Applying Key Methods in the Observable Class (Part 3)

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

- Recognize key methods in the Observable class & how they are applied in the case studies

Class Observable<T>

java.lang.Object
    io.reactivex.rxjava3.core.Observable<T>

Type Parameters:
    `T` - the type of the items emitted by the `Observable`

All Implemented Interfaces:
    ObservableSource<T>

Direct Known Subclasses:
    ConnectableObservable, GroupedObservable, Subject

```
public abstract class Observable<T>
extends Object
implements ObservableSource<T>
```

The `Observable` class is the non-backpressured, optionally multi-valued base reactive class that offers factory methods, intermediate operators and the ability to consume synchronous and/or asynchronous reactive dataflows.

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/core/Observable.html

Learning Objectives in this Part of the Lesson

- Case study ex2 shows how to apply various RxJava operations *asynchronously* to determine if randomly-generated BigInteger objects are prime or not
  - e.g., create(), interval(), map(), filter(), doOnNext(), take(), doOnComplete(), subscribe(), subscribeOn(), observeOn(), range(), ignoreElements(), count(), & various thread pools

```
Observable
   .create(ObservableEx::emitAsync)
   .doOnNext(s -> ObservableEx
                  .print(s, sb))
   .observeOn(Schedulers.newThread())
   .map(bi ->
        ObservableEx.checkIfPrime
          (bi, sb))
   .doOnNext(bi -> ObservableEx
              .processResult(bi, sb))
   .doOnComplete
      (() -> BigFractionUtils
       .display(sb.toString()))
   .ignoreElements();
```

See github.com/douglascraigschmidt/LiveLessons/tree/master/Reactive/Observable/ex2

Applying Key Methods in the Observable Class to ex2

Applying Key Methods in the Observable Class to ex2

- testIsPrimeAsync()
  - Use an asynchronous Observable stream that processes random BigInteger objects to determine which ones are prime

```
Observable
   .create(ObservableEx::emitAsync)
   .doOnNext(s -> ObservableEx
                  .print(s, sb))
   .observeOn(Schedulers.newThread())
   .map(bi ->
        ObservableEx.checkIfPrime
          (bi, sb))
   .doOnNext(bi -> ObservableEx
              .processResult(bi, sb))
   .doOnComplete
      (() -> BigFractionUtils
       .display(sb.toString()))
   .ignoreElements();
```

See Reactive/Observable/ex2/src/main/java/ObservableEx.java

Applying Key Methods in the Observable Class to ex2

- testIsPrimeAsync()
  - Use an asynchronous Observable stream that processes random BigInteger objects to determine which ones are prime
  - Demonstrates create(), map(), filter(), doOnNext(), take(), doOnComplete(), subscribe(), subscribeOn(), observeOn(), range(), ignoreElements() & Schedulers.newThread()

```
Observable
   .create(ObservableEx::emitAsync)
   .doOnNext(s -> ObservableEx
                  .print(s, sb))
   .observeOn(Schedulers.newThread())
   .map(bi ->
        ObservableEx.checkIfPrime
          (bi, sb))
   .doOnNext(bi -> ObservableEx
              .processResult(bi, sb))
   .doOnComplete
      (() -> BigFractionUtils
       .display(sb.toString()))
   .ignoreElements();
```

Applying Key Methods in the Observable Class to ex2

- The range() method
  - Build a Observable that only emits a sequence of incrementing integers

```
static Observable<Integer> range
   (int start, int count)
```

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/core/Observable.html#range

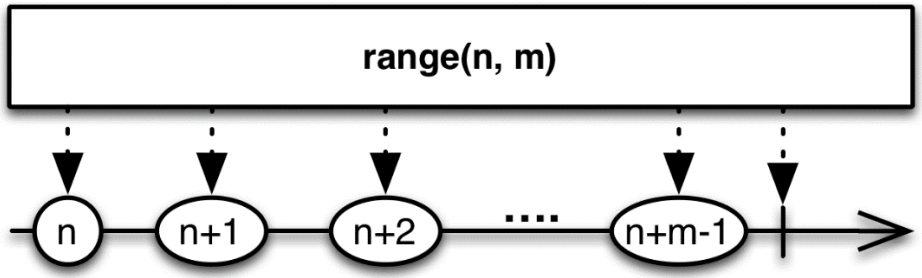
Applying Key Methods in the Observable Class to ex2

- The range() method
  - Build a Observable that only emits a sequence of incrementing integers
  - range() emits integers between start & start + count & then completes

```
static Observable<Integer> range
   (int start, int count)
```

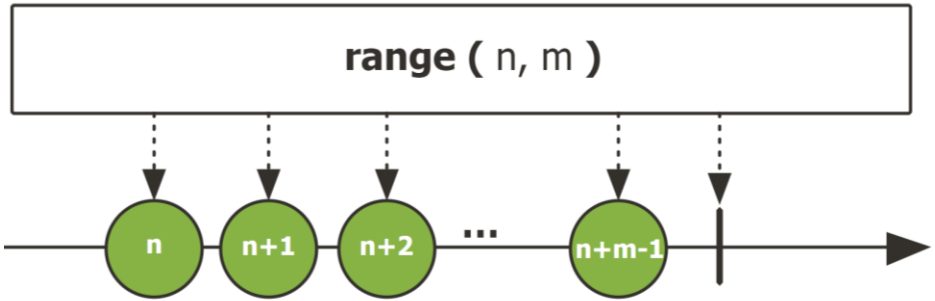
Applying Key Methods in the Observable Class to ex2

- The range() method
  - Build a Observable that only emits a sequence of incrementing integers
  - range() emits integers between start & start + count & then completes
    - start is included in the range, up to & including count



Applying Key Methods in the Observable Class to ex2

- The range() method
  - Build a Observable that only emits a sequence of incrementing integers
  - range() emits integers between start & start + count & then completes
  - Project Reactor's Flux.range() method works the same



Applying Key Methods in the Observable Class to ex2

- The range() method
  - Build a Observable that only emits a sequence of incrementing integers
  - range() emits integers between start & start + count & then completes
  - Project Reactor's Flux.range() method works the same
  - Similar to the IntStream.rangeClosed() method in Java Streams

rangeClosed

```
static IntStream rangeClosed(int startInclusive,
                             int endInclusive)
```

Returns a sequential ordered `IntStream` from `startInclusive` (inclusive) to `endInclusive` (inclusive) by an incremental step of 1.

API Note:

An equivalent sequence of increasing values can be produced sequentially using a for loop as follows:

```
for (int i = startInclusive; i <= endInclusive ; i++) { ... }
```

Parameters:

`startInclusive` - the (inclusive) initial value

`endInclusive` - the inclusive upper bound

Returns:

a sequential `IntStream` for the range of int elements

See docs.oracle.com/javase/8/docs/api/java/util/stream/IntStream.html#rangeClosed

Applying Key Methods in the Observable Class to ex2

- The subscribeOn() method
  - Run subscribe(), onSubscribe(), & request() on the specified Scheduler worker

```
Observable<T>
subscribeOn(Scheduler scheduler)
```

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/core/Observable.html#subscribeOn

Applying Key Methods in the Observable Class to ex2

- The subscribeOn() method
  - Run subscribe(), onSubscribe(), & request() on the specified Scheduler worker
    - The scheduler param indicates what thread to perform the operation on

```
Observable<T>
subscribeOn(Scheduler scheduler)
```

Class Scheduler

java.lang.Object
    io.reactivex.rxjava3.core.Scheduler

Direct Known Subclasses:
    TestScheduler

```
public abstract class Scheduler
extends Object
```

A `Scheduler` is an object that specifies an API for scheduling units of work provided in the form of `Runnables` to be executed without delay (effectively as soon as possible), after a specified time delay or periodically and represents an abstraction over an asynchronous boundary that ensures these units of work get executed by some underlying task-execution scheme (such as custom Threads, event loop, `Executor` or Actor system) with some uniform properties and guarantees regardless of the particular underlying scheme.

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/core/Scheduler.html

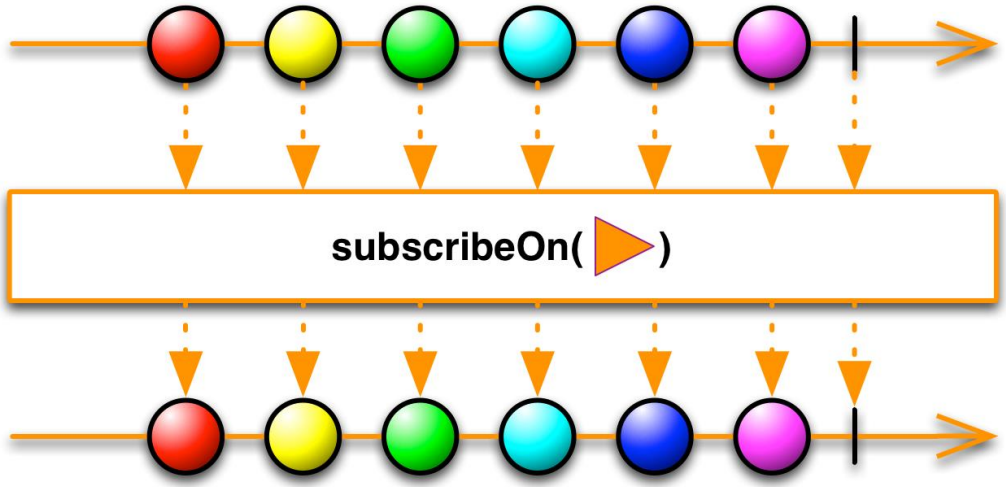
Applying Key Methods in the Observable Class to ex2

- The subscribeOn() method
  - Run subscribe(), onSubscribe(), & request() on the specified Scheduler worker
    - The scheduler param indicates what thread to perform the operation on
    - Returns the Observable requesting async processing

```
Observable<T>
subscribeOn(Scheduler scheduler)
```

Applying Key Methods in the Observable Class to ex2

- The subscribeOn() method
  - Run subscribe(), onSubscribe(), & request() on the specified Scheduler worker
  - The subscribeOn() semantics are a bit unusual



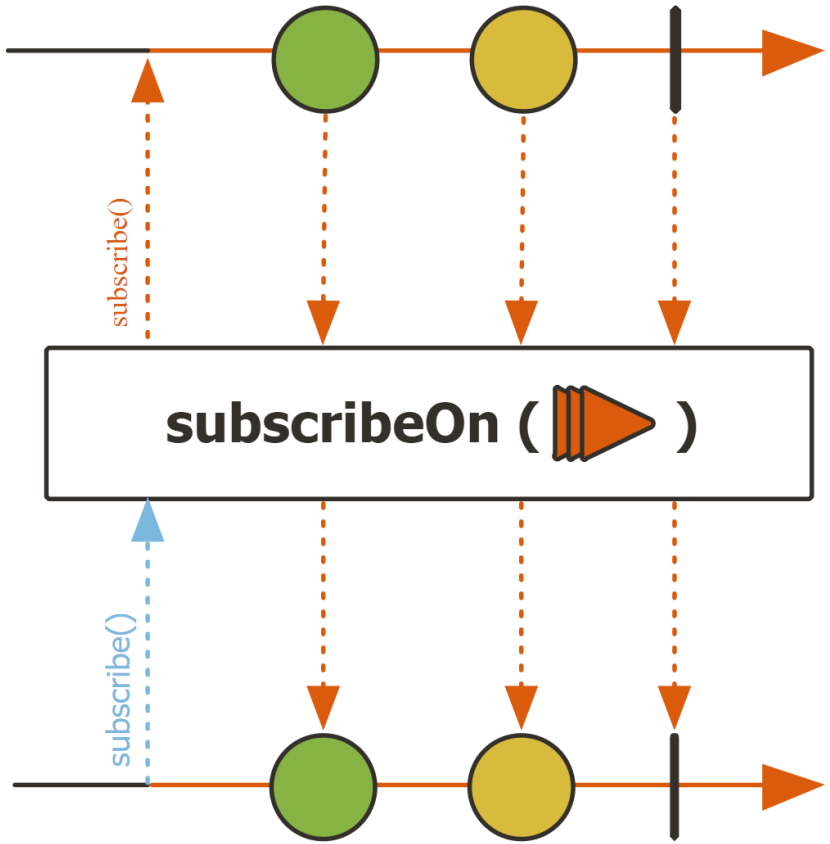
Applying Key Methods in the Observable Class to ex2

- The subscribeOn() method
  - Run subscribe(), onSubscribe(), & request() on the specified Scheduler worker
  - The subscribeOn() semantics are a bit unusual
    - Placing this operator in a chain impacts the execution context of the onNext(), onError(), & onComplete() signals
      - i.e., from beginning of chain up to the next occurrence of an observeOn() (if any)

```
Observable
    .range(1, sMAX_ITERATIONS)
    .subscribeOn(Schedulers
       .newThread())
    .map(__ -> BigInteger
      .valueOf(lowerBound + rand
        .nextInt(sMAX_ITERATIONS)))
    .doOnNext(s ->
         ObservableEx.print(s, sb))
    .subscribe(emitter::next,
               error ->
               emitter.complete(),
               emitter::complete);
```

Applying Key Methods in the Observable Class to ex2

- The subscribeOn() method
  - Run subscribe(), onSubscribe(), & request() on the specified Scheduler worker
  - The subscribeOn() semantics are a bit unusual
  - Project Reactor's method Flux.subscribeOn() works the same



See projectreactor.io/docs/core/release/api/reactor/core/publisher/Flux.html#subscribeOn

Applying Key Methods in the Observable Class to ex2

- The observeOn() method
  - Run onNext(), onComplete(), & onError() on a supplied Scheduler worker

```
Observable<T>
observeOn(Scheduler scheduler)
```

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/core/Observable.html#observeOn

Applying Key Methods in the Observable Class to ex2

- The observeOn() method
  - Run onNext(), onComplete(), & onError() on a supplied Scheduler worker
    - The scheduler param indicates what thread to perform the operation on

```
Observable<T>
observeOn(Scheduler scheduler)
```

Class Scheduler

java.lang.Object
io.reactivex.rxjava3.core.Scheduler

Direct Known Subclasses:
TestScheduler

```
public abstract class Scheduler
extends Object
```

A `Scheduler` is an object that specifies an API for scheduling units of work provided in the form of `Runnables` to be executed without delay (effectively as soon as possible), after a specified time delay or periodically and represents an abstraction over an asynchronous boundary that ensures these units of work get executed by some underlying task-execution scheme (such as custom Threads, event loop, `Executor` or Actor system) with some uniform properties and guarantees regardless of the particular underlying scheme.

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/core/Scheduler.html

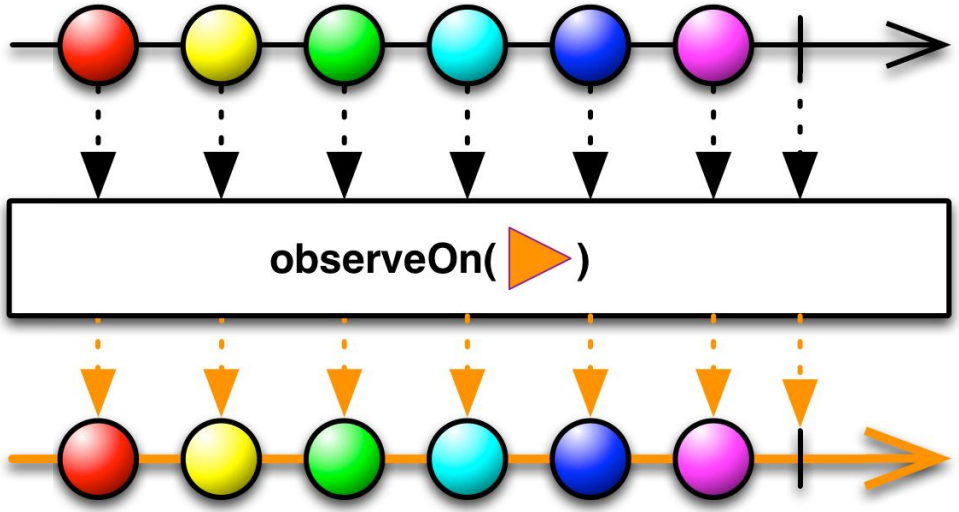
Applying Key Methods in the Observable Class to ex2

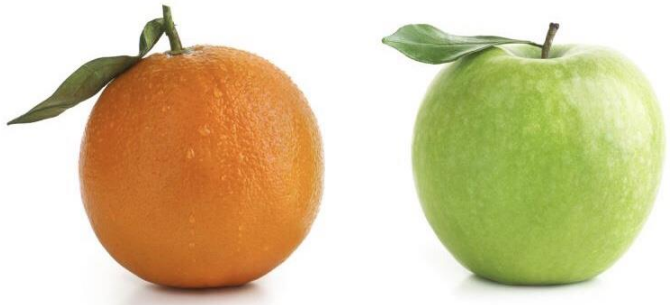
- The observeOn() method
  - Run onNext(), onComplete(), & onError() on a supplied Scheduler worker
    - The scheduler param indicates what thread to perform the operation on
    - Returns the Observable requesting async processing

```
Observable<T>
observeOn(Scheduler scheduler)
```

Applying Key Methods in the Observable Class to ex2

- The observeOn() method
  - Run onNext(), onComplete(), & onError() on a supplied Scheduler worker
  - The observeOn() semantics are fairly straightforward





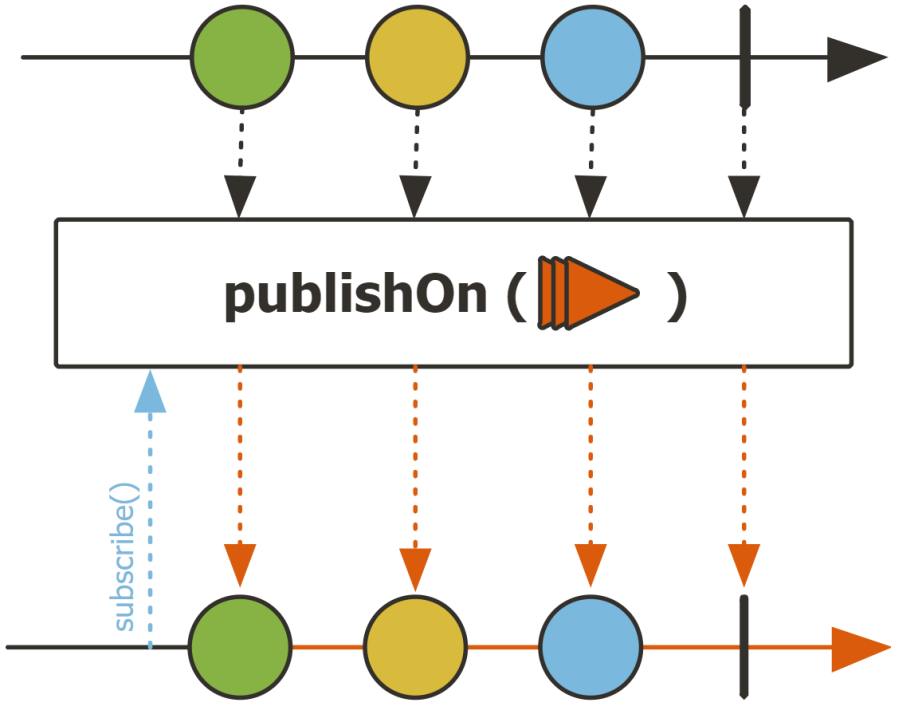
Applying Key Methods in the Observable Class to ex2

- The observeOn() method
  - Run onNext(), onComplete(), & onError() on a supplied Scheduler worker
  - The observeOn() semantics are fairly straightforward
    - It influences the threading context where the rest of the operators in the chain below it execute
      - Up to a new occurrence of observeOn() in a chain (if any)

```
return Observable
   .create(ObservableEx::emitAsync)
   .observeOn(Schedulers
      .newThread())
   .map(bi -> ObservableEx
        .checkIfPrime(bi, sb))
   .doOnNext(bi -> ObservableEx
      .processResult(bi, sb))
   .doOnComplete(() ->
         BigFractionUtils
         .display(sb.toString()))
   .count()
   .ignoreElement();
```

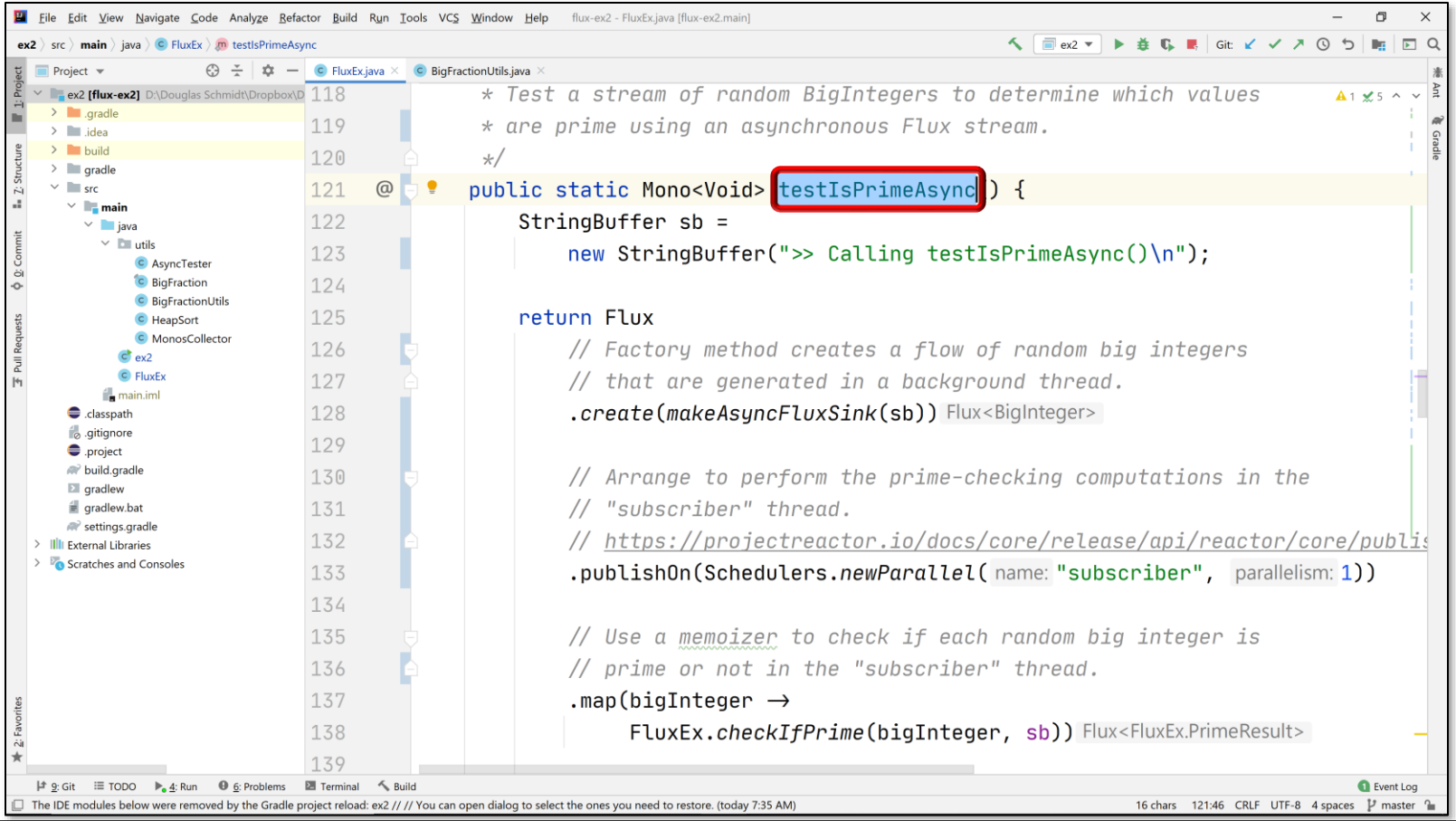
Applying Key Methods in the Observable Class to ex2

- The observeOn() method
  - Run onNext(), onComplete(), & onError() on a supplied Scheduler worker
  - The observeOn() semantics are fairly straightforward
  - Project Reactor's method Flux.publishOn() works the same



See projectreactor.io/docs/core/release/api/reactor/core/publisher/Flux.html#publishOn

Applying Key Methods in Observable & Single to ex2



See github.com/douglascraigschmidt/LiveLessons/tree/master/Reactive/Observable/ex2

End of Applying Key Methods in the Observable Class (Part 3)