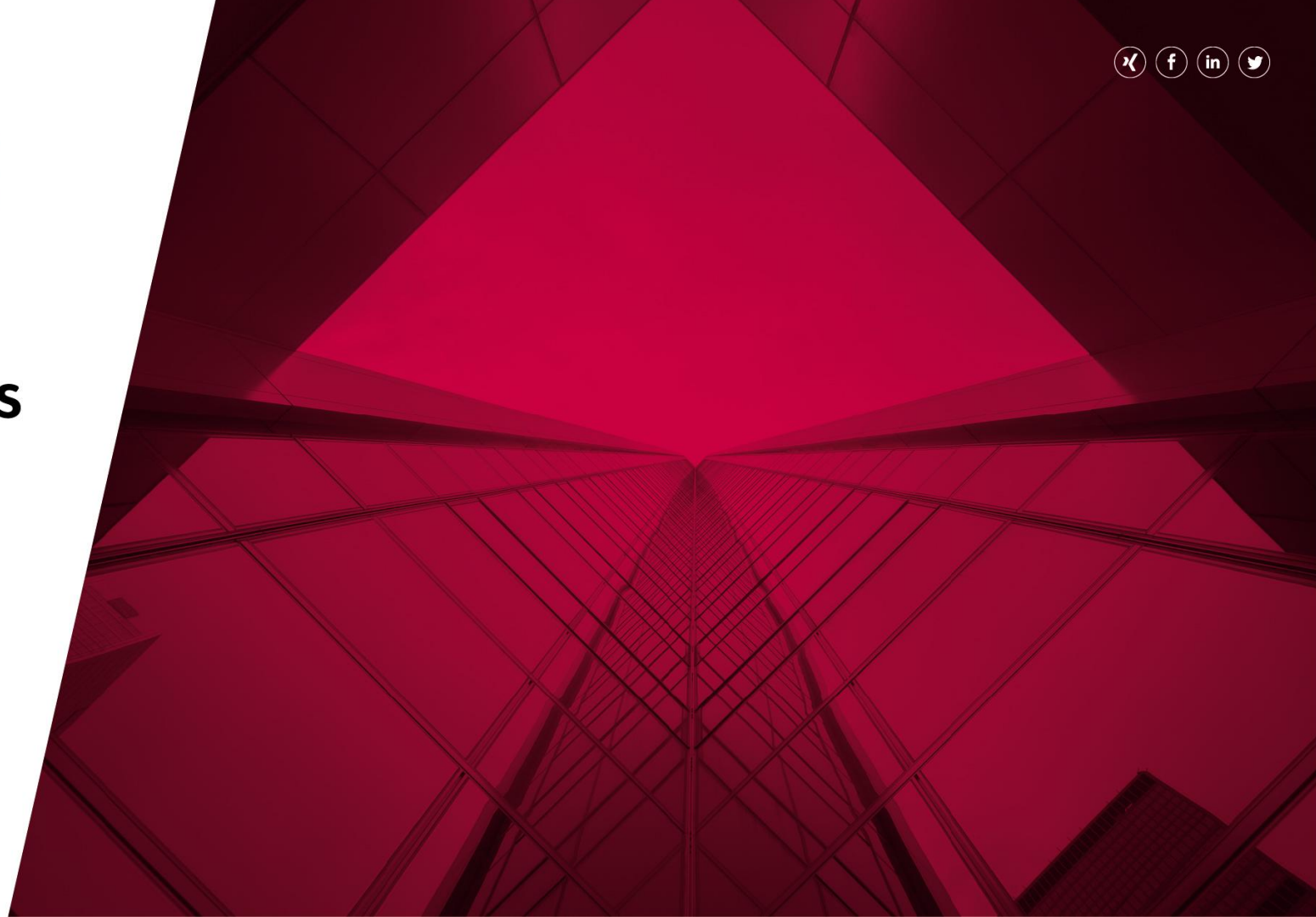

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Agenda

- Dependency Injection - Services
- Intro RxJS - Observables
- Subscription handling / Error Handling
  - Async pipe
  - Unsubscribing
- Rxjs Operators
  - Nested Pipes
  - Handling concurrent API calls

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Services

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Services

- “Local Singletons”
- Data-Model-Layer of our application
- May be injected via Dependency Injection (DI)
- Two roles:
  - Provide methods or streams of data to subscribe to
  - Provide operations to modify data

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Services - Example

<code>

Services are the Data-Model-Layer of our application

```
@Injectable({
  providedIn: 'root',
})
export class BookDataService {
  private books = [{...}, {...}, {...}];

  getBooks() {
    return this.books;
  }
}
```

Services - Example

<code>

With `providedIn:'root'` the service is registered globally

```
@Injectable({
  providedIn: 'root',
})
export class BookDataService {
  private books = [{...}, {...}, {...}];

  getBooks() {
    return this.books;
  }
}
```

Services - Example

<code>

They define an API to interact with them

```
@Injectable({
  providedIn: 'root',
})
export class BookDataService {
  private books = [{...}, {...}, {...}];

  getBooks() {
    return this.books;
  }
}
```

Services

<code>

Create a service explicit for a module with the providers array

```
@NgModule({
  providers: [
    BookDataService
  ]
})

@Component({ … })
export BookListComponent {
  constructor(private bookData: BookDataService) {}
}
```

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Services

<code>

Create a service instance for a component and its children

```
@Component({
  // ...
  providers: [BookDataService]
})
export class BookListComponent {
  constructor(private bookData: BookDataService) {}
}
```

Services

<code>

Create a service instance for a component and its children

```
@Component({
  // ...
})
export class BookListComponent {
  constructor(private bookData: BookDataService) {}
}
```

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Dependency Injection

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Dependency Injection - Why

- Keep component classes clean
- Better testable code
- Easy replacement of services

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Without Dependency Injection

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Dependency Injection

You have to create instances on your own.

```
@Component({ … })
class BookListComponent {
  private bookDataService;
  constructor() {
    this.bookDataService = new BookDataService();
  }
}
```

With Dependency Injection

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Dependency Injection

Dependency Injection is also called **Inversion of control**.

The injector has control over service instantiation.

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Dependency Injection

<code>

Injector is responsible for creating instances.

```
@NgModule({
  providers: [BookDataService],
})
export class AppModule { }


@Component({})
class BookListComponent {
  constructor(private bookDataService: BookDataService) {}
}
```

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Dependency Injection

<code>

Injector is responsible for creating instances.

```
@Component({
  providers: [BookDataService]
})
class BookListComponent {
  constructor(private bookDataService: BookDataService) {}
}
```

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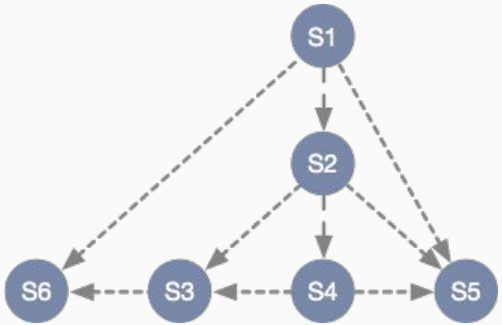
Dependency Injection

- Services can have dependencies, too
- Injects service instances created in a component, where service is used!
- Watch out for dependency cycles!




```
service 'S1', (S2, S5, S6)
service 'S2', (S3, S4, S5)
service 'S3', (S6)
service 'S4', (S3, S5)
service 'S5', ()
service 'S6', ()
```

Dependency Injection

- Based on the type of a class
- An instance is available for all child components, too

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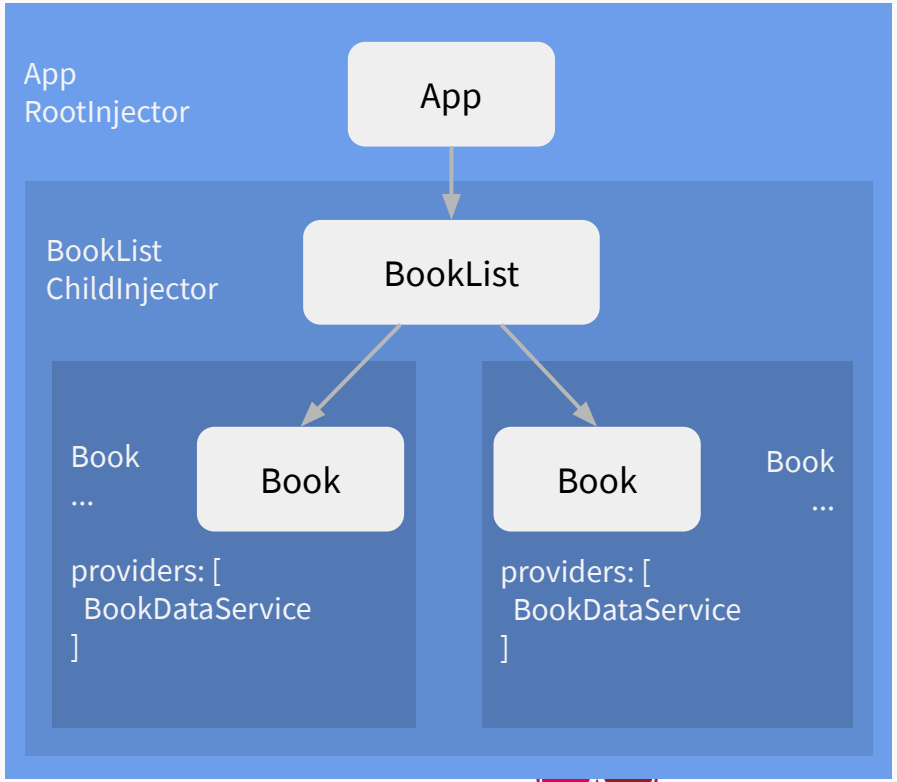
Dependency Injection

- **Injector** per component
- Each component has an own injector
- Base injector = **RootInjector**
- Each nested component has a **ChildInjector**



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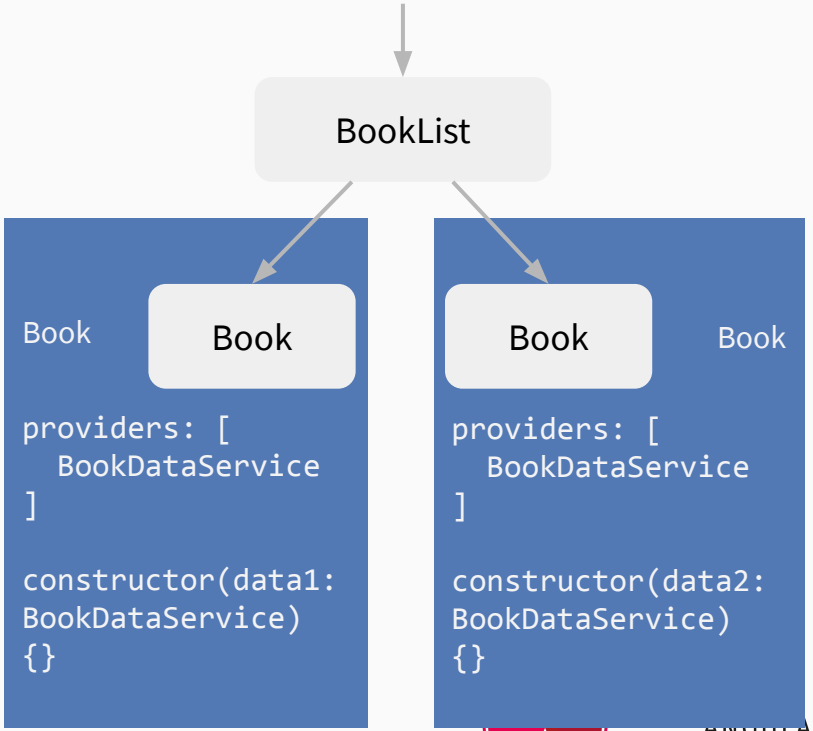
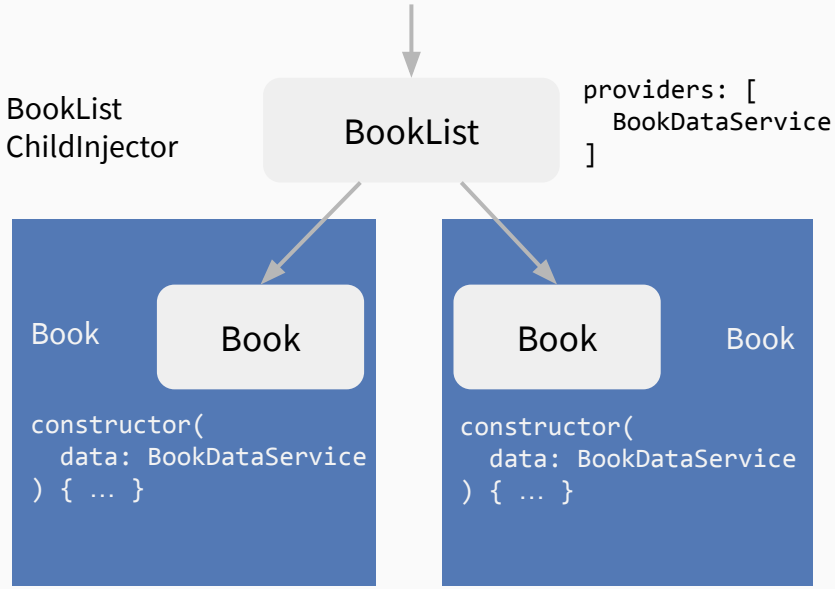
Dependency Injection

- New service instance for each BookComponent



Dependency Injection

- Share one service instance
- Create instance in parent component BookList
- Only inject service in BookComponent → no providers!



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Dependency Injection - @Injectable()

- Annotation of classes that use DI
- Metadata to compile the type-information to the ES5 code
- Without an annotation you lose the type information

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Task 1

Create a BookData service

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Workshop
Angular RxJS

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RxJS Versions

Stable 🏭

7.0.0

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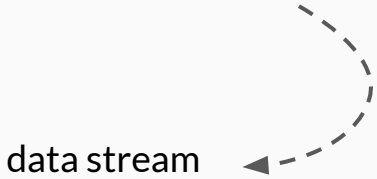
Observable & Promise

	Single	Multiple
Pull	Function	Iterator
Push	Promise	Observable



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RxJS Versions

Stable 🏭

7.0.0

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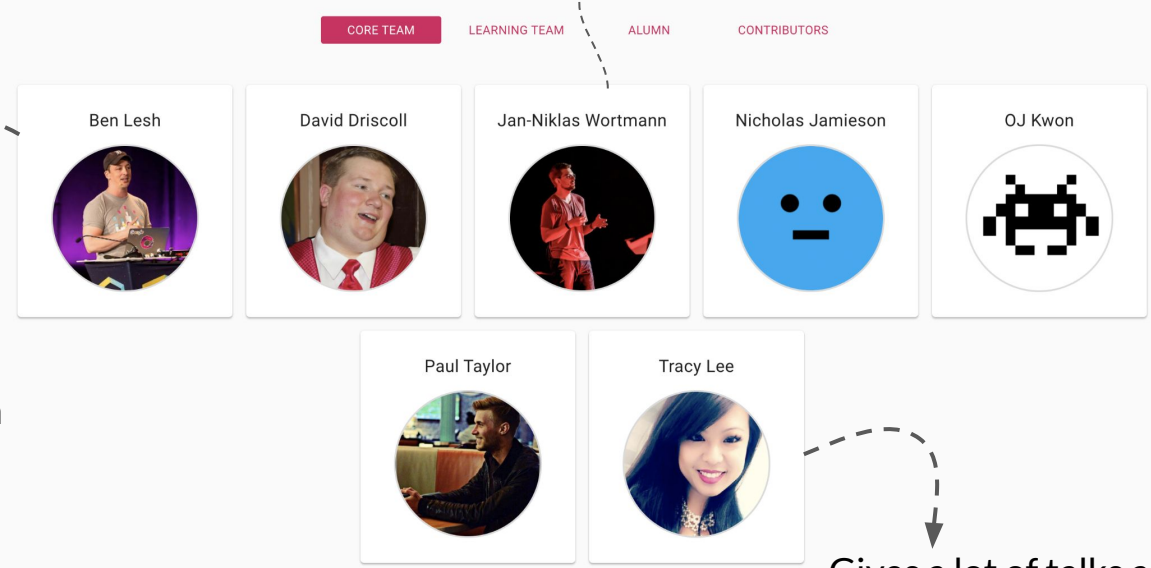
RxJS Core team

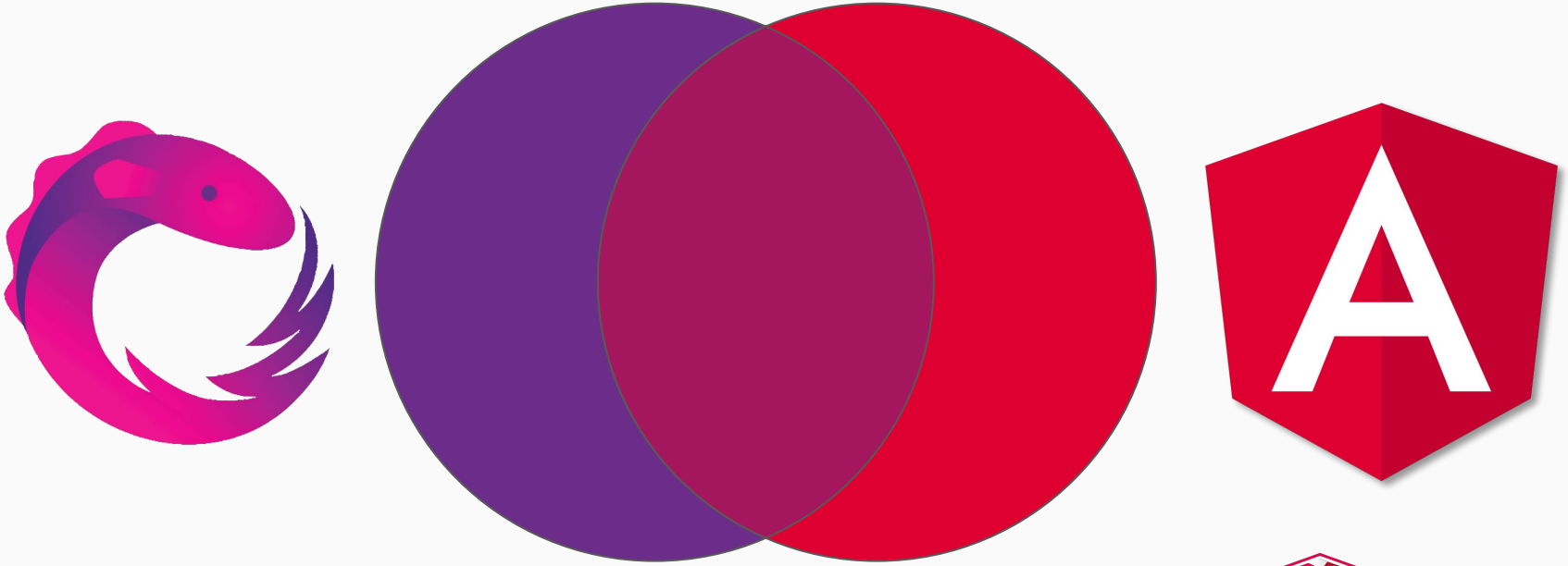
Core Team Member from Germany 🤗



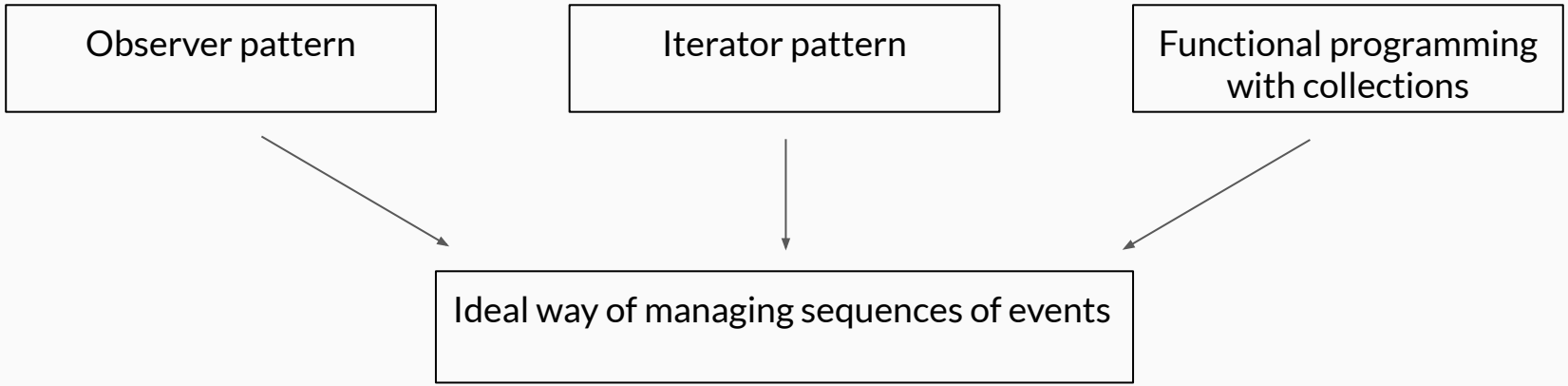
Team lead Did the whole rewrite from JS to TS.

Gives a lot of talks about RxJS, runs Workshops & spreads the word about RxJS all over the world.

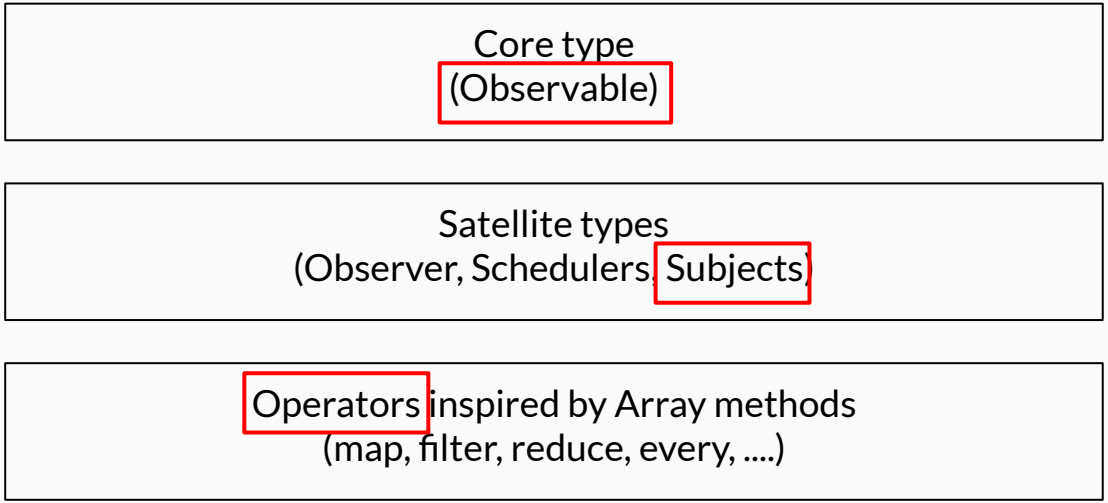
Intersection with Angular community



Patterns & paradigms in RxJS



Content of RxJS



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What is an observable?

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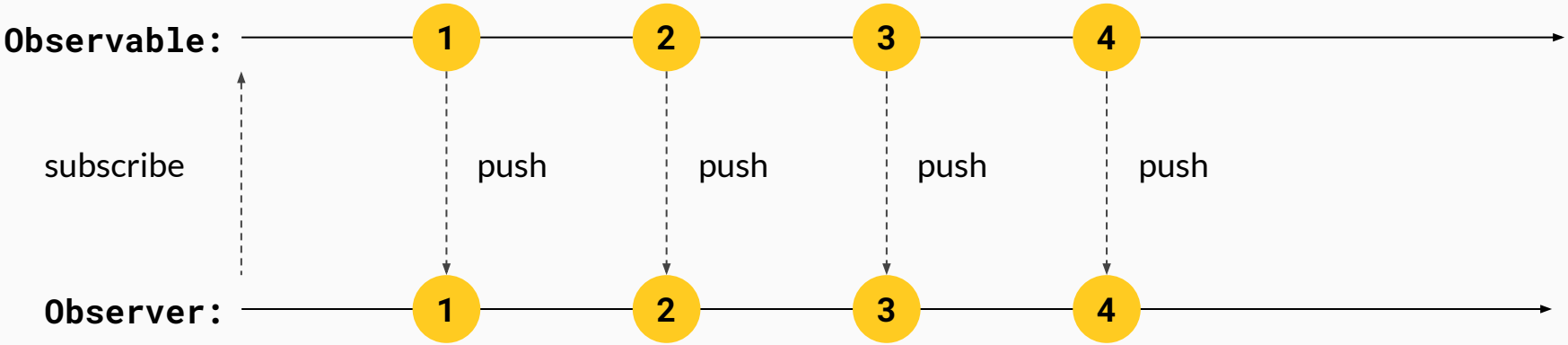
Observable & observer



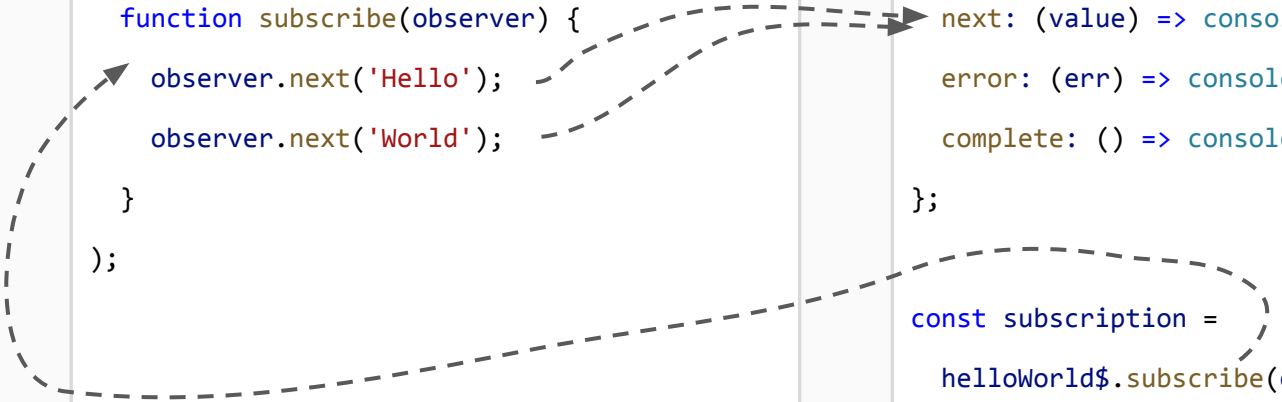
Create & subscribe to observable

hello-world.ts

```ts
import { Observable } from 'rxjs';

const helloWorld$ = new Observable(
  function subscribe(observer) {
    observer.next('Hello');
    observer.next('World');
  }
);
```

hello-world.ts

```ts
// ...

const observer = {
  next: (value) => console.log(value),
  error: (err) => console.error(err),
  complete: () => console.log('done')
};

const subscription =
  helloWorld$.subscribe(observer);
```



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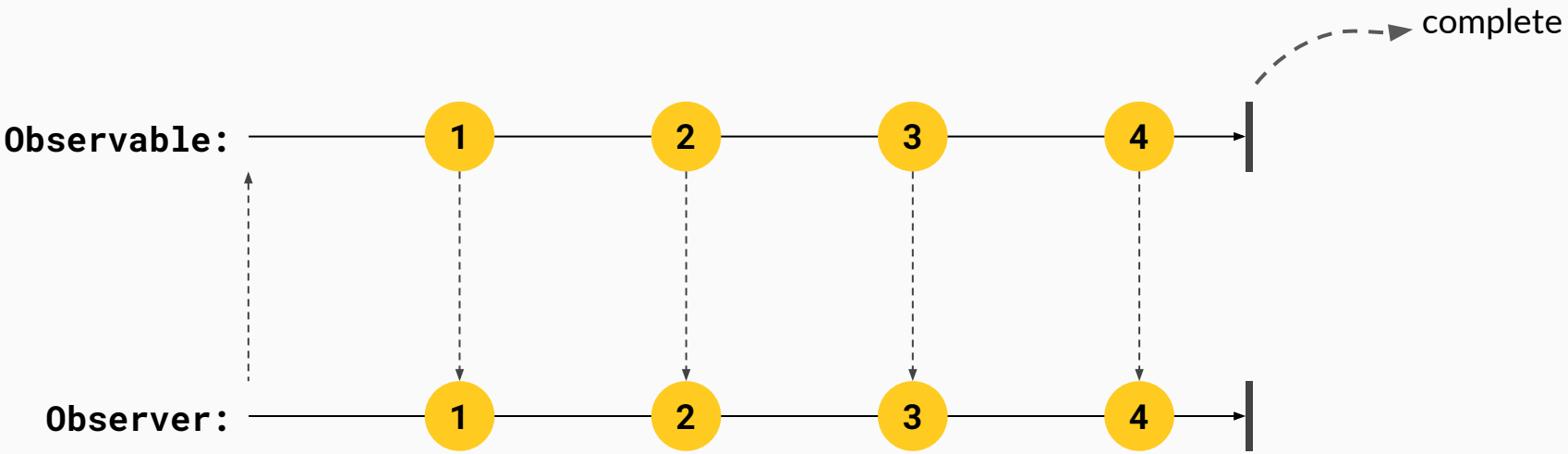
Complete



Complete

hello-world.ts

```ts
import { Observable } from 'rxjs';

const helloWorld$ = new Observable(
  function subscribe(observer) {
    observer.next('Hello');
    observer.next('World');
    observer.complete();
  }
);
```

hello-world.ts

```ts
// ...

const observer = {
  next: (value) => console.log(value),
  error: (err) => console.error(err),
  complete: () => console.log('done')
};

const subscription =
  helloWorld$.subscribe(observer);
```

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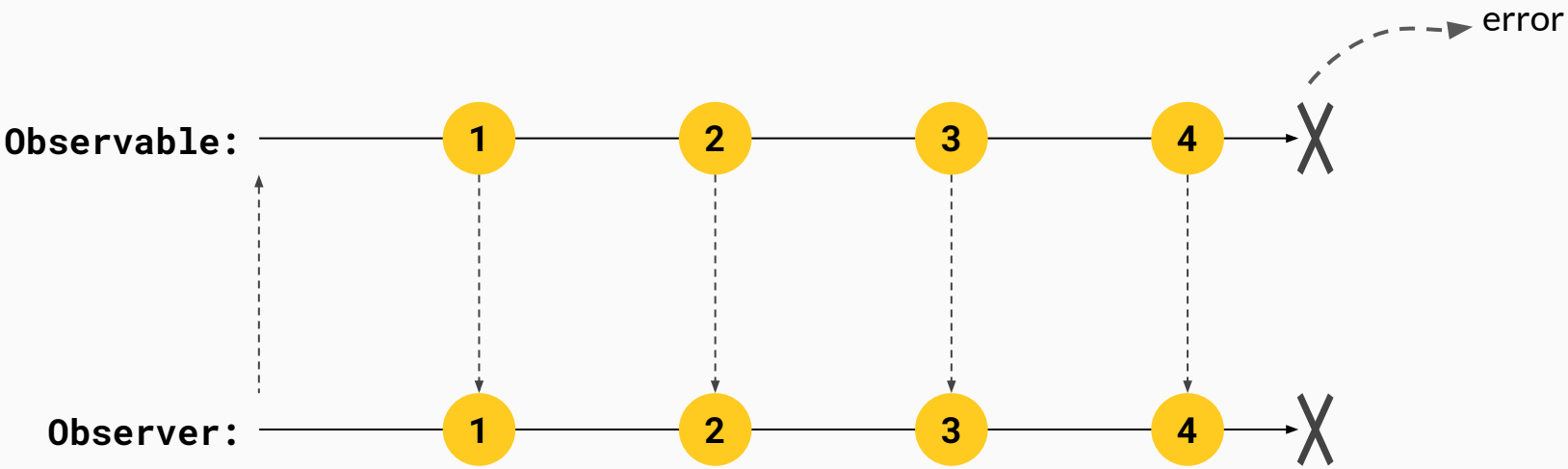
Error



Error

hello-world.ts

```ts
import { Observable } from 'rxjs';

const helloWorld$ = new Observable(
  function subscribe(observer) {
    observer.next('Hello');
    observer.next('World');
    observer.error(new Error('fail'));
  }
);
```

hello-world.ts

```ts
// ...

const observer = {
  next: (value) => console.log(value),
  error: (err) => console.error(err),
  complete: () => console.log('done')
};

const subscription$ =
  helloWorld.subscribe(observer);
```

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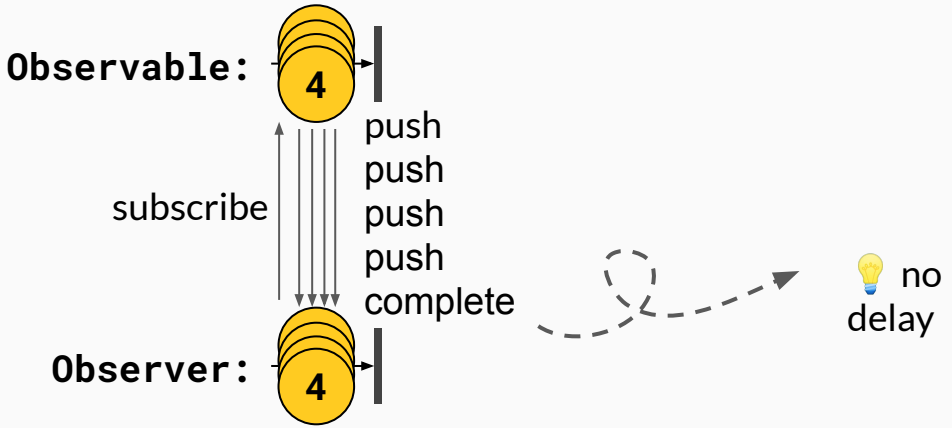
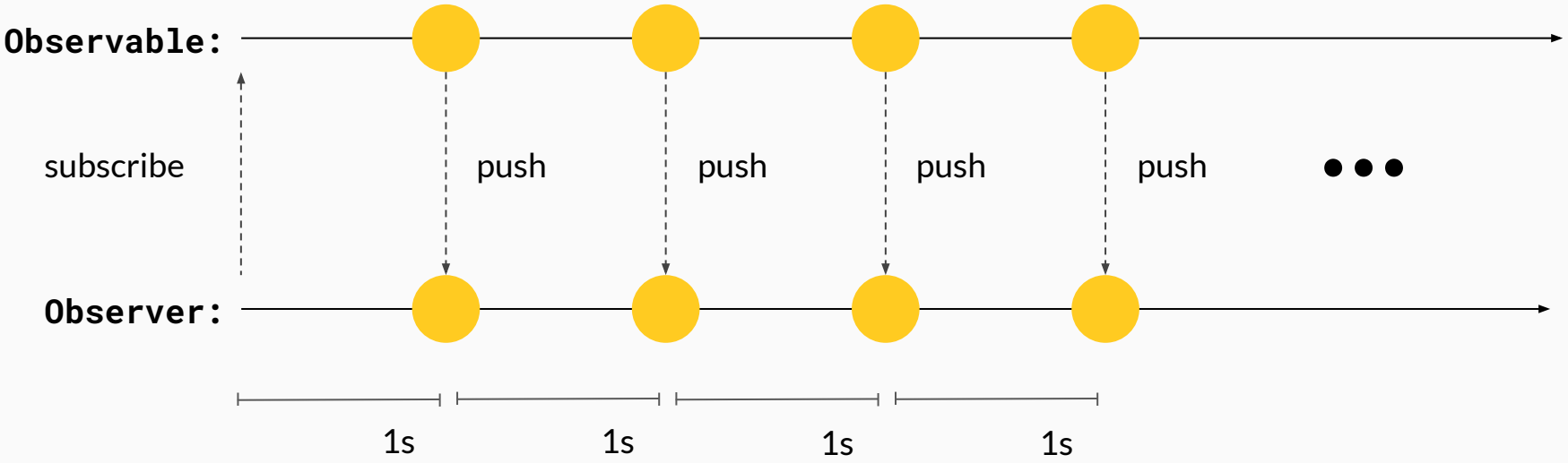
What it looks like



Let’s add a delay



Task 2

Create an Observable

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Observables - cancellation

```
const subscription = observable.subscribe(...)

subscription.unsubscribe()
```

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Operator

- Operators are functions
- allow complex asynchronous code to be easily composed in a declarative manner.

```
observableInstance.pipe(operator()).
```

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Transformation Operators

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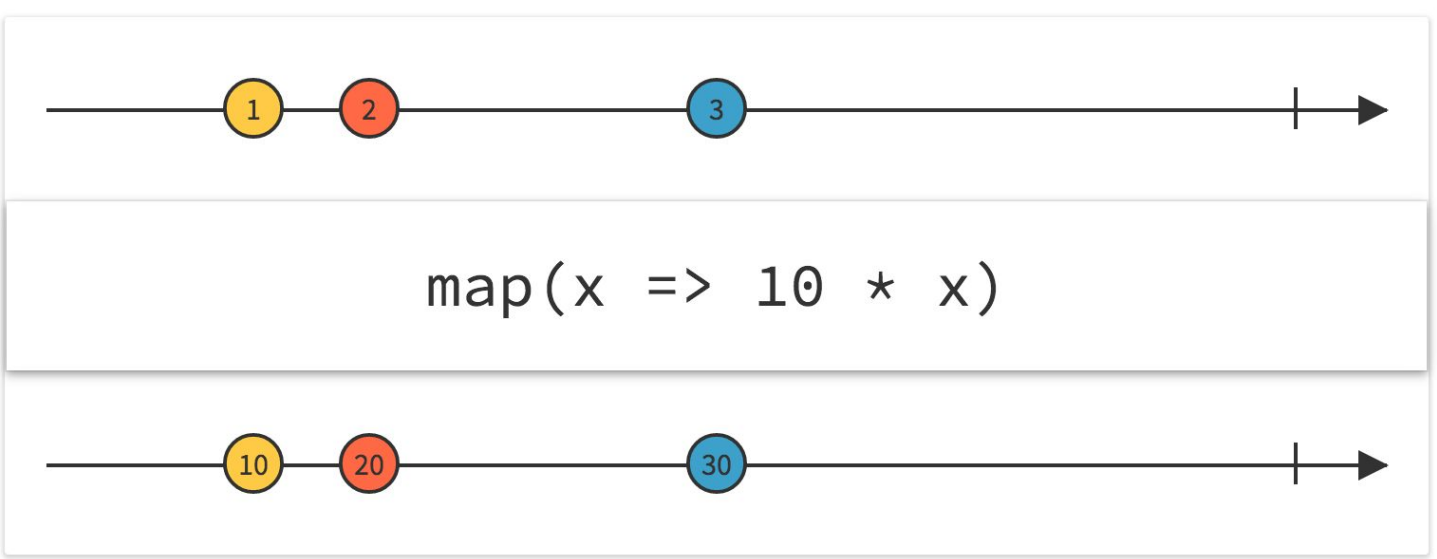
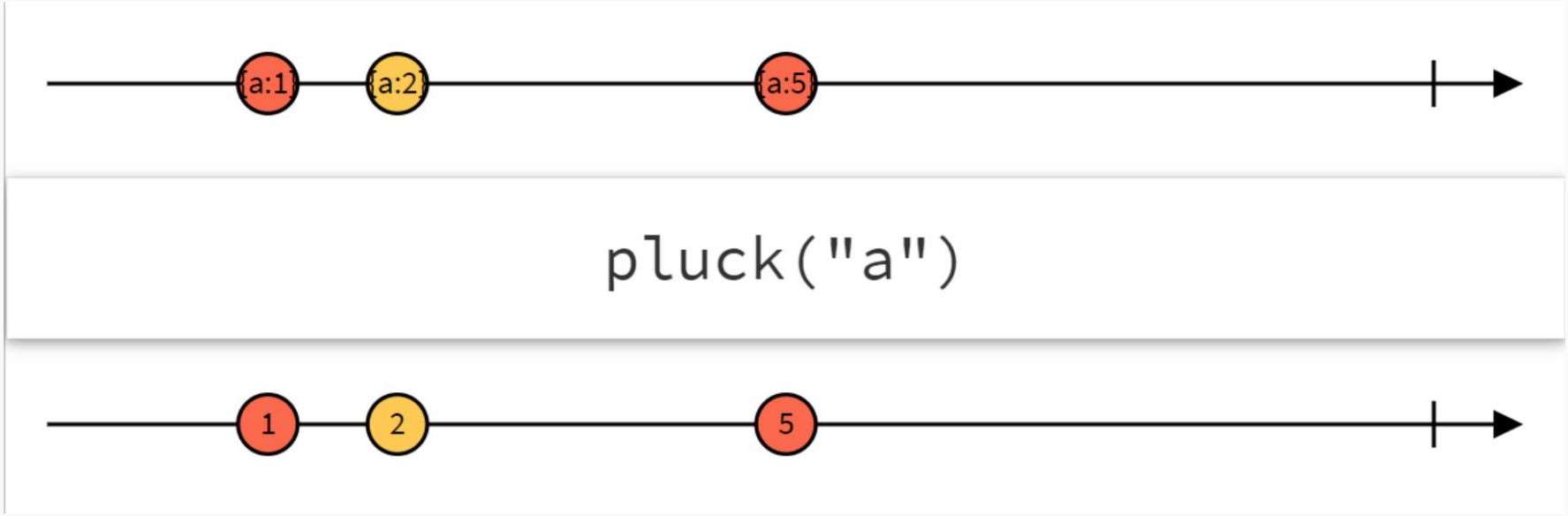
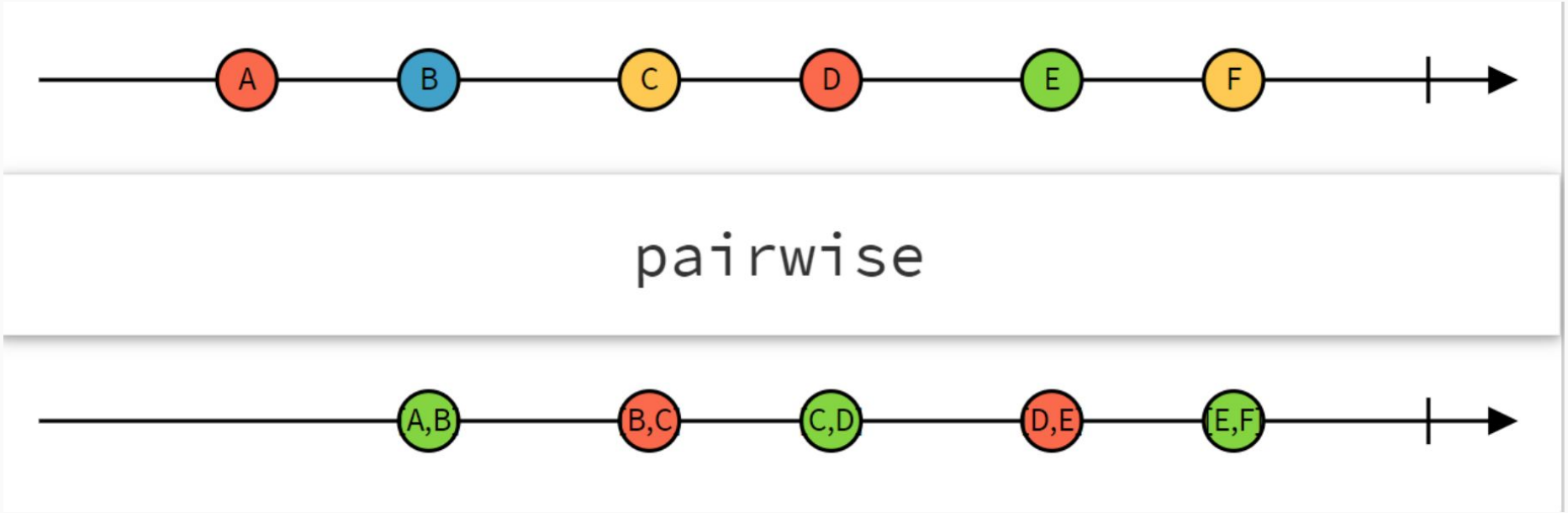
.map()



.pluck()



.pairwise()



Filtering Operators

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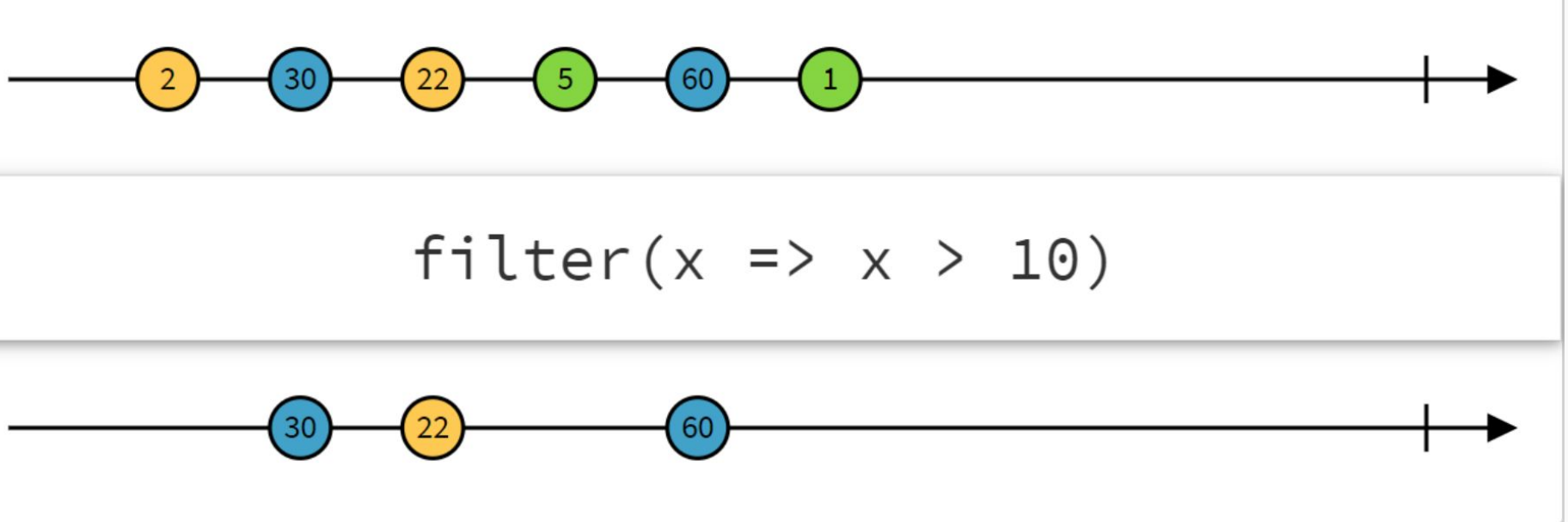
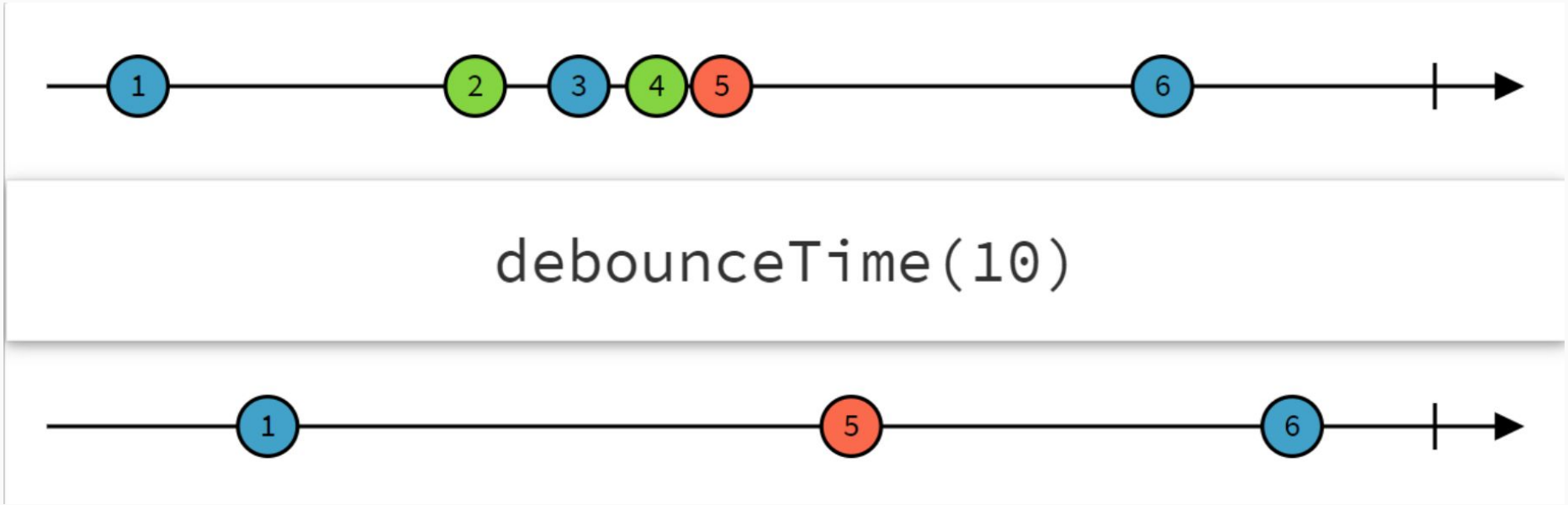
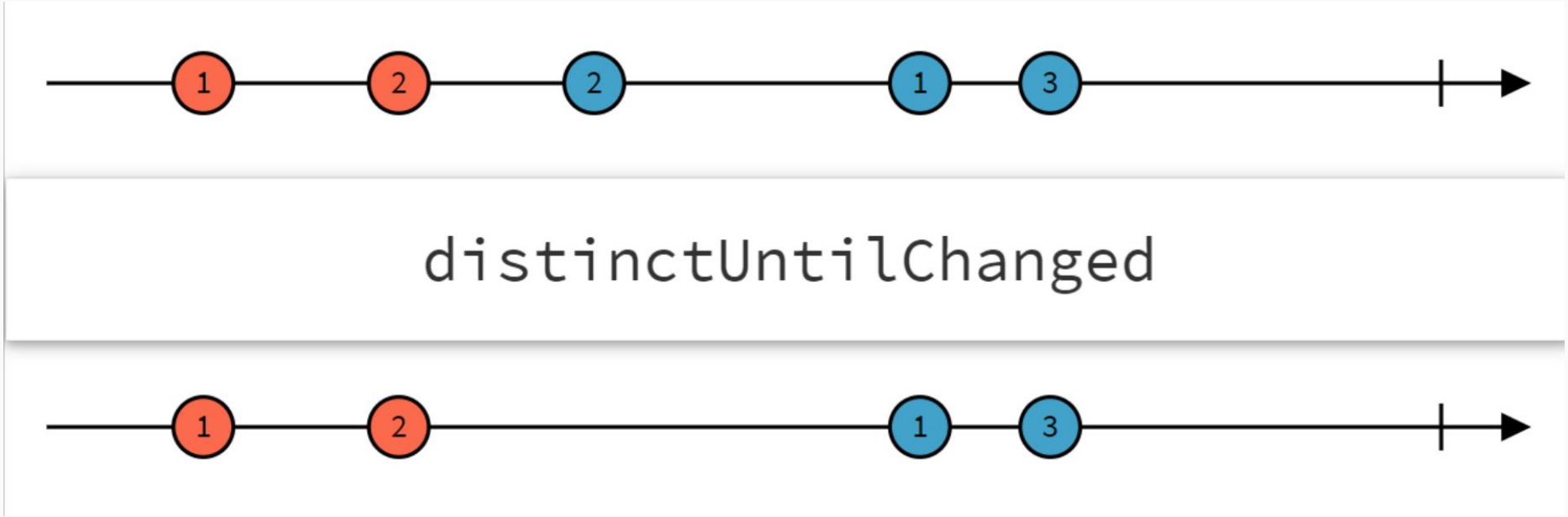
.filter()



.debounceTime(n: milliseconds)



distinctUntilChanged()



Combination Operators

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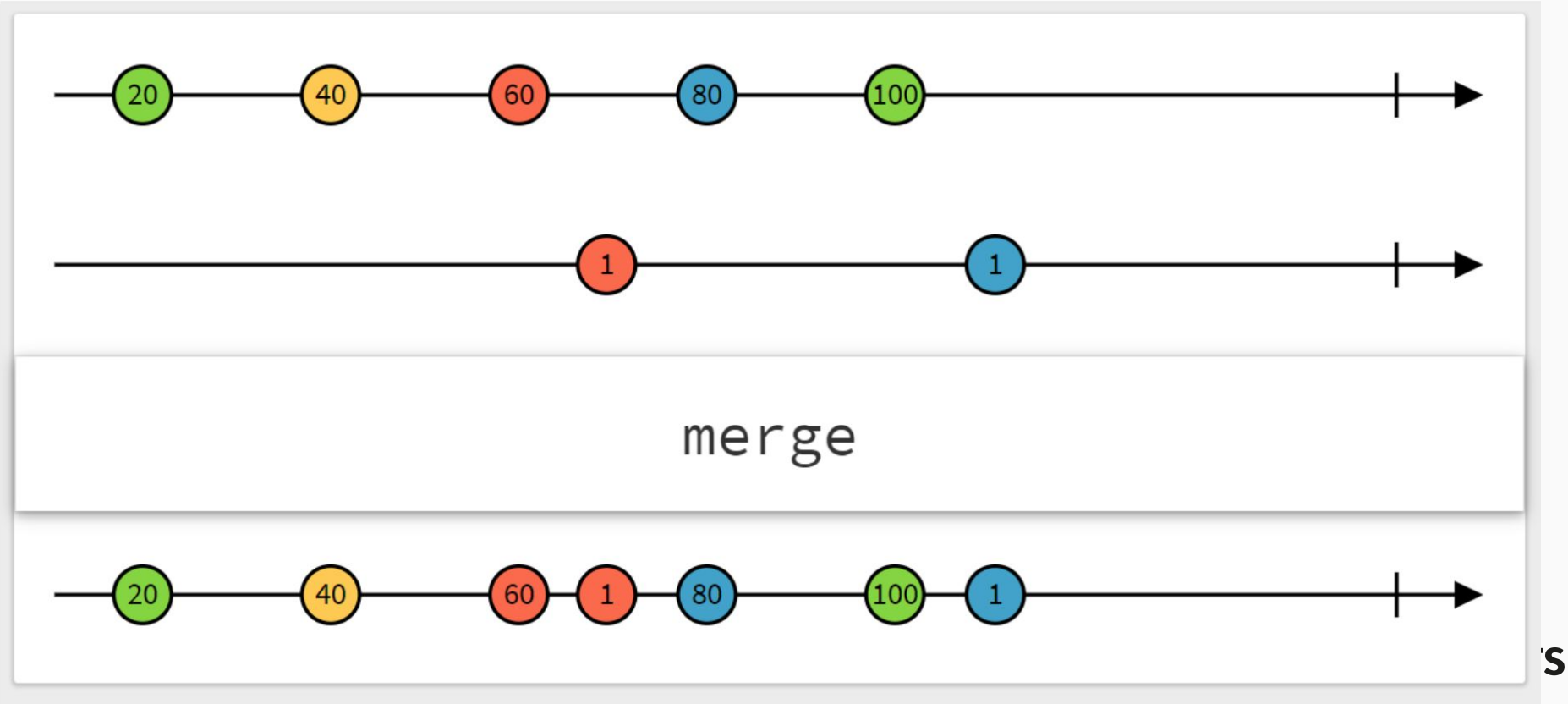
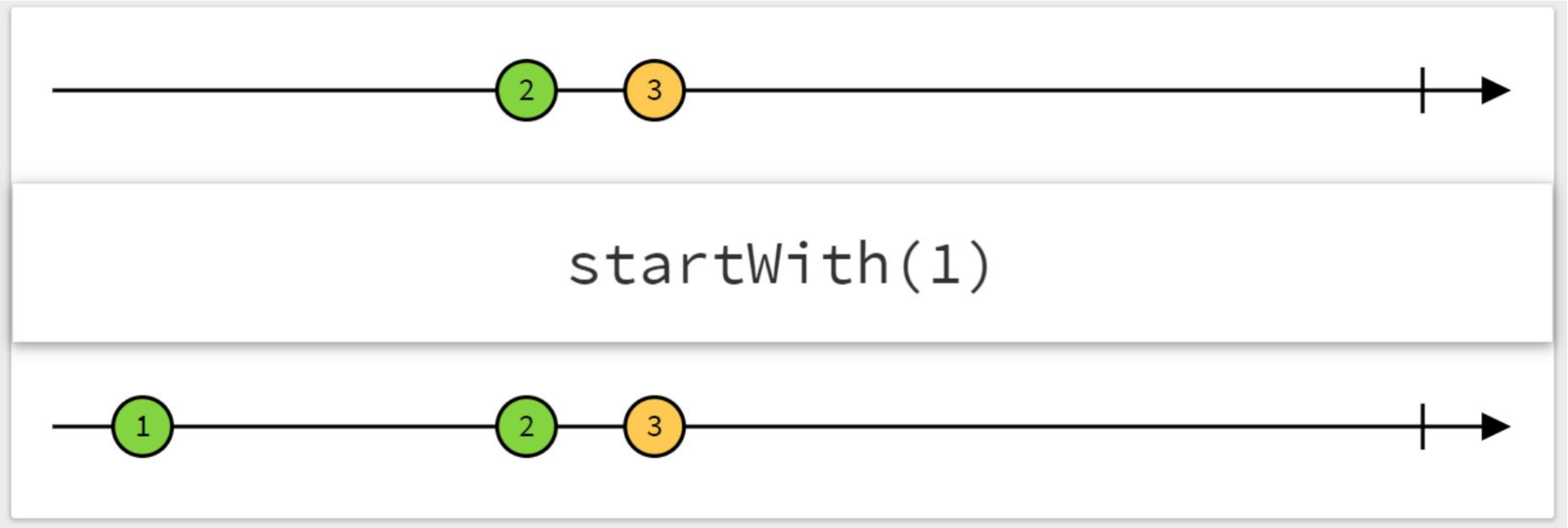
merge()



startWith()



Error Handling

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Operators for Error Handling

- catchError
- Retry
- retryWhen
- throwError

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Observable Creation Operators

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Observables creation helpers

- of(value1, value2, …)
- from(promise/iterable/observable)
- fromEvent(item, eventName)
- Angular HttpClient
- Many more

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You are usually not creating

your own observables!

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Observables - subscribing

Without subscribing an observable will not be fired

```
.subscribe(nextFn, errorFn, completeFn)
```

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Unsubscribe!!!

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Need to unsubscribe!!!

<code>

```
BookComponent implements OnInit, OnDestroy {
Subscription: Subscription;
    ngOnInit() {
         subscription = this.bookData
          .getBooks()
          .subscribe(books => this.books = books);
    }

    ngOnDestroy() {
        subscription.unsubscribe()
    }
}
```

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HttpClient

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Using the HttpClient

- Basic HTTP handling
- `import {HttpClientModule} from '@angular/common/http'`
- `import {HttpClient} from '@angular/common/http'`
- Provides methods for
  - GET
  - PUT
  - POST
  - DELETE

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Http service

<code>

HttpClientModule has to be imported

```
import { HttpClientModule } from '@angular/common/http';

@NgModule({
  imports: [
    BrowserModule,
    HttpClientModule
  ],
  ...
})
```

HttpClient Interface

Name	Parameter	Returnvalue
get	url, options?	Observable<TPayload>
post	url, body, options?	Observable<TPayload>
put	url, body, options?	Observable<TPayload>
delete	url, options?	Observable<TPayload>
patch	url, body, options?	Observable<TPayload>
head	url, options?	Observable<TPayload>
request	Request, options?	Observable<TPayload>

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HttpClient usage

HttpClient functions return response observables

```
import { HttpClient } from '@angular/common/http';
...
  constructor(private http: HttpClient) {}

  getBooks() {
    return this.http.get<Book[]>(this.baseUrl)
  }
...
```

HttpClient

- Returns an observable
- Expects data in JSON format

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HttpClient - Full response

<code>

Use observe: 'response' to get the full response

```
http
  .get<Book[]>('/books', {observe: 'response'})
  .subscribe(resp => {
    console.log(resp.headers.get('X-Custom-Header'));
    console.log(resp.body);
  });
```

HttpClient service

<code>

Subscribe to service observable in a component

```
constructor(private bookData: BookDataService) {
  this.bookData
      .getBooks()
      .subscribe(books => this.books = books);
}
```

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Task 3

Load data from local API

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Async Pipe

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The AsyncPipe accepts a Promise or Observable as input and subscribes to the input automatically, eventually returning the emitted values.

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Async Pipe

- Subscribe to Observable
- UnSubscribe on component destruction
- Built-In Pipe
- Simple use: {{ books$ | async }}

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Async Pipe

<code>

For every async a new subscription is made. Try to minimize use of async

```
<li *ngFor="let book of books$ | async">
  {{book.title}}
</li>

<span>{{ (books$ | async).length }}
```

Two subscriptions created.
Could cause performance issues

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Async Pipe

<code>

Finnish Notation. Naming observables with an $ suffix

```
<li *ngFor="let book of books$ | async">
  {{book.title}}
</li>
```

Task 4

Use the async pipe

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Angular Subjects

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Helps to manage the state of your application

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Why?

- Unidirectional data flow
- Predictable state changes and rendering
- Helping you application to be more “reactive”

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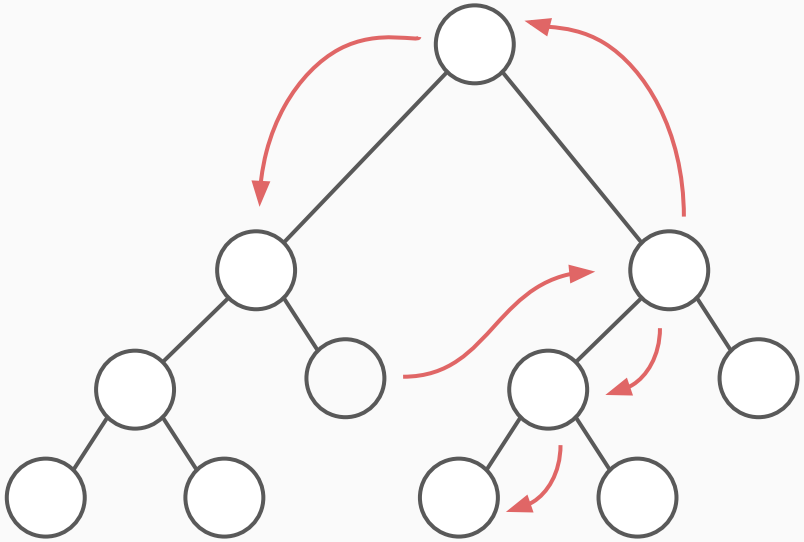
Why?



This is how we manage state at the moment:

@Input()
@Output()

State management with Subjects

- Subjects are Observables but also Observers themselves
- Components can subscribe to Subjects
- Subjects **can emit data** too

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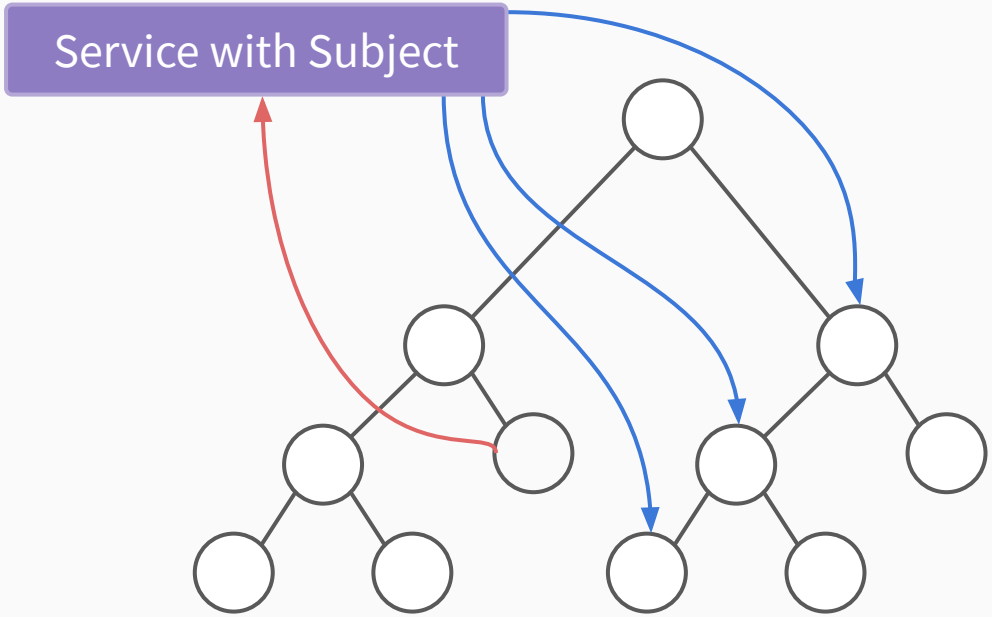
State management with Subjects



Everything is dispatched from and to **one global store**

Creating a Subject

<code>

```
let subject = new Subject<string>();

// We subscribe to the subject
subject.subscribe((data) => {
 console.log(`Hello ${data}`)
});


subject.next('Angular');
// Hello Angular
```

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Task 5

Create a HeaderService with a Subject

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Subjects are multicast

<code>

```
let subject = new Subject<string>();
subject.subscribe((data) => {
 console.log(`Subscriber 1 received ${data}`);
});

subject.subscribe((data) => {
 console.log(`Subscriber 2 received ${data}`);
});

subject.next('Hello Angular');

// Subscriber 1 received Hello Angular
// Subscriber 2 received Hello Angular
```

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Don’t expose Subjects directly !!!

- Subscribers will be able to “mess up” with your Subjects
- Return an Observable:

```
private subject = new Subject<string>();

observable$ = this.subject.asObservable();
```

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Task 6

Change Headertitle on BookListItem-Click

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Using Subjects to unsubscribe

- We need to unsubscribe of all Subscriptions (otherwise we might geht memory leaks)
- But that can get really messy:

```
subsription1 = observable1$.subscribe((data) => {});
subsription2 = observable2$.subscribe((data) => {});
subsription3 = observable3$.subscribe((data) => {});
subsription4 = observable4$.subscribe((data) => {});

//ngOnDestroy:
subsription1.unsubscribe()
subsription2.unsubscribe()
subsription3.unsubscribe()
subsription4.unsubscribe()
```

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Using Subjects to unsubscribe

<code>

```
let destroy$ = new Subject<boolean>();

this.apiService.getObservable().pipe(
     takeUntil(this.destroy$)
)
.subscribe((data) => {
  ...
});


ngOnDestroy() {
     this.destroy$.next(true)
}
```

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Other Subjects?

- A simple subject is not keeping the state
- Subscribers of subjects after value was emitted are not getting it

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BehaviourSubject

- BehaviourSubject always stores the last emitted Value
- It needs a default Value to

```
private behaviourSubject = new BehaviourSubject<string>('default');
```

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ReplaySubject

- ReplaySubjects always stores the last emitted Value**s**
- It needs the amount of Values it should store

```
private replaySubject = new ReplaySubject<string>(11);
```

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Flattening Operators

concatMap(), mergeMap(), switchMap(), and exhaustMap().

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switchMap ⭐

- Switching to a new “inner” observable
  - The previous observable is cancelled
- Maintains only one inner subscription at a time
- Previous requests will be cancelled if source emits quickly enough

Stackblitz Example

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mergeMap / flatMap ⭐

- flatMap is an alias for mergeMap
- Allows multiple inner subscriptions
- Requests that should not be canceled

Stackblitz Example

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mergeMap / flatMap ⭐

<code>

```
book$: Observable<{}>;
 constructor(private http: HttpClient) {}

 ngOnInit() {
   this.book$ = this.http
     .get('/api/book/11')
     .pipe(flatMap(book => this.http.get(book.authorId)));
 }
```

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concatMap ⭐

- Same like mergeMap but take care about the order
- Does not subscribe to the next observable until the previous completes

Stackblitz Example

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exhaustMap

- The first emitted value will be mapped
- While this inner observable is still active all other emitted values will be ignored

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Combination Operators

combineLatest(), withLatestFrom(), concat(), forkJoin() and zip()

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combineLatest ⭐

- Used for long-lived observables relying on each other
- Will not emit an initial value until each observable emitted

Stackblitz Example

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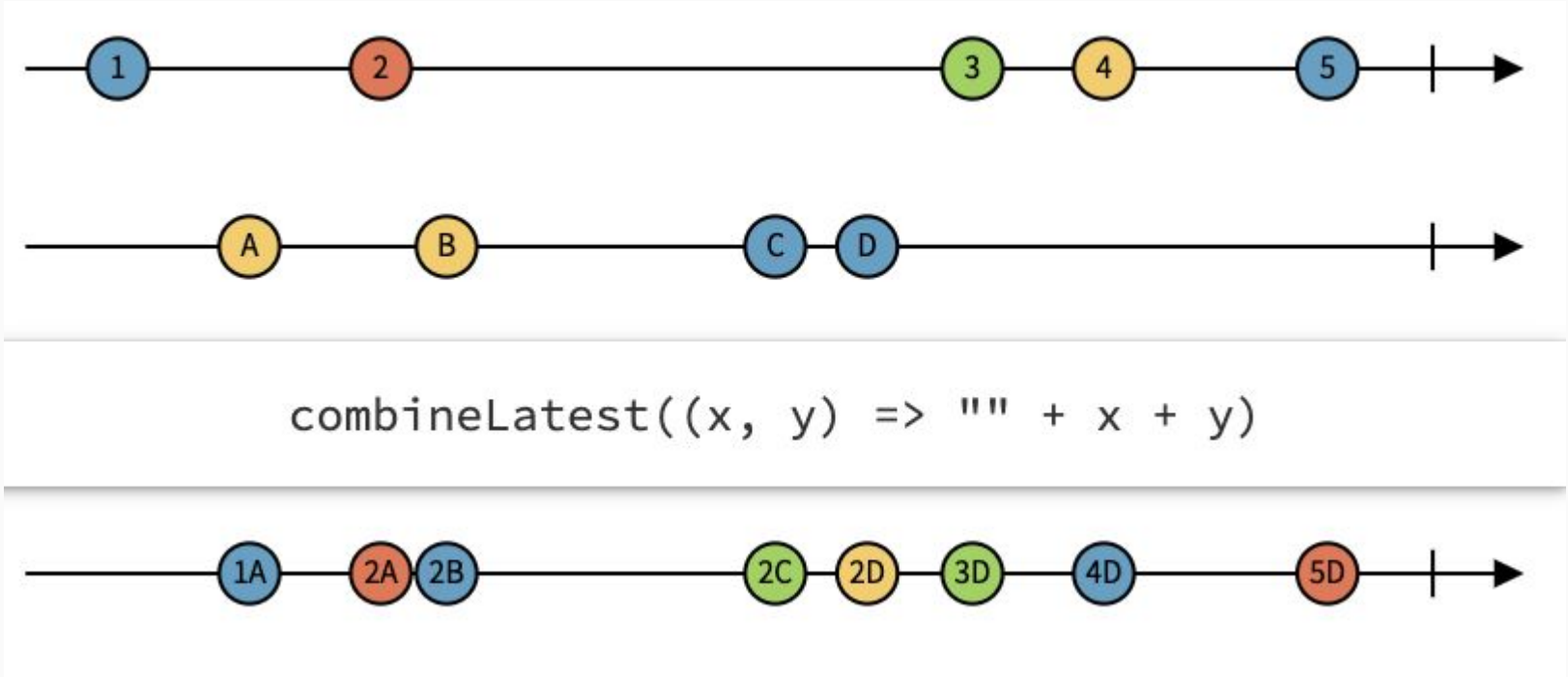
combineLatest ⭐



withLatestFrom ⭐

- Also provide the last value from another observable
- Both sources must emit at least one value

Stackblitz Example

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concat ⭐

- Transaction based
- just if previous Observables completes the next subscription starts
- When one source never completes, other observables never run

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concat ⭐

<code>

```
concat(
    of(1, 2, 3),
    // subscribed after first completes
    of(4, 5, 6),
    // subscribed after second completes
    of(7, 8, 9)
    )
.subscribe(console.log);

// log: 1, 2, 3, 4, 5, 6, 7, 8, 9
```

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forkJoin

- Similar to Promise.all()
- Takes a list of Observables and executes them in parallel
- Waits for every Observable to emit a value and then emit a single value
- Emits the last emitted value from after all inner observables completed

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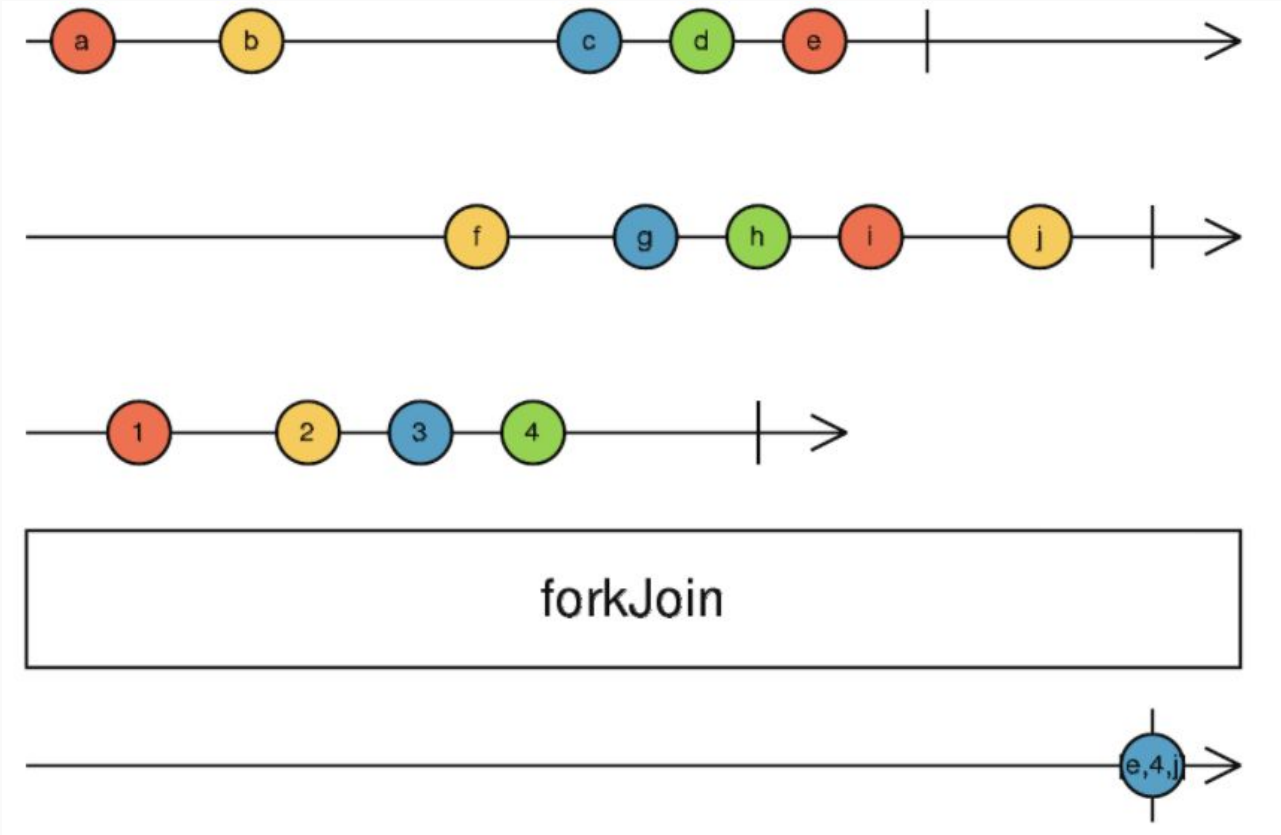
forkJoin



zip

- Combines values together from multiple source Observables
- Doesn’t start to emit until each inner observable has at least one value
- Emits as long as emitted values can be collected from all inner observables

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Good example

```
const you$ = ['Cola Zero', 'Margherita Pizza', 'Tiramisu'];
const mario$ = ['Sprite', 'Carbonara Pizza', 'Fruits salad'];
const luigi$ = ['Pepsi', 'Quattro Formaggi Pizza', 'Ice cream'];

const waiter$ = zip(
  from(you$),
  from(mario$),
  from(luigi$)
);

waiter$.subscribe(
  next => console.log(next),
  error => console.log(error),
  () => console.log('completed!')
);

// ["Cola Zero", "Sprite", "Pepsi"]
// ["Margherita Pizza", "Carbonara Pizza", "Quattro Formaggi Pizza"]
// ["Tiramisu", "Fruits salad", "Ice cream"]
// completed!
```

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Bad Example

```
const you$ = ['Cola Zero', 'Margherita Pizza', 'Tiramisu'];
const girlfriend$ = ['Sprite'];

const waiter$ = zip(
  from(you$),
  from(girlfriend$)
);

waiter$.subscribe(
  next => console.log(next),
  error => console.log(error),
  () => console.log('completed!')
);

// ["Cola Zero", "Sprite"]
// completed!
```

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Sending Http Requests

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Multiple parallel HTTP requests with forkJoin

```
  forkJoin([
    this.http.get(`https://api/1/`),
    this.http.get(`https://api/2/`),
    this.http.get(`https://api/3/`),
  ])
    .subscribe(console.log)

// [resultObject1, resultObject2, resultObject3]
```

The forkJoin issue

- The order will be preserved but if one request is delayed all the others have to wait
- If any of the requests fails, it will fail for the whole collection

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Multiple parallel HTTP requests with mergeMap

```
getPokemons(pokeIds: number[]): Observable<Item> {
  return from(pokeIds).pipe(
    mergeMap(pokeIds => this.http.get<Pokemon>(`pokemon/${id}`))
  );
}
```

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Sequential HTTP requests [0]

<code>

```
this.http.get('url').pipe(
    concatMap(result1 => this.http.get('url', result1))
    concatMap(result2 => this.http.get('url', result2))
    concatMap(result3 => this.http.get('url', result3))
 ).subscribe();
```

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Sequential HTTP requests [1]

<code>

```
this.http.get(`https://pokemon.com/api/pokemon/11`)
    .pipe(
      switchMap(response =>
        forkJoin(response.enemies.map(url => this.http.get(url)))
        )
    ).subscribe(console.log)


// [{ name: “Zapdos” },{ name: “Lugia” },{ name: “Suicune” },...]
```