Overview of the BigFraction Case Studies

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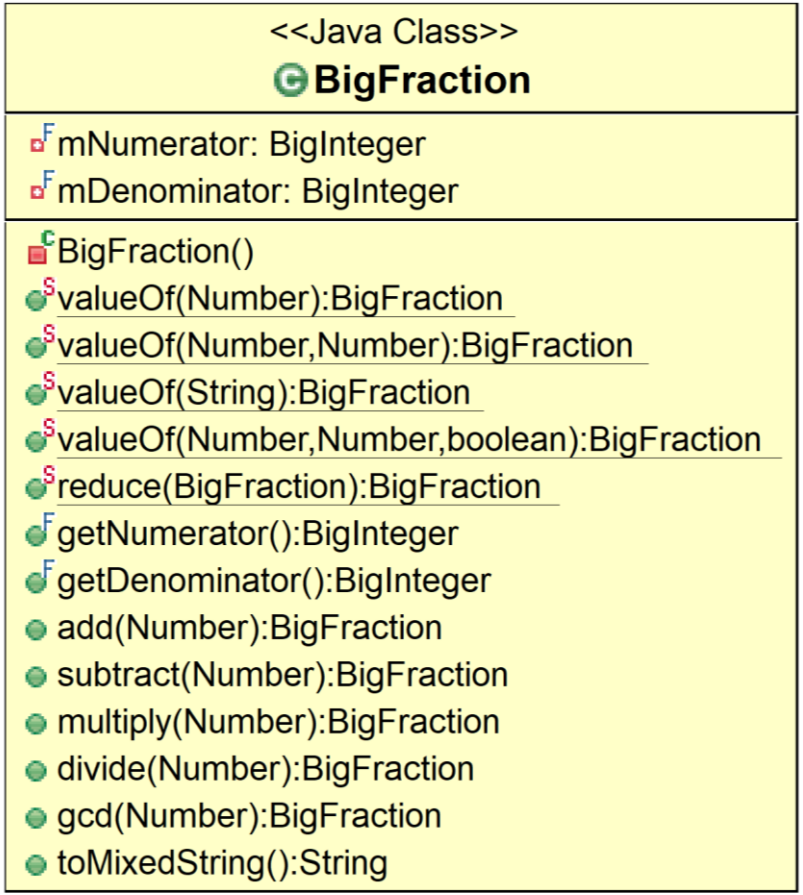
Learning Objectives in this Part of the Lesson

- Understand key classes in the Project Reactor API
- Understand key classes in the RxJava API
- Be aware of the structure & functionality of the BigFraction case studies

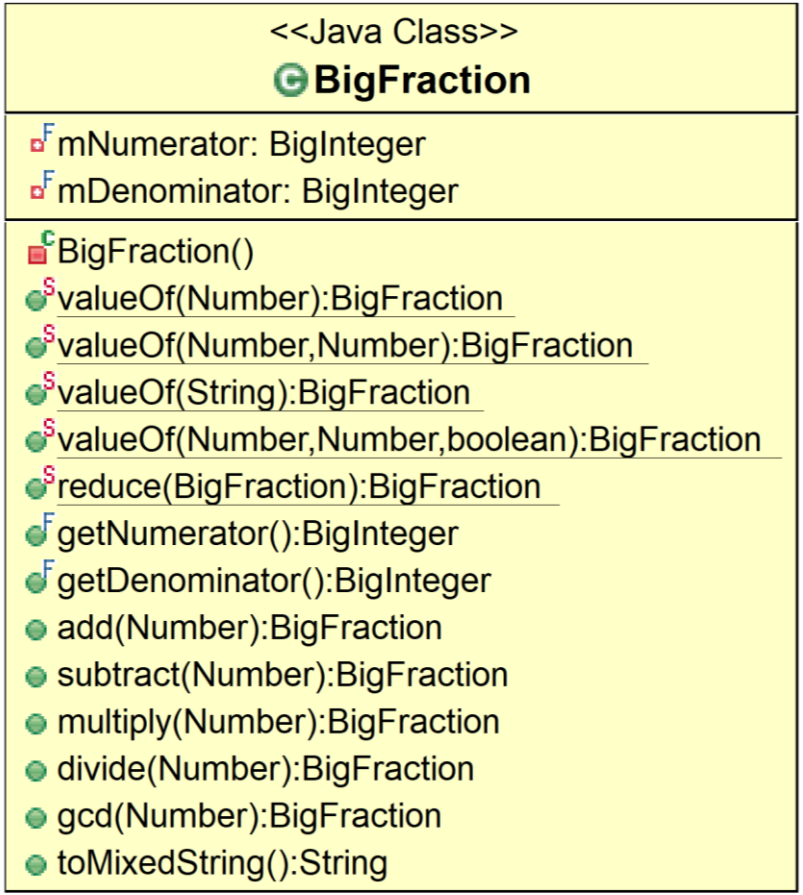


These case studies demonstrate many Project Reactor & RxJava features

Overview of the BigFraction Class

Overview of the BigFraction Class

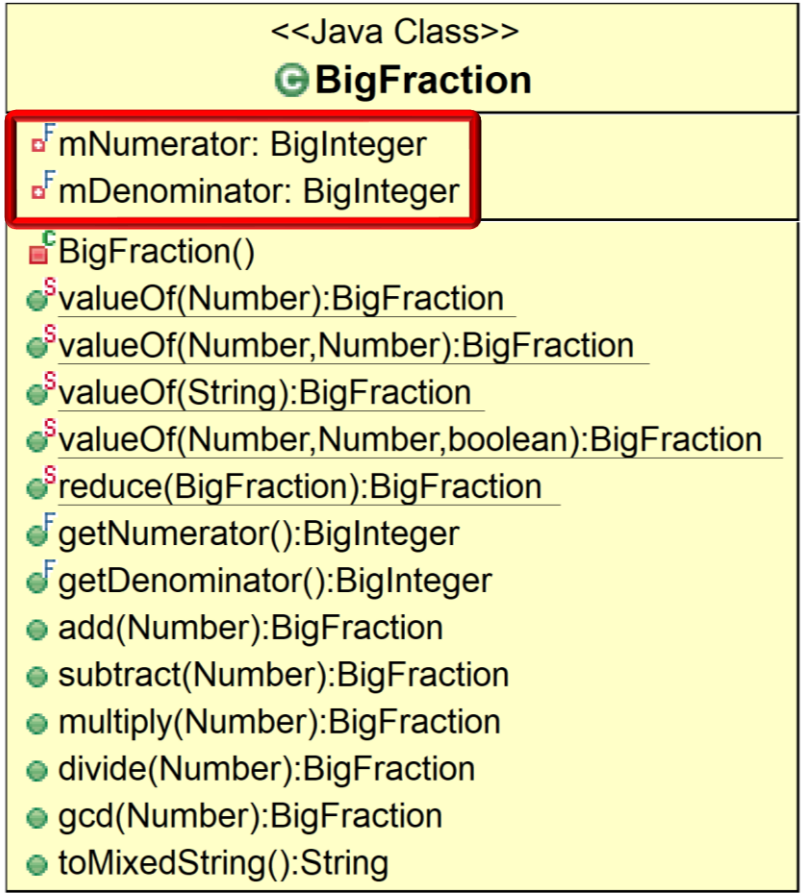
- Upcoming lessons show how to apply Project Reactor & RxJava features in the context of a BigFraction class



See LiveLessons/blob/master/Java8/ex8/src/utils/BigFraction.java

Overview of the BigFraction Class

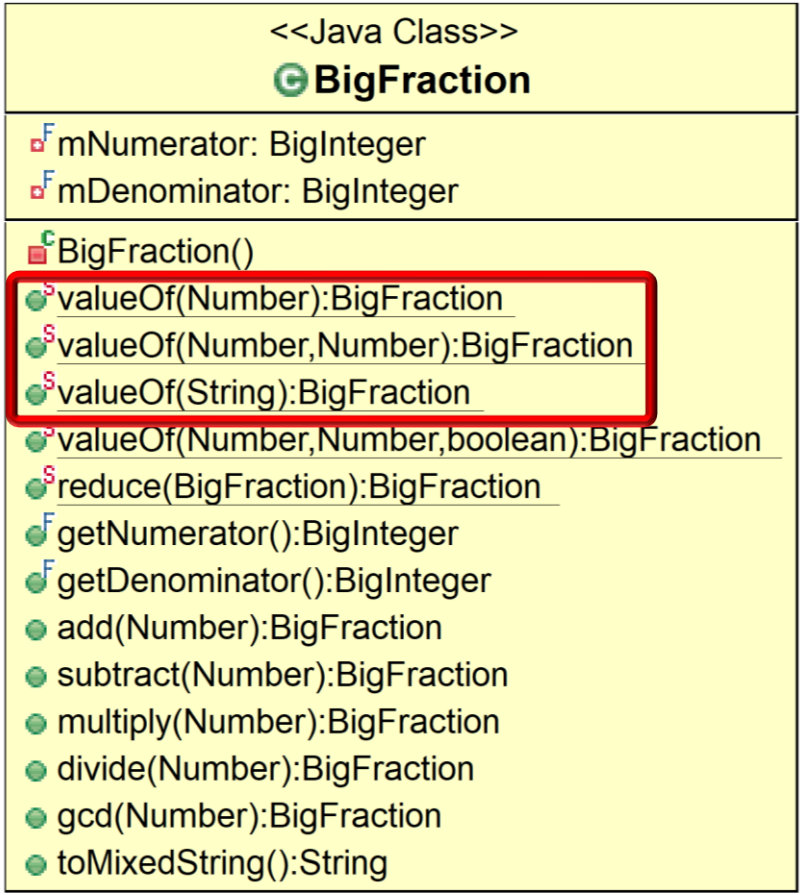
- Upcoming lessons show how to apply Project Reactor & RxJava features in the context of a BigFraction class
  - Arbitrary-precision fraction, utilizing BigIntegers for numerator & denominator



See docs.oracle.com/javase/8/docs/api/java/math/BigInteger.html

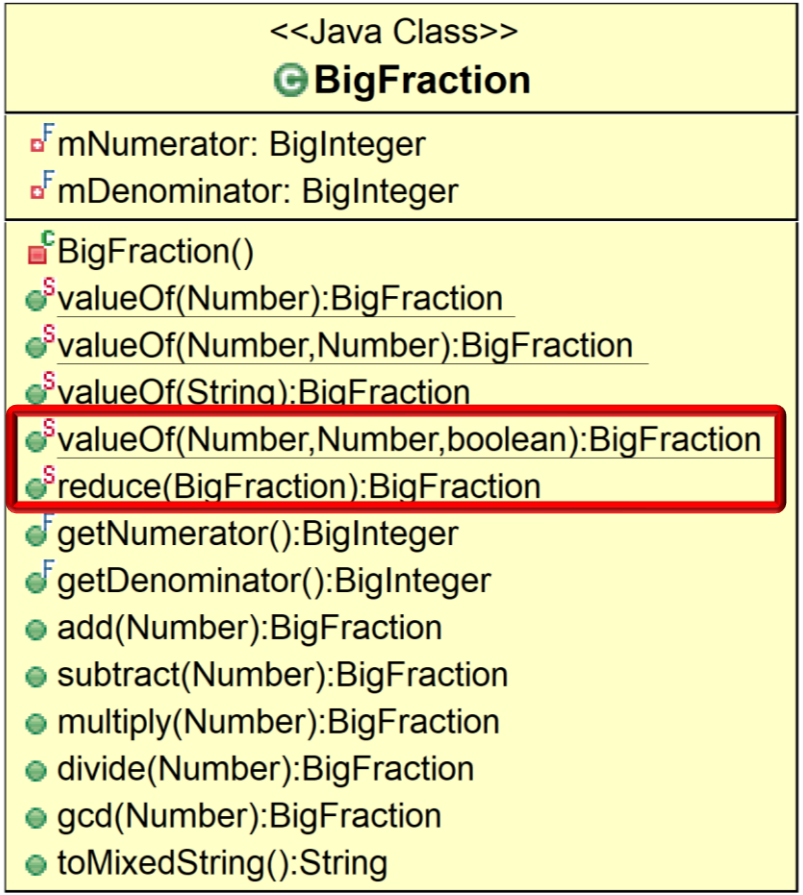
Overview of the BigFraction Class

- Upcoming lessons show how to apply Project Reactor & RxJava features in the context of a BigFraction class
  - Arbitrary-precision fraction, utilizing BigIntegers for numerator & denominator
  - Factory methods to "reduce" fractions
    - 44/55 → 4/5
    - 12/24 → 1/2
    - 144/216 → 2/3



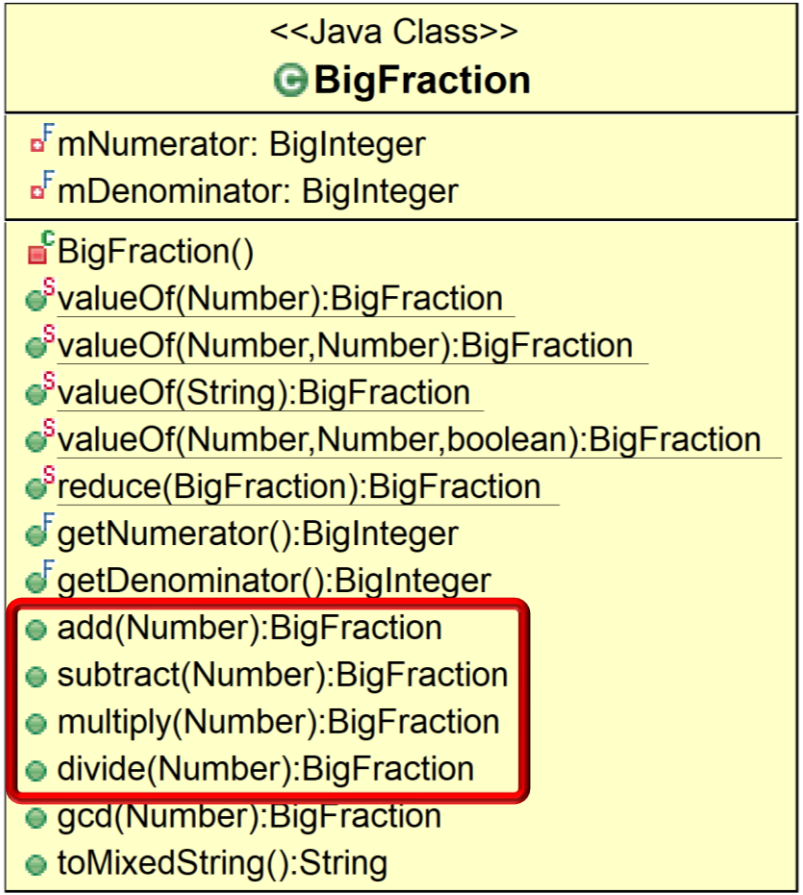
Overview of the BigFraction Class

- Upcoming lessons show how to apply Project Reactor & RxJava features in the context of a BigFraction class
  - Arbitrary-precision fraction, utilizing BigIntegers for numerator & denominator
  - Factory methods to "reduce" fractions
  - Factory methods to create "non-reduced" fractions (& then reduce them)
    - e.g., 12/24 (→ 1/2)



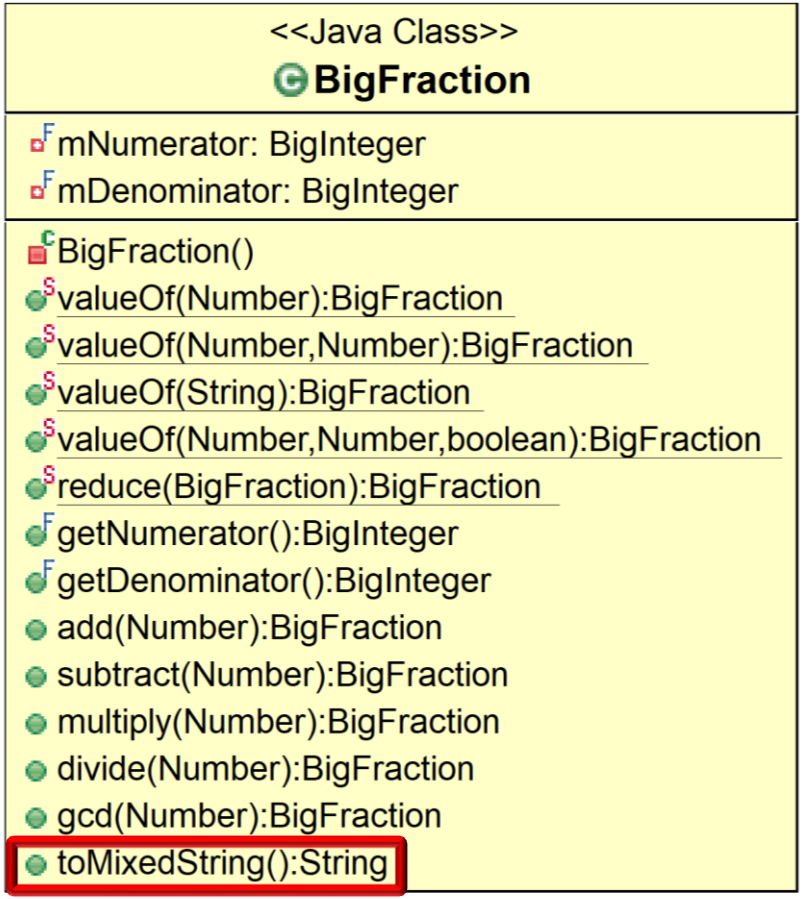
Overview of the BigFraction Class

- Upcoming lessons show how to apply Project Reactor & RxJava features in the context of a BigFraction class
  - Arbitrary-precision fraction, utilizing BigIntegers for numerator & denominator
  - Factory methods to "reduce" fractions
  - Factory methods to create "non-reduced" fractions (& then reduce them)
  - Arbitrary-precision fraction arithmetic
    - e.g., 18/4 ×2/3 = 3



Overview of the BigFraction Class

- Upcoming lessons show how to apply Project Reactor & RxJava features in the context of a BigFraction class
  - Arbitrary-precision fraction, utilizing BigIntegers for numerator & denominator
  - Factory methods to "reduce" fractions
  - Factory methods to create "non-reduced" fractions (& then reduce them)
  - Arbitrary-precision fraction arithmetic
  - Create a mixed fraction from an improper fraction
    - e.g., 18/4 → 4 1/2

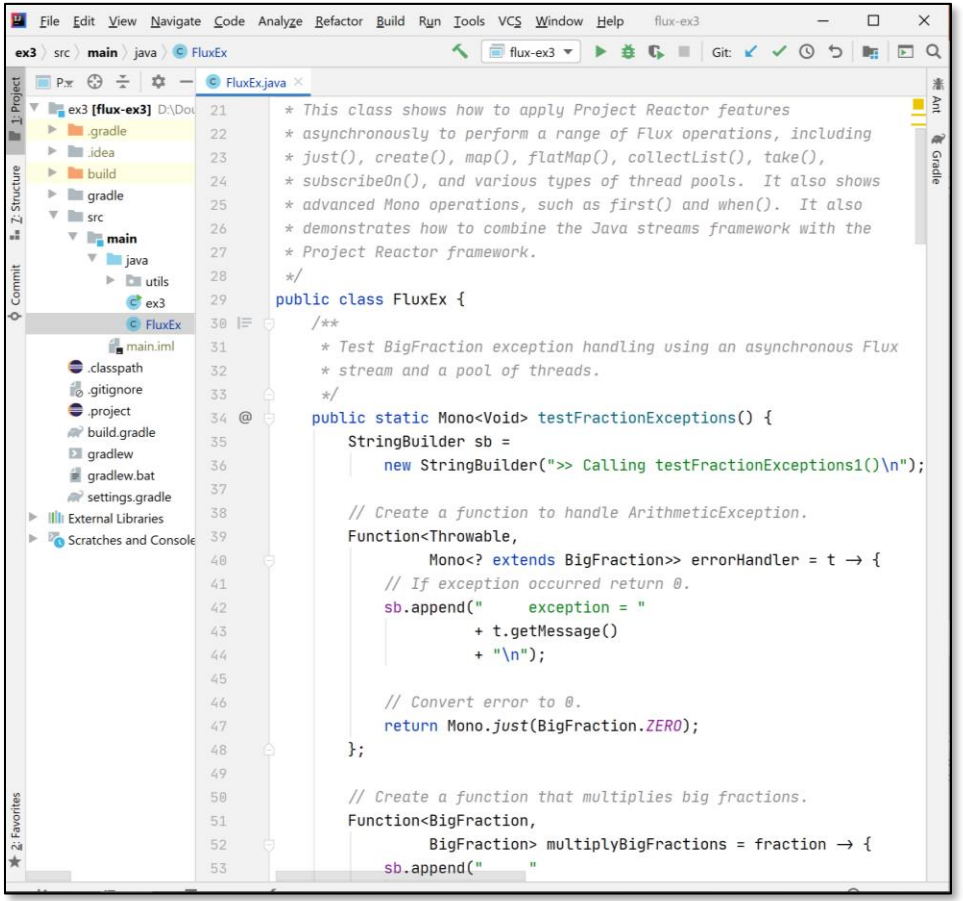


See www.mathsisfun.com/improper-fractions.html

Overview of the BigFraction Case Studies

Overview of the BigFraction Case Studies

- These case studies show how to reduce & multiply big fractions synchronously, asynchronously, & concurrently using Project Reactor & RxJava framework features



Overview of the BigFraction Case Studies

- The Project Reactor Mono case studies show how to reduce & multiply big fractions using the following Mono features
  - e.g., fromCallable(), just(), zipWith(), doOnSuccess(), first(), when(), then(), subscribeOn(), & various thread pools

```
BigFraction unreducedFraction =
  makeBigFraction(...);

return Mono
   .fromCallable(() -> BigFraction
        .reduce(unreducedFraction))
   .subscribeOn
       (Schedulers.single())
   .map(result ->
        result.toMixedString())
   .doOnSuccess(result ->
                  System.out.println
                   ("big fraction = "
                   + result + "\n"))
   .then();
```

See github.com/douglascraigschmidt/LiveLessons/tree/master/Reactive/Mono

Overview of the BigFraction Case Studies

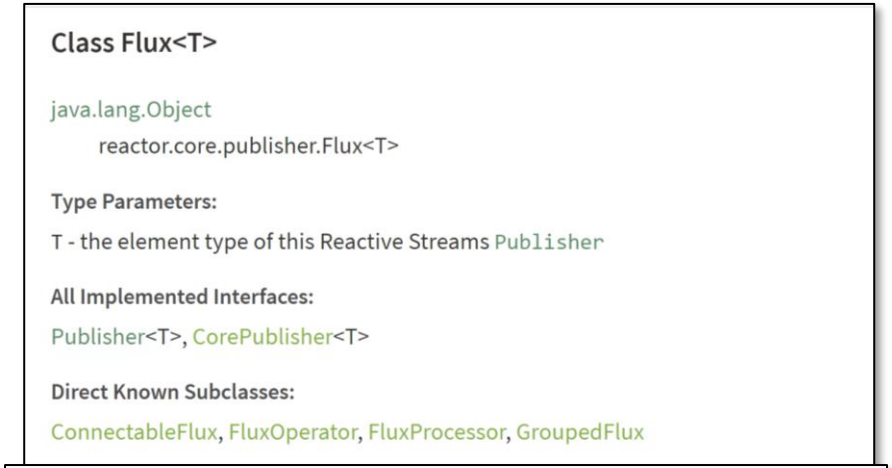
- The Project Reactor Flux case studies show how to reduce & multiply big fractions using the following Flux features
  - e.g., fromIterable(), just(), map(), create(), doOnNext(), flatMap(), take(), interval(), subscribeOn(), collectList(), subscribe(), & various thread pools

```
Flux
   .create
      (bigFractionEmitter)
   .take(sMAX_FRACTIONS)
   .flatMap(unreducedFraction ->
         reduceAndMultiplyFraction
          (unreducedFraction,
           Schedulers.parallel()))
   .collectList()
   .flatMap(list ->
            BigFractionUtils
              .sortAndPrintList
                 (list, sb));
```

See github.com/douglascraigschmidt/LiveLessons/tree/master/Reactive/Flux

Overview of the BigFraction Case Studies

- The Project Reactor Flux case studies show how to reduce & multiply big fractions using the following Flux features
  - e.g., fromIterable(), just(), map(), create(), doOnNext(), flatMap(), take(), interval(), subscribeOn(), collectList(), subscribe(), & various thread pools
  - They also demonstrate how the Java streams framework can be used together with the Project Reactor framework



Class Flux<T>

java.lang.Object
reactor.core.publisher.Flux<T>

Type Parameters:

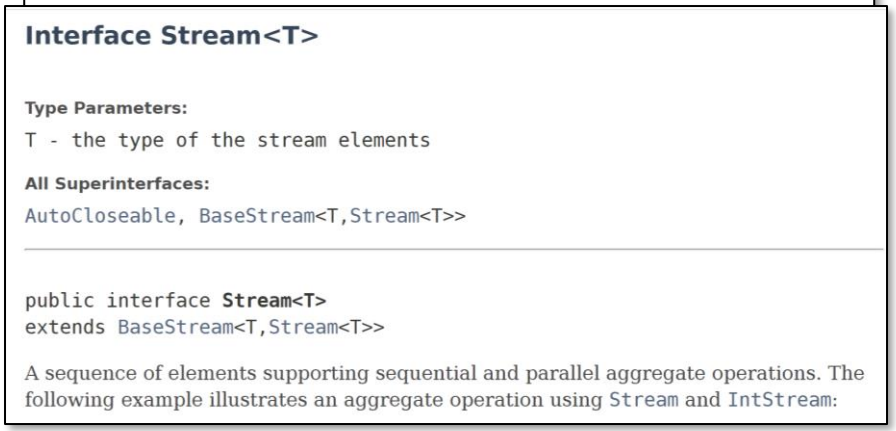
T - the element type of this Reactive Streams Publisher

All Implemented Interfaces:

Publisher<T>, CorePublisher<T>

Direct Known Subclasses:

ConnectableFlux, FluxOperator, FluxProcessor, GroupedFlux



Interface Stream<T>

Type Parameters:

T - the type of the stream elements

All Superinterfaces:

AutoCloseable, BaseStream<T,Stream<T>>

public interface Stream<T>
extends BaseStream<T,Stream<T>>

A sequence of elements supporting sequential and parallel aggregate operations. The following example illustrates an aggregate operation using Stream and IntStream:

Overview of the BigFraction Case Studies

- The RxJava Single case studies show how to reduce & multiply big fractions using the following Single features
  - e.g., fromCallable(), zipWith(), doOnSuccess(), ignoreElement(), subscribeOn(), map(), & the parallel thread pool

```
BigFraction unreducedFraction =
  makeBigFraction(...);

return Single
   .fromCallable(() -> BigFraction
        .reduce(unreducedFraction))
   .subscribeOn
       (Schedulers.single())
   .map(result ->
        result.toMixedString())
   .doOnSuccess(result ->
                  System.out.println
                   ("big fraction = "
                   + result + "\n"))
   .ignoreElement();
```

See github.com/douglascraigschmidt/LiveLessons/tree/master/Reactive/Single

Overview of the BigFraction Case Studies

- The RxJava Observable case studies show how to reduce & multiply big fractions using the following Observable features
  - e.g., just(), map(), create(), interval(), filter(), doOnNext(), blockingSubscribe(), take(), doOnComplete(), subscribe(), flatMap(), fromIterable(), subscribeOn(), observeOn(), range(), count(), collectList(), & various thread pools

```
return Observable
   .fromCallable(() -> BigFraction
           .reduce(unreducedFraction))

   .subscribeOn(scheduler)

   .flatMap(reducedFraction ->
       Observable
          .fromCallable(() ->
              reducedFraction.multiply
                 (sBigReducedFraction))
          .subscribeOn
             (scheduler));
```

See github.com/douglascraigschmidt/LiveLessons/tree/master/Reactive/Observable

Overview of the Project Reactor AsyncTester Class

Overview of the Project Reactor AsyncTester Class

- Most test methods in the BigFraction case studies run asynchronously via subscribeOn(), so these methods return before their computations complete

```
public static Mono<Void> testFractionReductionAsync() {
  BigFraction unreducedFraction = makeBigFraction(...);
  ...
  return Mono
    .fromCallable(() -> BigFraction.reduce(unreducedFraction))
    .subscribeOn(Schedulers.single())
    .map(result -> result.toMixedString())
    .doOnSuccess(result ->
                 System.out.println
                  ("big fraction = "
                  + result + "\n"))
    .then();
```

See Reactive/Mono/ex2/src/main/java/MonoEx.java

Overview of the Project Reactor AsyncTester Class

- It's therefore helpful to define a single location in the main test driver code that waits for all asynchronously executing test methods to complete

```
public static void main (String[] argv) ... {
  AsyncTester
    .register(MonoEx::testFractionReductionAsync);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .block();
  ...
}
```

See Reactive/Mono/ex2/src/main/java/ex2.java

Overview of the Project Reactor AsyncTester Class

- The AsyncTester class provides an API to register non-blocking test methods that run *asynchronously*

```
public static void main (String[] argv) ... {
  AsyncTester
    .register(MonoEx::testFractionReductionAsync);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .block();
  ...
}
```

Overview of the Project Reactor AsyncTester Class

- The AsyncTester class provides an API to register non-blocking test methods that run *asynchronously*

```
public static void main (String[] argv) ... {
  AsyncTester
    .register(MonoEx::testFractionReductionAsync);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .block();
  ...
}
```

This framework also handles test methods that run and/or block *synchronously*

Overview of the Project Reactor AsyncTester Class

- All registered test methods start running (a)synchronously when AsyncTester.runTests() is called

```
public static void main (String[] argv) ... {
  AsyncTester
    .register(MonoEx::testFractionReductionAsync);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .block();
  ...
}
```

Overview of the Project Reactor AsyncTester Class

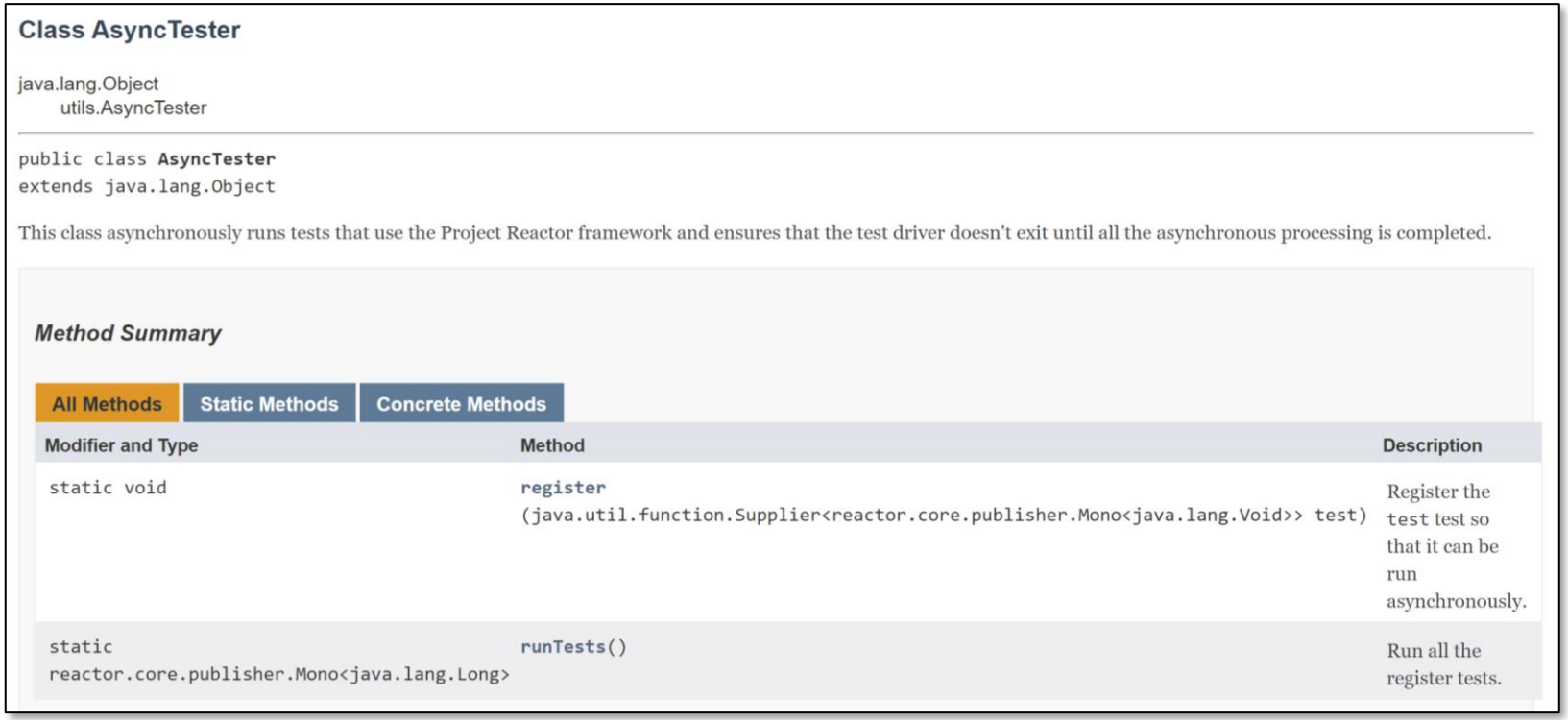
- The test driver then calls block() on the Mono returned from runTests() to wait for all the asynchronous processing to complete

```
public static void main (String[] argv) ... {
  AsyncTester
    .register(MonoEx::testFractionReductionAsync);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(MonoEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .block();
  ...
}
```

Overview of the Project Reactor AsyncTester Class

- The AsyncTester class provides a framework that asynchronously runs tests & ensures the test driver does not exit until all async processing completes



Class AsyncTester

java.lang.Object
    utils.AsyncTester

```
public class AsyncTester
extends java.lang.Object
```

This class asynchronously runs tests that use the Project Reactor framework and ensures that the test driver doesn't exit until all the asynchronous processing is completed.

Method Summary

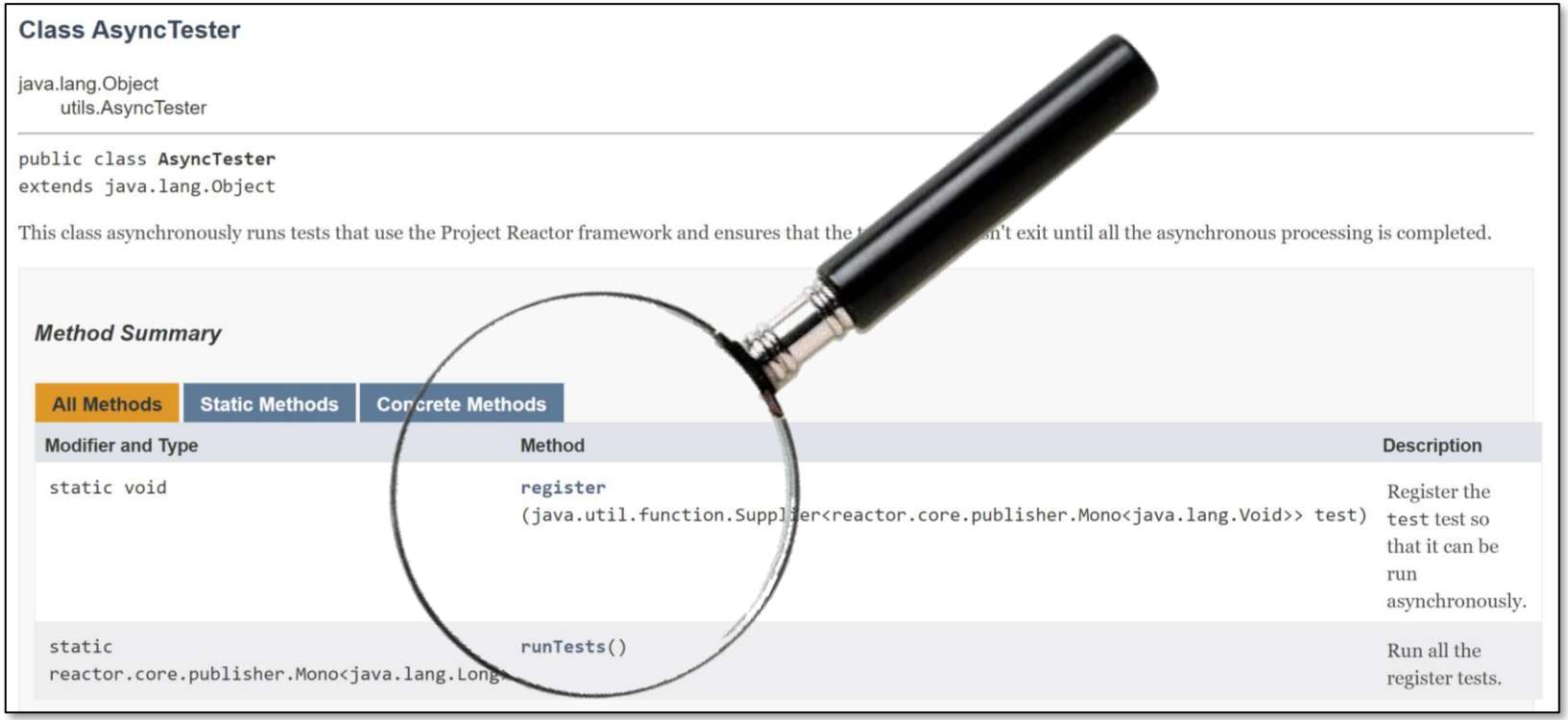
All Methods | Static Methods | Concrete Methods

Modifier and Type	Method	Description
static void	register (java.util.function.Supplier<reactor.core.publisher.Mono<java.lang.Void>> test)	Register the test test so that it can be run asynchronously.
static reactor.core.publisher.Mono<java.lang.Long>	runTests()	Run all the register tests.

See Reactive/Mono/ex2/src/main/java/utils/AsyncTester.java

Overview of the Project Reactor AsyncTester Class

- The AsyncTester class provides a framework that asynchronously runs tests & ensures the test driver does not exit until all async processing completes



We'll explore this AsyncTester class after covering Mono & Flux in more detail

Overview of the RxJava AsyncTester Class

Overview of the RxJava AsyncTester Class

- Most test methods in the BigFraction case studies run asynchronously via subscribeOn(), so these methods return before their computations complete

```
public static Completable testFractionReductionAsync() {
  BigFraction unreducedFraction = makeBigFraction(...);
  ...
  return Mono
    .fromCallable(() -> BigFraction.reduce(unreducedFraction))
    .subscribeOn(Schedulers.single())
    .map(result -> result.toMixedString())
    .doOnSuccess(result ->
                 System.out.println
                  ("big fraction = "
                  + result + "\n"))
    .ignoreElement();
```

See Reactive/Single/ex2/src/main/java/SingleEx.java

Overview of the RxJava AsyncTester Class

- It's therefore helpful to define a single location in the main test driver code that waits for all asynchronously executing test methods to complete

```
public static void main (String[] argv) ... {
  AsyncTester
    .register(SingleEx::testFractionReductionAsync);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .blockingGet();
  ...
}
```

See Reactive/Single/ex2/src/main/java/ex2.java

Overview of the RxJava AsyncTester Class

- The AsyncTester class provides an API to register non-blocking test methods that run *asynchronously*

```
public static void main (String[] argv) ... {
  AsyncTester
    .register(SingleEx::testFractionReductionAsync);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .blockingGet();
  ...
}
```

Overview of the RxJava AsyncTester Class

- The AsyncTester class provides an API to register non-blocking test methods that run *asynchronously*

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public static void main (String[] argv) ... {
  AsyncTester
    .register(SingleEx::testFractionReductionAsync);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .blockingGet();
  ...
}
```

This framework also handles test methods that run and/or block *synchronously*

Overview of the RxJava AsyncTester Class

- All registered test methods start running (a)synchronously when AsyncTester.runTests() is called

```
public static void main (String[] argv) ... {
  AsyncTester
    .register(SingleEx::testFractionReductionAsync);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .blockingGet();
  ...
}
```

Overview of the RxJava AsyncTester Class

- The test driver then calls blockingGet() on the Single returned from runTests() to wait for all the asynchronous processing to complete

```
public static void main (String[] argv) ... {
  AsyncTester
    .register(SingleEx::testFractionReductionAsync);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable1);
  AsyncTester
    .register(SingleEx::testFractionMultiplicationCallable2);

  long testCount = AsyncTester
    .runTests()
    .blockingGet();
  ...
}
```

Overview of the RxJava AsyncTester Class

- The AsyncTester class provides a framework that asynchronously runs tests & ensures the test driver does not exit until all async processing completes

public class **AsyncTester**
extends java.lang.Object

This class asynchronously runs tests that use the RxJava framework and ensures that the test driver doesn't exit until all the asynchronous processing is completed.

Constructor Summary

Constructors

Constructor	Description
`AsyncTester()`	

Method Summary

All Methods | **Static Methods** | **Concrete Methods**

Modifier and Type	Method	Description
`static void`	`register (io.reactivex.rxjava3.functions.Supplier<io.reactivex.rxjava3.core.Completable> test)`	Register the `test` test so that it can be run asynchronously.
`static io.reactivex.rxjava3.core.Single<java.lang.Long>`	`runTests()`	Run all the register tests.

See Reactive/Single/ex2/src/main/java/utils/AsyncTester.java

Overview of the RxJava AsyncTester Class

- The AsyncTester class provides a framework that asynchronously runs tests & ensures the test driver does not exit until all async processing completes

We'll explore this AsyncTester class after covering Single & Observable in detail

End of Overview of the BigFraction Case Studies