~RxJava-Android~

What is Reactive Programming?

:~It is all about *responding to value changes*. For example, let's say we define $\boldsymbol{x = y+z}$**.** When we change the value of $\boldsymbol{y}$ or $\boldsymbol{z}$, the value of $\boldsymbol{x}$ automatically changes. This can be done by observing the values of $\boldsymbol{y}$ and $\boldsymbol{z}$.

Why doing asynchronous programming

Reactive programming provides a simple way of asynchronous programming.

1. This allows to simplify the asynchronously processing of potential long running operations.
2. It also provides a defined way of handling multiple events, errors and termination of the event stream.
3. Reactive programming provides also a simplified way of running different tasks in different threads. For example, widgets in SWT and
4. Android have to be updated from the UI thread and reactive programming provides ways to run observables and subscribers in different threads.
5. It is also possible to convert the stream before its received by the observers. And you can chain operations, e.g., if a API call depends on

the call of another API Last but not least, reactive programming reduces the need for state variables, which can be the source of errors

Reactive Extensions is a library that follows Reactive Programming principles to compose asynchronous and event-based programs by using observable sequence.

RxJava is a Java based implementation of Reactive Programming.

RxAndroid is specific to Android platform which utilises some classes on top of the RxJava library.

The building blocks of RxJava are:

1. **Observables** representing sources of data:
2. **Subscribers (or observers)** listening to the observables
3. A set of methods for modifying and composing the data

Observable: Observables are the sources for the data. Usually they start providing data once a subscriber starts listening. An observable may emit any number of items (including zero items). It can terminate either successfully or with an error.

::class that emits a stream of data or events. i.e. a class that can be used to perform some action, and publish the result. Ex:~

```
Observable observable = Observable.just("A", "B", "C", "D", "E",
"F");
```

You can create different types of observables:~

Table 1. Obervable types

Type	Description
`Flowable<T>`	Emits 0 or n items and terminates with an success or an error event. Supports backpressure, which allows to control how fast a source emits items.
`Observable<T>`	Emits 0 or n items and terminates with an success or an error event.
`Single<T>`	Emits either a single item or an error event. The reactive version of a method call.
`Maybe<T>`	Succeeds with an item, or no item, or errors. The reactive version of an `Optional`.
`Completable`	Either completes with an success or with an error event. It never emits items. The reactive version of a `Runnable`.

Observer(Subscriber): class that receivers the events or data and acts upon it. i.e. a class that waits and watches the Observable, and reacts whenever the Observable publishes results.

The **Observer** has 4 interface methods to know the different states of the **Observable**.

- **onSubscribe():** This method is invoked when the Observer is subscribed to the Observable.
- **onNext():** This method is called when a new item is emitted from the Observable.
- **onError():** This method is called when an error occurs and the emission of data is not successfully completed.
- **onComplete():** This method is called when the Observable has successfully completed emitting all items.

we hold the reference to the returned Subscription object and later invoke `subscription#unsubscribe()` when necessary. In Android, this is best invoked within `Activity#onDestroy()` or `Fragment#onDestroy()`.

```
new Observer() {
            @Override
            public void onSubscribe(Disposable d) {
                System.out.println("onSubscribe");
            }

            @Override
            public void onNext(Object o) {
                System.out.println("onNext: " + o);
            }

            @Override
            public void onError(Throwable e) {
                System.out.println("onError: " + e.getMessage());
            }

            @Override
            public void onComplete() {
                System.out.println("onComplete");
            }
        };
```

::~Points to remember

- A observable can have any number of subscribers.
- If a new item is emitted from the observable, the `onNext()` method is called on each subscriber.
- If the observable finishes its data flow successful, the `onComplete()` method is called on each subscriber.
- If the observable finishes its data flow with an error, the `onError()` method is called on each subscriber.

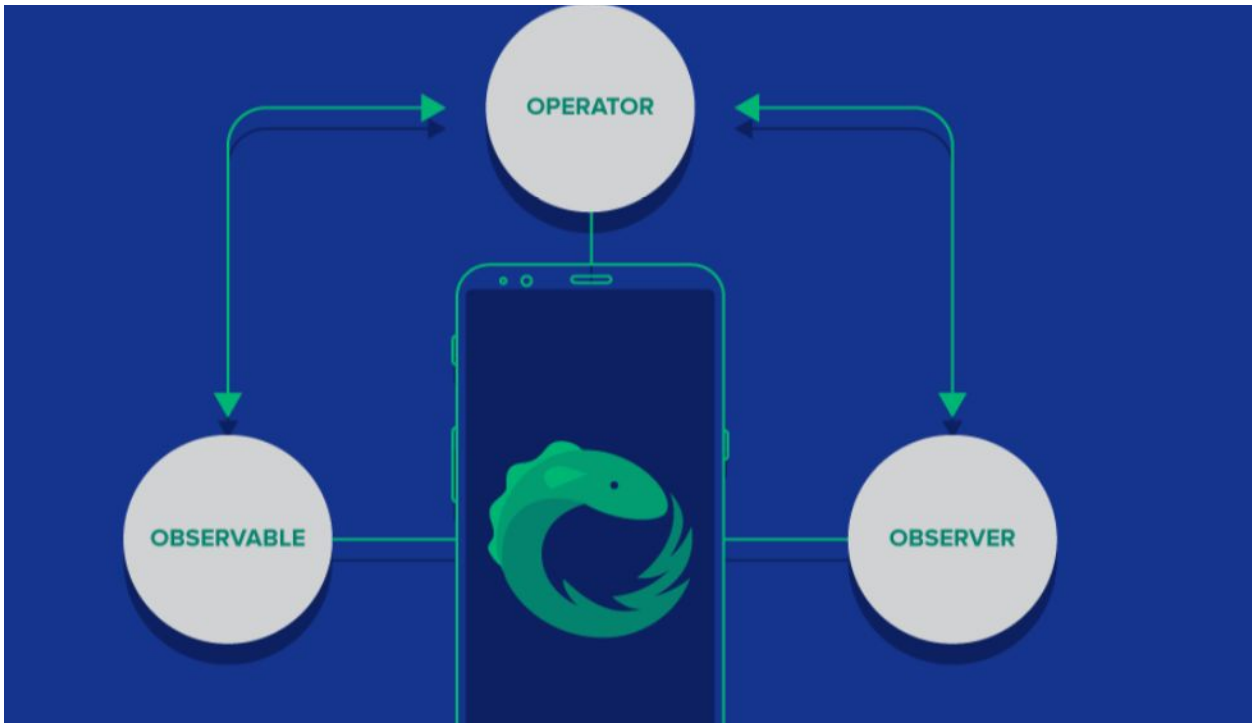
Basic Example:

NOte: *// Call unsubscribe when appropriate* **subscription.unsubscribe();**

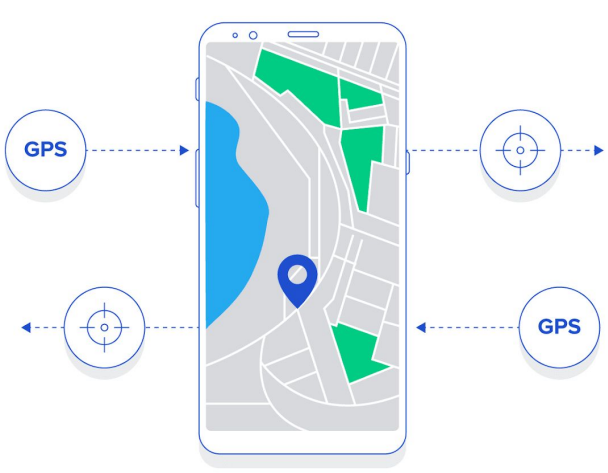
```
Observable<Integer> observable = Observable.just(1, 2, 3);

observable.subscribe(new Observer<Integer>() {

    @Override public void onCompleted() {

        Log.d("Test", "In onCompleted()");

    }

@Override public void onError(Throwable e) {

        Log.d("Test", "In onError()");

    }

@Override public void onNext(Integer integer) {

        Log.d("Test", "In onNext():" + integer);

    }
});
```

Rx- Operators:

Operators allow you to manipulate the data that was emitted or create new Observables.



If you think about it, a stream is not a new concept: click events can be a stream, location updates can be a stream, push notifications can be a stream, and so on.



Some of the most common operations found in functional programming (such as map, filter, reduce, etc.) can also be applied to an Observable stream. Let's look at map as an example:

```
Observable.just(1, 2, 3, 4, 5).map(new Func1<Integer, Integer>() {
    @Override public Integer call(Integer integer) {
        return integer * 3;
    }
}).subscribe(new Observer<Integer>() {
    @Override public void onCompleted() {
        // ...
    }

    @Override public void onError(Throwable e) {
        // ...
    }

    @Override public void onNext(Integer integer) {
        // ...
    }
});
```

Given the stream above, say we wanted to only receive even numbers. This can be achieved by chaining a *filter* operation.

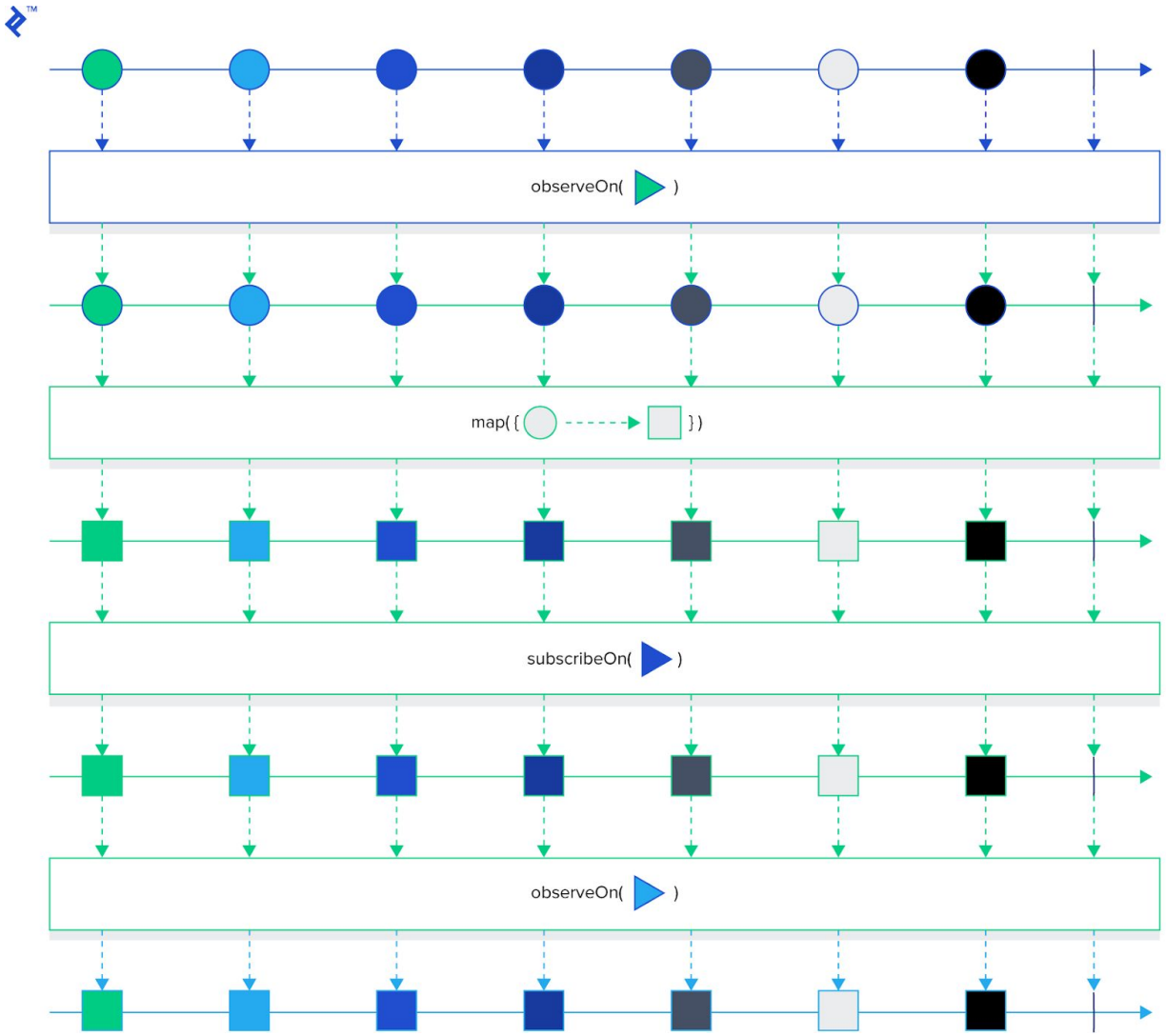
```
Observable.just(1, 2, 3, 4, 5).map(new Func1<Integer, Integer>() {
    @Override public Integer call(Integer integer) {
        return integer * 3;
    }
}).filter(new Func1<Integer, Boolean>() {
    @Override public Boolean call(Integer integer) {
        return integer % 2 == 0;
    }
}).subscribe(new Observer<Integer>() {
    @Override public void onCompleted() {
        // ...
    }

    @Override public void onError(Throwable e) {
        // ...
    }

    @Override public void onNext(Integer integer) {
        // ...
    }
});
```

Multithreading with RxJava

- Controlling the thread within which operations occur in the Observable chain is done by specifying the Scheduler within which an operator should occur. Essentially, you can think of a Scheduler as a thread pool that, when specified, an operator will use and run on.
- By default, if no such Scheduler is provided, the Observable chain will operate on the same thread where `Observable#subscribe(...)` is called. Otherwise, a Scheduler can be specified via `Observable#subscribeOn(Scheduler)` and/or `Observable#observeOn(Scheduler)` wherein the scheduled operation will occur on a thread chosen by the Scheduler.

NOTE**

- The key difference between the two methods is that `Observable#subscribeOn(Scheduler)` instructs the source Observable which Scheduler it should run on. The chain will continue to run on the thread from the Scheduler specified in `Observable#subscribeOn(Scheduler)` until a call to `Observable#observeOn(Scheduler)` is made with a different Scheduler. When such a call is made, all observers from there on out (i.e., subsequent operations down the chain) will receive notifications in a thread taken from the `observeOn` Scheduler.



**As shown in above example, In the context of Android, if a UI operation needs to take place as a result of a long operation, we'd want that operation to take place on the UI thread. For this purpose, we can use `AndroidScheduler#mainThread()`, one of the Schedulers provided in the RxAndroid library.

Let's create a demo App:

In this example, we will look at Retrofit, an HTTP client open sourced by Square which has built-in bindings with RxJava to interact with GitHub's API. Specifically, we'll create a simple app that presents all the starred repositories for a user given a GitHub username. If you want to jump ahead, the source code is available here- manishkaushik Github repo.

Operators for creating Observables:

1. Create
2. Defer
3. From
4. Interval
5. Just
6. Range
7. Repeat
8. Timer

1.**Create**:

This operator creates an Observable from scratch by calling observer methods programmatically. An emitter is provided through which we can call the respective interface methods when needed.

The below sample creates an Observable using Observable.create() method. The create() method does not have an option to pass values. So we have to create the list beforehand

and perform operations on the list inside the onNext() method. The below code will print each item from the list.

```
final List<String> alphabets = getAlphabetList();

    /*
     * Observable.create() -> We will need to call the
     * respective methods of the emitter such as onNext()
     * & onComplete() or onError()
     *
     * */
    Observable observable = Observable.create(new ObservableOnSubscribe() {
        @Override
        public void subscribe(ObservableEmitter emitter) {

            try {

                /*
                 * The emitter can be used to emit each list item
                 * to the subscriber.
                 *
                 * */
                for (String alphabet : alphabets) {
                    emitter.onNext(alphabet);
                }

                /*
                 * Once all the items in the list are emitted,
                 * we can call complete stating that no more items
                 * are to be emitted.
                 *
                 * */
                emitter.onComplete();

            } catch (Exception e) {

                /*
                 * If an error occurs in the process,
```

```
             * we can call error.
             *
             * */
            emitter.onError(e);
        }
    }
});


/*
 * We create an Observer that is subscribed to Observer.
 * The only function of the Observer in this scenario is
 * to print the valeus emitted by the Observer.
 *
 * */
Observer observer = new Observer() {
    @Override
    public void onSubscribe(Disposable d) {
        System.out.println("onSubscribe");
    }

    @Override
    public void onNext(Object o) {
        System.out.println("onNext: " + o);
    }

    @Override
    public void onError(Throwable e) {
        System.out.println("onError: " + e.getMessage());
    }

    @Override
    public void onComplete() {
        System.out.println("onComplete");
    }
};

/*
 * We can call this method to subscribe
```

```
 * the observer to the Observable.
 * */
observable.subscribe(observer);
```