Key Concurrency & Scheduler Operators Associated with the Mono Class (Part 2)

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Learning Objectives in this Part of the Lesson

- Recognize key Mono operators
  - Concurrency & scheduler operators
    - These operators arrange to run other operators in designated threads & thread pools
      - e.g., Schedulers.parallel()

Key Scheduler Operators Associated with the Mono Class

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- The Schedulers.parallel() operator
  - Returns a Scheduler that hosts a fixed pool of Executor Service-based workers suitable for parallel work

```
static Scheduler
       parallel()
```

See projectreactor.io/docs/core/release/api/reactor/core/scheduler/Schedulers.html#parallel

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```
static Scheduler
       parallel()
```

```
Mono<BigFraction> multiplyAsync(BigFraction bf1,
                                BigFraction bf2) {
  return Mono
    .fromCallable(() -> bf1.multiply(bf2))

    .subscribeOn(Schedulers.parallel());
}
```

Create a Mono that emits the results of multiplying bf1 & bf2 in a thread from the parallel thread pool

See Reactive/mono/ex3/src/main/java/MonoEx.java

Key Scheduler Operators Associated with the Mono Class

- The Schedulers.parallel() operator
  - Returns a Scheduler that hosts a fixed pool of Executor Service-based workers suitable for parallel work
    - Optimized for fast running non-blocking operations
      - i.e., computation-intensive *not* I/O-intensive!

Class Schedulers

java.lang.Object

reactor.core.scheduler.Schedulers

```
public abstract class Schedulers
extends Object
```

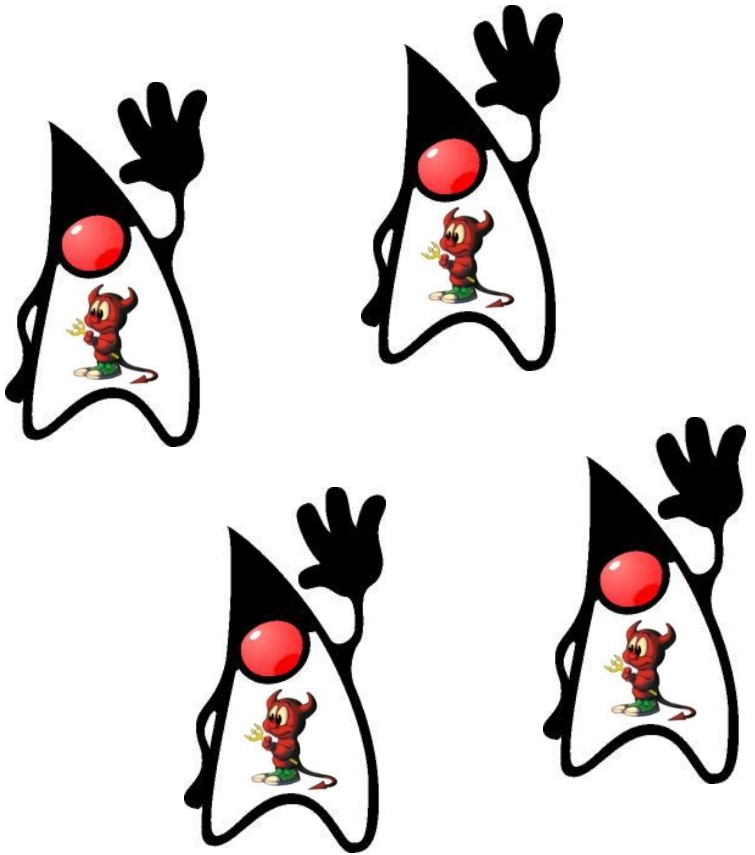
`Schedulers` provides various `Scheduler` flavors usable by `publishOn` or `subscribeOn`:

- `parallel()`: Optimized for fast `Runnable` non-blocking executions
- `single()`: Optimized for low-latency `Runnable` one-off executions
- `elastic()`: Optimized for longer executions, an alternative for blocking tasks where the number of active tasks (and threads) can grow indefinitely
- `boundedElastic()`: Optimized for longer executions, an alternative for blocking tasks where the number of active tasks (and threads) is capped
- `immediate()`: to immediately run submitted `Runnable` instead of scheduling them (somewhat of a no-op or "null object" `Scheduler`)
- `fromExecutorService(ExecutorService)` to create new instances around `Executors`

See projectreactor.io/docs/core/release/api/reactor/core/scheduler/Schedulers.html

Key Scheduler Operators Associated with the Mono Class

- The Schedulers.parallel() operator
  - Returns a Scheduler that hosts a fixed pool of Executor Service-based workers suitable for parallel work
    - Optimized for fast running non-blocking operations
    - Implemented via "daemon threads"
      - i.e., won't prevent the app from exiting even if its work isn't done



See www.baeldung.com/java-daemon-thread

Key Scheduler Operators Associated with the Mono Class

- The Schedulers.parallel() operator
  - Returns a Scheduler that hosts a fixed pool of Executor Service-based workers suitable for parallel work
  - This operator is often used with the flatMap() concurrency idiom

```
return Flux
   .fromIterable(bigFractions)

   .flatMap(bf -> Mono
            .fromCallable(() ->
                          bf)
            .subscribeOn
               (Schedulers
                .parallel())

            .map
               (multiplyFracs))

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

Multiply many BigFraction objects concurrently

See lesson on "*Key Transforming Operators in the Flux Class (Part 2)*"

Key Scheduler Operators Associated with the Mono Class

- The Schedulers.parallel() operator
  - Returns a Scheduler that hosts a fixed pool of Executor Service-based workers suitable for parallel work
  - This operator is often used with the flatMap() concurrency idiom
- RxJava's Schedulers.computation() is similar

computation

```
@NonNull
public static @NonNull Scheduler computation()
```

Returns a default, shared `Scheduler` instance intended for computational work.

This can be used for event-loops, processing callbacks and other computational work.

It is not recommended to perform blocking, IO-bound work on this scheduler. Use `io()` instead.

The default instance has a backing pool of single-threaded `ScheduledExecutorService` instances equal to the number of available processors (`Runtime.availableProcessors()`) to the Java VM.

Unhandled errors will be delivered to the scheduler Thread's `Thread.UncaughtExceptionHandler`.

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/schedulers/Schedulers.html#computation

End of Key Concurrency & Scheduler Operators Associated with the Mono Class (Part 2)