Key Factory Method Operators in the Observable Class (Part 1)

Douglas C. Schmidt

d.schmidt@vanderbilt.edu

www.dre.vanderbilt.edu/~schmidt

Professor of Computer Science

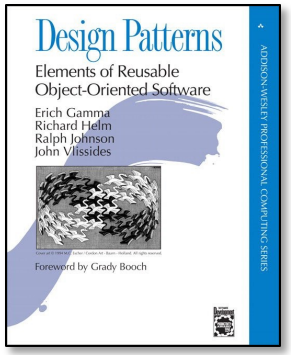
Institute for Software Integrated Systems

Vanderbilt University

Nashville, Tennessee, USA

Learning Objectives in this Part of the Lesson

- Recognize key operators defined in—or used with—Observables
  - Factory method operators
    - These operators create reactive Observable streams in various ways from non-reactive input sources
      - e.g., just(), fromArray(), fromIterable(), & fromCallable()



See en.wikipedia.org/wiki/Factory_method_pattern

Key Factory Method Operators in the Observable Class

Key Factory Method Operators in the Observable Class

- The just() operator
  - Creates an Observable that emits the given element(s) & then completes

```
static <T> Observable<T>
           just(T... data)
```

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

Key Factory Method Operators in the Observable Class

- The just() operator
  - Creates an Observable that emits the given element(s) & then completes
    - The param(s) are the elements to emit, as a varargs param

```
static <T> Observable<T>
           just(T... data)
```

See www.baeldung.com/java-varargs

Key Factory Method Operators in the Observable Class

- The just() operator
  - Creates an Observable that emits the given element(s) & then completes
    - The param(s) are the elements to emit, as a varargs param
  - Returns a new Observable that's captured at "assembly time"
    - i.e., it's "eager"

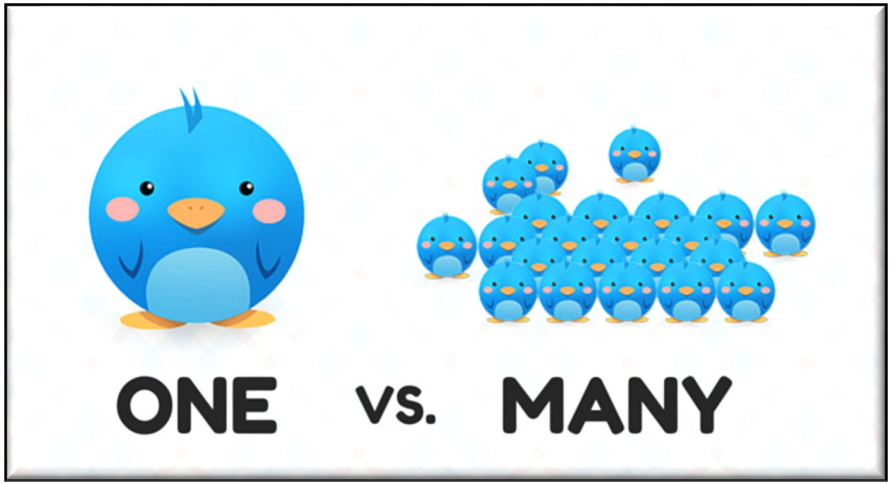
```
static <T> Observable<T>
           just(T... data)
```

Contrast with the discussion of the Observable.fromCallable() operator later in this lesson

Key Factory Method Operators in the Observable Class

- The just() operator
  - Creates an Observable that emits the given element(s) & then completes
    - The param(s) are the elements to emit, as a varargs param
    - Returns a new Observable that's captured at "assembly time"
    - Multiple elements can be emitted, unlike the Single.just() operator

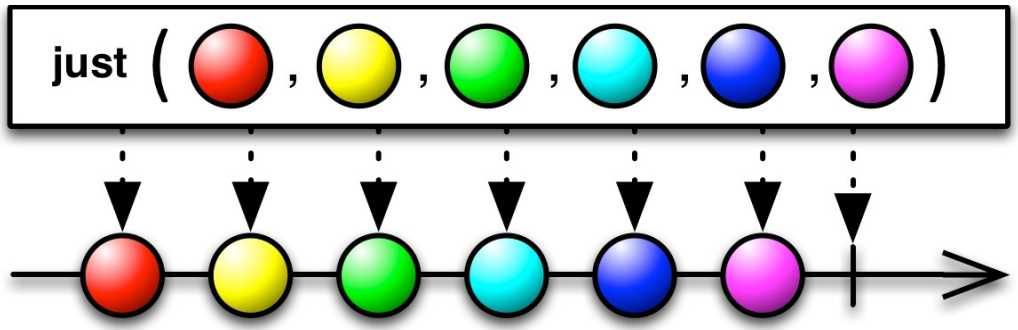
```
static <T> Observable<T>
           just(T... data)
```



See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/core/Single.html#just

Key Factory Method Operators in the Observable Class

- The just() operator
  - Creates an Observable that emits the given element(s) & then completes
  - This factory method adapts non-reactive input sources into the reactive model



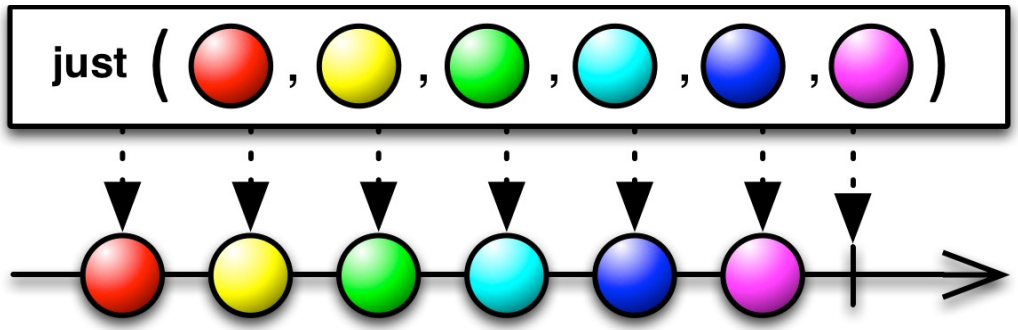

```
Observable
        .just(BigFraction.valueOf(100,3),
              BigFraction.valueOf(100,4),
              BigFraction.valueOf(100,2),
              BigFraction.valueOf(100,1))
        ...
```

Create an Observable stream of four BigFraction objects

See Reactive/Observable/ex1/src/main/java/ObservableEx.java

Key Factory Method Operators in the Observable Class

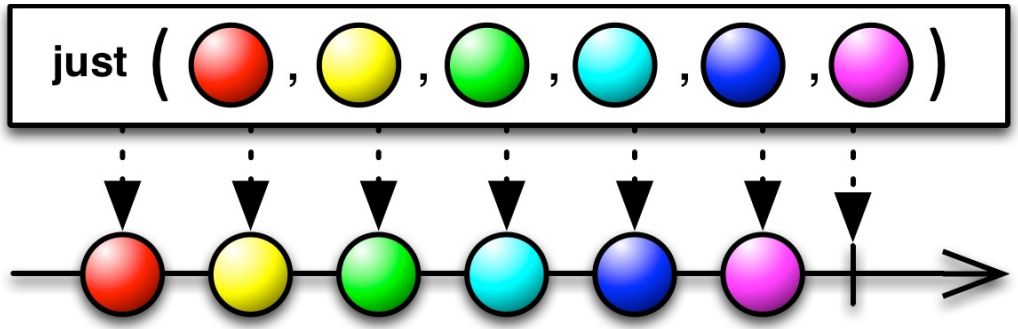
- The just() operator
  - Creates an Observable that emits the given element(s) & then completes
  - This factory method adapts non-reactive input sources into the reactive model
    - just() is evaluated eagerly at "assembly time"

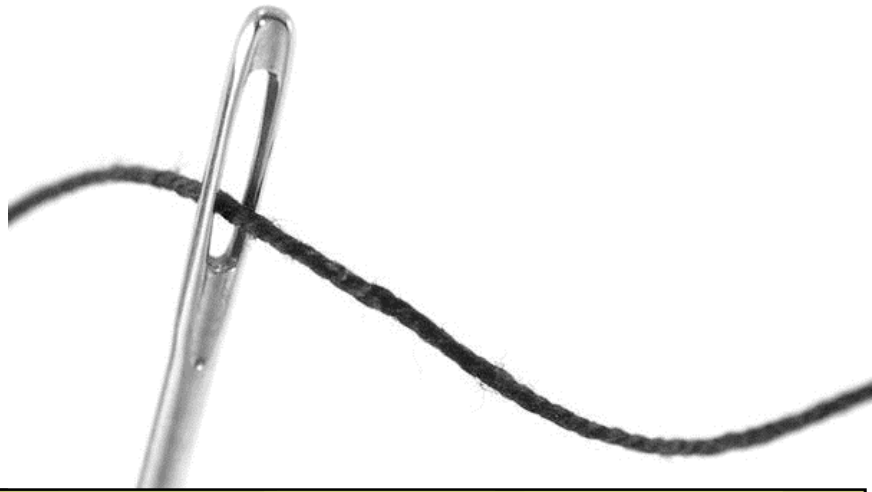


See proandroiddev.com/operator-fusion-in-rxjava-2-dcd6612cffae

Key Factory Method Operators in the Observable Class

- The just() operator
  - Creates an Observable that emits the given element(s) & then completes
  - This factory method adapts non-reactive input sources into the reactive model
    - just() is evaluated eagerly at "assembly time"
    - It therefore always runs in the context of the thread where the Observable is instantiated

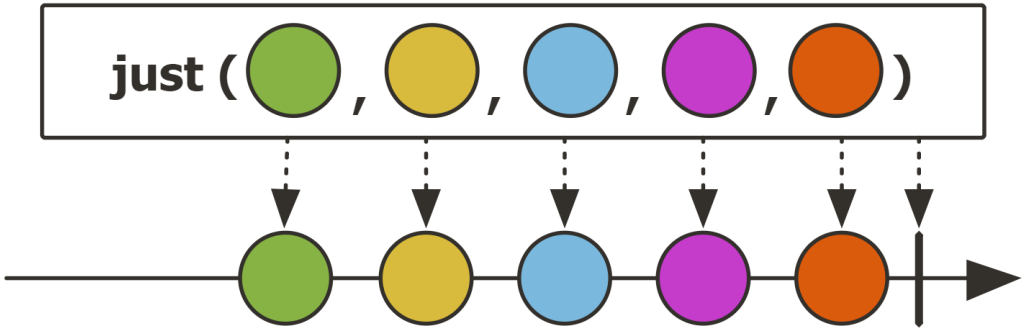




The fromIterable() & fromArray() factory method operators also evaluate eagerly

Key Factory Method Operators in the Observable Class

- The just() operator
  - Creates an Observable that emits the given element(s) & then completes
  - This factory method adapts non-reactive input sources into the reactive model
  - Project Reactor's Flux.just() operator works the same




```
Flux
   .just(BigFraction.valueOf(100,3),
         BigFraction.valueOf(100,4),
         BigFraction.valueOf(100,2),
         BigFraction.valueOf(100,1))
   ...
```

Create a Flux stream of four BigFraction objects

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

Key Factory Method Operators in the Observable Class

- The just() operator
  - Creates an Observable that emits the given element(s) & then completes
  - This factory method adapts non-reactive input sources into the reactive model
  - Project Reactor's Flux.just() operator works the same
- Similar to Stream.of() factory method in Java Streams

of

```
@SafeVarargs
static <T> Stream<T> of(T... values)
```

Returns a sequential ordered stream whose elements are the specified values.

Type Parameters:

T - the type of stream elements

Parameters:

values - the elements of the new stream

Returns:

the new stream

```
Stream
   .of(BigFraction.valueOf(100,3),
       BigFraction.valueOf(100,4),
       BigFraction.valueOf(100,2),
       BigFraction.valueOf(100,1))
...
```

Create a stream of 4 BigFraction objects

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

Key Factory Method Operators in the Observable Class

- The fromArray() operator
  - Create an Observable that emits items from a Java built-in array

```
static <T> Observable<T>
   fromArray(T[] array)
```

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

Key Factory Method Operators in the Observable Class

- The fromArray() operator
  - Create an Observable that emits items from a Java built-in array
    - The param provides the array to read the data from

```
static <T> Observable<T>
  fromArray(T[] array)
```

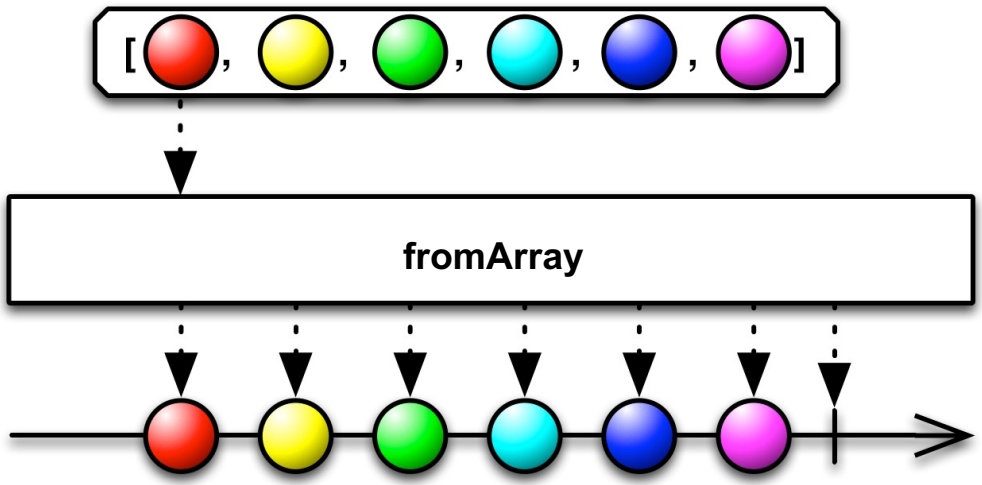
Key Factory Method Operators in the Observable Class

- The fromArray() operator
  - Create an Observable that emits items from a Java built-in array
    - The param provides the array to read the data from
    - The returned Observable emits the items from the array

```
static <T> Observable<T>
  fromArray(T[] array)
```

Key Factory Method Operators in the Observable Class

- The fromArray() operator
  - Create an Observable that emits items from a Java built-in array
  - This factory method operator also adapts non-reactive input sources into the reactive model



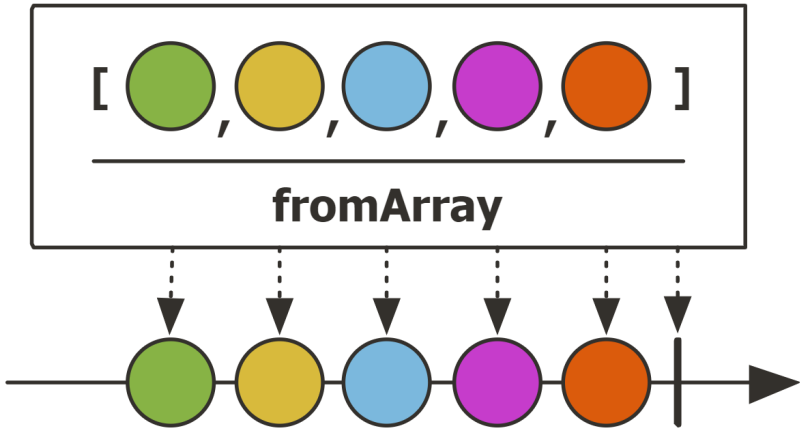

```
Integer[] array =
  {0, 1, 1, 2, 3, 5, 8, 13, 21};

Observable
    .fromArray(array)
    ...
```

Create an Observable stream of Integer objects from a built-in array

See Reactive/Observable/ex1/src/main/java/ObservableEx.java

Key Factory Method Operators in the Observable Class

- The fromArray() operator
  - Create an Observable that emits items from a Java built-in array
  - This factory method operator also adapts non-reactive input sources into the reactive model
  - Project Reactor's operator Flux.fromArray() works the same




```
Integer[] array =
  {0, 1, 1, 2, 3, 5, 8, 13, 21};

Flux
    .fromArray(array)
    ...
```

Create a Flux stream of Integer objects from a Java built-in array

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

Key Factory Method Operators in the Observable Class

- The fromArray() operator
  - Create an Observable that emits items from a Java built-in array
  - This factory method operator also adapts non-reactive input sources into the reactive model
  - Project Reactor's operator Flux.fromArray() works the same
- Similar to the of() method in Java Streams

of

```
@SafeVarargs
static <T> Stream<T> of(T... values)
```

Returns a sequential ordered stream whose elements are the specified values.

Type Parameters:

T - the type of stream elements

Parameters:

values - the elements of the new stream

Returns:

the new stream

```
Integer[] array =
  {0, 1, 1, 2, 3, 5, 8, 13, 21};

Stream
   .of(array)
   ...
```

Create a stream of Integer objects from a built-in array

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

Key Factory Method Operators in the Observable Class

- The fromArray() operator
  - Create an Observable that emits items from a Java built-in array
  - This factory method operator also adapts non-reactive input sources into the reactive model
  - Project Reactor's operator Flux.fromArray() works the same
- Similar to the of() method in Java Streams
  - Also, similar to the stream() method in Java Arrays

stream

```
public static <T> Stream<T> stream(T[] array)
```

Returns a sequential Stream with the specified array as its source.

Type Parameters:

T - The type of the array elements

Parameters:

array - The array, assumed to be unmodified during use

Returns:

a Stream for the array

```
Integer[] array =
  {0, 1, 1, 2, 3, 5, 8, 13, 21};

Arrays
   .stream(array)
   ...
```

Create a stream of Integer objects from a built-in array

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

Key Factory Method Operators in the Observable Class

- The fromIterable() operator
  - Create an Observable that emits the items contained in the given Iterable

```
static <T> Observable<T>
fromIterable
   (Iterable<? extends T> it)
```

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

Key Factory Method Operators in the Observable Class

- The fromIterable() operator
  - Create an Observable that emits the items contained in the given Iterable
    - The Iterable.iterator() method will be invoked at least once & at most twice for each subscriber

```
static <T> Observable<T>
fromIterable
   (Iterable<? extends T> it)
```

Interface Iterable<T>

Type Parameters:

T - the type of elements returned by the iterator

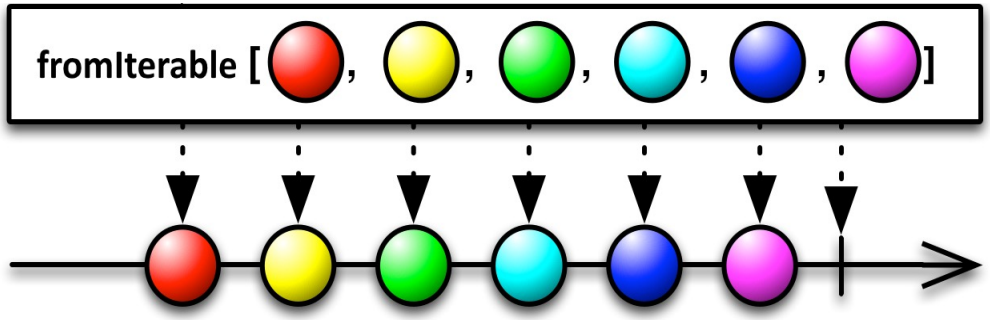
All Known Subinterfaces:

BeanContext, BeanContextServices, BlockingDeque<E>, BlockingQueue<E>, Collection<E>, Deque<E>, DirectoryStream<T>, List<E>, NavigableSet<E>, Path, Queue<E>, SecureDirectoryStream<T>, Set<E>, SortedSet<E>, TransferQueue<E>

See docs.oracle.com/javase/8/docs/api/java/lang/Iterable.html

Key Factory Method Operators in the Observable Class

- The fromIterable() operator
  - Create an Observable that emits the items contained in the given Iterable
  - This factory method adapts non-reactive input sources into the reactive model
    - e.g., Java collections like List & Set



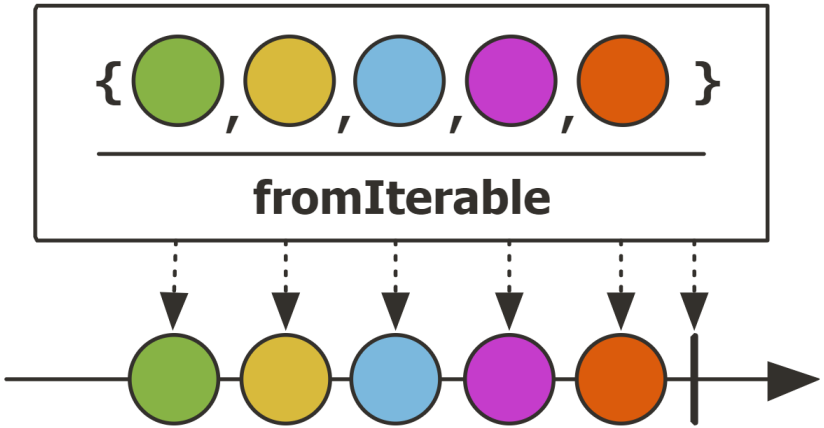

```
List<Integer> denominators =
  List.of(3, 4, 2, 0 1);

Observable
   .fromIterable(denominators)
   ...
```

Create an Observable stream of Integer objects from a Java List collection

See Reactive/Observable/ex1/src/main/java/ObservableEx.java

Key Factory Method Operators in the Observable Class

- The fromIterable() operator
  - Create an Observable that emits the items contained in the given Iterable
  - This factory method adapts non-reactive input sources into the reactive model
- Project Reactor's Flux.fromIterable() operator works the same




```
List<Integer> list =
  List.of(0,1,1,2,3,5,8,13,21);
```

Create a Flux stream of Integer objects from a Java List collection

```
Flux
  .fromIterable(list)
  ...
```

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

Key Factory Method Operators in the Observable Class

- The fromIterable() operator
  - Create an Observable that emits the items contained in the given Iterable
  - This factory method adapts non-reactive input sources into the reactive model
  - Project Reactor's Flux.fromIterable() operator works the same
  - Similar to the Collection.stream() method in Java Streams

stream

`default Stream<E> stream()`

Returns a sequential `Stream` with this collection as its source.

This method should be overridden when the `spliterator()` method cannot return a spliterator that is `IMMUTABLE`, `CONCURRENT`, or *late-binding*. (See `spliterator()` for details.)

Implementation Requirements:

The default implementation creates a sequential `Stream` from the collection's `Spliterator`.

Returns:

a sequential `Stream` over the elements in this collection

```
List<Integer> list =
  List.of(0,1,1,2,3,5,8,13,21);

list.stream()...
```

Create a stream of Integer objects

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

Key Factory Method Operators in the Observable Class

- The fromCallable() operator
  - Returns an Observable that, when an observer subscribes to it, does certain things

```
static <T> Observable<T>
  fromCallable(Callable<? extends T>
                 callable)
```

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

Key Factory Method Operators in the Observable Class

- The fromCallable() operator
  - Returns an Observable that, when an observer subscribes to it, does certain things
    - Invokes a Callable param

```
static <T> Observable<T>
  fromCallable(Callable<? extends T>
                 callable)
```

Interface Callable<V>

Type Parameters:

V - the result type of method call

All Known Subinterfaces:

DocumentationTool.DocumentationTask, JavaCompiler.CompilationTask

Functional Interface:

This is a functional interface and can therefore be used as the assignment target for a lambda expression or method reference.

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/Callable.html

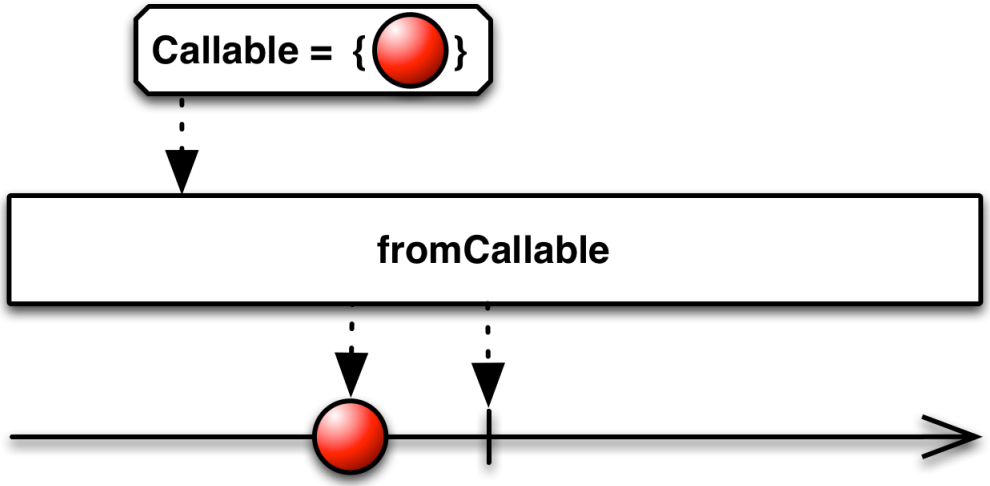
Key Factory Method Operators in the Observable Class

- The fromCallable() operator
  - Returns an Observable that, when an observer subscribes to it, does certain things
    - Invokes a Callable param
    - The returned Observable emits the value returned from the Callable

```
static <T> Observable<T>
  fromCallable(Callable<? extends T>
                    callable)
```

Key Factory Method Operators in the Observable Class

- The fromCallable() operator
  - Returns an Observable that, when an observer subscribes to it, does certain things
  - This factory method adapts non-reactive input sources into the reactive model



Create an Observable that emits one random BigFraction

```
Observable
   .fromCallable
     (()
      -> BigFractionUtils
        .makeBigFraction(random,
                         true))
```

See Reactive/Observable/ex1/src/main/java/ObservableEx.java

Key Factory Method Operators in the Observable Class

- The fromCallable() operator
  - Returns an Observable that, when an observer subscribes to it, does certain things
  - This factory method adapts non-reactive input sources into the reactive model
  - This operator defers executing the Callable until an observer subscribes to the Observable
    - i.e., it is "lazy"

```
Observable
   .fromCallable
     (()
      -> BigFractionUtils
        .makeBigFraction(random,
                         true))
```

Key Factory Method Operators in the Observable Class

- The fromCallable() operator
  - Returns an Observable that, when an observer subscribes to it, does certain things
  - This factory method adapts non-reactive input sources into the reactive model
  - This operator defers executing the Callable until an observer subscribes to the Observable
    - i.e., it is "lazy"

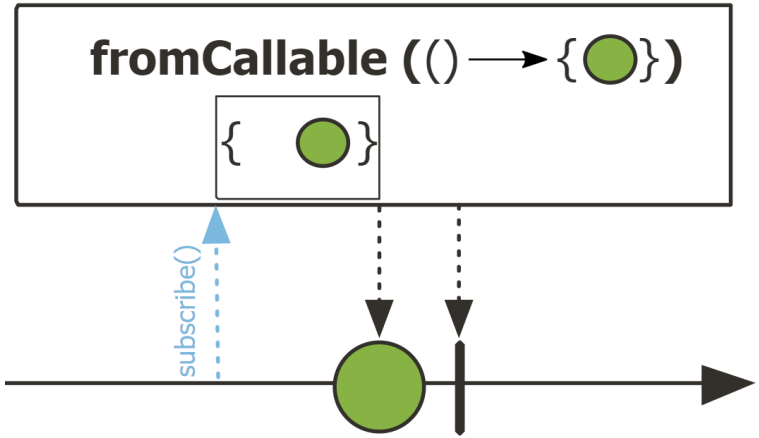
Conversely, Observable.just() is "eager"

```
Observable
   .just(BigFraction.valueOf(100,3),
         BigFraction.valueOf(100,4),
         BigFraction.valueOf(100,2),
         BigFraction.valueOf(100,1))
   ...
```

Contrast with "eager" Observable factory method operators earlier in this lesson

Key Factory Method Operators in the Observable Class

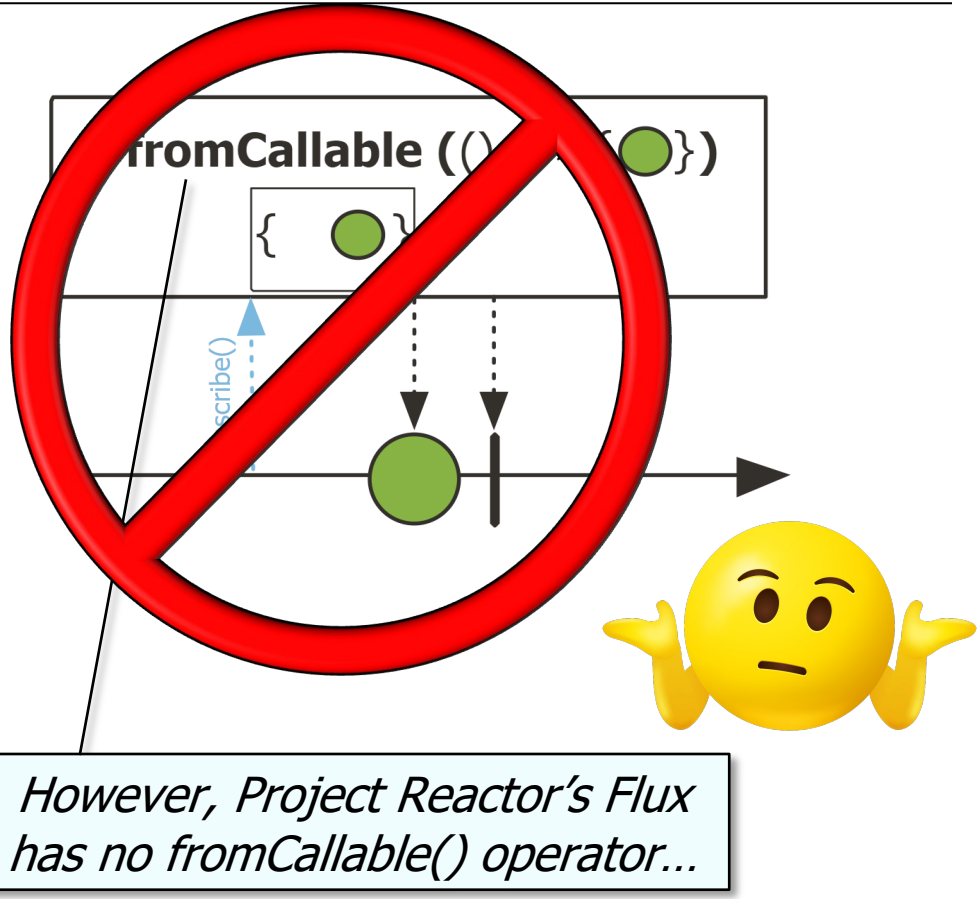
- The fromCallable() operator
  - Returns an Observable that, when an observer subscribes to it, does certain things
  - This factory method adapts non-reactive input sources into the reactive model
  - This operator defers executing the Callable until an observer subscribes to the Observable
  - Project Reactor's operator Mono .fromCallable() is similar



See projectreactor.io/docs/core/release/api/reactor/core/publisher/Mono.html#fromCallable

Key Factory Method Operators in the Observable Class

- The fromCallable() operator
  - Returns an Observable that, when an observer subscribes to it, does certain things
  - This factory method adapts non-reactive input sources into the reactive model
  - This operator defers executing the Callable until an observer subscribes to the Observable
- Project Reactor's operator Mono .fromCallable() is similar



End of Key Factory Method Operators in the Observable Class (Part 1)