Key Transforming Operators in the Flux Class (Part 2)

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 Flux operators
  - Factory method operators
  - Transforming operators
    - Transform the values and/or types emitted by a Flux
      - e.g., flatMap()

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return Flux
   .fromCallable(() -> BigFraction
       .reduce(unreducedFraction))

   .subscribeOn(scheduler)

   .flatMap(reducedFraction ->
            Flux
            .fromCallable(() ->
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                  (sBigReducedFrac))
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```

This lesson also describes the Project Reactor flatMap() concurrency idiom

Key Transforming Operators in the Flux Class

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- The flatMap() operator
  - Transform the elements emitted by this Flux asynchronously

```
<R> Flux<R> flatMap
  (Function<? super T,
            ? extends Publisher<?
                                extends R>>
            mapper)
```

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

Key Transforming Operators in the Flux Class

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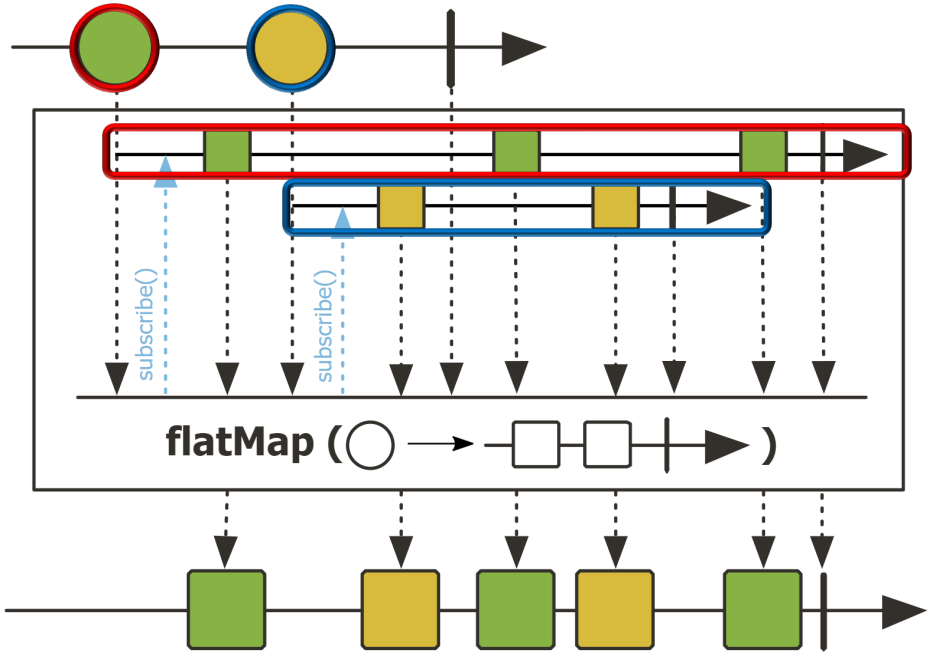
- The flatMap() operator
  - Transform the elements emitted by this Flux asynchronously
    - These elements are emitted into inner Publishers
      - Each <T> input element is mapped to a Publisher<R>
      - That publisher will emit one or more items



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- The flatMap() operator
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    - These inner publishers are then flattened into one Flux by merging

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- The flatMap() operator
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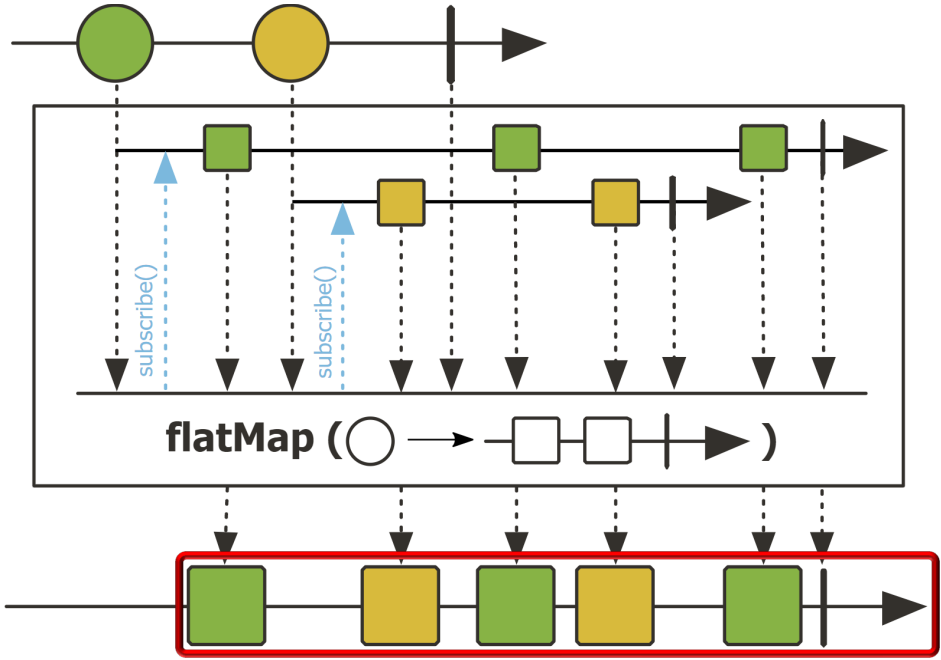
    - These elements are emitted into inner Publishers
  - These inner publishers are then flattened into one Flux by merging
    - They thus can interleave
      - Especially when used for concurrent processing



See upcoming walkthrough of the "flatMap() concurrency idiom" example

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- The flatMap() operator
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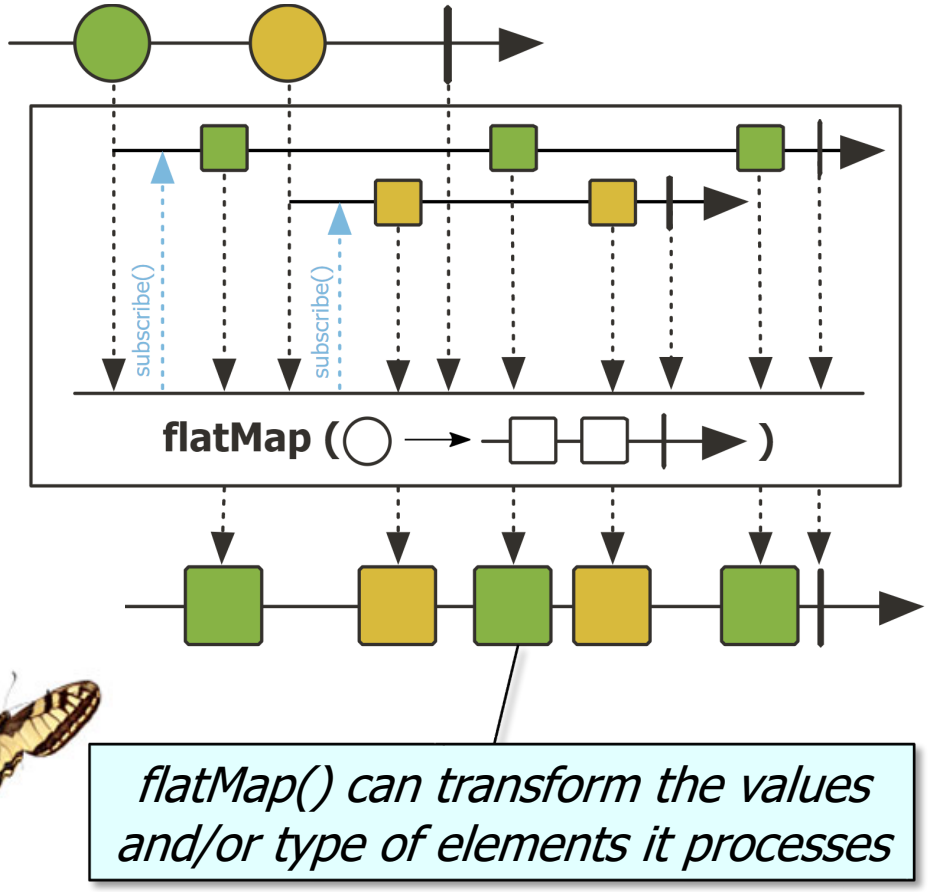
    - It has similarities & differences compared to map()



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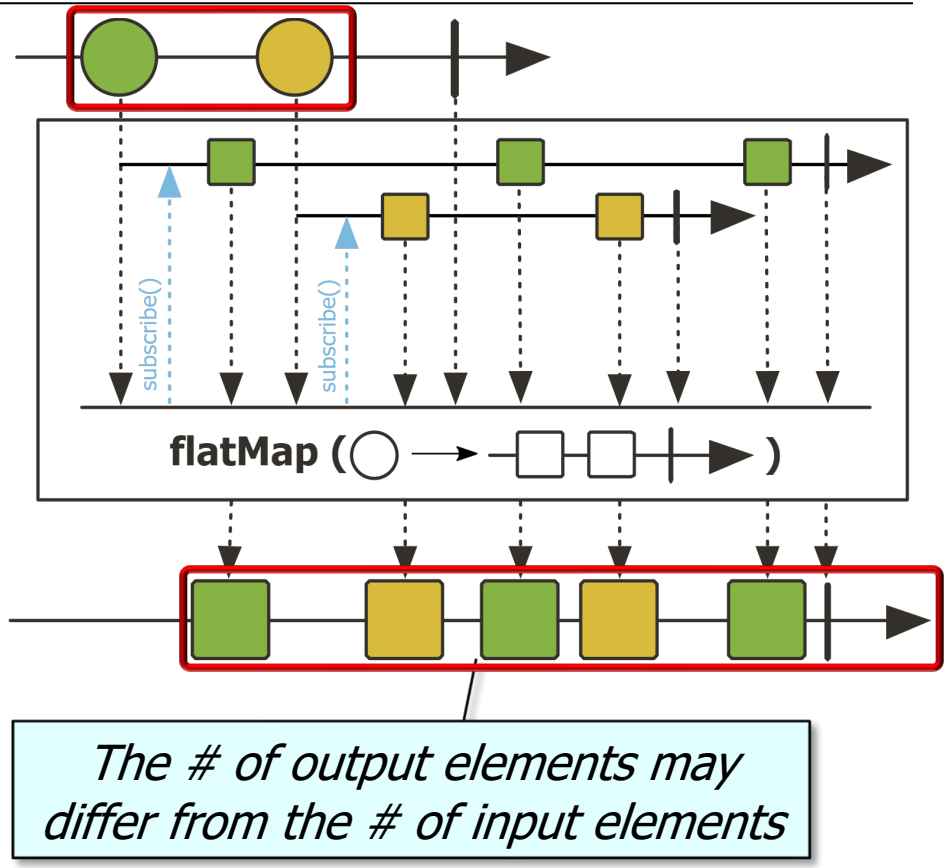

Key Transforming Operators in the Flux Class

- The flatMap() operator
  - Transform the elements emitted by this Flux asynchronously
  - This method is often used to trigger concurrent processing

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return Flux
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See upcoming discussion on the Project Reactor flatMap() concurrency idiom

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Return a Flux to a multiplied big fraction using the Project Reactor flatMap() concurrency idiom

See Reactive/flux/ex3/src/main/java/FluxEx.java

Key Transforming Operators in the Flux Class

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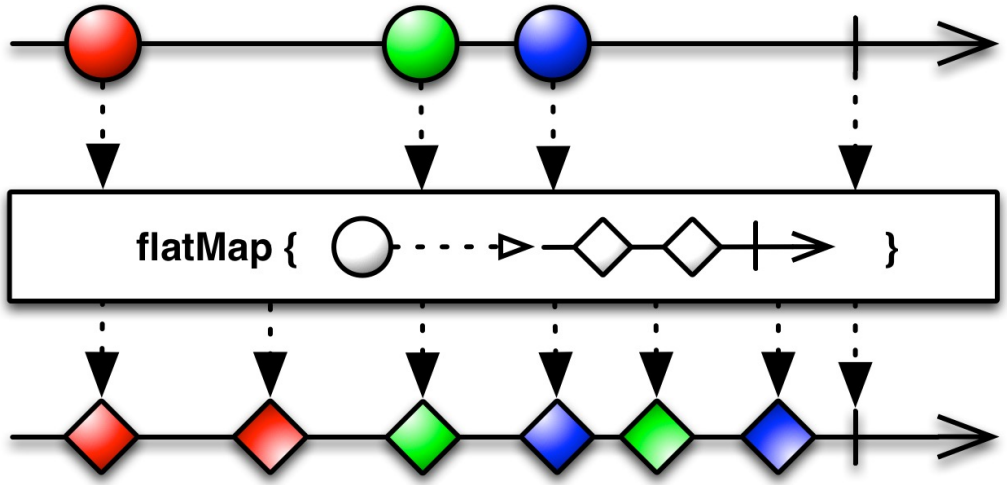
  - RxJava's Observable.flatMap() operator works the same way



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

Key Transforming Operators in the Flux Class

- The flatMap() operator
  - Transform the elements emitted by this Flux asynchronously
  - This method is often used to trigger concurrent processing
  - RxJava's Observable.flatMap() operator works the same way
- Similar to the Java Streams flatMap() operator

flatMap

```
<R> Stream<R> flatMap(
Function<? super T,? extends Stream<? extends R>> mapper)
```

Returns a stream consisting of the results of replacing each element of this stream with the contents of a mapped stream produced by applying the provided mapping function to each element. Each mapped stream is `closed` after its contents have been placed into this stream. (If a mapped stream is `null` an empty stream is used, instead.)

```
List<String> a = List.of("d", "g");
List<String> b = List.of("a", "c");
Stream
     .of(a, b)
     .flatMap(List::stream)
     .sorted()
     .forEach(System.out::println);
```

Flatten, sort, & print two lists of strings

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

Key Transforming Operators in the Flux Class

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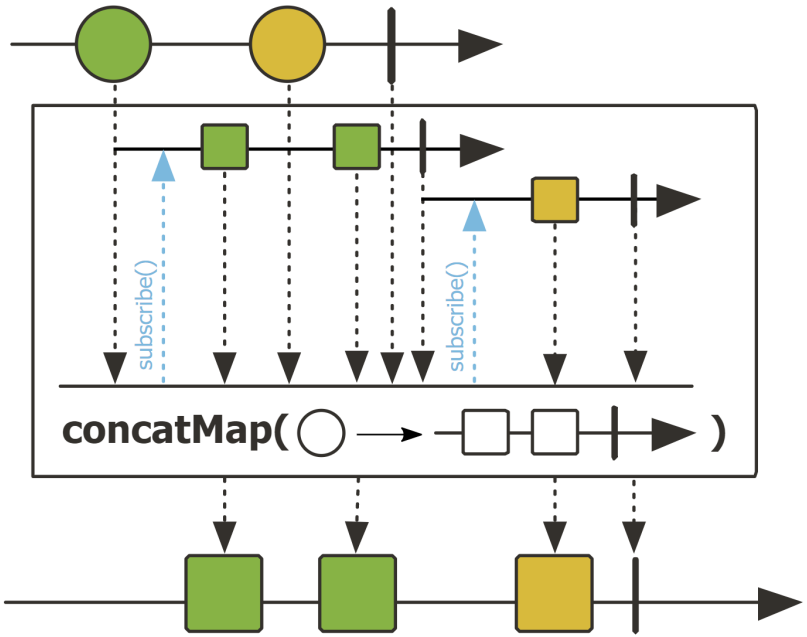
- flatMap() doesn't guarantee the order of the items in the resulting stream
  - use concatMap() if order matters



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

The Project Reactor flatMap() Concurrency Idiom

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- flatMap()'s often used when each item emitted by a stream needs to apply its own threading operators


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return Flux
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            .subscribeOn
               (Schedulers
                .parallel()))

   .reduce(BigFraction::add)
   ...
```

The Project Reactor flatMap() Concurrency Idiom

- flatMap()'s often used when each item emitted by a stream needs to apply its own threading operators
  - This structure is known as the "flatMap() concurrency idiom"

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See ebaytech.berlin/declarative-concurrency-with-reactor-70507e04054a

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Create a Flux BigFraction stream from a BigFraction list

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Iterate thru the Flux stream multiplying big fractions in the parallel thread pool

See Reactive/flux/ex3/src/main/java/FluxEx.java

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Each BigFraction in the stream is processed concurrently in the parallel thread pool

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Multiply each BigFraction in a thread from the parallel thread pool

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Arrange to process each emitted BigFraction in the parallel thread pool

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After all the concurrent processing completes then add all the Big Fractions to compute the final sum

Comparing map & flatMap()

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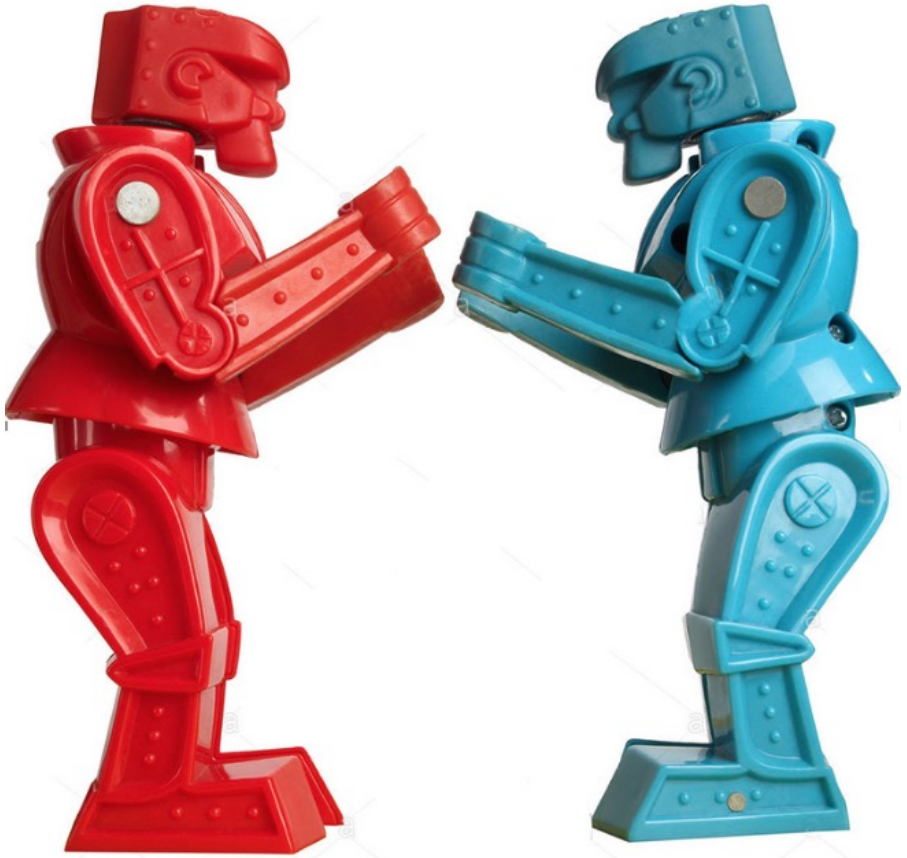
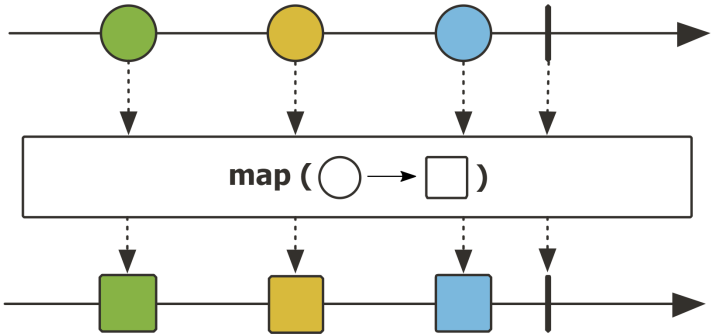
- The map() vs. flatMap() operators



Comparing map() & flatMap()

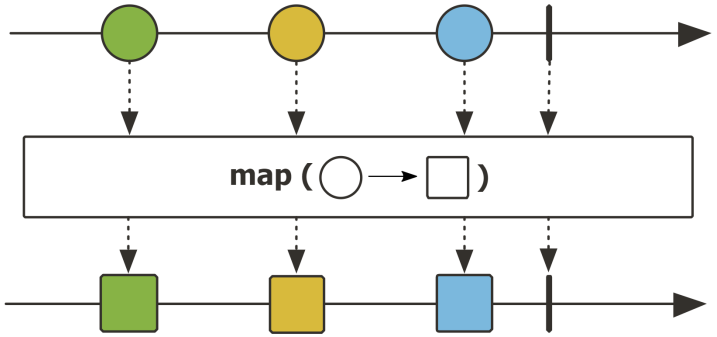
- The map() vs. flatMap() operators
  - The map() operator transforms each value in a Flux stream into a single value
    - i.e., intended for synchronous, non-blocking, 1-to-1 transformations

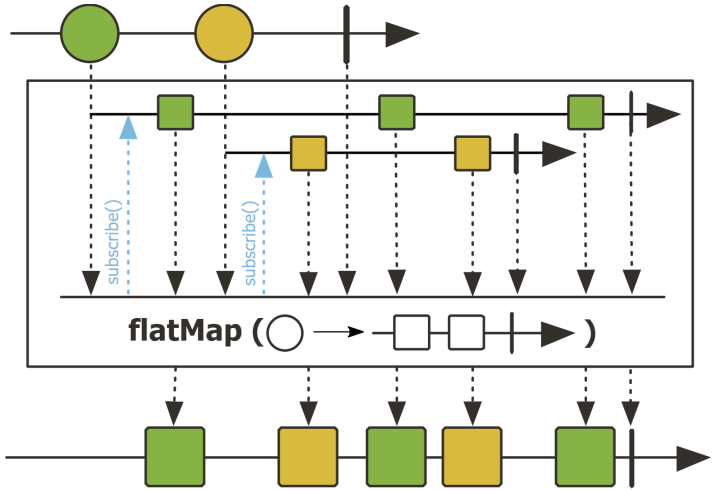


See stackoverflow.com/questions/49115135/map-vs-flatmap-in-reactor

Comparing map() & flatMap()

- The map() vs. flatMap() operators
  - The map() operator transforms each value in a Flux stream into a single value
  - The flatMap() operator transforms each value in a Flux stream into an arbitrary number (zero or more) values
    - i.e., intended for asynchronous (often non-blocking) 1-to-N transformations





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End of Key Transforming Operators in the Flux Class (Part 2)