Reactive Extensions for JavaScript - Basics

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Outline

- Motivation
- Observable
- Observer
- Subscription
- Factories
- Subjects
- Closing Observables
- Hot vs. Cold Observables
- Observables vs. Promises

Motivation

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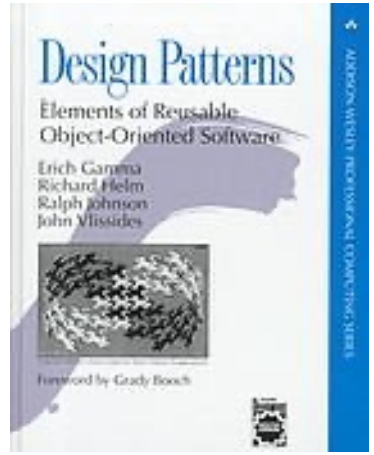
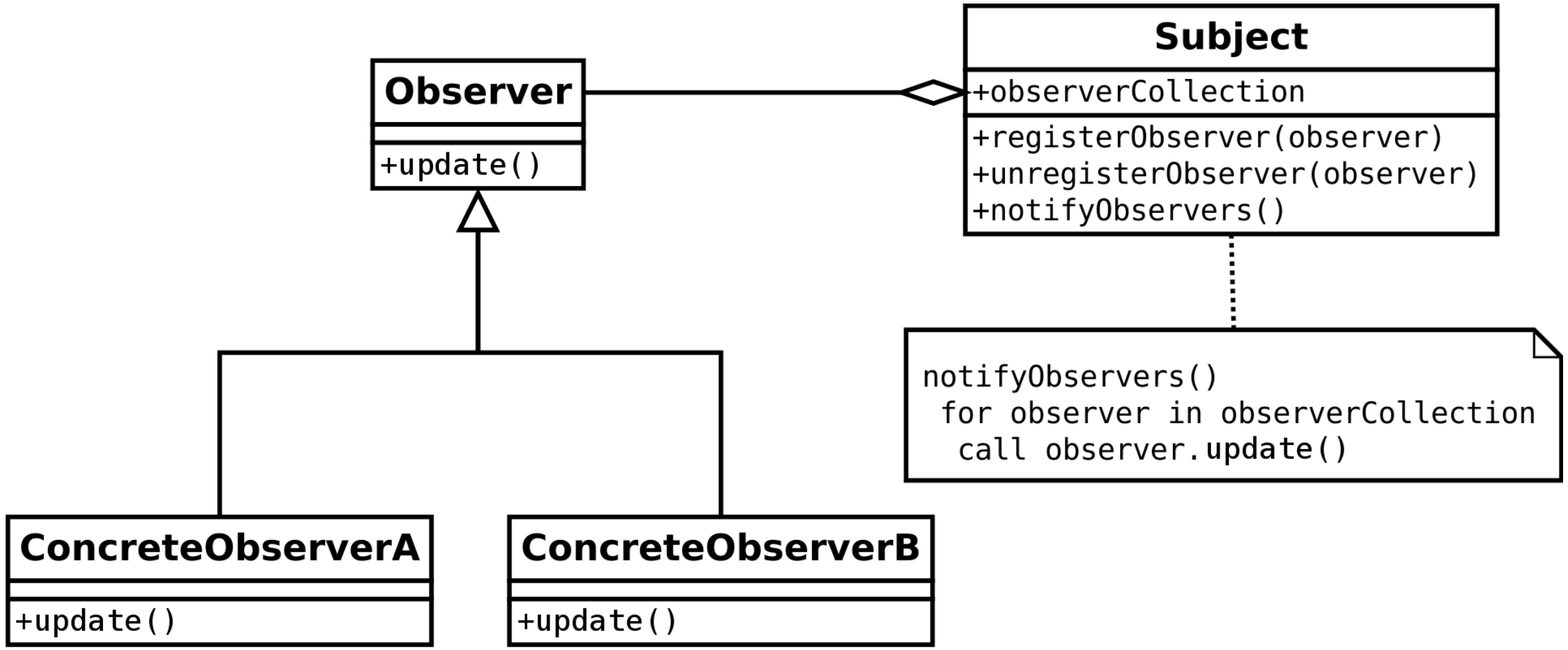
Once upon a time

- Design Patterns (1994 - Gang Of Four)
  - Iterator Pattern (Behavioral Design Pattern)
    - Decouble data from alogrithms



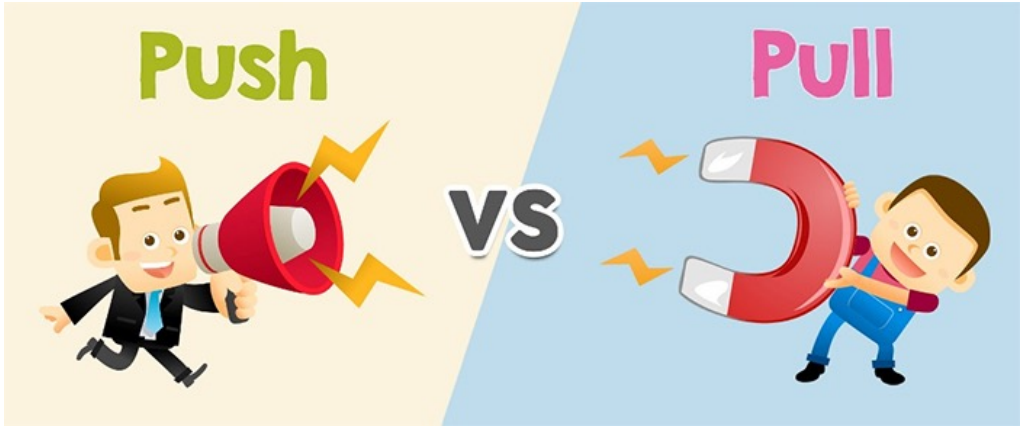

```
class Iterable {
 [Symbol.iterator]() {
   …
 }
}

const iterable = new Iterable();
for (const item of iterable) {
  …
}
```

Observer pattern (Behavioral DP)



Pull vs Push Architecure (I)

- Pull-based
  - Consumer decide when data is pulled
  - Producer unaware when
  - Every function is a producer



- Push-based
  - Get notified when changes happen
  - E.g. Mobile App Push Notifications

Pull vs Push Architecure (II)

	Producer	Consumer
Pull	**Passive:** produces data when requested.	**Active:** decides when data is requested.
Push	**Active:** produces data at its own pace.	**Passive:** reacts to received data.

Concurrency (I)

- Synchronous vs. asynchronous computing
  - Latency → wait time

- Non-blocking code with callbacks
  - Often used in JavaScript

Concurrency (II)

	Single items	Mulitple items
synchronous / Pull	Function	Iterable
asynchronous / Push	Promise / async|await	?

Concurrency (II)

	Single items	Mulitple items
synchronous / Pull	Function	Iterable
asynchronous / Push	Promise / async|await	**Observable**

Observables & Observer

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What are observables?

- Represents (asynchronous) data that is published over time
- A collection of values over any amount of time
  - 0..N values could be emitted
- Cancelable
- Lazy
- Operator support

Why Observables?

Asynchronous operations

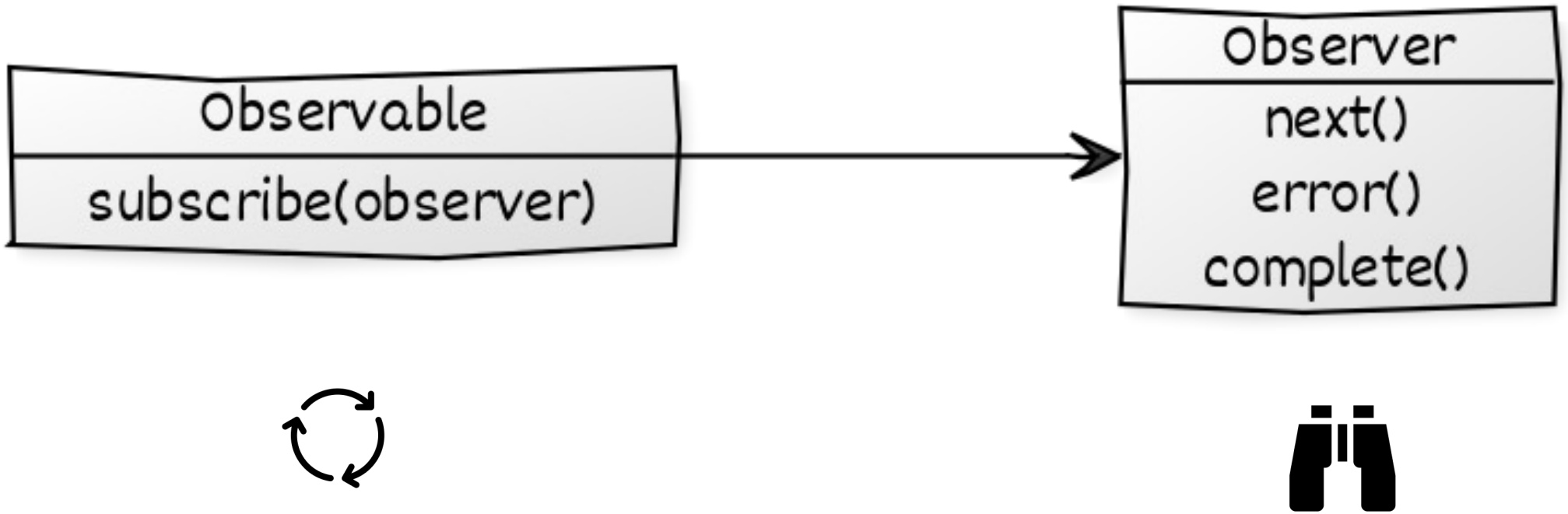
Interactive (reactive) behavior

Observable (asynchornous) data streams?

- User Input
  - Mouse / Keyboard Interactions (e.g. mousemove, click, keydown)
- HTTP requests
- Websockets
- Server Send Events


Observable
„Source“
Operator
(z. B. map)
Observer
„Destination“

Observable and Observer



Subscribing an Observer

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Observer

```
myObservable.subscribe(
    (result) => { … }
);
```

Observer

Observer

```
myObservable.subscribe(
    (result) => { … },
    (error) => { … },
    () => { … }
);
```

Observer

Option with more than one parameter is now deprecated!

Observer

```
myObservable.subscribe({
    next: (result) => { … },
    error: (error) => { … },
    complete: () => { … }
});
```

DEMO: Observable

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Creating Observables

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Creating an Observable

```
let observable = new Observable((sender) => {

    sender.next(4711);
    sender.next(815);

    // sender.error("err!");

    sender.complete();

    return () => { console.debug('Bye bye'); };
});
```

Sync/Async, Event-driven

```
let subscription = observable.subscribe(…);
```

```
subscription.unsubscribe();
```

Creation Operators (Factories)

[https://www.learnrxjs.io]

fromEvent

of

throwError

interval

timer

Subjects

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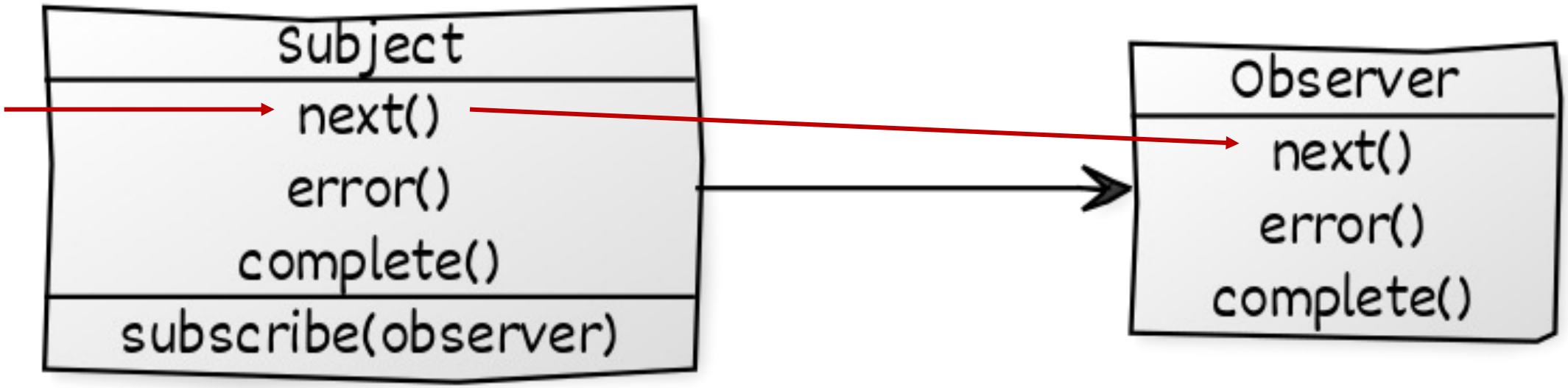
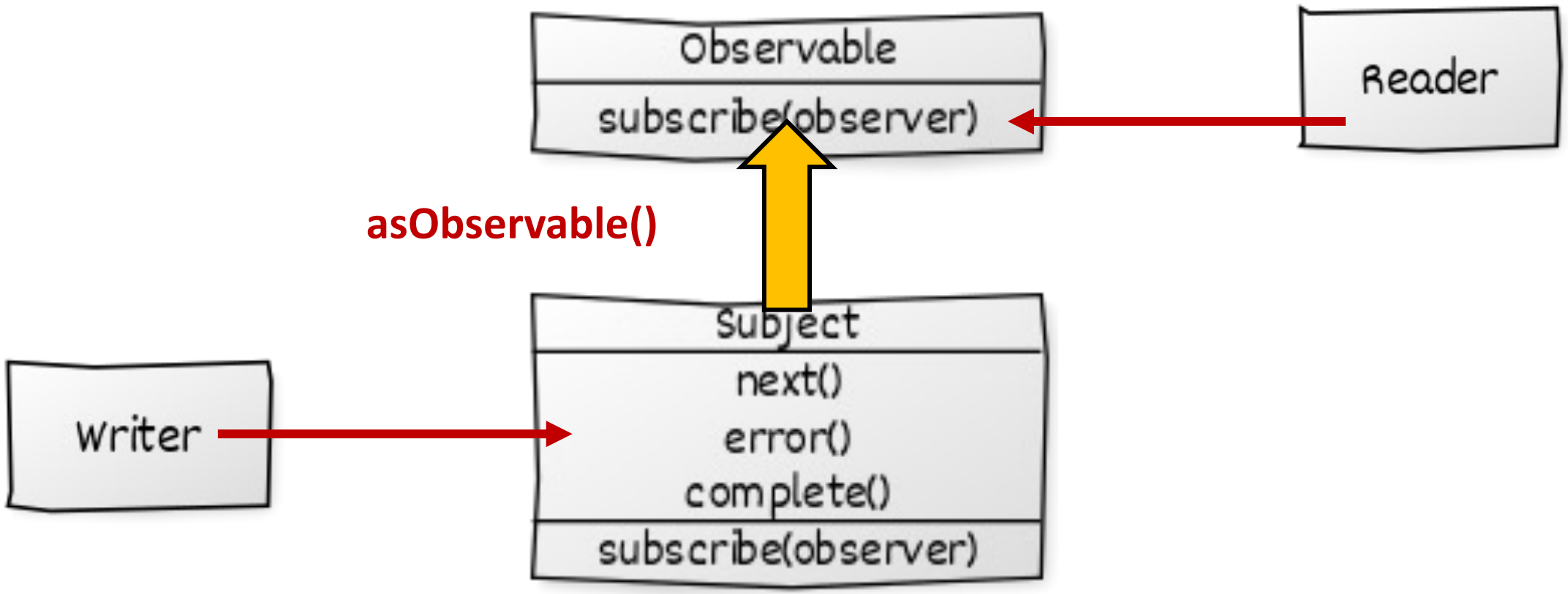
Subjects: Special Observables



Convert Subject into Observable



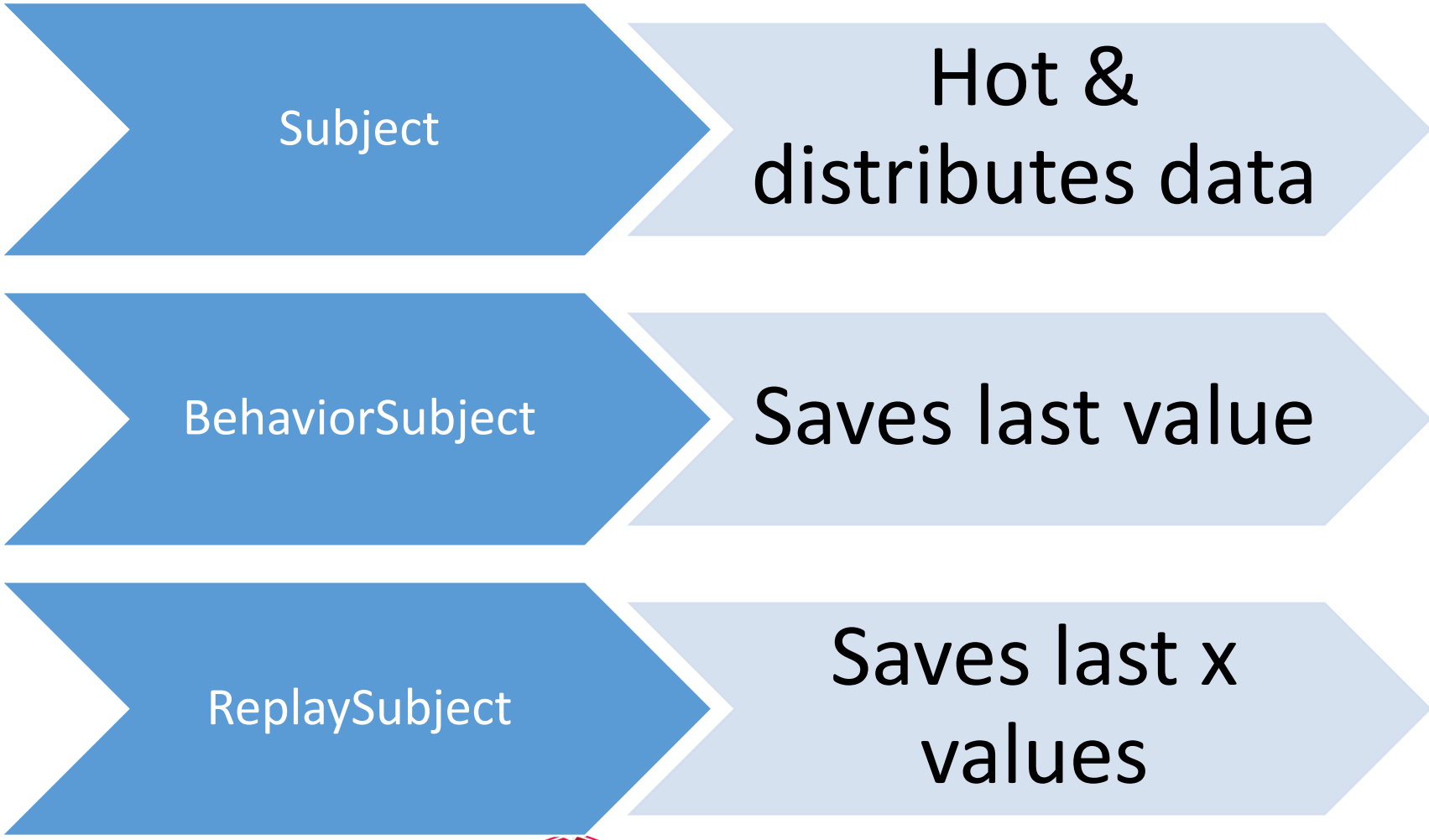
asObservable

```
private subject = new Subject<Flight>();
readonly observable = subject.asObservable();

[…]
this.observable.subscribe(…)

[…]
this.subject.next(…)
```

Subjects



Eventing mit Subject

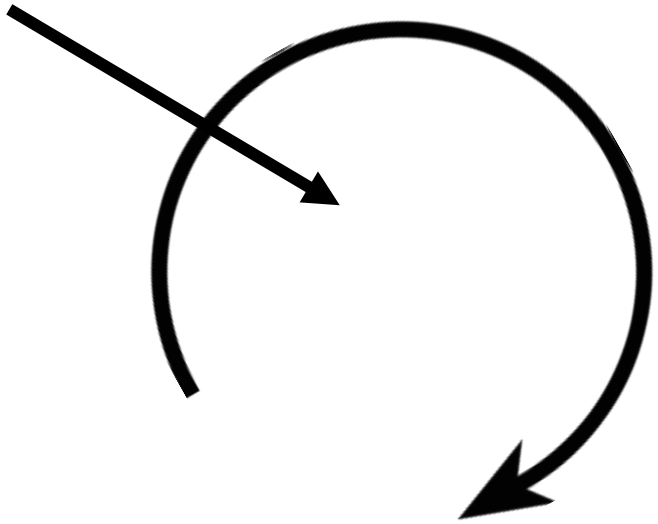
```
const sub = new Subject<Flight>();

sub.subscribe(nextFlight => console.debug(nextFlight));

sub.next({ id: 1, ...})
```

Subjects

Data/Notification



Subject

```
.subscribe({
    (result) => { … },
    (error) => { … },
    () => { … }
});
```

Observer

Closing Observables

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Closing Observables

- Explicitly

  let subscription = observable$.subscribe(…);
  subscription.**unsubscribe()**;

- Implicitly
  - observable$.pipe(**take(2)**).subscribe(…);
  - observable$.pipe(**first()**).subscribe(…);
  - observable$.pipe(**takeUntil(otherSubject)**).subscribe(…);
- Implicitly with async-Pipe in Angular

  {{ observable$ | **async** }}
- Automatic by Angular
  - Everything, Angular opens is also closed by it

DEMO: Closing Observables

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Cold vs. Hot Observables

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Cold vs. Hot Observables

Cold

- Point to point
- Lazy: Only starts at subscription

Default

Hot

- Multicast
- Eager: Sender starts without subscriptions

Create Hot Observable

```
let o = this.find(from, to)
            .pipe(publish()) as ConnectableObservable<Flight[]>;

o.subscribe(…);

o.connect();

o.subscribe(…);
```

Create Hot Observable

```
let o = this.find(from, to).pipe(share());

o.subscribe(…);

o.subscribe(…);
```

Sender starts with first subscription

Sender stops after all receiver have been unsubscribed

Create Hot Observable

```
let o = this.find(from, to)
            .pipe(shareReplay(1));

o.subscribe(…);

o.subscribe(…);
```

DEMO: Hot Observable

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RxJS Basics

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Observables vs Promises

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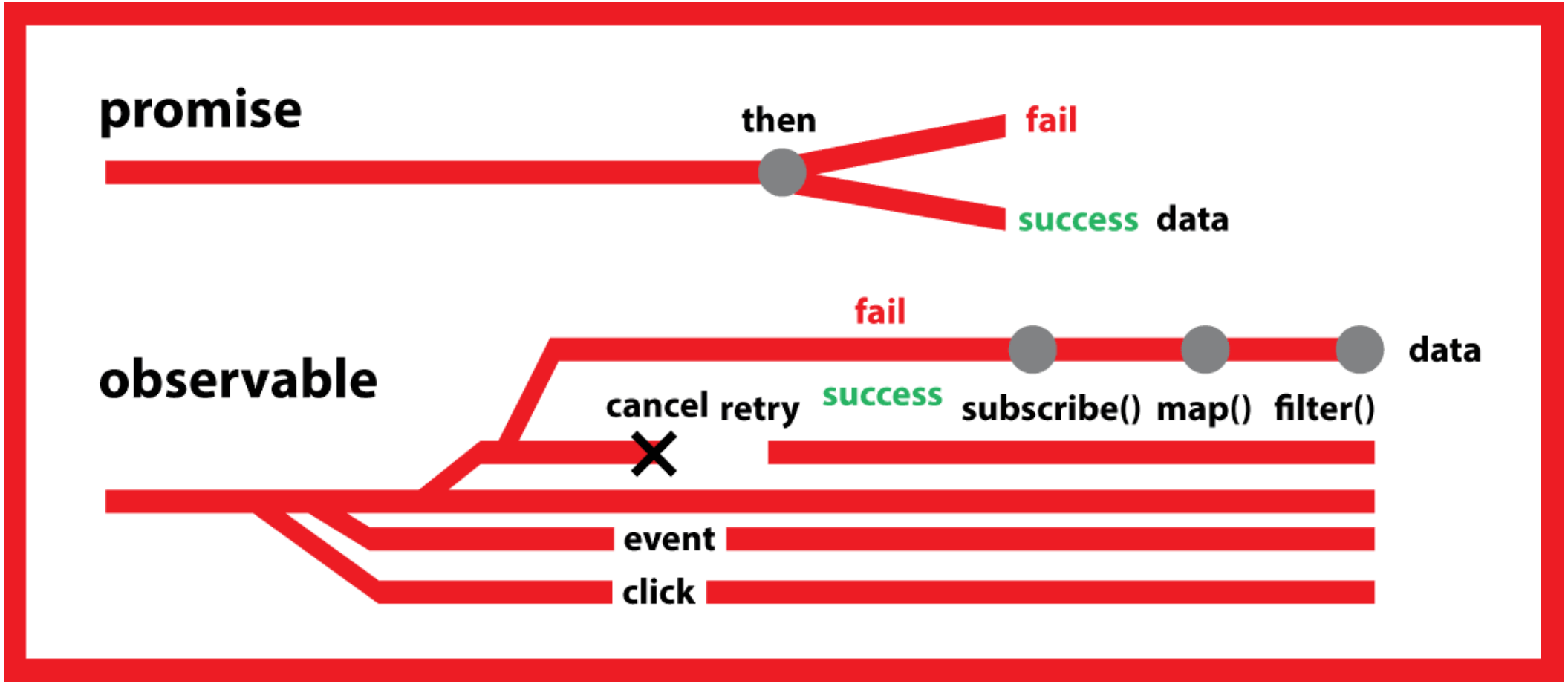
Observables vs Promises – Overview



Observables vs Promises – Details

Observables (Streams)	Promises (Single Event)
More features	Less powerful
Can emit zero, **one or multiple** values over time.	Emit a **single** value at a time.
Lazy: they're not executed until we subscribe using the subscribe() method.	**Eager**: execute immediately after creation.
Subscriptions are **cancellable** using the unsubscribe() method, which stops the listener from receiving further values.	Are **not cancellable**.
RxJS provides a **ton of functionality** to operate on observables like the map, forEach, filter, reduce, retry, and retryWhen operators.	Don't provide any operations.
Deliver errors to the subscribers.	Push errors to the child promises.
Used by Angular in HTTP Client & Route Params	Used by Angular in Router.navigate

Recap

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