Key Scheduler Operators for RxJava Reactive Types (Part 3)

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Learning Objectives in this Part of the Lesson

- Recognize key operators defined in—or used with—ParallelFlowables
  - Scheduler operators
    - These operators provide the context to run other operators in designated threads & thread pools
      - e.g., Schedulers.io()

These operators also work with the Flowable, ParallelFlowable, Single, & Maybe classes

Key Scheduler Operators for RxJava Reactive Types

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- The Schedulers.io() operator
  - Hosts a variable-size pool of single -threaded Executor Service-based workers

```
static Scheduler io()
```

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

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      - Optimized for blocking operations

Class Schedulers

java.lang.Object
io.reactivex.rxjava3.schedulers.Schedulers

```
public final class Schedulers
extends Object
```

Static factory methods for returning standard Scheduler instances.

The initial and runtime values of the various scheduler types can be overridden via the `RxJavaPlugins.setInit(scheduler name)SchedulerHandler()` and `RxJavaPlugins.set(scheduler name)SchedulerHandler()` respectively.

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

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      - Optimized for blocking operations
        - i.e., I/O-bound tasks *not* compute-/CPU-bound tasks!

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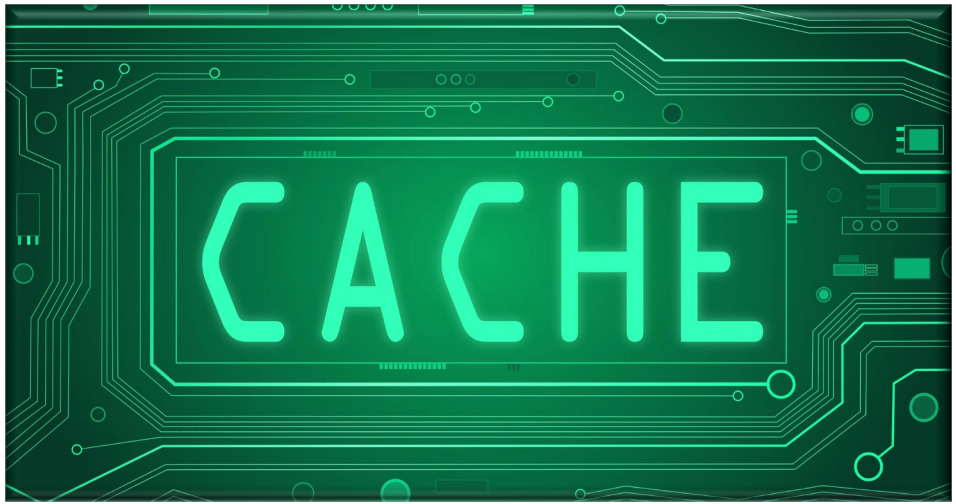

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    - Either starts a new thread or reuses an idle one from a cache
      - The goal is to maximally utilize the CPU cores

Key Scheduler Operators for RxJava Reactive Types

- The Schedulers.io() operator
  - Hosts a variable-size pool of single-threaded Executor Service-based workers
  - Used for making network calls, file I/O, database operations, etc.

Download images from remote web servers in parallel & store them on the local computer

```
return Options.instance()
   .getUrlFlowable()

   .parallel()

   .runOn(Schedulers.io())

   .map(downloadAndStoreImage)

   .sequential()

   .collect(Collectors.toList())

   .doOnSuccess(...)
```

See github.com/douglascraigschmidt/LiveLessons/tree/master/Reactive/Flowable/ex4

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Create a Flowable containing URLs to download from remote web servers

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Convert the Flowable into a ParallelFlowable

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Designate the I/O Scheduler that will download & store each image in parallel

See reactivex.io/RxJava/3.x/javadoc/io/reactivex/rxjava3/parallel/ParallelFlowable.html#runOn

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Download & store images in parallel

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```

Merge the values from each 'rail' in a round-robin fashion & expose it as a regular Flowable sequence

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Collect the Flowable into a List

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```

Handle the final 'reduced' results

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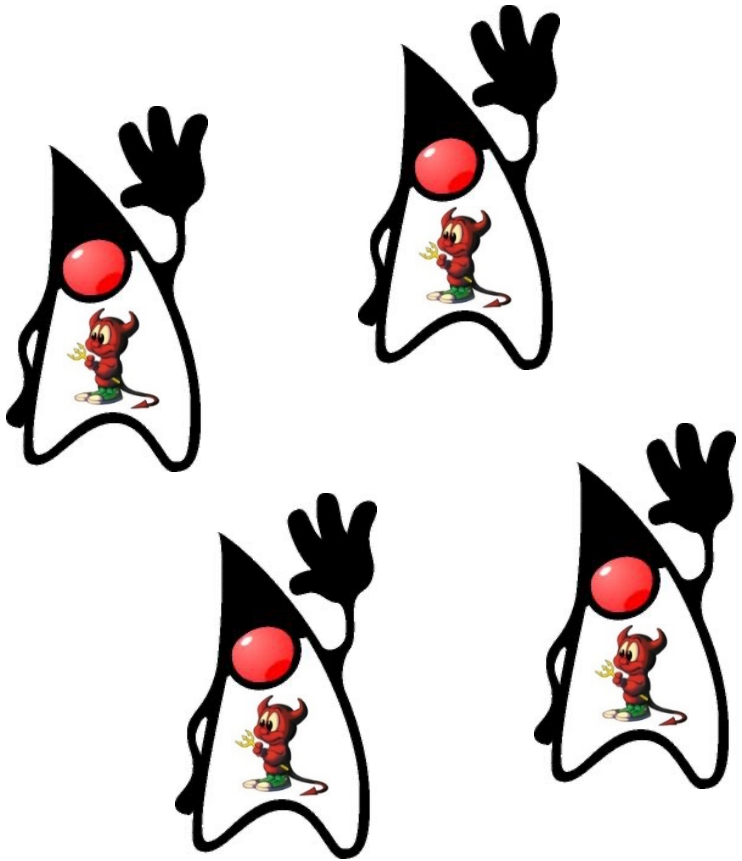
  - Hosts a variable-size pool of single-threaded Executor Service-based workers
  - Used for making network calls, file I/O, database operations, etc.
  - Implemented via "daemon threads"
    - i.e., won't prevent the app from exiting even if its work isn't done



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

Key Scheduler Operators for RxJava Reactive Types

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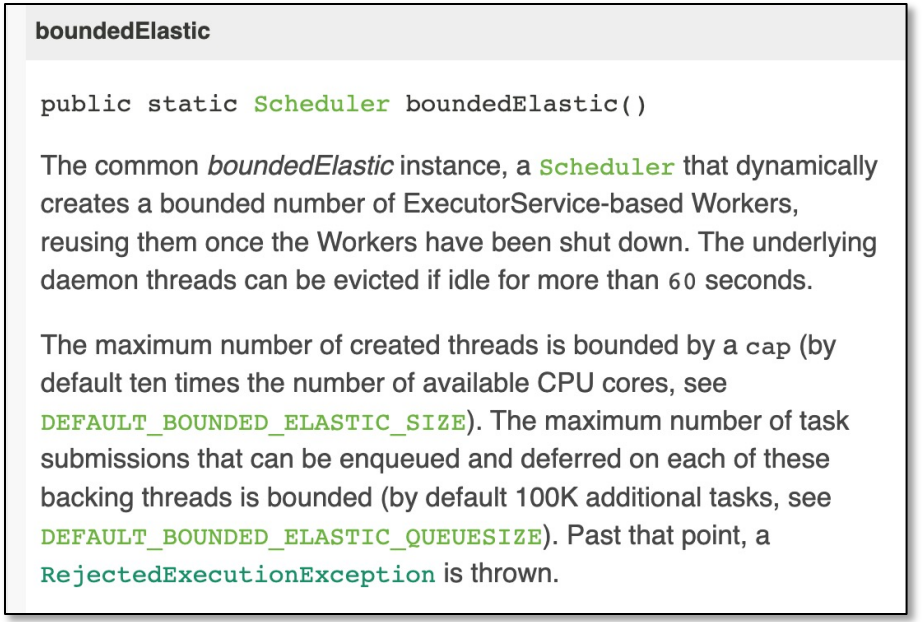
  - Used for making network calls, file I/O, database operations, etc.
  - Implemented via "daemon threads"
- The Schedulers.boundedElastic() operator in Project Reactor is similar



boundedElastic

```
public static Scheduler boundedElastic()
```

The common *boundedElastic* instance, a `Scheduler` that dynamically creates a bounded number of ExecutorService-based Workers, reusing them once the Workers have been shut down. The underlying daemon threads can be evicted if idle for more than `60` seconds.

The maximum number of created threads is bounded by a `cap` (by default ten times the number of available CPU cores, see `DEFAULT_BOUNDED_ELASTIC_SIZE`). The maximum number of task submissions that can be enqueued and deferred on each of these backing threads is bounded (by default 100K additional tasks, see `DEFAULT_BOUNDED_ELASTIC_QUEUESIZE`). Past that point, a `RejectedExecutionException` is thrown.

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

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  - Implemented via "daemon threads"
  - The Schedulers.boundedElastic() operator in Project Reactor is similar
- The Java common fork-join pool is also similar

commonPool

```
public static ForkJoinPool commonPool()
```

Returns the common pool instance. This pool is statically constructed; its run state is unaffected by attempts to `shutdown()` or `shutdownNow()`. However this pool and any ongoing processing are automatically terminated upon program `System.exit(int)`. Any program that relies on asynchronous task processing to complete before program termination should invoke `commonPool().awaitQuiescence`, before exit.

Returns:

the common pool instance

See docs.oracle.com/javase/8/docs/api/java/util/concurrent/ForkJoinPool.html#commonPool

Key Scheduler Operators for RxJava Reactive Types

- The Schedulers.io() operator
  - Hosts a variable-size pool of single -threaded Executor Service-based workers
  - Used for event-loops, callbacks, & other computational work
  - Implemented via "daemon threads"
  - The Schedulers.boundedElastic() operator in Project Reactor is similar
- The Java common fork-join pool is also similar
  - When used with the ManagedBlocker mechanism..

Interface ForkJoinPool.ManagedBlocker

Enclosing class:
ForkJoinPool

public static interface **ForkJoinPool.ManagedBlocker**

Interface for extending managed parallelism for tasks running in ForkJoinPools.

A ManagedBlocker provides two methods. Method isReleasable() must return true if blocking is not necessary. Method block() blocks the current thread if necessary (perhaps internally invoking isReleasable before actually blocking). These actions are performed by any thread invoking ForkJoinPool.managedBlock(ManagedBlocker). The unusual methods in this API accommodate synchronizers that may, but don't usually, block for long periods. Similarly, they allow more efficient internal handling of cases in which additional workers may be, but usually are not, needed to ensure sufficient parallelism. Toward this end, implementations of method isReleasable must be amenable to repeated invocation.

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

End of Key Scheduler Operators for RxJava Reactive Types (Part 3)