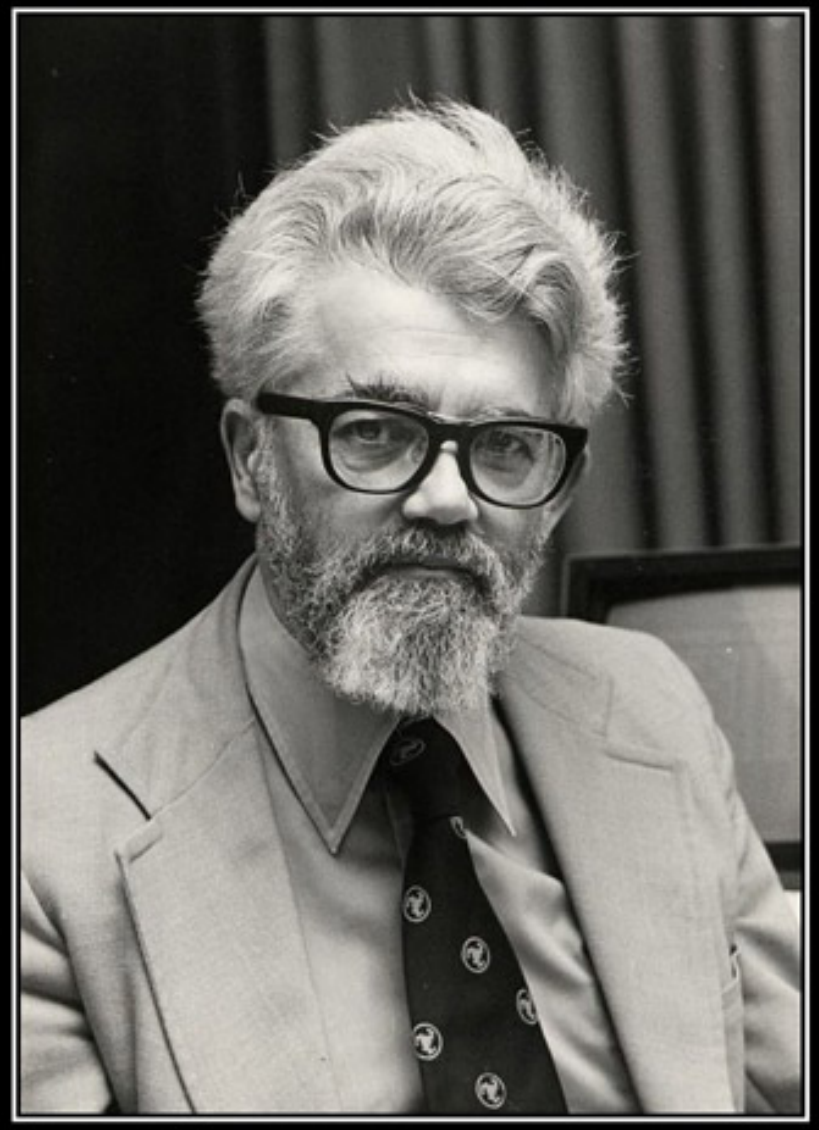


Async and Streaming JS
Are We doing it wrong?

Matthew Podwysocki @mattpodwysocki

github.com/mattpodwysocki/nordic.js-2015

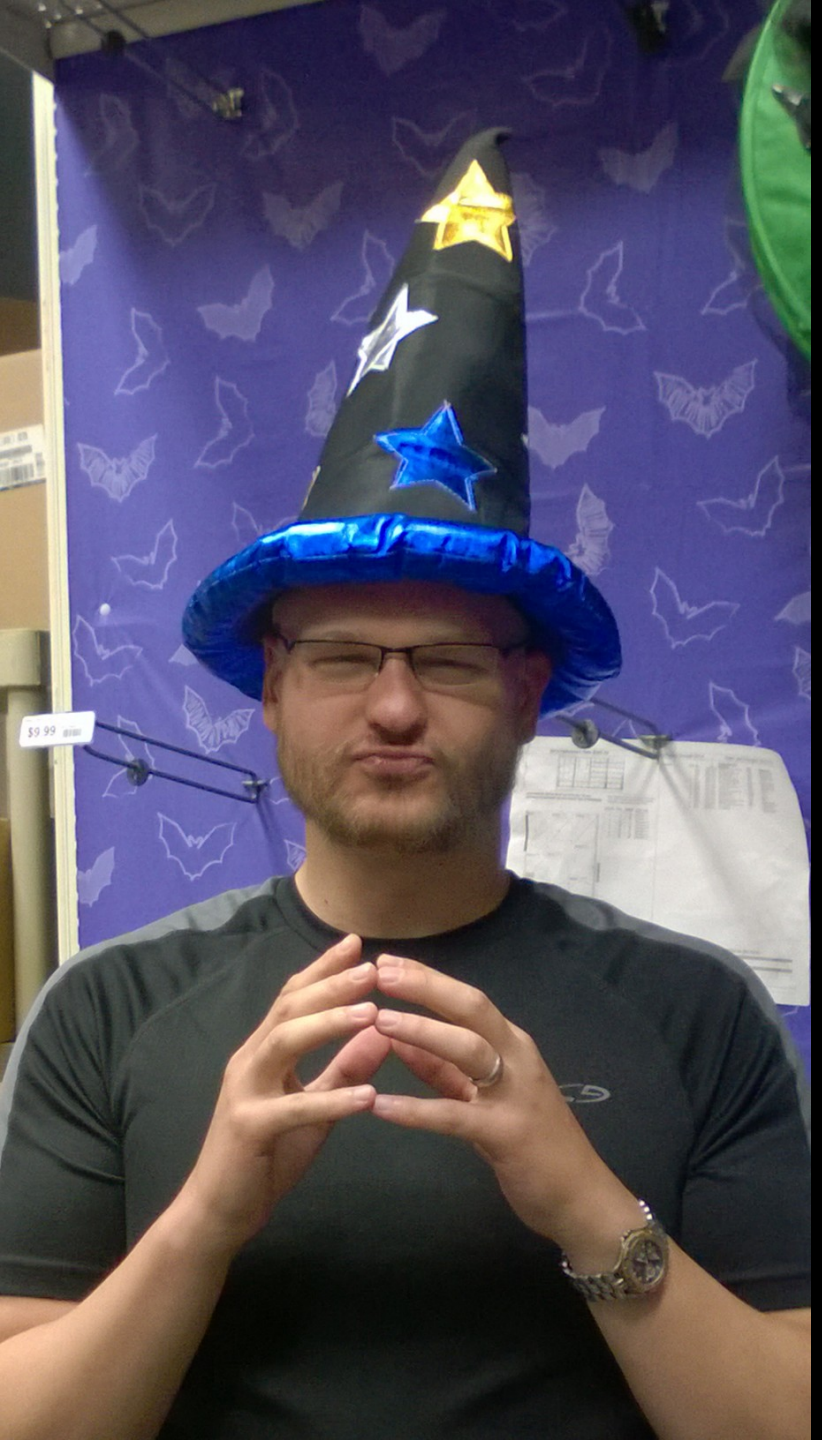

OR:
HOW I LEARNED TO STOP WORRYING ABOUT ASYNCHRONOUS PROGRAMMING AND LOVE THE OBSERVABLE

Or "I thought I had a problem. I thought to myself, "I know, I'll solve it with callbacks and events!". have Now problems. two I


trapd in Monad tutorl
plz help

A MONAD IS JUST A MONOID IN THE CATEGORY OF ENDOFUNCTORS.

WHAT'S THE PROBLEM ?



Princpal Open Source Engineer

Open Sourcerer

@mattpodwysocki

github.com/mattpodwysocki


MICROSOFT

Reactive Extensions (Rx)

@ReactiveX

http://reactivex.io

Real-Time is Everywhere...

Let's Face It, Asynchronous Programming is Awful!

“We choose to go to solve asynchronous programming and do the other things, not because they are easy, but because they are hard”

Former US President John F. Kennedy - 1962
[citation needed]

Callback Hell

```
function play(movieId, callback) {
    var movieTicket, playError,
        tryFinish = function () {
            if (playError) {
                callback(playError);
            } else if (movieTicket && player.initialized) {
                callback(null, ticket);
            }
        };
    if (!player.initialized) {
        player.init(function (error) {
            playError = error;
            tryFinish();
        }
    }
    authorizeMovie( function (error, ticket) {
        playError = error;
        movieTicket = ticket;
        tryFinish();
    });
```


culturepub.fr
next
ad

Events and the Enemy of the State

```
var isDown = false, state;

function mousedown (e) {
  isDown = true;
  state = { startX: e.offsetX,
            startY: e.offsetY; }
}

function mousemove (e) {
  if (!isDown) { return; }
  var delta = { endX: e.clientX - state.startX,
                endY: e.clienyY - state.startY };
  // Now do something with it
}

function mouseup (e) {
  isDown = false;
  state = null;
}
```

```
function dispose() {
  elem.removeEventListener('mousedown', mousedown, false);
  elem.removeEventListener('mouseup', mouseup, false);
  doc.removeEventListener('mousemove', mousemove, false);
}

elem.addEventListener('mousedown', mousedown, false);
elem.addEventListener('mouseup', mouseup, false);
doc.addEventListener('mousemove', mousemove, false);
```

First Class Async with Promises

then

```
player.initialize()
   .then(authorizeMovie, loginError)
   .then(playMovie, unauthorizedMovie)
```

Breaking the Promise...

then

```
var promise;

input.addEventListener('keyup', (e) => {

  if (promise) {
    // Um, how do I cancel?
  } else {
    promise = getData(e.target.value).then(populateUI);
  }
}, false);
```

Aborting a fetch #27

New issue

Open **annevk** opened this issue on Mar 26 · 204 comments

annevk commented on Mar 26 — Owner

Goal

Provide developers with a method to abort something initiated with `fetch()` in a way that is not overly complicated.

Previous discussion

- #20
- slightlyoff/ServiceWorker#592
- slightlyoff/ServiceWorker#625
- whatwg/streams#297

Viable solutions

We have two contenders. Either `fetch()` returns an object that is more than a promise going forward or `fetch()` is passed something, either an object or a callback that gets handed an object.

A promise-subclass

Labels

None yet

Milestone

No milestone

Assignee


jakearchibald

Notifications

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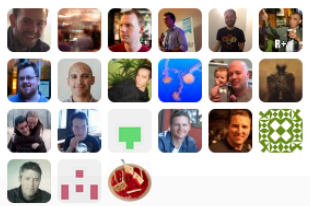
21 participants



https://github.com/whatwg/fetch/issues/27

The Final Countdown...

then

```
var resource;

try {
  var resource = getResource();
} catch (e) {
  throw e;
} finally {
  resource && resource.dispose();
}
```

```
getresource()
  .success(
    function (resource) {

    })
  .catch(
    function (err) {

    });

// How do I clean up my resource?
```

then

UNSAFE AT ANY SPEED

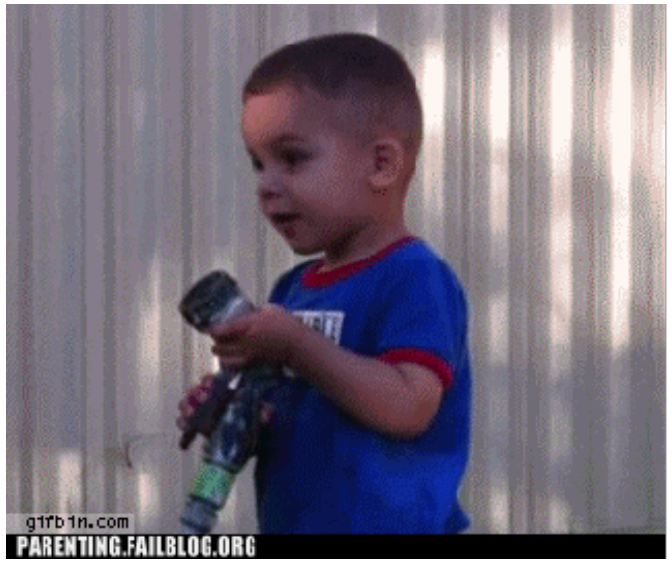
The Designed-In Dangers of The American Automobile

By Ralph Nader


streem prosesing

Let's Face it, Streams1 were terrible...

- The pause method didn't
- The 'data' event started immediately, ready or not!
- Can't just consume a specified number of bytes
- Pause and resume were impossible to get right...



Streams 2 Electric Boogaloo

Streams 33 1/3

WHATWG Streams

Specification for creating, composing and consuming streams of data

- Focused on low-level I/O, not on object mode
- Think Node.js Streams + Promises

```
readableStream.pipeTo(writableStream)
  .then(() => console.log("All data successfully written!"))
  .catch(e => console.error("Something went wrong!", e));
```

https://whatwg.github.io/streams/

Reactive Programming

React

What is Reactive Programming Anyhow?

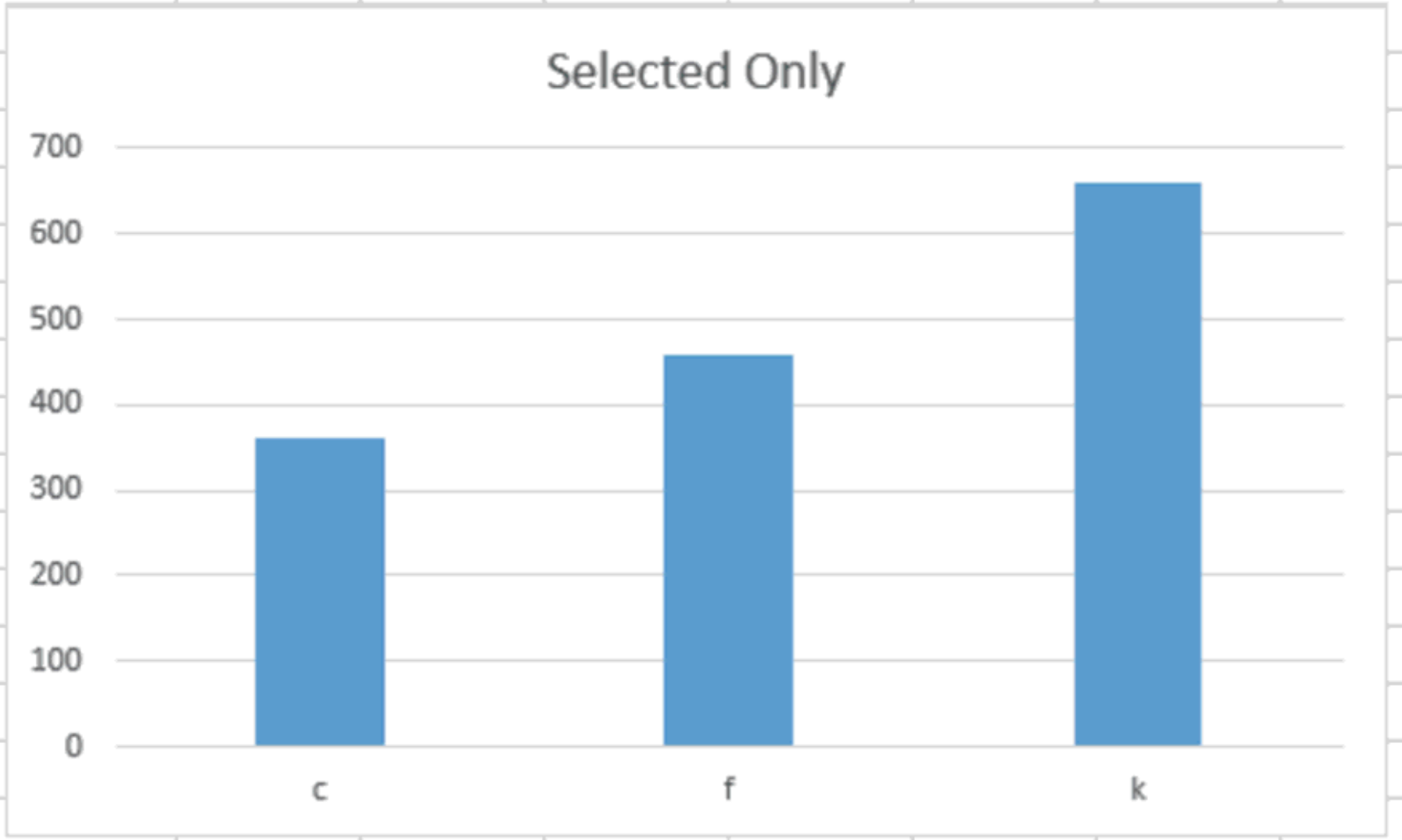
Merriam-Webster defines reactive as *“readily responsive to a stimulus”*,
i.e. its components are “active” and always ready to receive events.

```
$( 'p' ).click(function() {
  $( this ).slideUp();
});
```

Clipboard | Font | Alignment | Number

T18

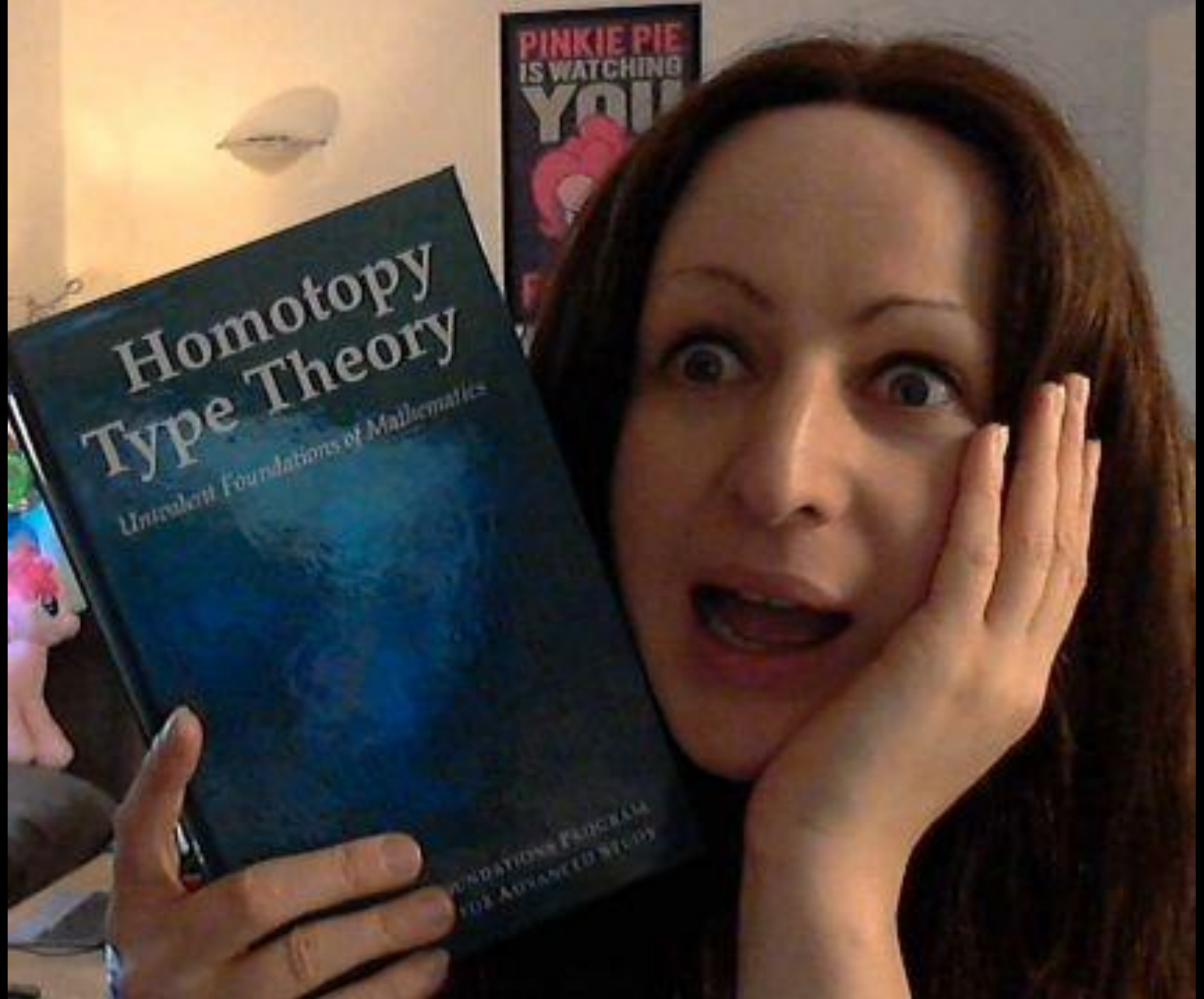
	A	B	C
1		2011	Show
2	a	330.33	
3	b	329.35	
4	c	359.85	Yes
5	d	376.94	
6	e	446.86	
7	f	457.7	Yes
8	g	509.38	
9	h	549.9	
10	i	566.84	
11	j	585.2	
12	k	658.24	Yes
13	l	720.2	
14			
15			



Wanna really know what Reactive Programming Is?

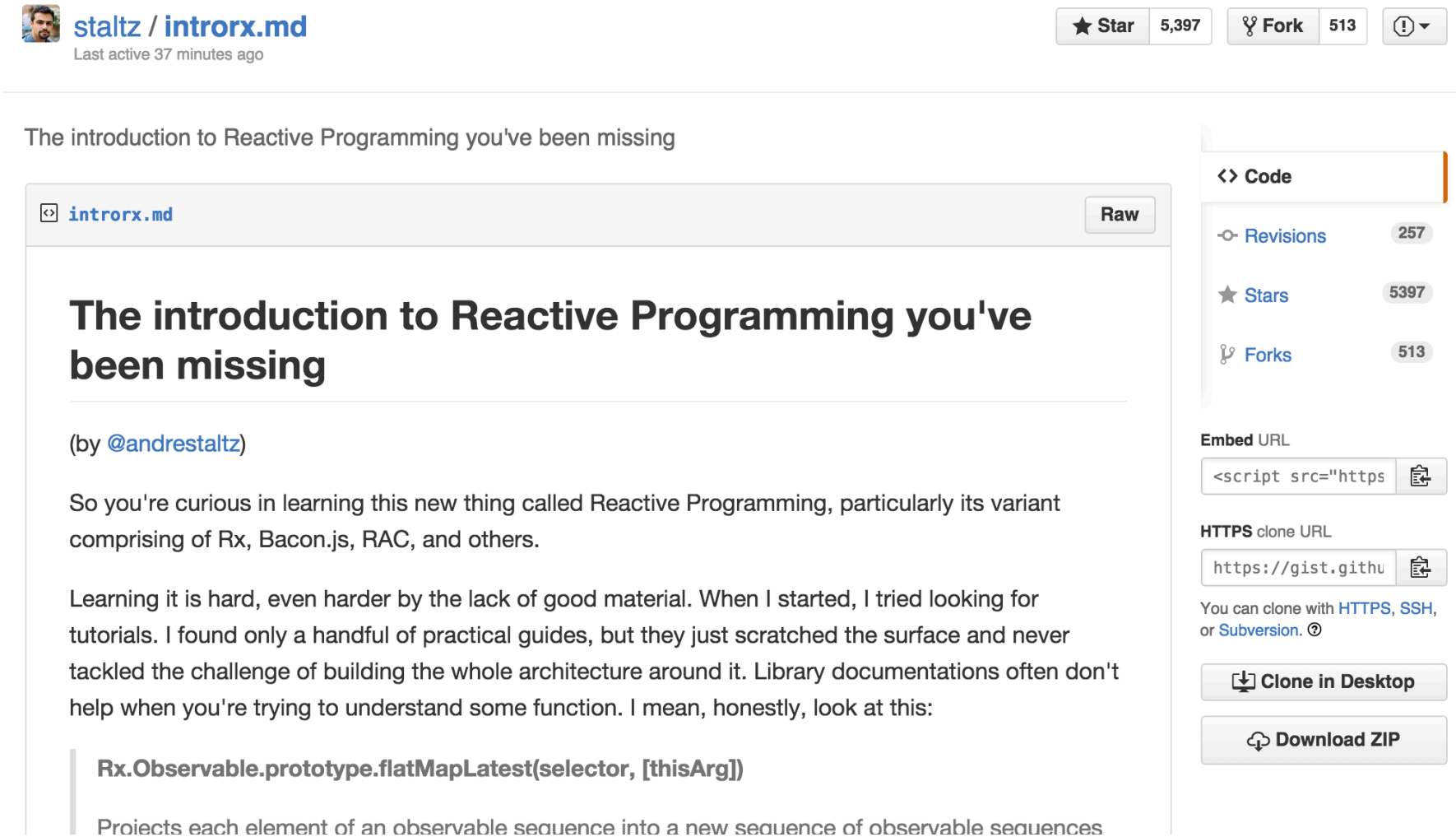
Real Time Programming: Special Purpose or General Purpose Languages
Gerard Berry

http://bit.ly/reactive-paper


PINKIE PIE
IS WATCHING
YOU
Homotopy
Type Theory
Univalent Foundations of Mathematics

ComputerWissenschaftAkademischesPapierPhobie

Ok, maybe this is better...



http://https://gist.github.com/staltz/868e7e9bc2a7b8c1f754

Functional Reactive Programming (FRP) is...

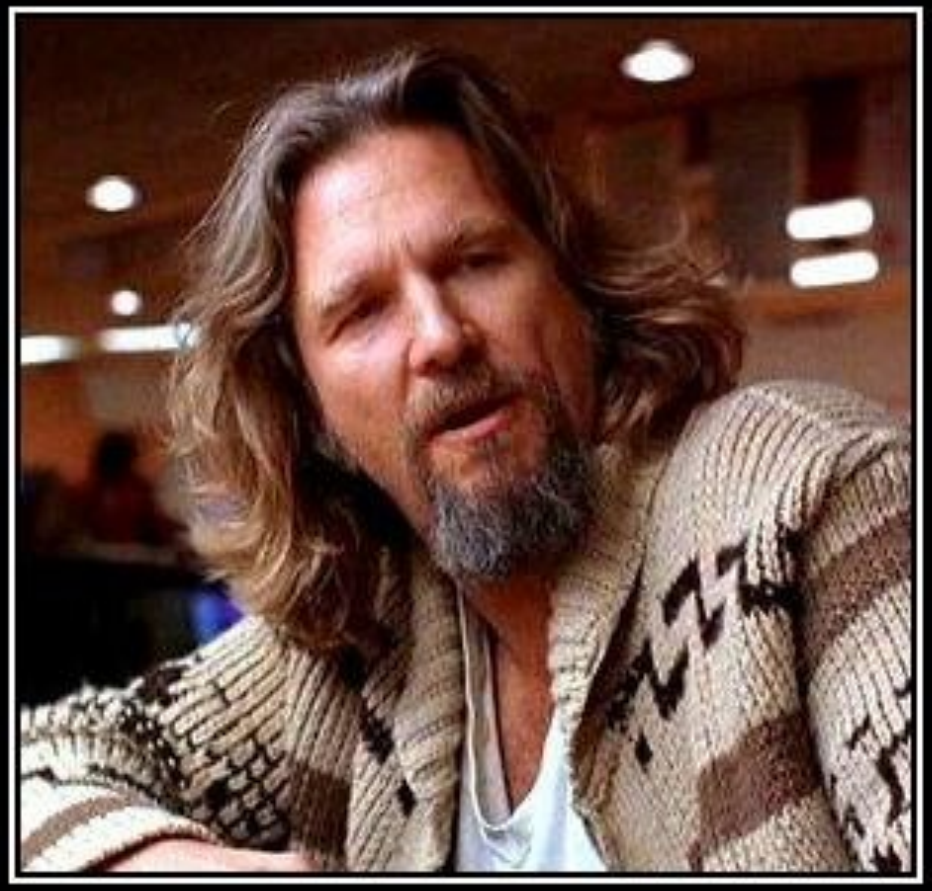
A concept consisting of

- Continuous Time
- Behaviors: Values over time
- Events: Discrete phenomena with a value and a time
- Denotational Semantics

```
type Behavior a

μ = Behavior a -> (R -> a)
```

http://stackoverflow.com/questions/1028250/what-is-functional-reactive-programming

Call Us RP, CEP, Compositional Event Processing



THE DUDE

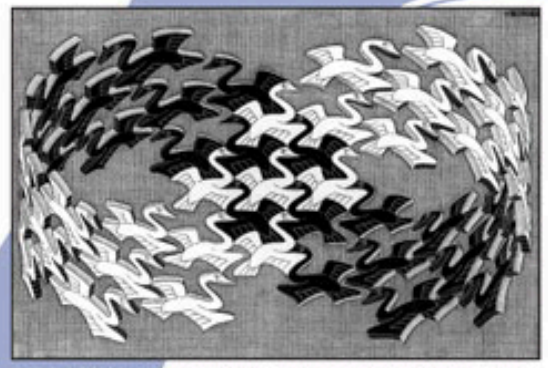
He's the Dude. So that's what you call him. You know, that or, uh, His Dudeness, or uh, Duder, or El Duderino.


1994
ACE VENTURA
PET DETECTIVE
Sports Illustrated
SUPER METROID
KEANU REEVES
Dookie
CLERKS
A very funny look at the over-the-counter culture.
NIRVANA
UNPLUGGED
IN NEW YORK
weezer
AMERICA
Online

Design Patterns

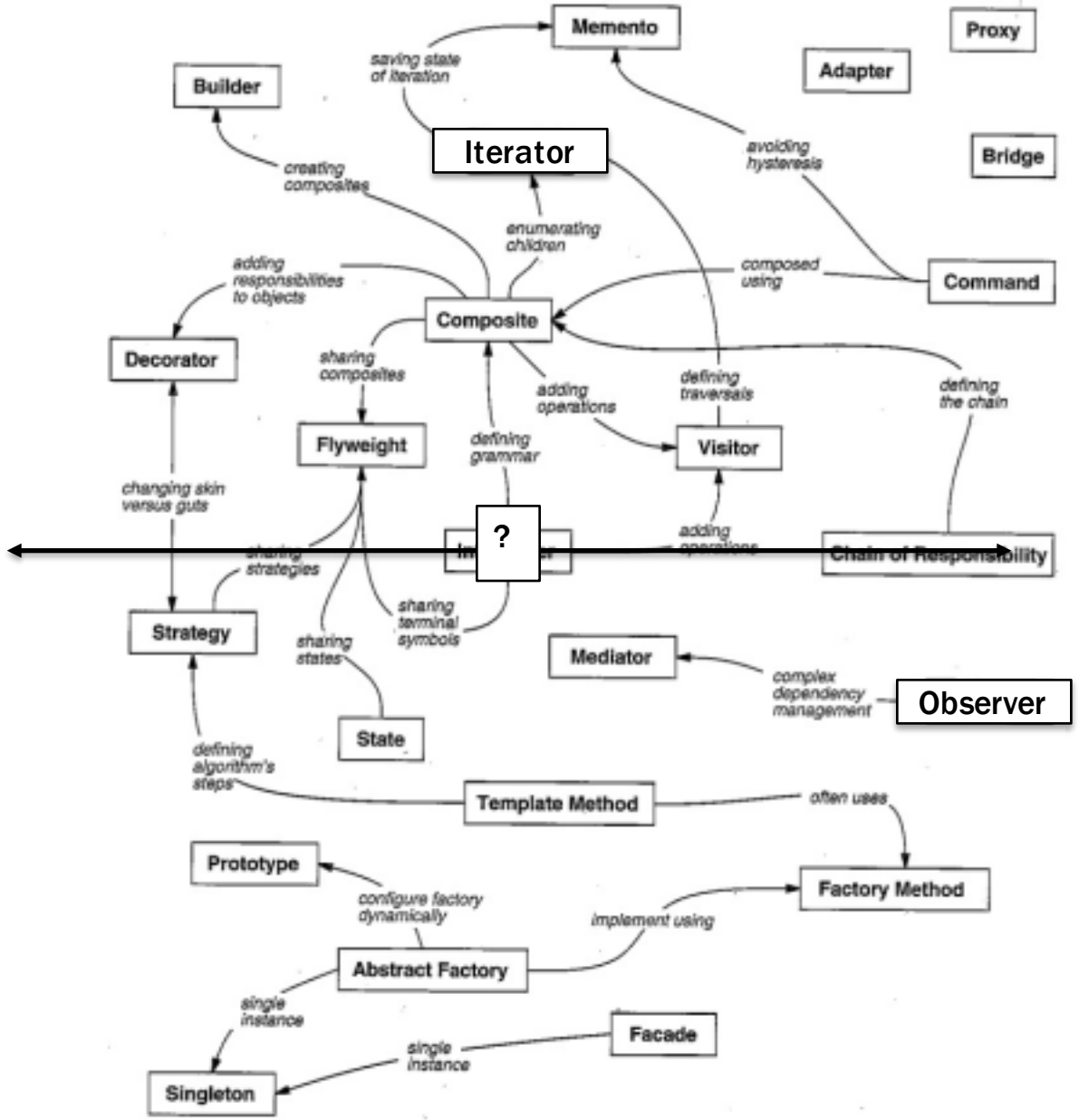
Elements of Reusable Object-Oriented Software

Erich Gamma
Richard Helm
Ralph Johnson
John Vlissides



Foreword by Grady Booch

ADDISON-WESLEY PROFESSIONAL COMPUTING SERIES



Design Pattern Relationships

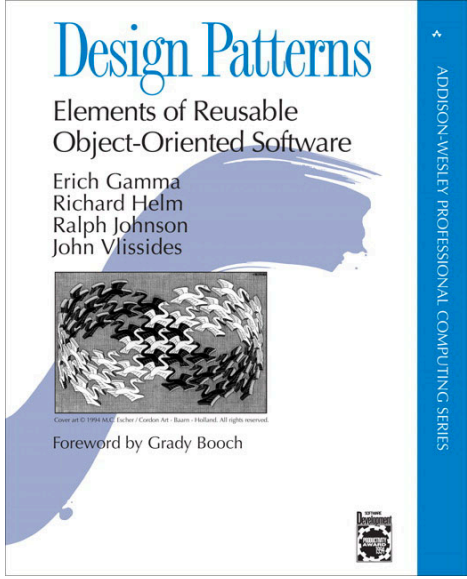
Iterator Pattern with ES2015

```
> let iterator = getNumbers();
> console.log(iterator.next());
> { value: 1, done: false }
> console.log(iterator.next());
> { value: 2, done: false }
> console.log(iterator.next());
> { value: 3, done: false }
> console.log(iterator.next());
> { done: true }
>
```

Subject/Observer Pattern with the DOM

```
> document.addEventListener(
    'mousemove',
    (e) =>
     console.log(e);
    );
> { clientX: 425, clientY: 543 }
> { clientX: 450, clientY: 558 }
> { clientX: 455, clientY: 562 }
> { clientX: 460, clientY: 743 }
> { clientX: 476, clientY: 760 }
> { clientX: 476, clientY: 760 }
> { clientX: 476, clientY: 760 }
> { clientX: 476, clientY: 760 }
```

Fundamental Abstractions

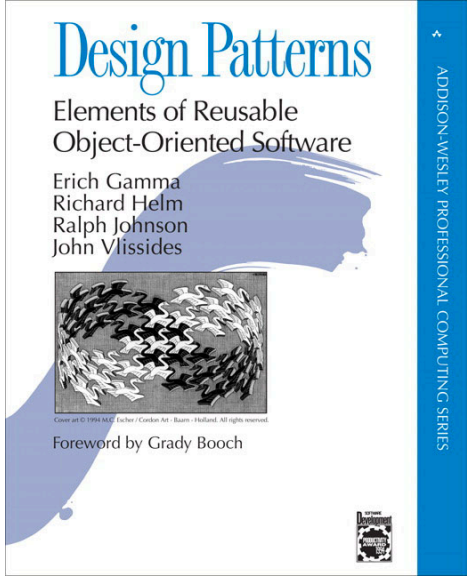


Gang of Four Subject/Observer Pattern

- Notifies Observers on State Change
- Not Very Compositional

```
function handler (e) {
  // Handle the event
}

eventTarget.addEventListener(event, handler, false);

eventTarget.removeEventListener(event, handler, false);
```

Fundamental Abstractions



Adapting the Subject/Observer Pattern

- Ensuring duality with the enumerator pattern
- More Compositional Approach

```
interface Observable<T> {
  subscribe(observer : Observer) : Disposable
}

interface Observer<T> {
  onNext(value : T) : void
  onError(error : Error) : void
  onCompleted() : void
}
```

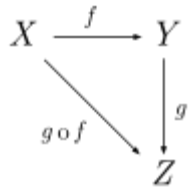
“What’s the difference between an Array...

```
[{x: 23, y: 44}, {x:27, y:55}, {x:27, y:55}]
```

... and an Event?

Events and Arrays are *both* collections.

Category Theory to the Rescue!



Category theory
www.Wikipedia.org

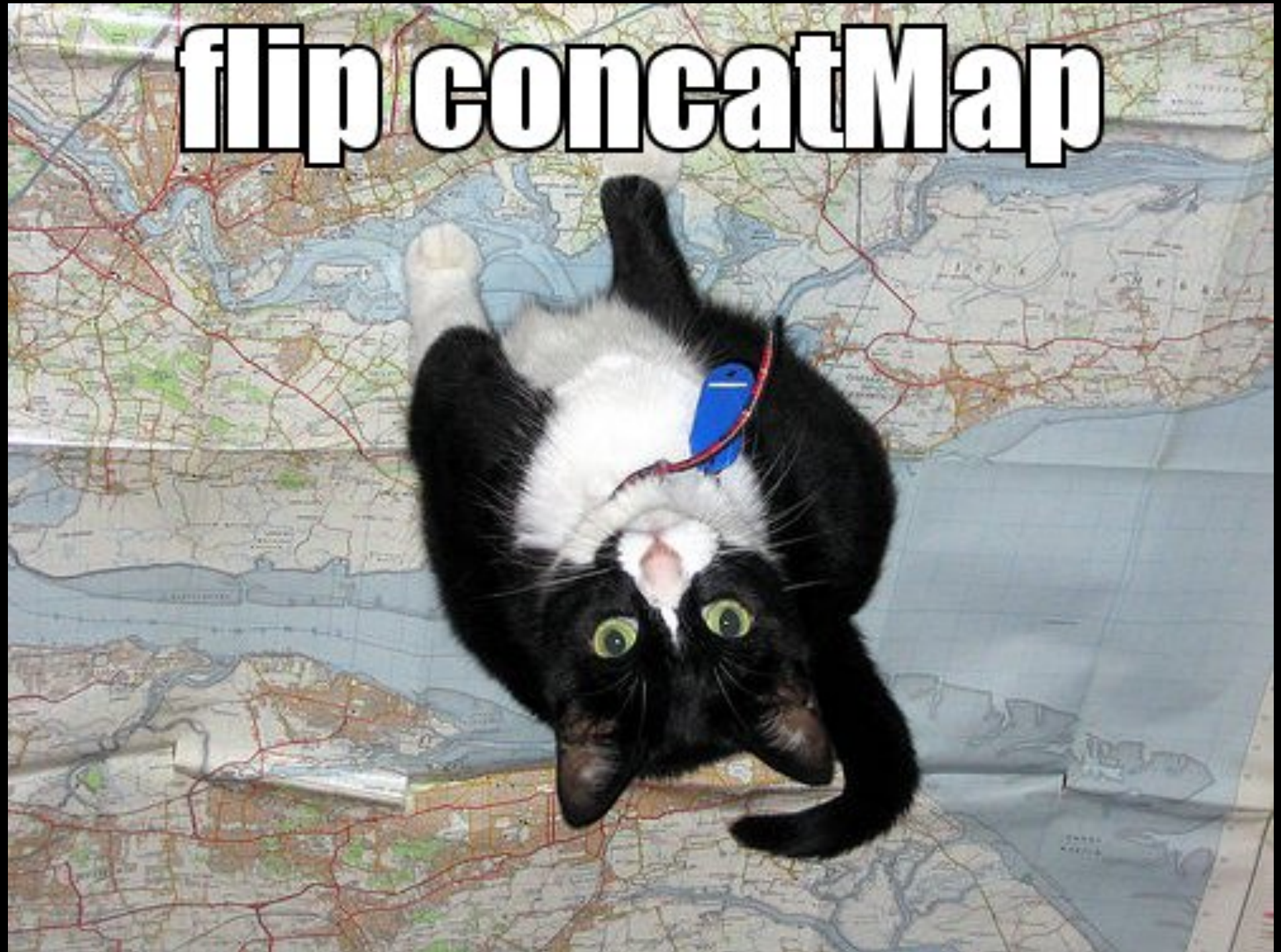
Adapting the Subject/Observer Pattern

- Observable/Observer (push) is dual to Iterable/Iterator (pull)
- Cross-influence from both domains

```
interface Observable<T> {
  subscribe(observer : Observer) : Disposable
}

interface Observer<T> {
  onNext(value : T) : void
  onError(error : Error) : void
  onCompleted() : void
}
```

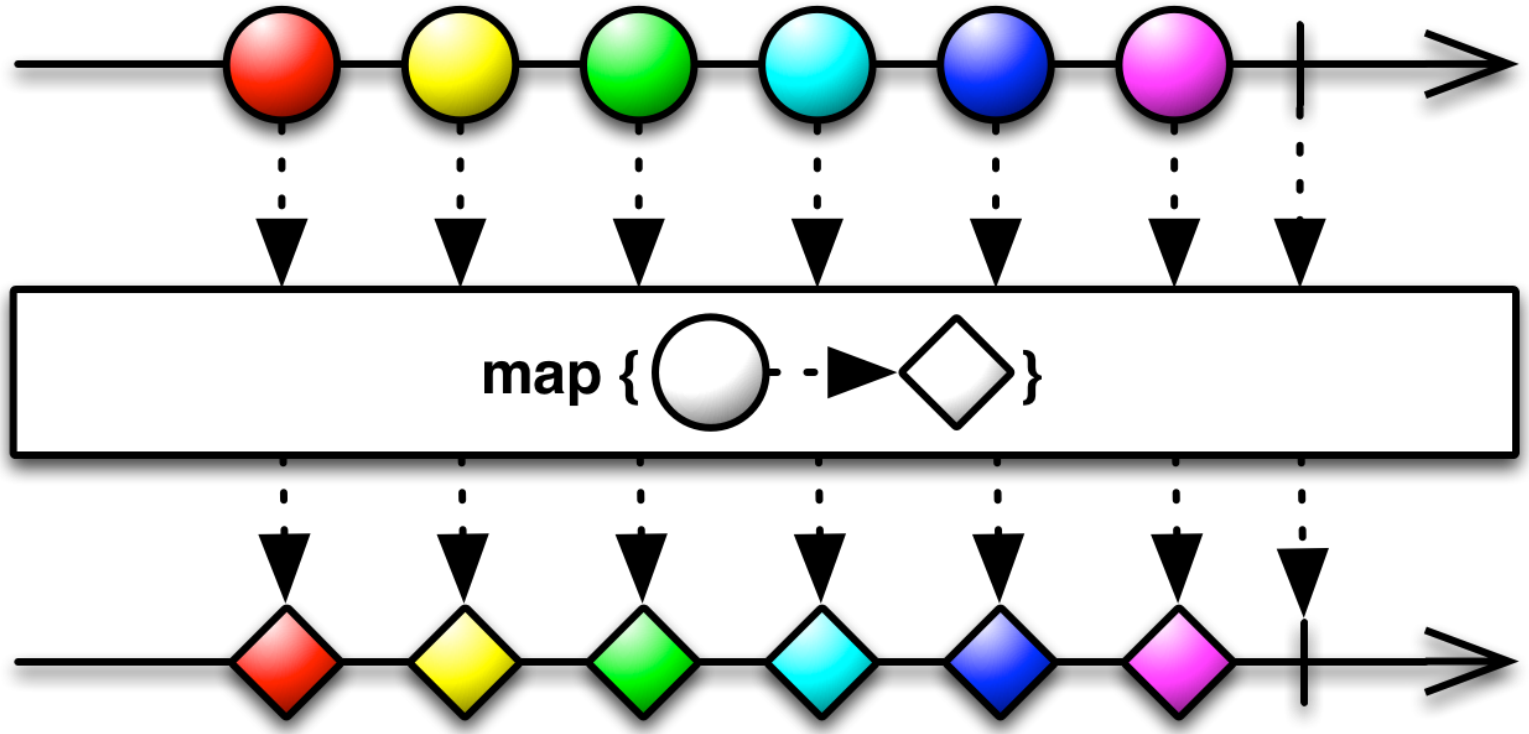
```
interface Iterable<T> {
  [Symbol.iterator]() : Iterator<T>
}

interface Iterator<T> {
  next() : IteratorResult<T> // throws
}

interface IterationResult<T> {
  done: boolean
  value: T
}
```

The majority of your asynchronous code is written with just a few *flexible* functions.


flip concatMap

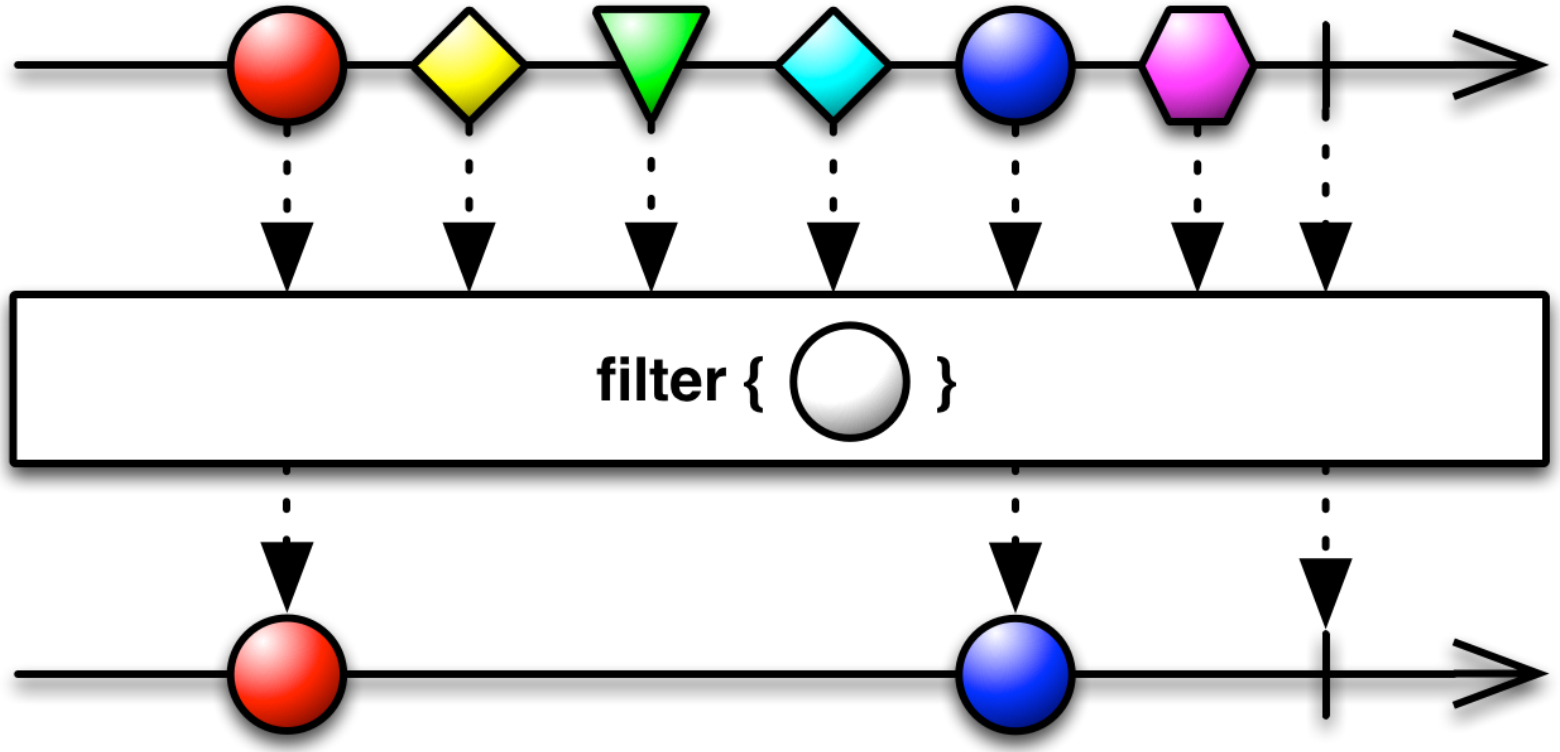
map()

Transform the items emitted by an Collection by applying a function to each of them



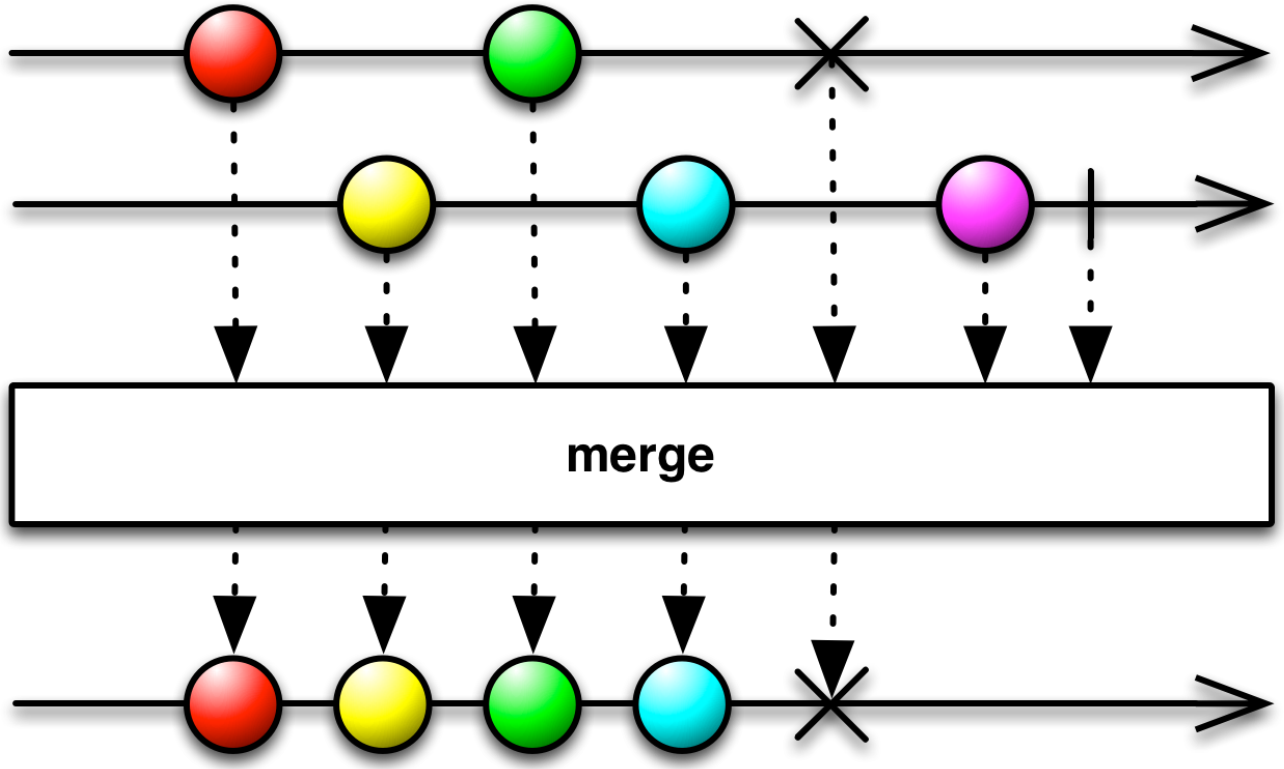
filter()

Filter items emitted by a Collection



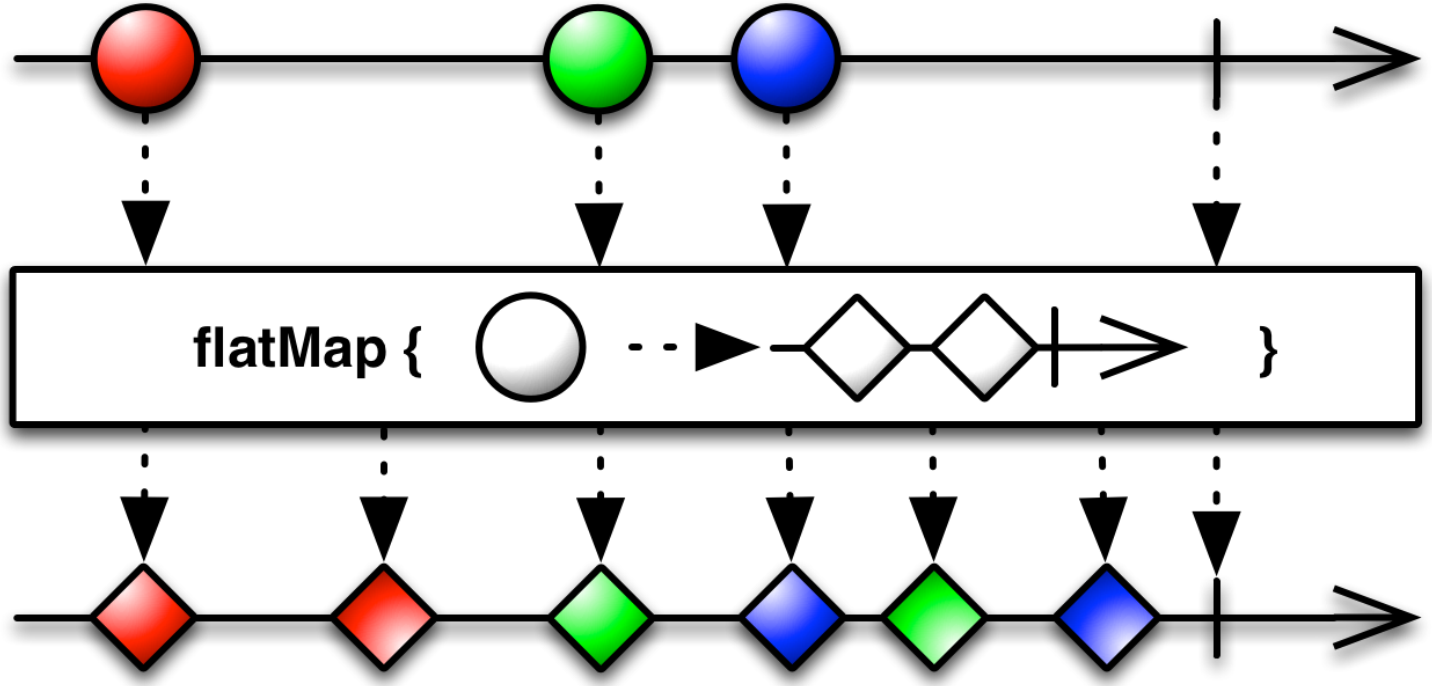
mergeAll()

combine multiple Collections into one by merging their emissions



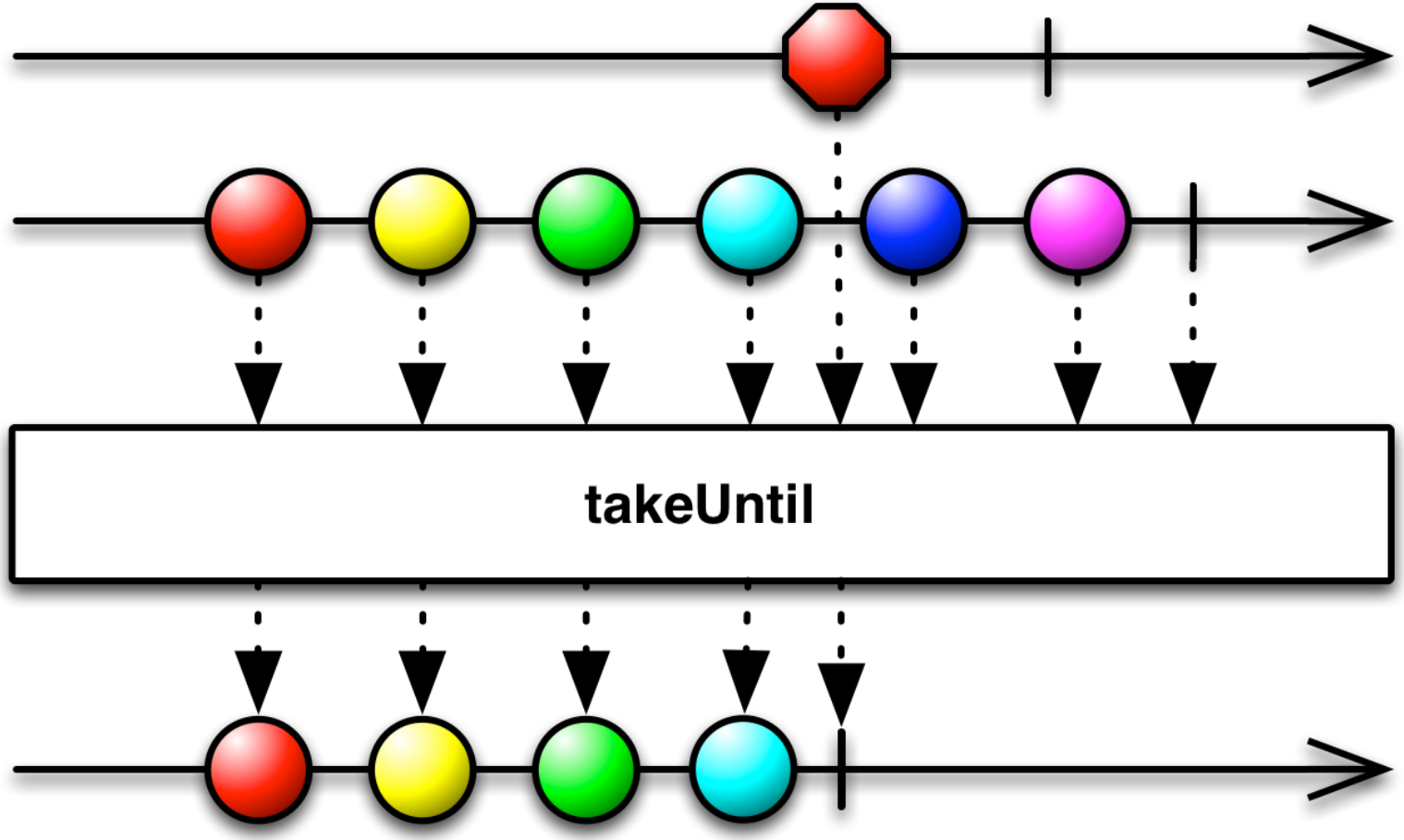
flatMap()

Transform the items emitted by a Collection into Collections, then flatten this into a single Collection



takeUntil()

Discard any items emitted by a Collection after a second Collection emits an item or terminates



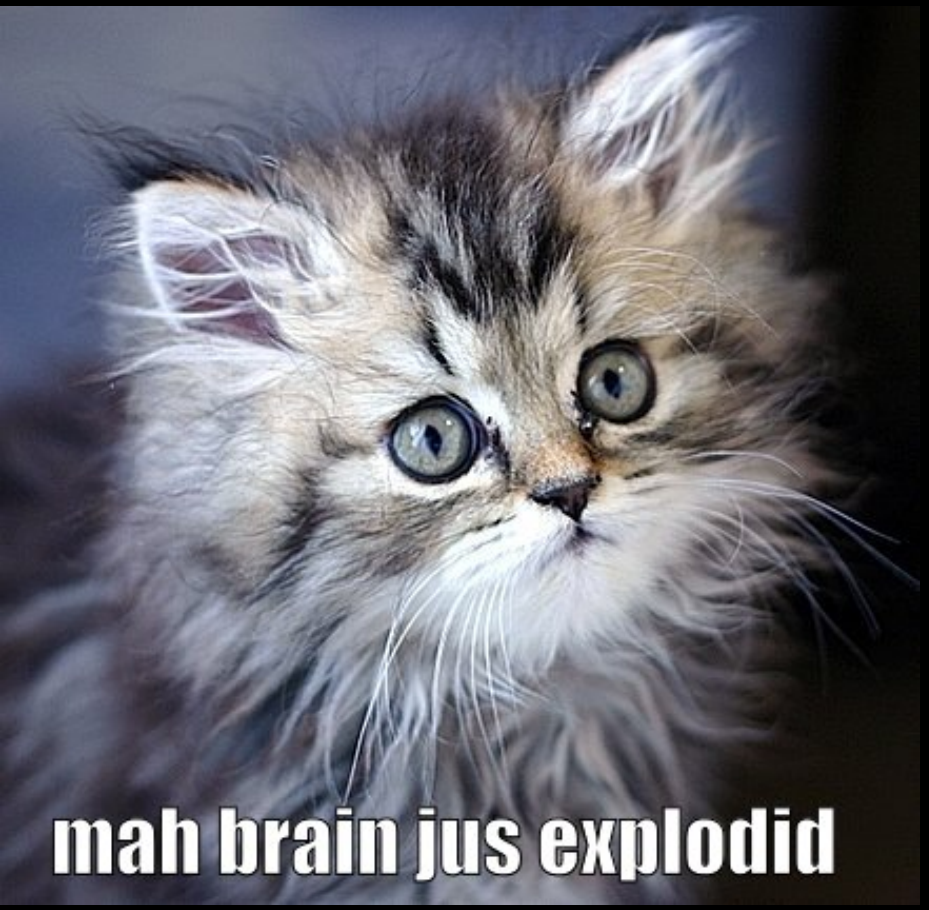
Top-rated Movies Collection

```
const getTopRatedFilms = (user) => {
  user.videoLists
    .map((videoList) =>
      videoList.videos
        .filter((v) => v.rating === 5)
    ).mergeAll();
};

getTopRatedFilms(me)
  .forEach(displayMovie);
```

Top-rated Movies Collection

```
const getTopRatedFilms = (user) =>
  user.videoLists
    .flatMap((videoList) =>
      videoList.videos
        .filter((v) => v.rating === 5)
    )
};

getTopRatedFilms(me)
  .forEach(displayMovie);
```

What if I told you…



…that you could create a drag event…

…with the almost the *same code*

Mouse Drags Collection

```
let getElementDrags = (elmt) =>
  dom.mousedown(elmt)
    .map((md) =>
      dom.mousemove(document)
        .filter   .takeUntil(dom.mouseup(elmt))
    ).mergeAll()
};

getElementDrags(image)
  .forEach(moveImage)
```

Mouse Drags Collection

```
let getElementDrags = (elmt) =>
  dom.mousedown(elmt)
    .flatMap((md) =>
      dom.mousemove(document)
        .filter   .takeUntil(dom.mouseup(elmt))
    )
};

getElementDrags(image)
  .forEah(moveImage)
```


Everything is a stream

First-Class Async and Events

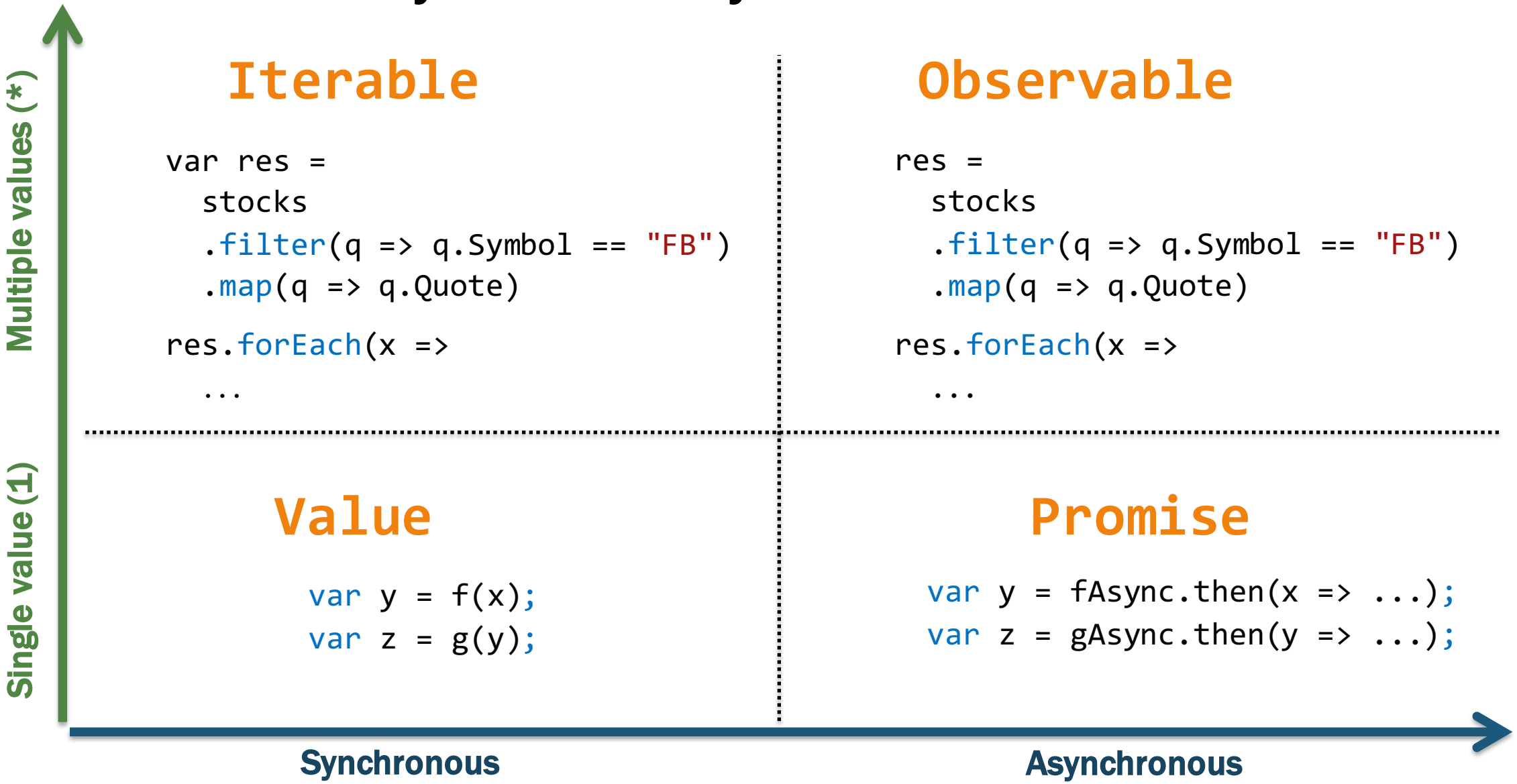
Objects to the rescue

An object is first-class when it:[4][5]

- can be stored in variables and data structures
- can be passed as a parameter to a subroutine
- can be returned as the result of a subroutine
- can be constructed at runtime
- has intrinsic identity (independent of any given name)

WIKIPEDIA
The Free Encyclopedia

The General Theory of Reactivity



Iterable

```
var res =
  stocks
  .filter(q => q.Symbol == "FB")
  .map(q => q.Quote)

res.forEach(x =>
  ...
```

Observable

```
res =
  stocks
  .filter(q => q.Symbol == "FB")
  .map(q => q.Quote)

res.forEach(x =>
  ...
```

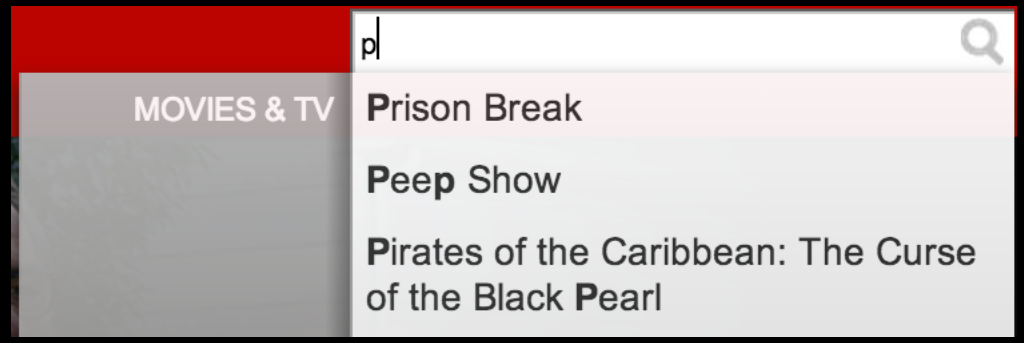
Value

```
var y = f(x);
var z = g(y);
```

Promise

```
var y = fAsync.then(x => ...);
var z = gAsync.then(y => ...);
```

Type Ahead Search

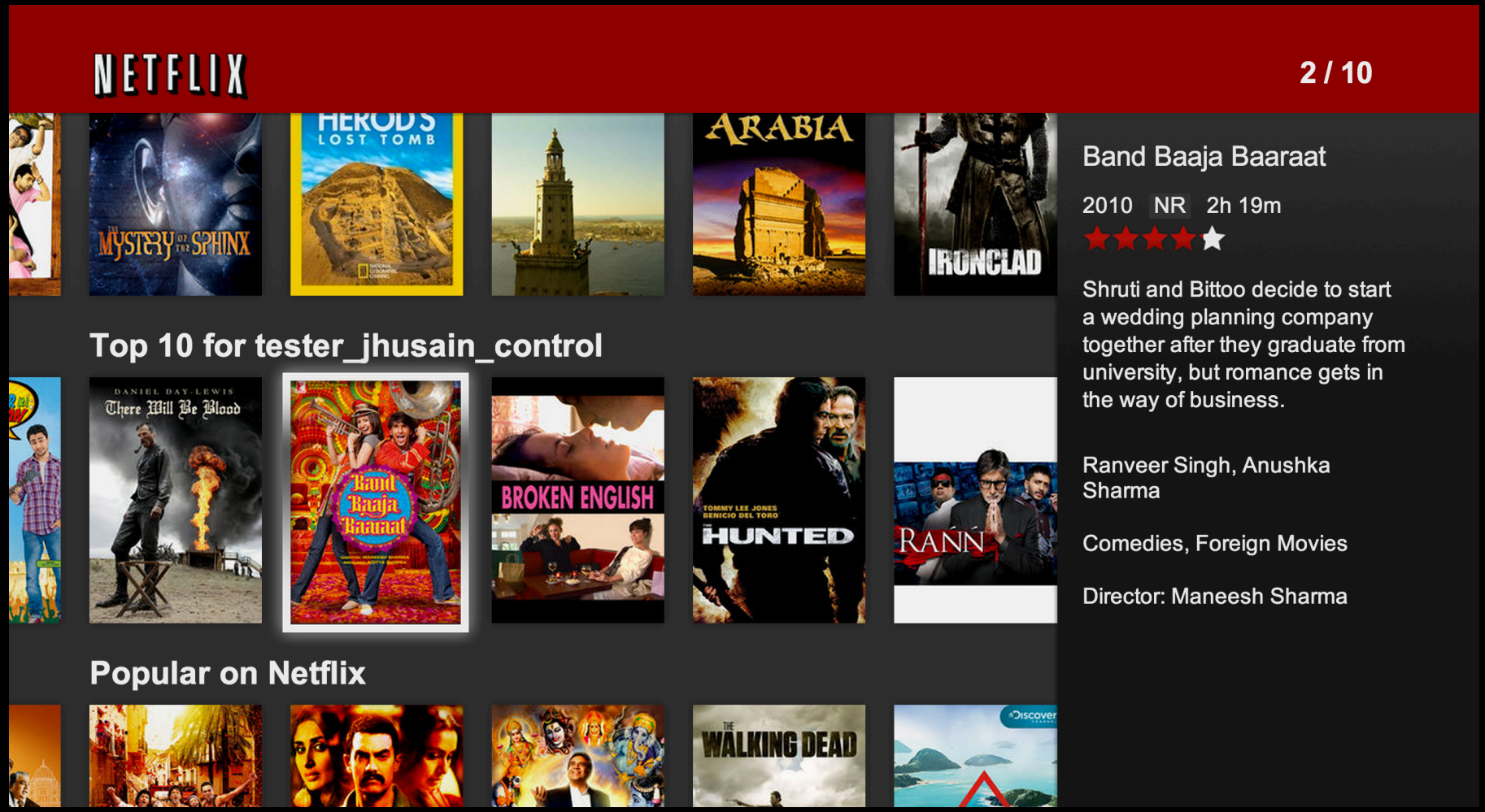


Type Ahead Search with Observables

```
let data = dom.keyup(input)
             .map(() => input.value)
             .debounce(500)
             .distinctUntilChanged()
             .flatMapLatest(
                (term) => search(term)
             );

let subscription = data.subscribe((data) => {
  // Bind data to the UI
});
```

Your Netflix Video Lists

Netflix Row Update Polling



Polling for Row Updates

```
function getRowUpdates(row) {
    let scrolls = Rx.Observable.fromEvent(document, 'scroll');
    let rowVisibilities =
        scrolls.debouce(50)
            .map((scrollEvent) => row.isVisible(scrollEvent.offset))
            .distinctUntilChanged()
            .share();
    let rowShows = rowVisibilities.filter((v) => v);
    let rowHides = rowVisibilities.filter((v) => !v);

    return rowShows
       .flatMap(Rx.Observable.interval(10))
       .flatMap(() => row.getRowData().takeUntil(rowHides))
       .toArray();
}
```

Netflix Player

Player Callback Hell

```
function play(movieId, cancelButton, callback) {
    var movieTicket,
        playError,
        tryFinish = function() {
            if (playError) {
                callback(null, playError);
            }
            else if (movieTicket && player.initialized) {
                callback(null, ticket);
            }
        };
    cancelButton.addEventListener("click", function() { playError = "cancel"; });
    if (!player.initialized) {
        player.init(function(error) {
            playError = error;
            tryFinish();
        }
    }
    authorizeMovie(movieId, function(error, ticket) {
        playError = error;
        movieTicket = ticket;
        tryFinish();
    });
});
```

Player With Observables

```
const authorizations =
    player.init().flatMap(() =>
        playAttempts.flatMap((movieId) =>
            player.authorize(movieId)
                .retry(3)
                .takeUntil(cancels))
        )
  );
let subscription = authorizations.subscribe(
    (license) => player.play(license),
    (error) => showDialog('Sorry, can’t play right now.');
```

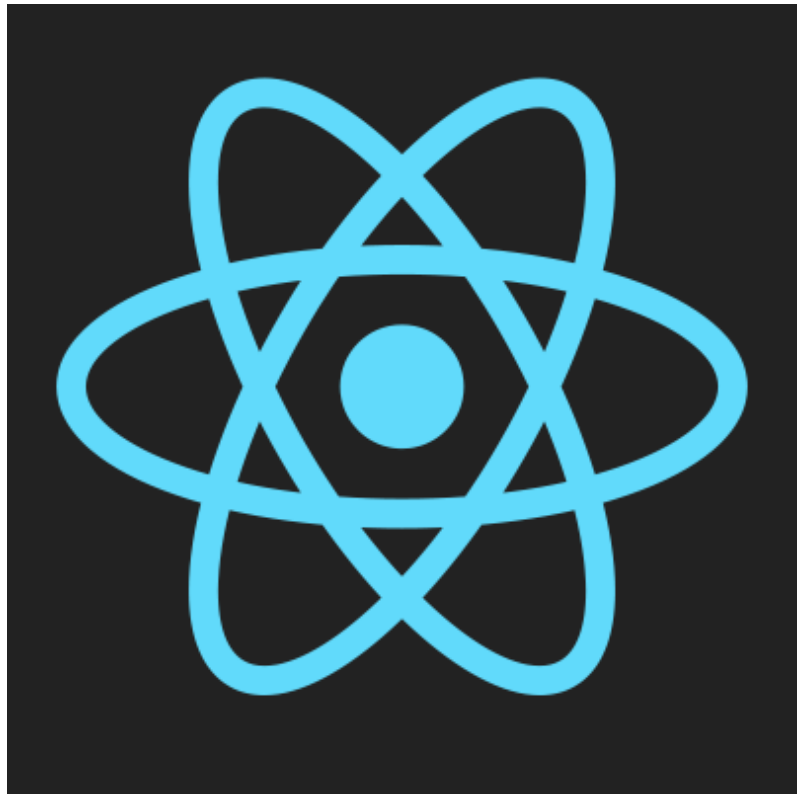

Oven Mitt
GRILLGLOVE
Professional Stunts
Do Not Attempt

The Final Countdown...

```
try {
  const resource = getData();
  for (let data of resource) {
    processItem(data);
  }
} catch (e) {
  throw e;
} finally {
  resource && resource.dispose();
}
```

```
const d = getData();

d.retry(3)
    .catch(defaultData)
    .finally(() => d.cleanup())
    .forEach(data =>
      processItem(data);
    );
```

Winning Friends And Influences Others



angular / angular

Watch 585 | Star 3,617 | Fork 909

feat(http): add basic http service

Browse files

```
This implementation only works in JavaScript, while the Observable transpilation
story gets worked out. Right now, the service just makes a simple request,
and returns an Observable of Response.

Additional functionality will be captured in separate issues.

Fixes #2028
```

master (#4)

jeffbcross authored on Apr 29 — 1 parent 363b9ba commit 21568106b114943b59ce37832d82c8fb9a63285b

Showing 35 changed files with 1,054 additions and 2 deletions.

Unified | Split

https://github.com/angular/angular/commit/21568106b114943b59ce37832d82c8fb9a63285b

Angular 2 and RxJS, perfect together?

Data Libraries

Select any of the following data-related libraries that you will likely utilize on a majority of your Angular 2 projects: (choose multiple)

RxJS	38.7%	522
Immutable.js	34.7%	469
Firebase	33.3%	449
angular-meteor	23.8%	321
Falcor	14.5%	196
Other	9.1%	123
BaconJS	6.6%	89

http://angularjs.blogspot.com/2015/09/angular-2-survey-results.html

```
const Timer = React.createClass({
  getInitialState: () => {
    return {secondsElapsed: 0};
  },
  componentDidMount: () => {
    this.subscription = Rx.Observable.interval(1000)
      .subscribe(x => this.setState({secondsElapsed: x}));
  },
  componentWillUnmount: () => {
    this.subscription.dispose();
  },
  render: () => {
    return (
      <div>Seconds Elapsed: {this.state.secondsElapsed}</div>
    );
  }
});
```

React

The Future of JS


Ur Kitteh of Death
Awaits
ROFLBOT

Async/Await

Coming to a JavaScript Engine Near You!

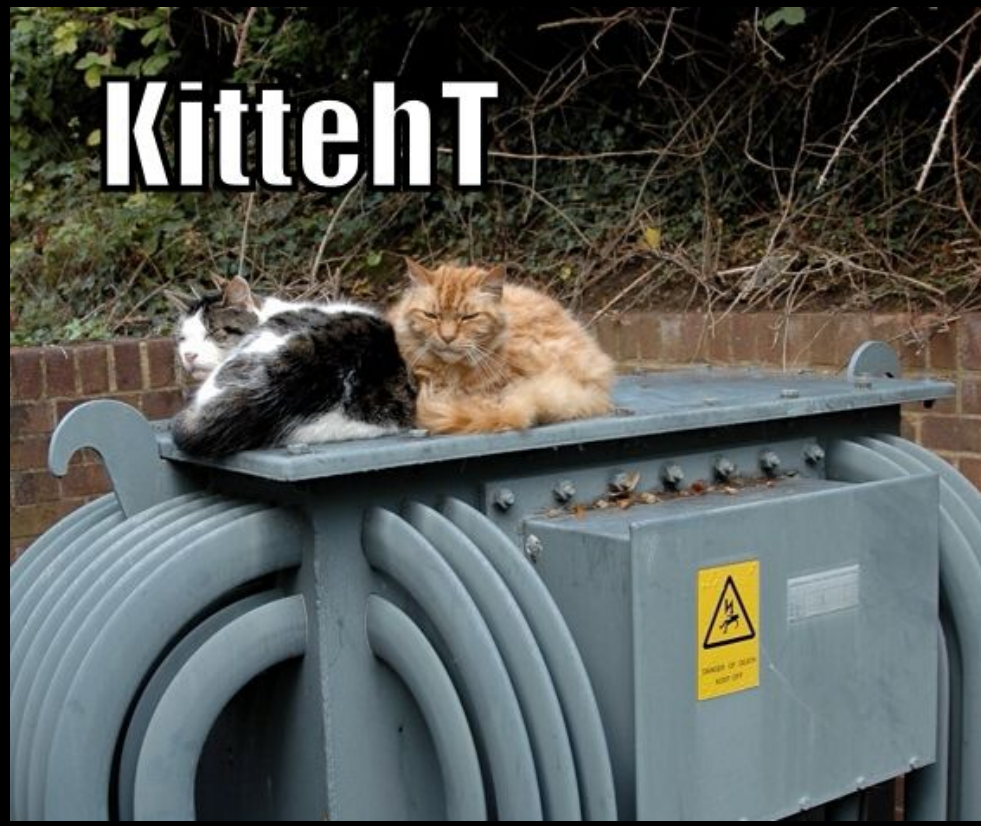
- Adds async and await keywords for Promises
- Accepted into Stage 1 of ECMAScript 7 in January 2014

```
async function chainAnimationsAsync(elem, animations) {
  let ret = null;
  try {
    for (let anim of animations) {
      ret = await anim(elem);
    }
  } catch (e) { /* ignore and keep going */ }
  return ret;
}
```

https://github.com/lukehoban/ecmascript-asyncawait

Async/Await with Observables and Generators...

```
Rx.Observable.spawn(function* () {
  const result = yield get('http://nordicjs.com')
    .retry(3)
    .catch(cachedVersion)
    .finally(doCleanup);

  return result;
}).subscribe(::console.log);
```



Asynchronous Programming with Futures and Streams

- Futures are like JavaScript Promises
- Streams unify I/O and events
- Mirrors Rx by adding map/filter/reduce, etc

```
Stream<List<int>> stream = new File('quotes.txt').openRead();
stream.transform(UTF8.decoder).listen(print);

querySelector('#myButton').onClick.listen((_) => print('Click.'));
```

https://api.dartlang.org/apidocs/channels/stable/dartdoc-viewer/dart-async

Observables Coming to ES2016!

ECMAScript Observable

This proposal introduces an **Observable** type to the ECMAScript standard library. The **Observable** type can be used to model push-based data sources such as DOM events, timer intervals, and sockets. In addition, observables are:

- *Compositional*: Observables can be composed with higher-order combinators.
- *Lazy*: Observables do not start emitting data until an **observer** has subscribed.
- *Integrated with ES6*: Data is sent to consumers using the ES6 generator interface.

> The **Observable** concept comes from *reactive programming*. See http://reactivex.io/ for more information.

Example: Observing Keyboard Events

Using the **Observable** constructor, we can create a function which returns an observable stream of events for an arbitrary DOM element and event type.

```
function listen(element, eventName) {
    return new Observable(sink => {
        // Create an event handler which sends data to the sink
        let handler = event => sink.next(event);

        // Attach the event handler
        element.addEventListener(eventName, handler, true);
```

https://github.com/zenparsing/es-observable

Observables in ES2016

```
function mouseDrags(element) {

    let moveStreams = listen(element, "mousedown").map(e => {

        e.preventDefault();

        return takeUntil(
            listen(element, "mousemove"),
            listen(document, "mouseup"));
    });

    return switchLatest(moveStreams);
}

let subscription = mouseDrags(document.body).subscribe({

    next(e) { console.log(`DRAG: <${ e.x }:${ e.y }>`) },
    throw(x) { console.log(`ERROR: ${ x }`) },
    return(x) { console.log(`COMPLETE: ${ x }`) },
});
```

https://github.com/zenparsing/es-observable/blob/master/demo/mouse-drags.js

http://github.com/Reactive-Extensions/RxJS
http://github.com/ReactiveX/RxJS

The Future of RxJS...