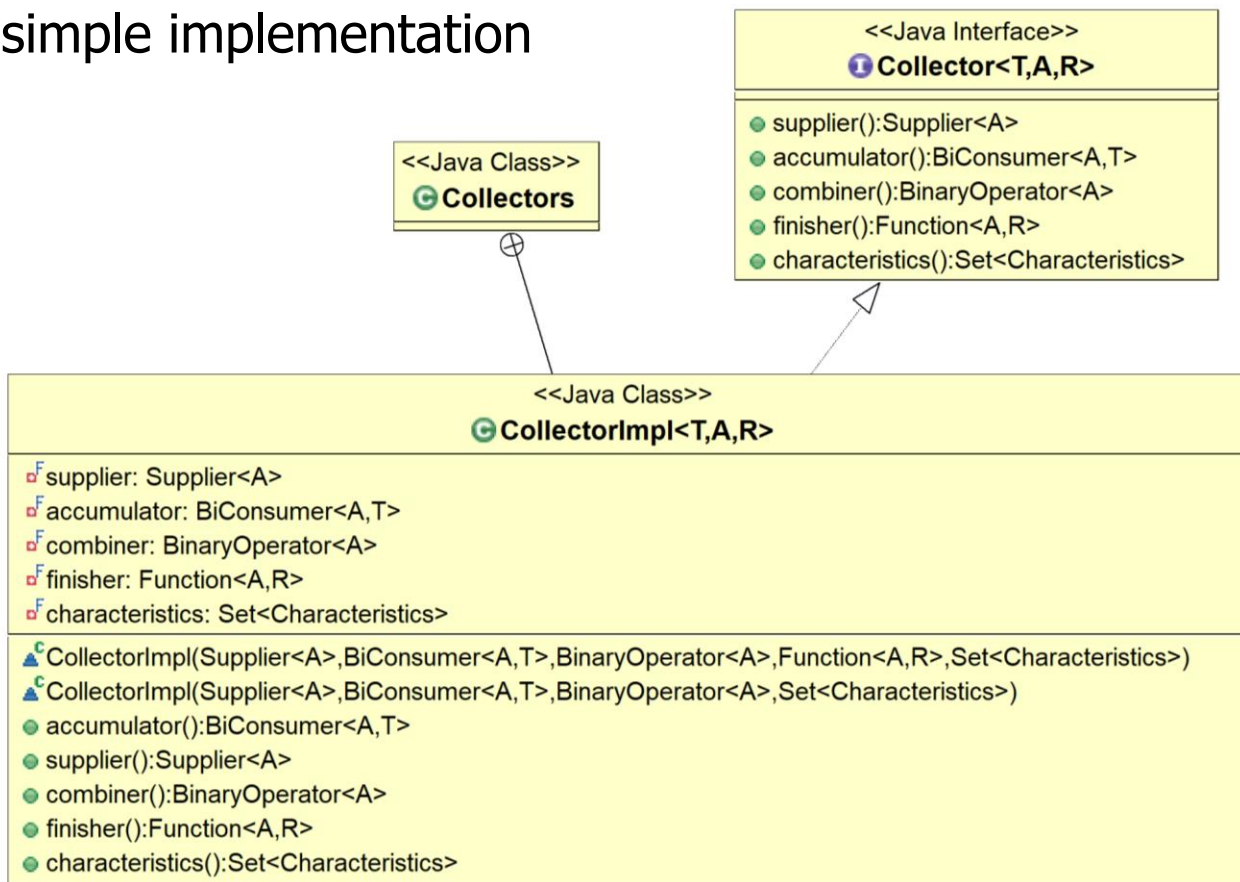
```
<<Java Class>>
G Collectors

Collectors()
toCollection(Supplier<C>):Collector<T,?,C>
toList():Collector<T,?,List<T>>>
toSet():Collector<T,?,Set<T>>>
joining():Collector<CharSequence,?,String>
joining(CharSequence):Collector<CharSequence,?,String>
joining(CharSequence,CharSequence,CharSequence):Collector<CharSequence,?,String>
mapping(Function<? super T,? extends U>,Collector<? super U,A,R>):Collector<T,?,R>
collectingAndThen(Collector<T,A,R>,Function<R,RR>):Collector<T,A,RR>
counting():Collector<T,?,Long>
minBy(Comparator<? super T>):Collector<T,?,Optional<T>>
maxBy(Comparator<? super T>):Collector<T,?,Optional<T>>
summingInt(ToIntFunction<? super T>):Collector<T,?,Integer>
summingLong(ToLongFunction<? super T>):Collector<T,?,Long>
summingDouble(ToDoubleFunction<? super T>):Collector<T,?,Double>
averagingInt(ToIntFunction<? super T>):Collector<T,?,Double>
averagingLong(ToLongFunction<? super T>):Collector<T,?,Double>
averagingDouble(ToDoubleFunction<? super T>):Collector<T,?,Double>
reducing(T,BinaryOperator<T>):Collector<T,?,T>
reducing(BinaryOperator<T>):Collector<T,?,Optional<T>>
reducing(U,Function<? super T,? extends U>,BinaryOperator<U>):Collector<T,?,U>
groupingBy(Function<? super T,? extends K>):Collector<T,?,Map<K,List<T>>>
toMap(Function<? super T,? extends K>,Function<? super T,? extends U>):Collector<T,?,Map<K,U>>
summarizingInt(ToIntFunction<? super T>):Collector<T,?,IntSummaryStatistics>
summarizingLong(ToLongFunction<? super T>):Collector<T,?,LongSummaryStatistics>
summarizingDouble(ToDoubleFunction<? super T>):Collector<T,?,DoubleSummaryStatistics>
```

See www.quora.com/What-is-the-best-way-to-write-utility-classes-in-Java/answer/Jon-Harley

How Pre-defined Non-Concurrent Collectors are Implemented

- CollectorImpl defines a simple implementation class for a Collector

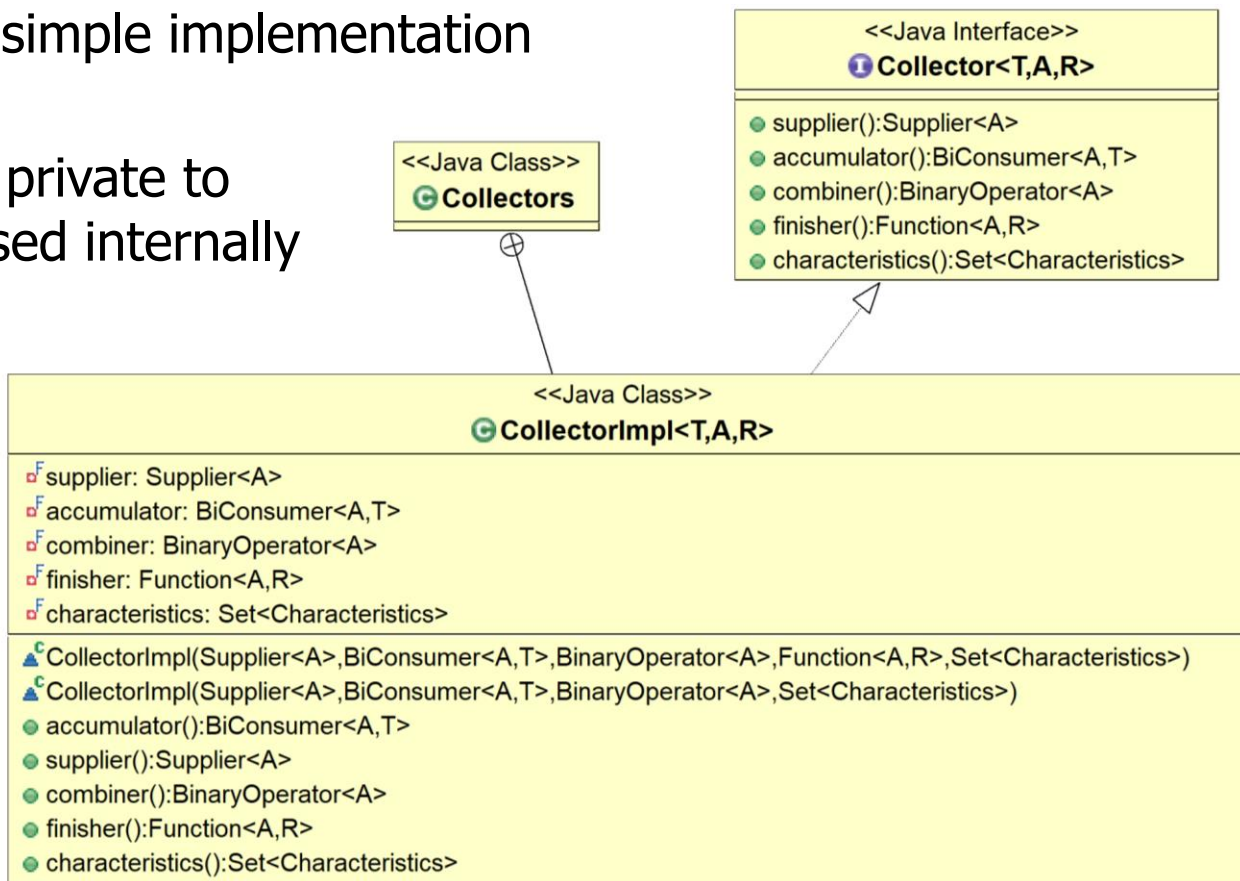


See openjdk/8-b132/java/util/stream/Collectors.java#Collectors.CollectorImpl

How Pre-defined Non-Concurrent Collectors are Implemented

- CollectorImpl defines a simple implementation class for a Collector
- However, this class is private to Collectors & is only used internally

PRIVATE



How Pre-defined Non-Concurrent Collectors are Implemented

- Collectors.toList() uses Collector Impl to return a non-concurrent Collector that accumulates input elements into a new (Array)List

```
final class Collectors {  
    ...  
    public static <T> Collector  
        <T, ?, List<T>>  
        toList() {  
        return new CollectorImpl<>  
            ((Supplier<List<T>>)  
             ArrayList::new,  
             List::add,  
             (left, right) -> {  
                 left.addAll(right);  
                 return left;  
             } ,  
             CH_ID) ;  
        } ...  
}
```


How Pre-defined Non-Concurrent Collectors are Implemented

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                ArrayList::new,  
                List::add,  
                (left, right) -> {  
                    left.addAll(right);  
                    return left;  
                },  
                CH_ID) ;  
        } ...  
}
```

The supplier constructor reference

How Pre-defined Non-Concurrent Collectors are Implemented

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             ArrayList::new,  
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                 return left;  
             } ,  
             CH_ID) ;  
        } ...  
}
```

The accumulator method reference

How Pre-defined Non-Concurrent Collectors are Implemented

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             ArrayList::new,  
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             (left, right) -> {  
                 left.addAll(right);  
                 return left;  
             }  
            ,  
            CH_ID) ;  
        } ...  
}
```

The combiner lambda expression

This combiner is only used for parallel streams

How Pre-defined Non-Concurrent Collectors are Implemented

- Collectors.toList() uses Collector Impl to return a non-concurrent Collector that accumulates input elements into a new (Array)List

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final class Collectors {  
    ...  
    public static <T> Collector  
        <T, ?, List<T>>  
        toList() {  
        return new CollectorImpl<>  
            ((Supplier<List<T>>)  
             ArrayList::new,  
             List::add,  
             (left, right) -> {  
                 left.addAll(right);  
                 return left;  
             } ,  
             CH_ID) ;  
        } ...  
}
```

Characteristics set



CH_ID is defined as Collector.Characteristics.IDENTITY_FINISH

How Pre-defined Non-Concurrent Collectors are Implemented

- Collector.of() defines a simple public factory method that implements a Collector

This of() method is passed four params

```
interface Collector<T, A, R> { ...  
    static<T, R> Collector<T, R, R> of  
        (Supplier<R> supplier,  
         BiConsumer<R, T> accumulator,  
         BinaryOperator<R> combiner,  
         Characteristics... chars) {  
        ...  
        return new Collectors  
            .CollectorImpl<>  
                (supplier,  
                 accumulator,  
                 combiner,  
                 chars) ;  
        } ...  
}
```

How Pre-defined Non-Concurrent Collectors are Implemented

- Collector.of() defines a simple public factory method that implements a Collector

This of() method is passed five params

```
interface Collector<T, A, R> { ...
    static<T, R> Collector<T, R, R> of
        (Supplier<R> supplier,
         BiConsumer<R, T> accumulator,
         BinaryOperator<R> combiner,
         Function<A,R> finisher,
         Characteristics... chars) {
        ...
        return new Collectors
            .CollectorImpl<>
                (supplier,
                 accumulator,
                 combiner,
                 chars) ;
    } ...
}
```

How Pre-defined Non-Concurrent Collectors are Implemented

- `Collector.of()` defines a simple public factory method that implements a `Collector`
- Both `of()` versions internally use the private `CollectorImpl` class

```
interface Collector<T, A, R> { ...
    static<T, R> Collector<T, R, R> of
        (Supplier<R> supplier,
         BiConsumer<R, T> accumulator,
         BinaryOperator<R> combiner,
         Function<A,R> finisher,
         Characteristics... chars) {
        ...
        return new Collectors
            .CollectorImpl<>
                (supplier,
                 accumulator,
                 combiner,
                 chars) ;
        } ...
}
```

See openjdk/8-b132/java/util/stream/Collectors.java#Collectors.CollectorImpl

End of Java Streams: Implementing Pre-defined Non-Concurrent Collectors