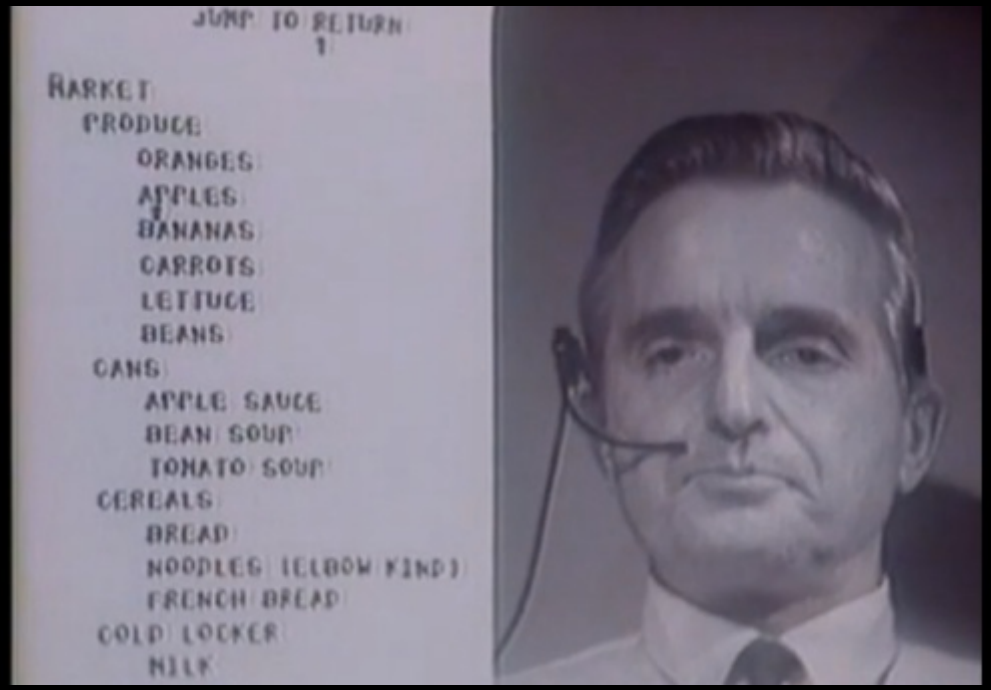


Mother of All Monad Demos

Bodil Stokke @bodil

Matthew Podwysocki @mattpodwysocki

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

WHAT'S THE PROBLEM ?


trapd in Monad tutorl
plz help

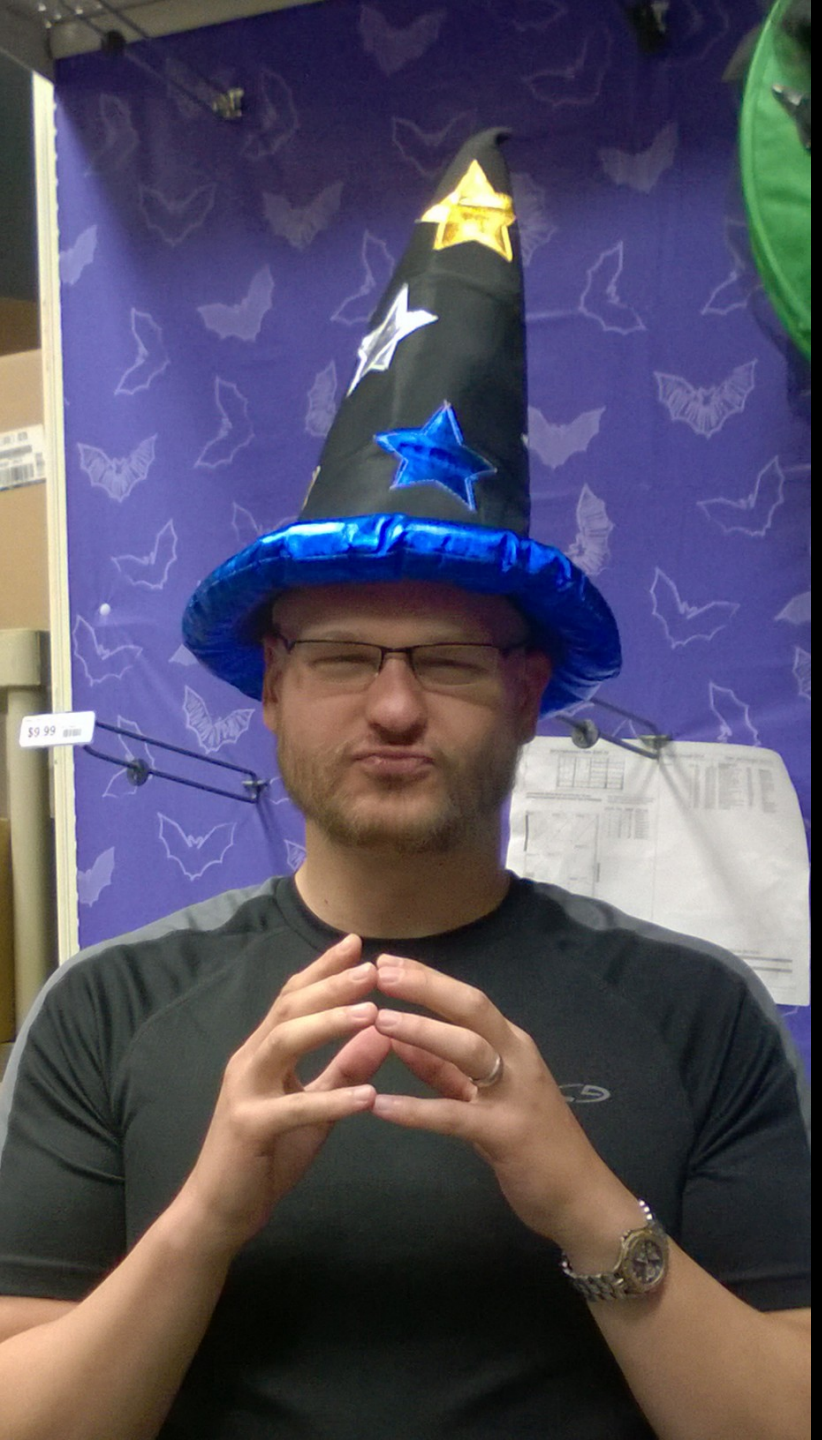
Async JavaScript at Netflix

Matthew Podwysocki @mattpodwysocki

github.com/mattpodwysocki/webrebels-2015

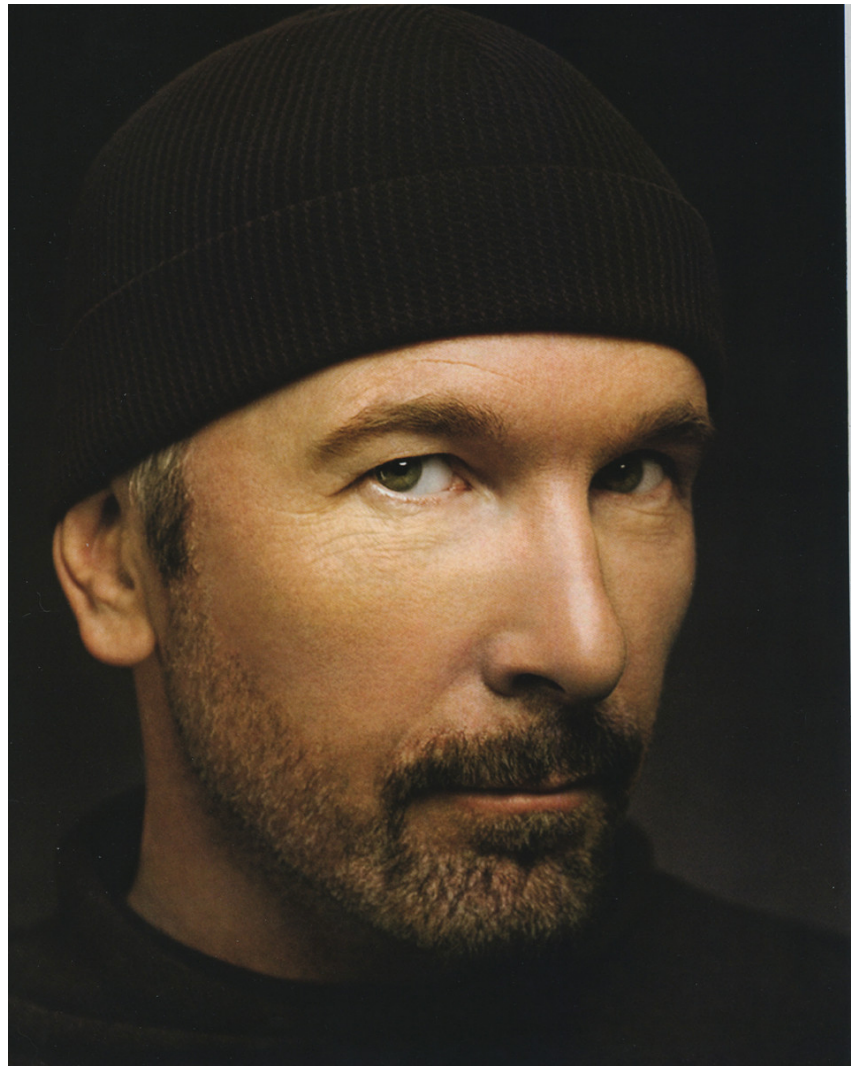

OR:
HOW I LEARNED TO STOP WORRYING ABOUT ASYNCHRONOUS PROGRAMMING AND LOVE THE OBSERVABLE

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



Principal SDE
Open Sourcerer
@mattpodwysocki
github.com/mattpodwysocki


MICROSOFT




COBOTS
CONF'19

YOU AND ME MAKES 2.0000000000000004

THANKS JAVASCRIPT AND IEEE 754...

Reactive Extensions (Rx)

@ReactiveX

http://reactivex.io

Stream Movies From Any Device

1/3 of US Broadband Traffic

This is the story of how Netflix solved

BIG async problems

by thinking differently about

Events.

The Netflix App is Asynchronous

- App Startup
- Player
- Data Access
- Animations
- View/Model Binding

Asynchronous Nightmares

- Memory Leaks
- Race Conditions
- Callback Hell
- Complex State Machines
- Disjointed Error Handling


2014

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);
```

whatwg / fetch

Watch 35 | Star 88 | Fork 11

Aborting a fetch #27

New issue

Open **annevk** opened this issue 26 days ago · 182 comments

annevk commented 26 days ago — 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.

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

Labels

None yet

Milestone

No milestone

Assignee

jakearchibald

Notifications

Subscribe

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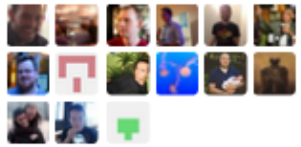
15 participants



petkaantonov / **bluebird**

Watch 182 | Star 6,048 | For

3.0 cancellation overhaul #415

New issue

Open **petkaantonov** opened this issue on Dec 27, 2014 · 79 comments

petkaantonov commented on Dec 27, 2014 — Owner

The current cancellation seems to be the most problematic feature due to some annoying limits in the design:

- Awkward API for attaching the callback that cancels the work (through typed catch handler)
- Cannot compose because it is impossible to tell the difference between rejection and cancellation (e.g. `Promise.all(...).cancel()` cannot do the obvious thing and also call `cancel()` on the promises in the array)
- `.cancel()` is asynchronous

Since all consumers and producers must be trusted/"your code", there is no reason to enforce that cancellable promises are single-consumer or create new primitives.

Edit: The below design has been scratched, see #415 (comment)

Labels

3.0.0

Milestone

No milestone

Assignee

No one assigned

Notifications

Subscribe

You're not receiving notifications from this thread.

https://github.com/petkaantonov/bluebird/issues/415

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

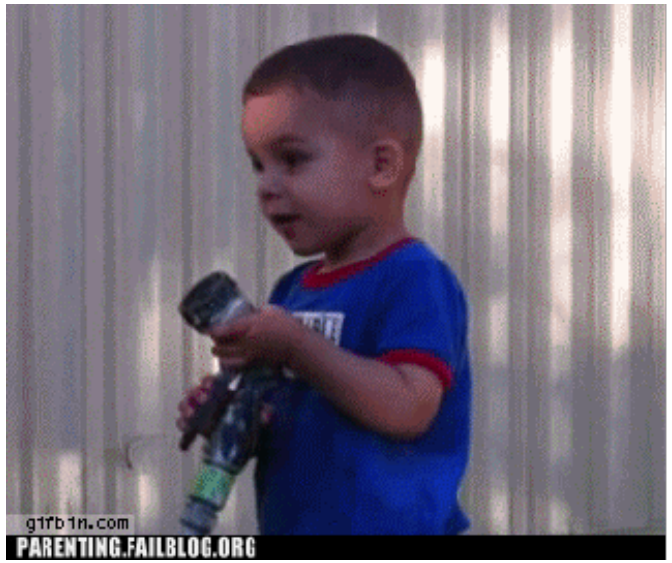
The Designed-In Dangers of The American Automobile

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...



Streams2 Electric Boogaloo

- Landed in 0.9.4
- Now supported “Object Mode”
- Flowing mode versus non-flowing mode
- Introduced the following Streams classes:
  - Readable
  - Writable
  - Duplex
  - Passthrough

Streams 33 1/3

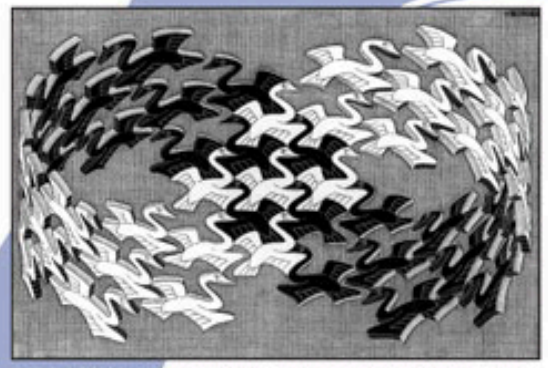
- Landed in 0.11.2
- Adds cork/uncork/_writev


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

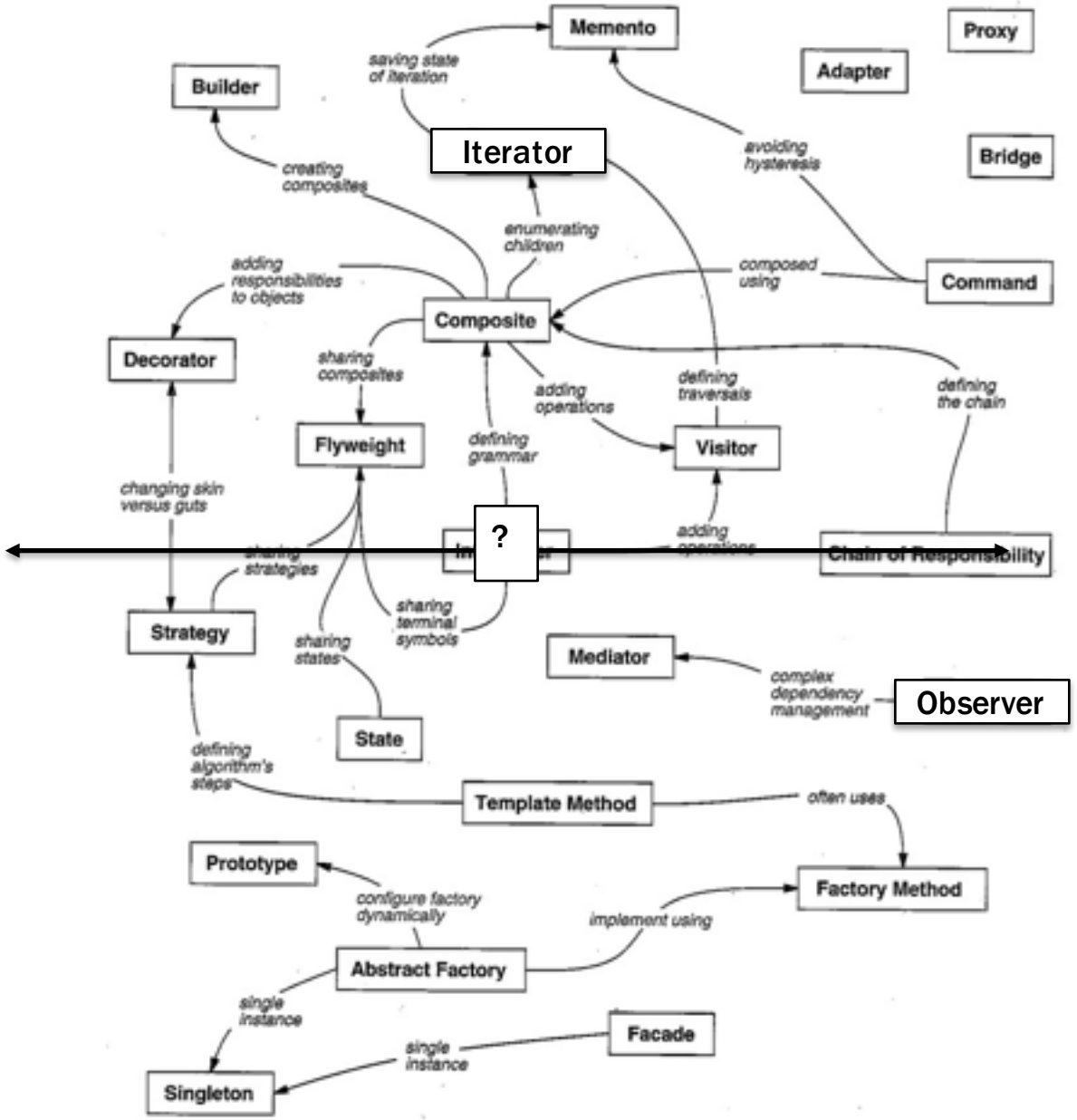
Elements of Reusable Object-Oriented Software

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 }
```

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

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

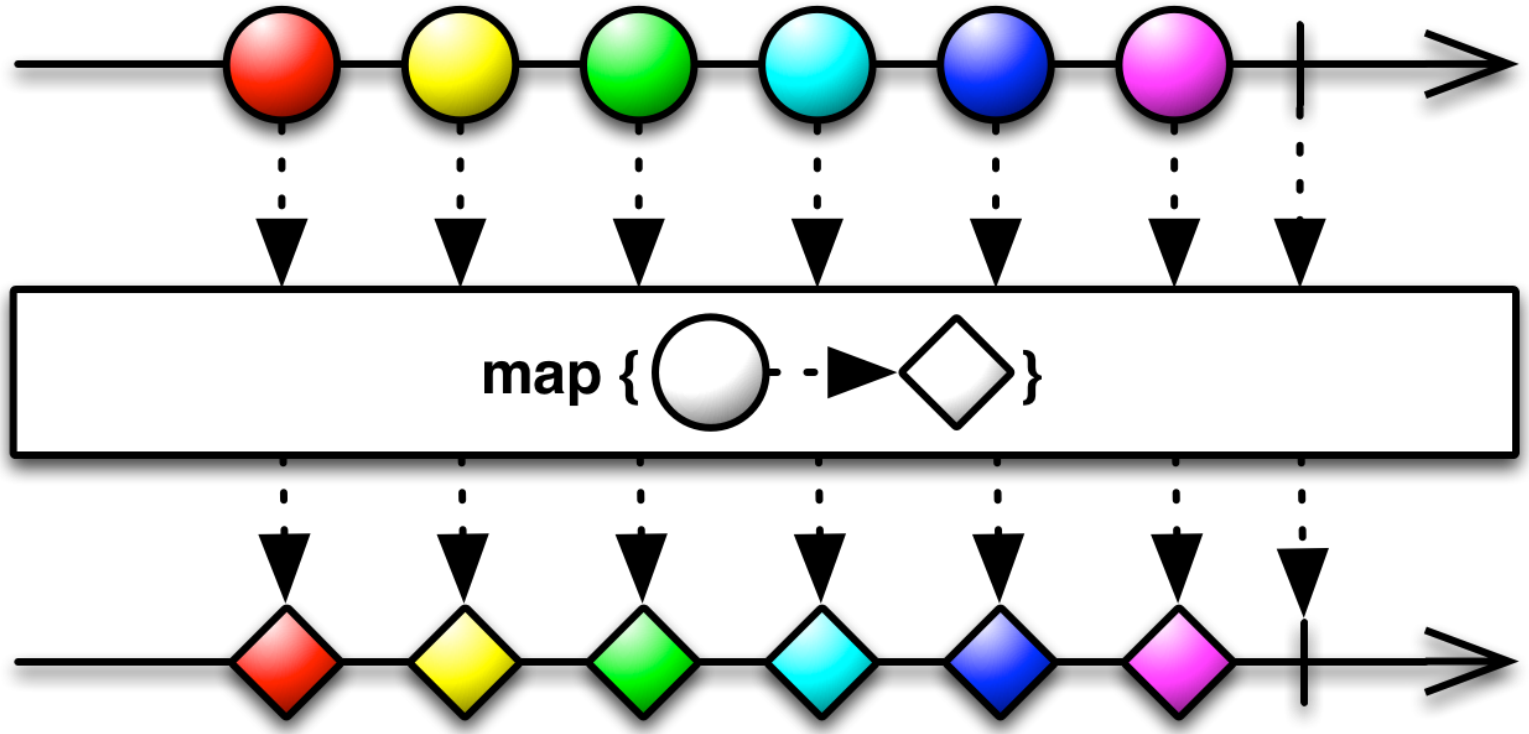
... and an Event?

Events and Arrays are *both* collections.

The majority of Netflix's asynchronous code is written with just a few *flexible* functions.

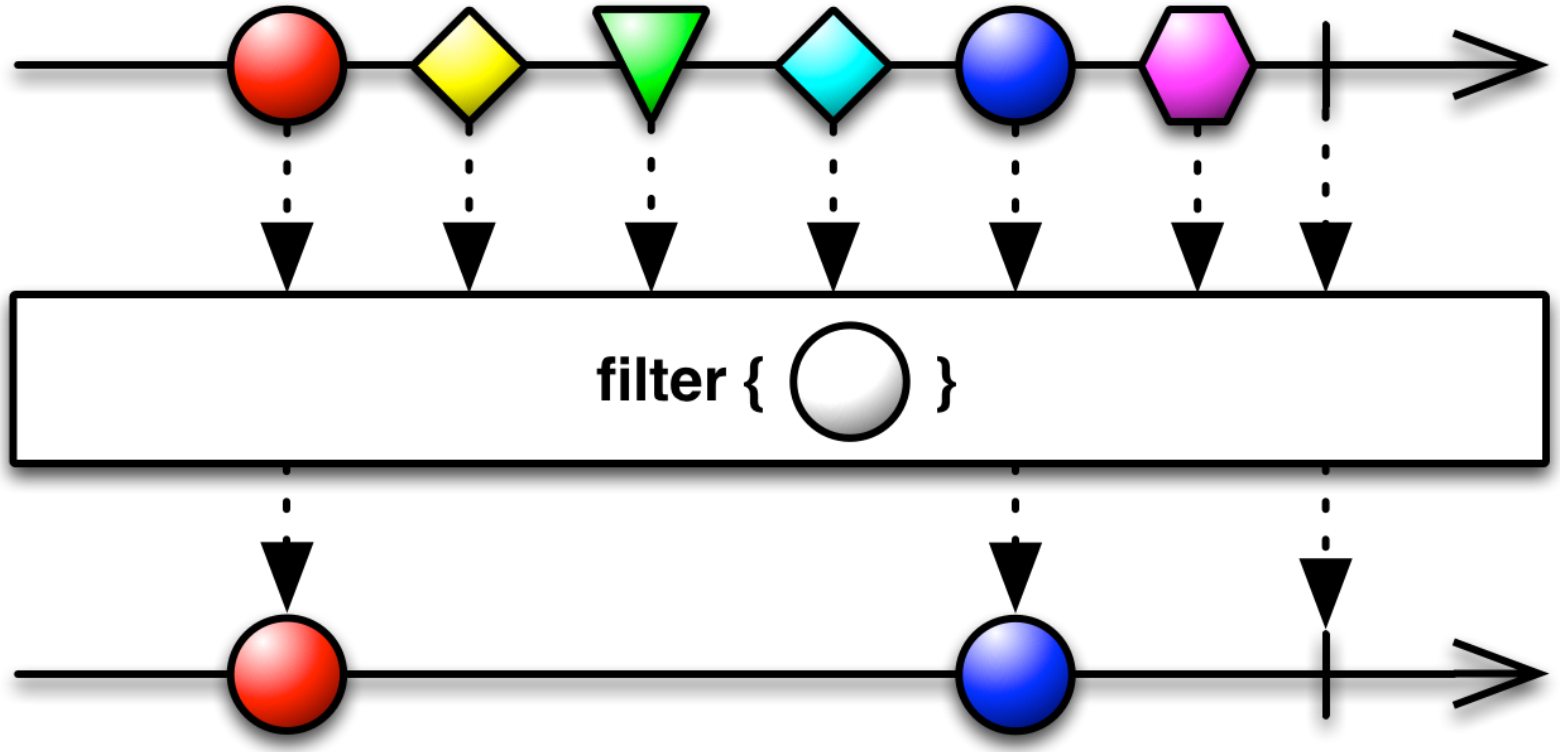
map()

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



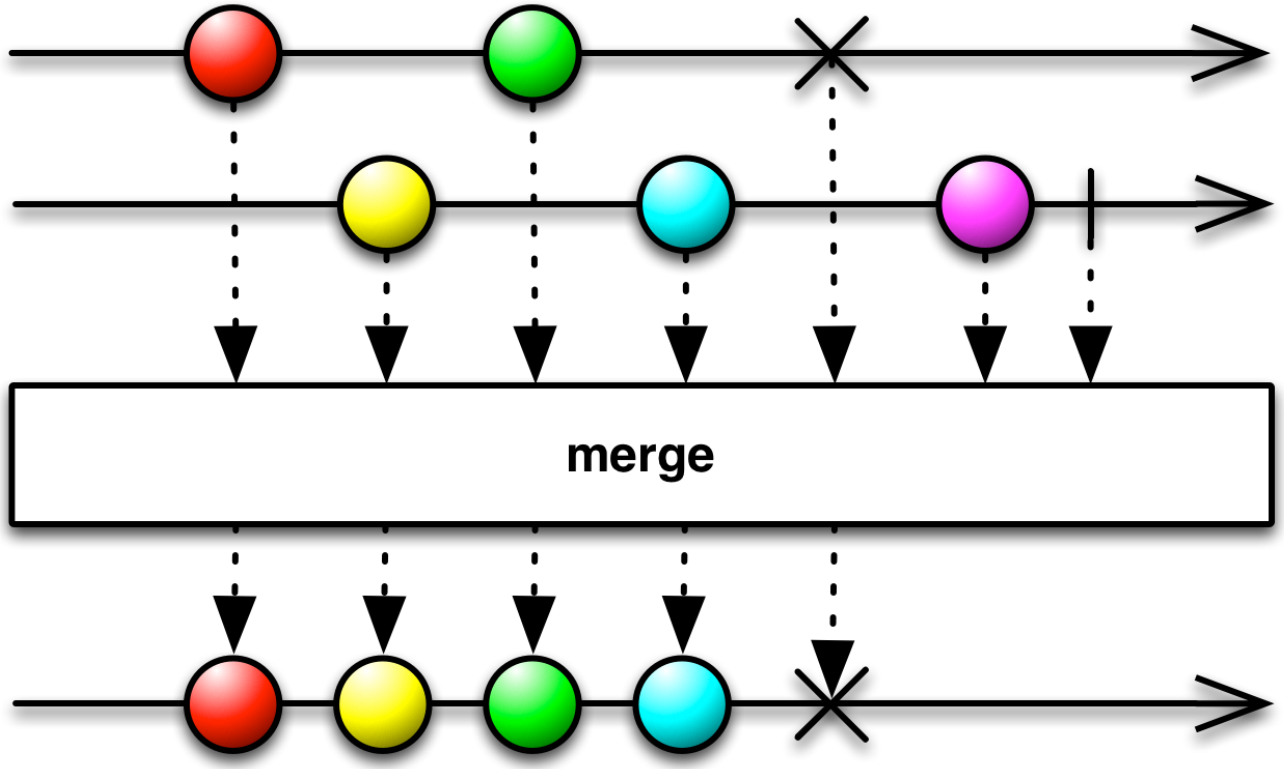
filter()

Filter items emitted by a Collection



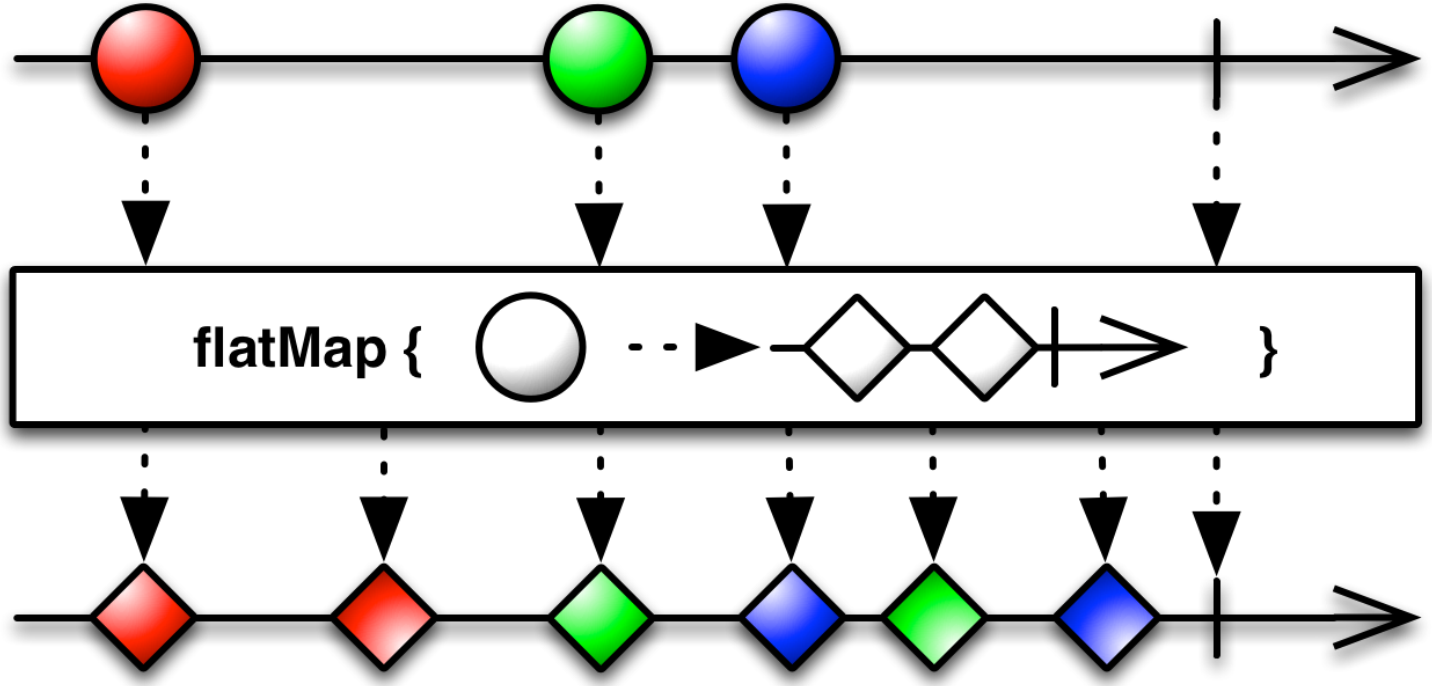
mergeAll()

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



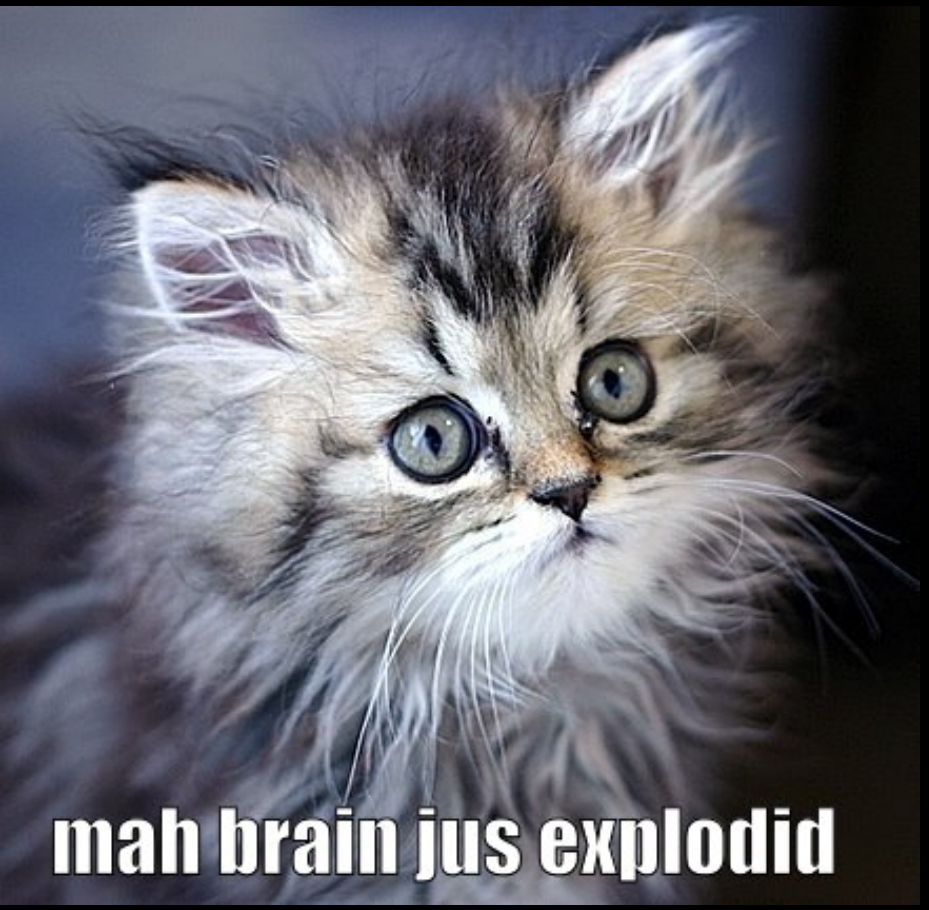
Top-rated Movies Collection

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

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

Top-rated Movies Collection

```
let 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…

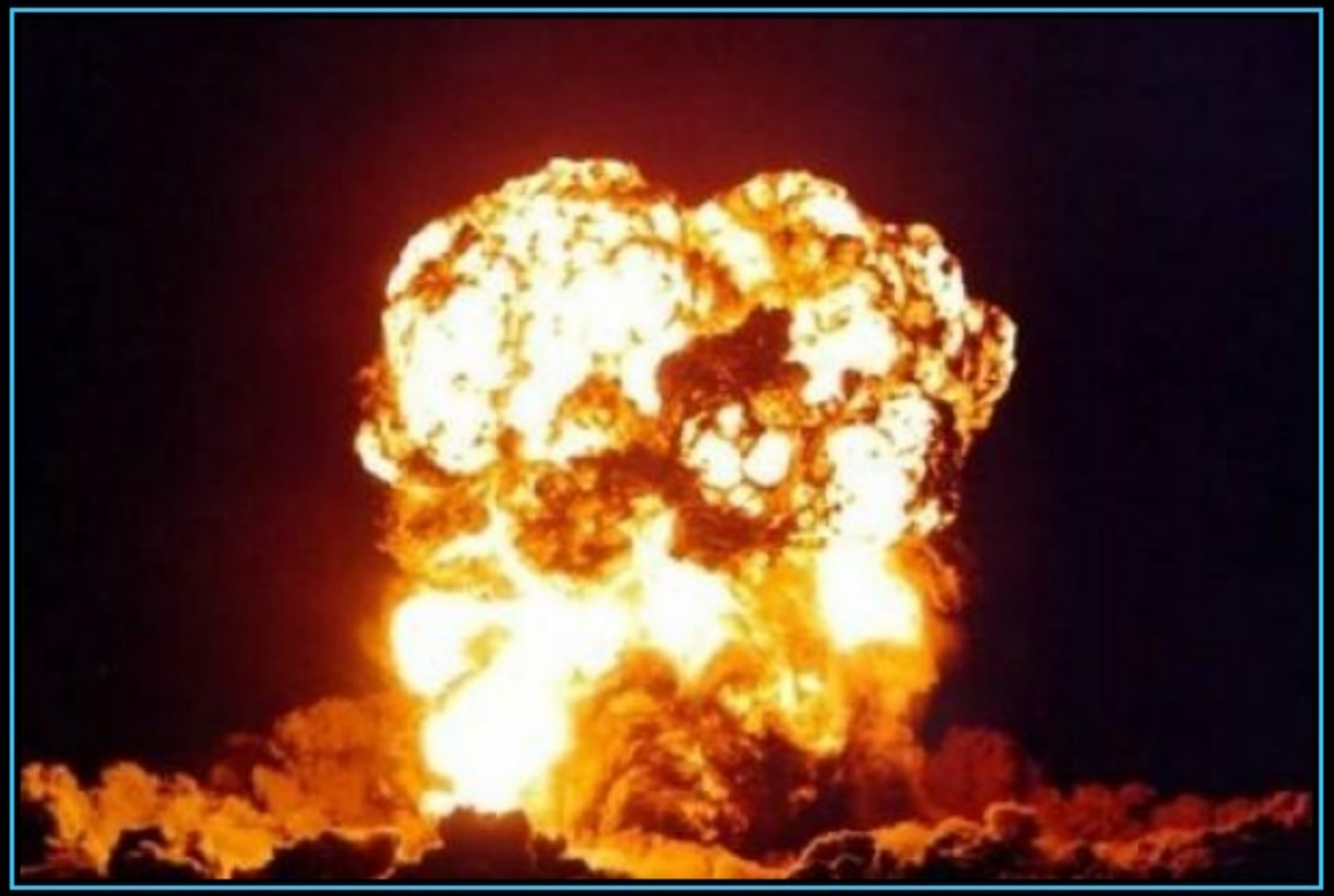
…with the almost the *same code*

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)
  .forEach(moveImage)
```



PROTONIC REVERSAL

You crossed the streams, didn't you?


Everything is a stream

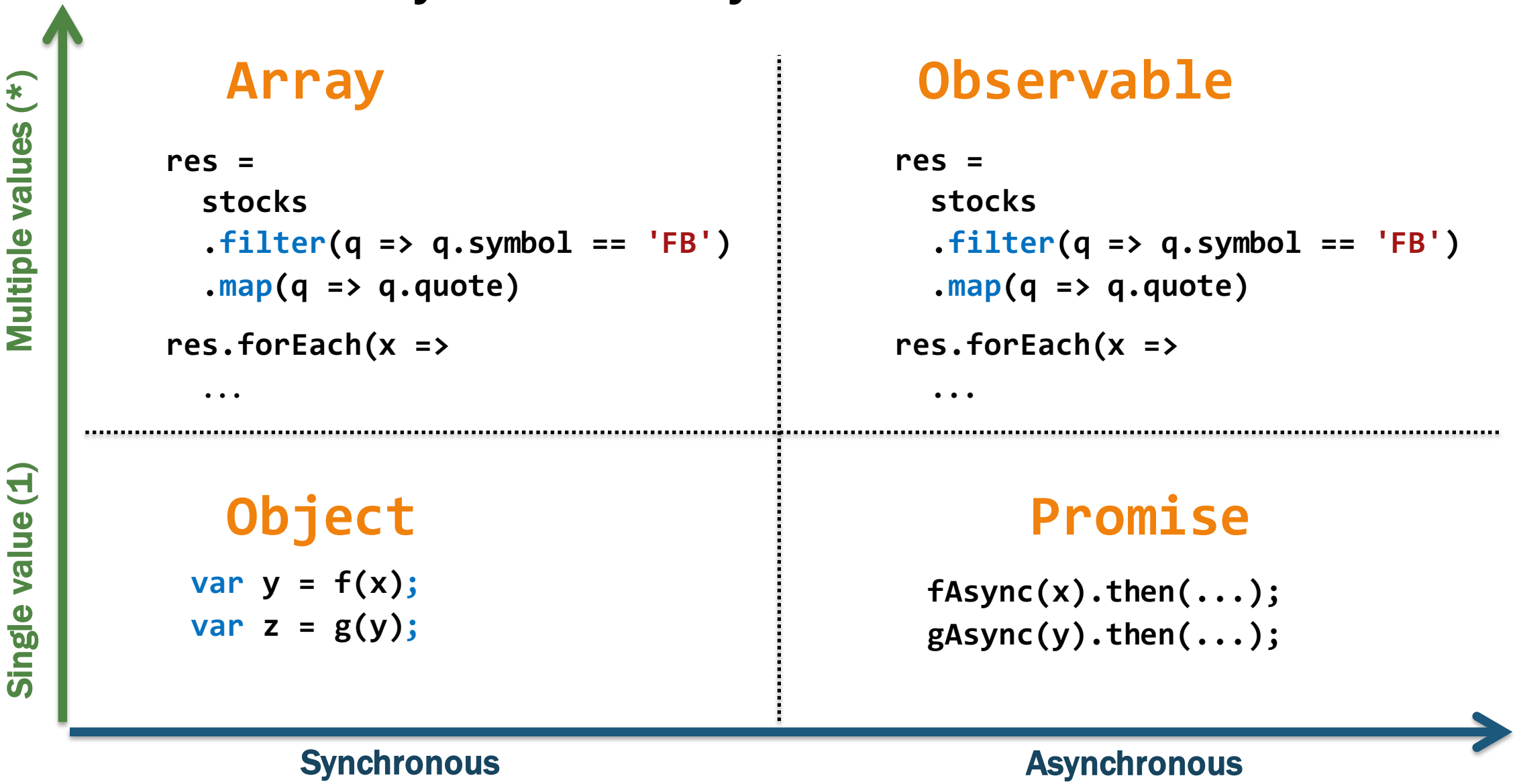
First-Class Asynchronous Values

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



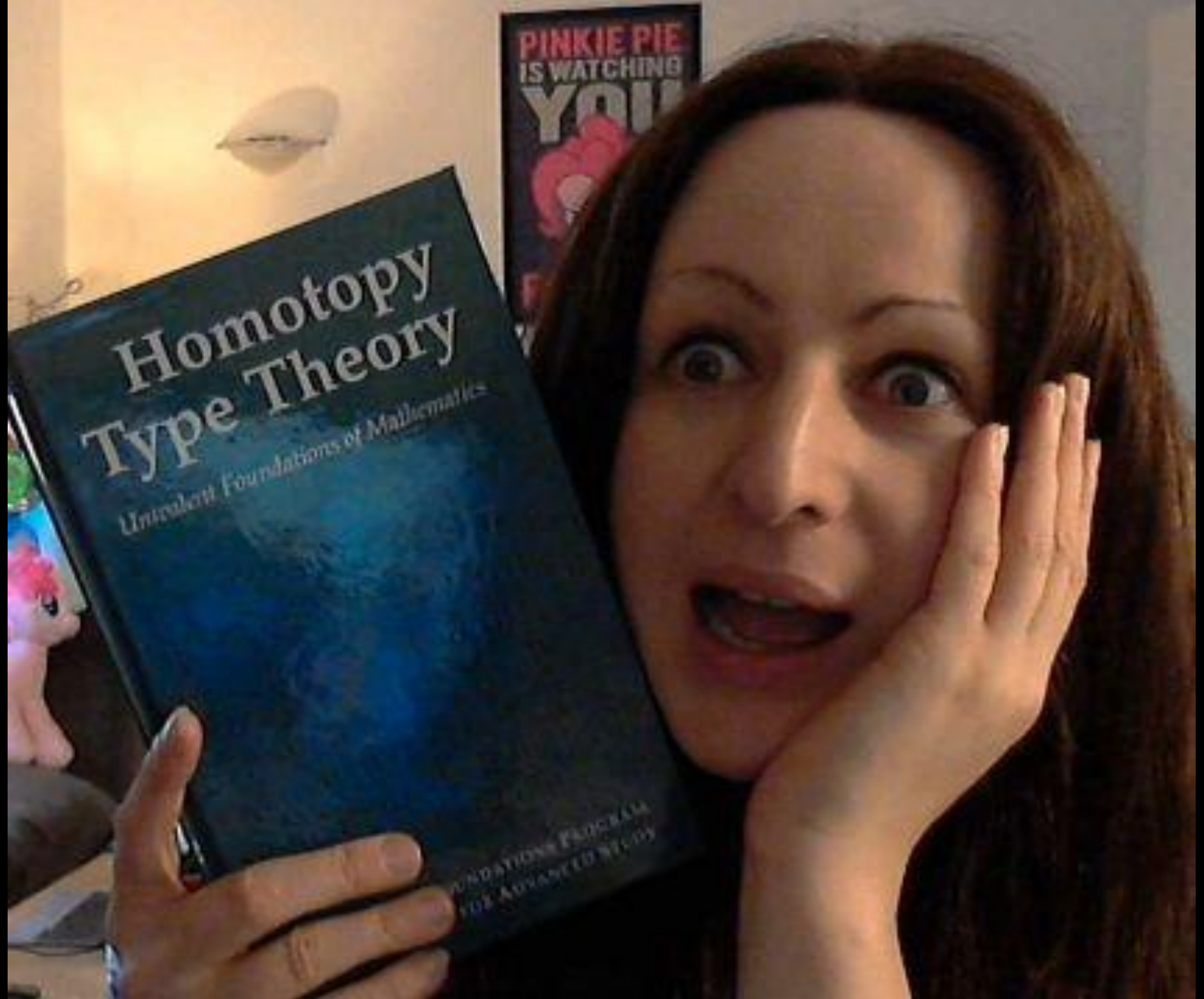
What is Reactive Programming Anyhow?

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

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

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

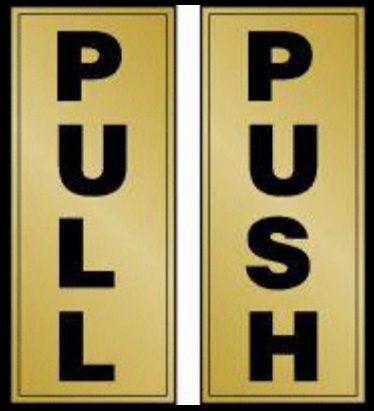
```
type Behavior a

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.

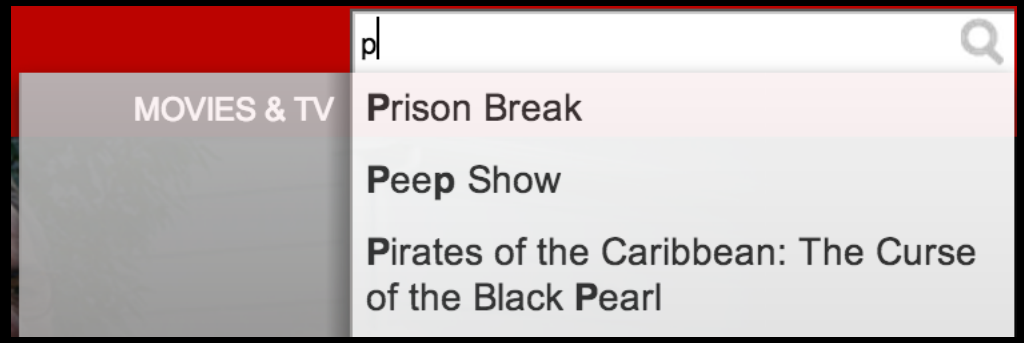



```
let source = getStockData();

source
  .filter((quote) =>
    quote.price > 30;
  )
  .map((quote) =>
    quote.price;
  )
  .forEach((price) =>
    console.log('> $30: $' + price);
  );
```

```
let source = getStockData();

source
  .filter((quote) =>
    quote.price > 30;
  )
  .map((quote) =>
    quote.price;
  )
  .forEach((price) =>
    console.log('> $30: $' + price);
  );
```

```
function fromEvent(element, event) {
  return Rx.Observable.create(observer => {

    function handler(e) {
      observer.onNext(e);
    }

    element.addEventListener(event, handler, false);

    return Rx.Disposable.create(() => {
      element.removeEventListener(event, handler, false);
    });
  }).share();
}
```

Netflix Search



Netflix Search with Observables

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

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

What exactly is Rx?

Language neutral model with 3 concepts:

1. **Observer/Observable**
2. Query operations (map/filter/reduce)
3. How/Where/When
    - Schedulers: a set of types to parameterize concurrency

Rx Grammar Police

onNext * (onError | onCompleted)?

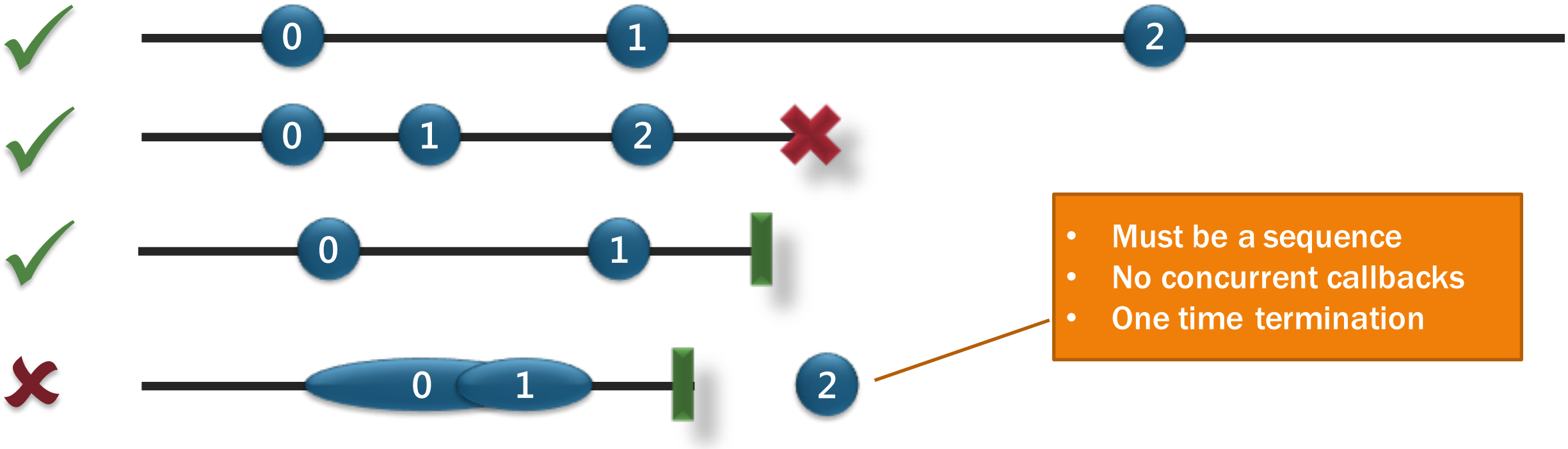
Zero or more values

E.g. events are ∞ sequences

Calls can fail

Resource management

Sequencing

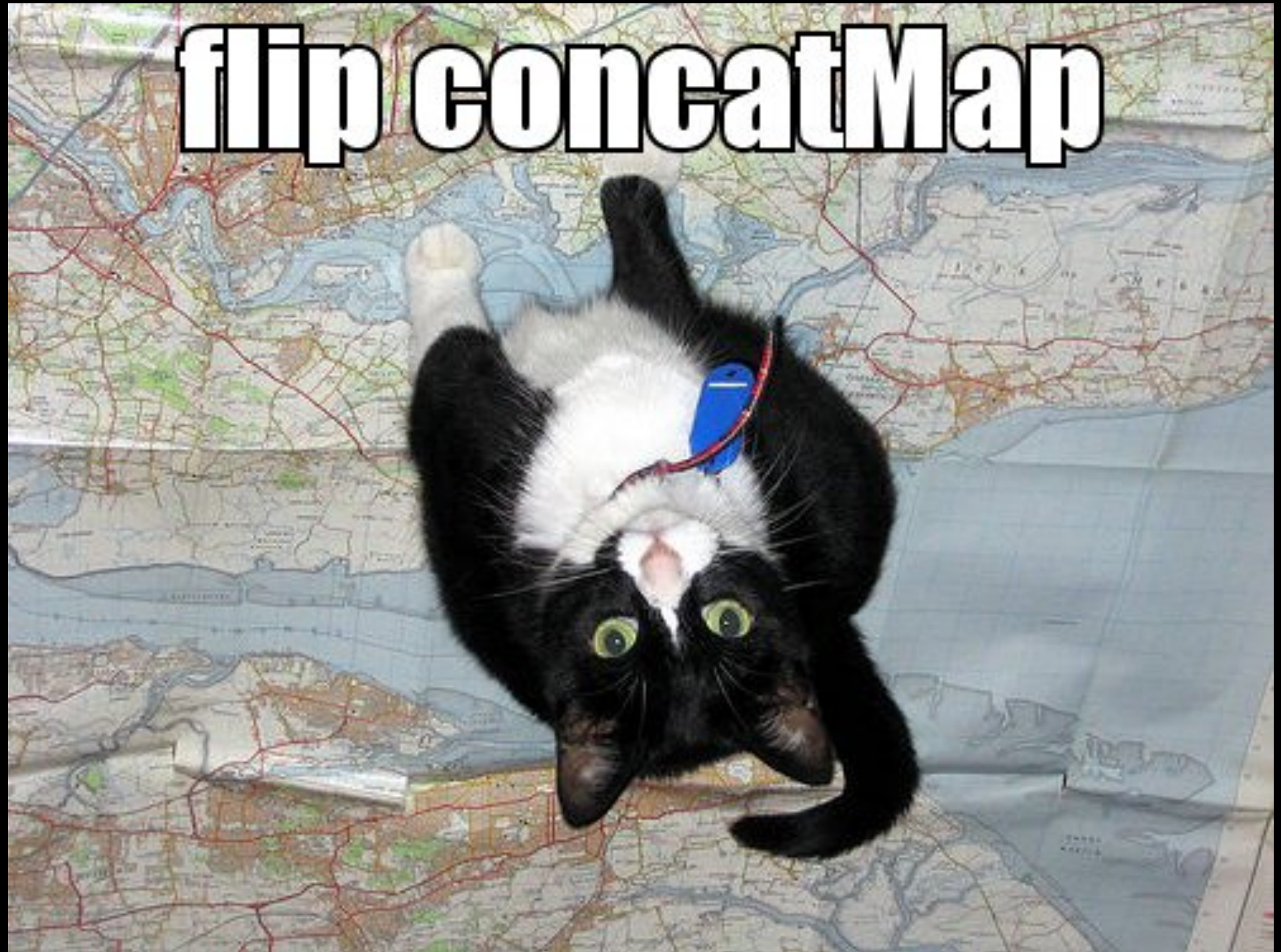


- Must be a sequence
- No concurrent callbacks
- One time termination

What exactly is Rx?

Language neutral model with 3 concepts:

1. Observer/Observable
2. Query operations (map/filter/reduce)
3. How/Where/When
    - Schedulers: a set of types to parameterize concurrency


flip concatMap

```
Observable.prototype.map = (selector, thisArg) => {
  let source = this;
  return Rx.Observable.create(o => {
    let i = 0;
    return source.subscribe(x => {
      try {
        var result = selector.call(thisArg, x, i++, source);
      } catch (e) {
        return o.onError(e);
      }
      o.onNext(result);
    }, o.onError.bind(o), o.onCompleted.bind(o));
  });
}
```

Observables - Querying UI Events

```
let mousedrag = mousedown.flatMap((md) => {

    // calculate offsets when mouse down
    let startX = md.offsetX,
        startY = md.offsetY;




});
```

1

For each mouse down

Observables - Querying UI Events

```
let mousedrag = mousedown.flatMap((md) => {

    // calculate offsets when mouse down
    let startX = md.offsetX,
        startY = md.offsetY;

    // calculate diffs until mouse up
    return mousemove.map((mm) => {
        return {
            left: mm.clientX - startX,
            top:  mm.clientY - startY
        };
    })
});
```

1

For each mouse down

2

Take mouse moves

Observables - Querying UI Events

```
let mousedrag = mousedown.flatMap((md) => {

    // calculate offsets when mouse down
    let startX = md.offsetX,
        startY = md.offsetY;

    // calculate diffs until mouse up
    return mousemove.map((mm) => {
        return {
            left: mm.clientX - startX,
            top:  mm.clientY - startY
        };
    }).takeUntil(mouseup);
});
```

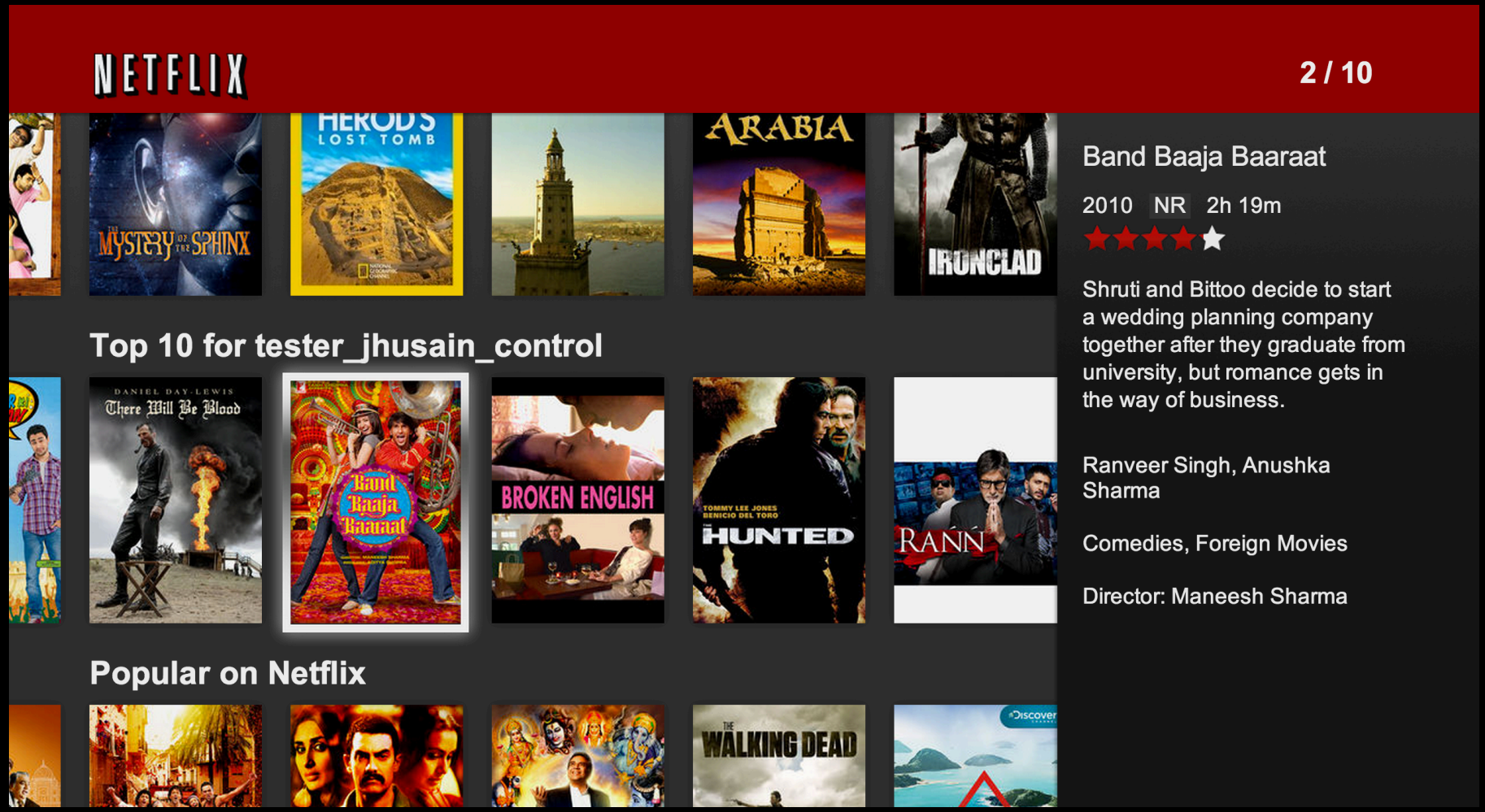
1 For each mouse down

2 Take mouse moves

3 until mouse up

Your Netflix Video Lists

Netflix Row Update Polling



Client: 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

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

RxSocketSubject

A more advanced web socket wrapper for RxJS

Install

With bower:

```
bower install -S rx-socket-subject
```

With npm:

```
npm install -S rx-socket-subject
```

Goals

The goals of this project is to produce an observable WebSocket implementation that meets a set of common needs for projects I'm currently working on. RxJS-DOM has a fine WebSocket implementation, which I modelled the initial work on this implementation off of. However, I need something that also does the following:

```
var RxWebSocketSubject = require('websocketsubject');

let socket = RxSocketSubject.create(
  ['ws://netflix.com/socket1',
   'ws://netflix.com/socket2',
   'ws://netflix.com/socket3']);

socket.forEach((e) => {
  if (e.data === 'end') {
    socket.onCompleted();
  }
  if (e.data === 'bad data') {
    socket.onError(new Error('bad data'));
  }
});

socket.onNext('some data');
```

The Final Countdown...

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

```
var d = getData();

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

What is Rx?

Language neutral model with 3 concepts:

1. Observer/Observable
2. Query operations (map/filter/reduce)
3. How/Where/When
    - Schedulers: a set of types to parameterize concurrency

Schedulers...

When?

Where?

How?

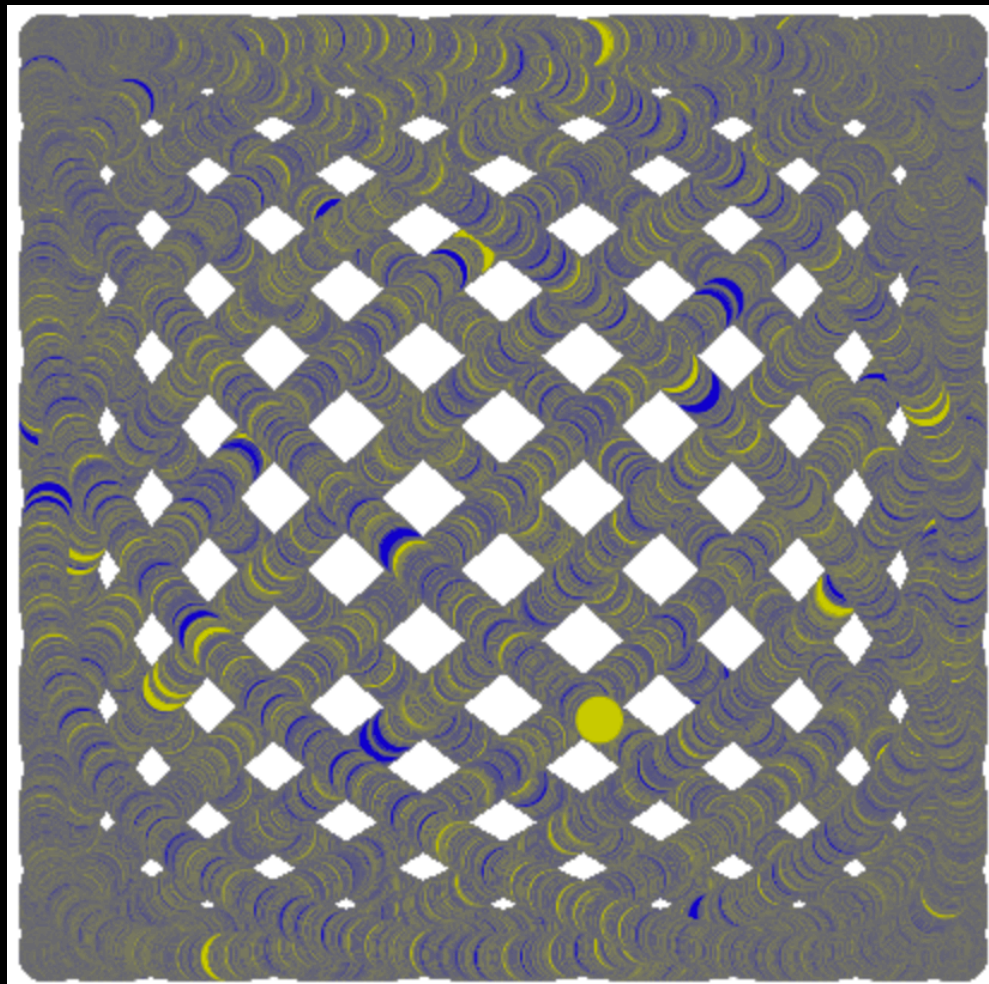
```
let d = scheduler.schedule(() => {
  // Do work async
}, 1000);

d.dispose();
```

Testing concurrent code: made easy!

```
let scheduler = new TestScheduler();


let input = scheduler.createHotObservable(
    onNext(300, 'WebRebels'),
    onNext(400, '2015'),
    onCompleted(500));


let results = scheduler.startWithCreate(() =>
    input.pluck('length')
);


results.messages.assertEqual(
    onNext(300, 9),
    onNext(400, 4),
    onCompleted(500));
```

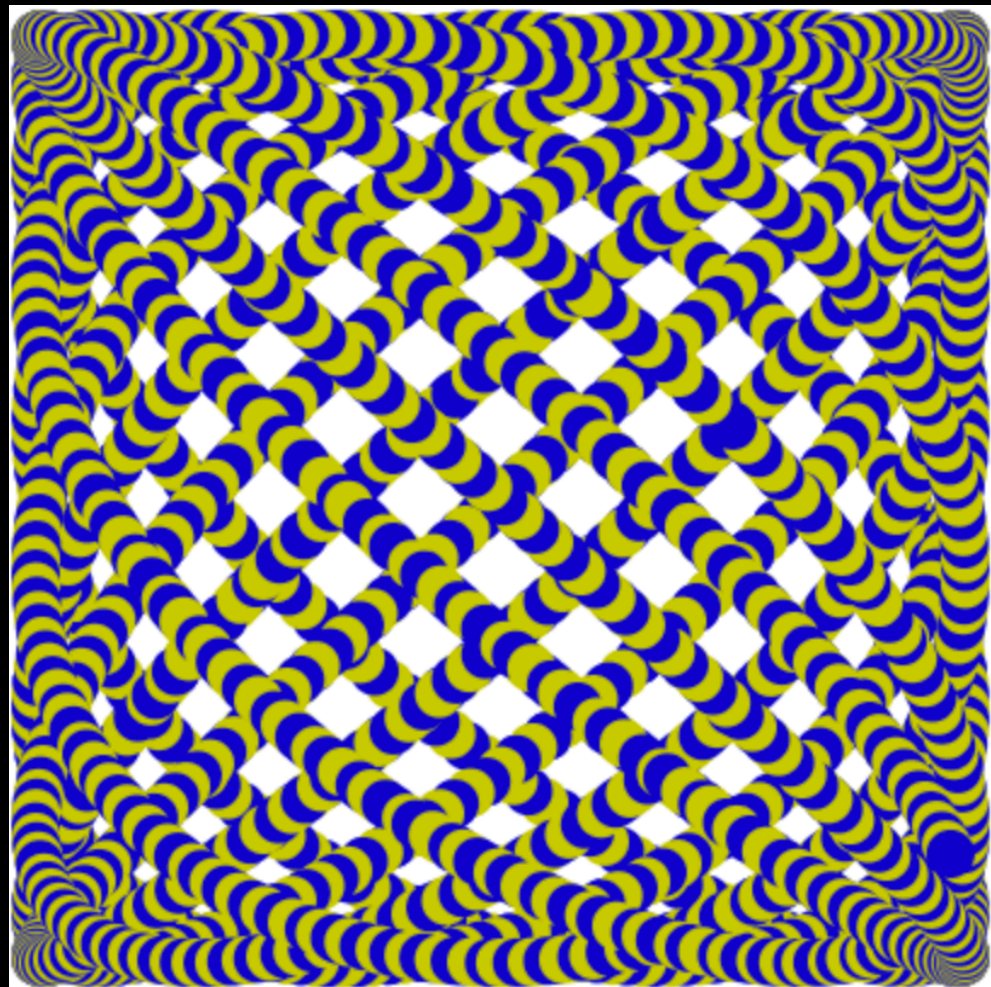
Schedulers Matter!

```
const subscription = Rx.Observable.generate(
    0,
    x => true,
    x => x + 1,
    x => x,
    Rx.Scheduler.default
  )
  .timestamp()
  .subscribe(draw);
```



Schedulers Matter!

```
const subscription = Rx.Observable.generate(
    0,
    x => true,
    x => x + 1,
    x => x,
    Rx.Scheduler.requestAnimationFrame
  )
  .timestamp()
  .subscribe(draw);
```



Observables and Backpressure

Yes, Observables can have backpressure

- Can be lossy (pausable, sample, throttle)
- Can be lossless (buffer, pausableBuffered, controlled)

```
let pausable = chattyObservable.pausableBuffered();
pausable.pause();
pausable.resume();

let controlled = chattyObservable.controlled();
controlled.request(10);
```


Ur Kitteh of Death
Awaits
ROFLBOT

Async/Await

Coming to a JavaScript Engine Near You!

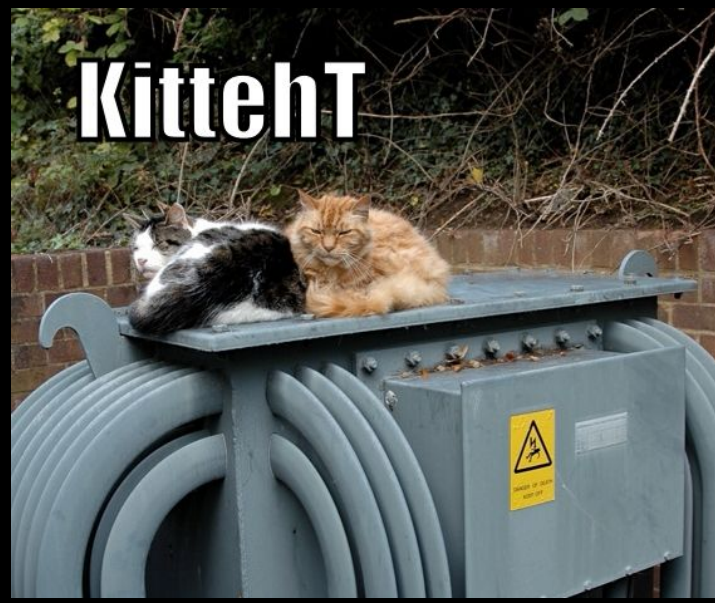
- Adds async and await keywords for Promises
- Accepted into Stage 1 of ECMAScript 7 in January 2014

```
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.spawn(function* () {
  var result = yield get('http://webrebels.org')
    .retry(3)
    .catch(cachedVersion)
    .finally(doCleanup);

  console.log(result);
}());
```



Async Generators in ES7/2016???

```
async function* getDrags(element) {
  for (let mousedown on element.mousedown) {
    for (let mousemove on
      document.mousemove.takeUntil(document.mouseup)) {
        yield mousemove;
    }
  }
}
```

http://esdiscuss.org/notes/2014-06/async%20generators.pdf

This is an interactive learning course with exercises you fill out right in the browser. **If you just want to browse the content click the button below**:

Show all the answers so I can just browse.

Functional Programming in Javascript

Functional programming provides developers with the tools to abstract common collection operations into reusable, composable building blocks. You'll be surprised to learn that most of the operations you perform on collections can be accomplished with **five simple functions**:

1. map
2. filter
3. concatAll
4. reduce
5. zip

Here's my promise to you: if you learn these 5 functions your code will become shorter, more self-descriptive, and more durable. Also, for reasons that might not be obvious right now, you'll learn that these five functions hold the key to simplifying asynchronous programming. Once you've finished this tutorial you'll also have all the tools you need to easily avoid race conditions, propagate and handle asynchronous errors, and sequence events and AJAX requests. In short, **these 5 functions will probably be the most powerful, flexible, and useful functions you'll ever learn.**

http://jhusain.github.io/learnrx/

RxMarbles

Interactive diagrams of Rx Observables

TRANSFORMING OPERATORS

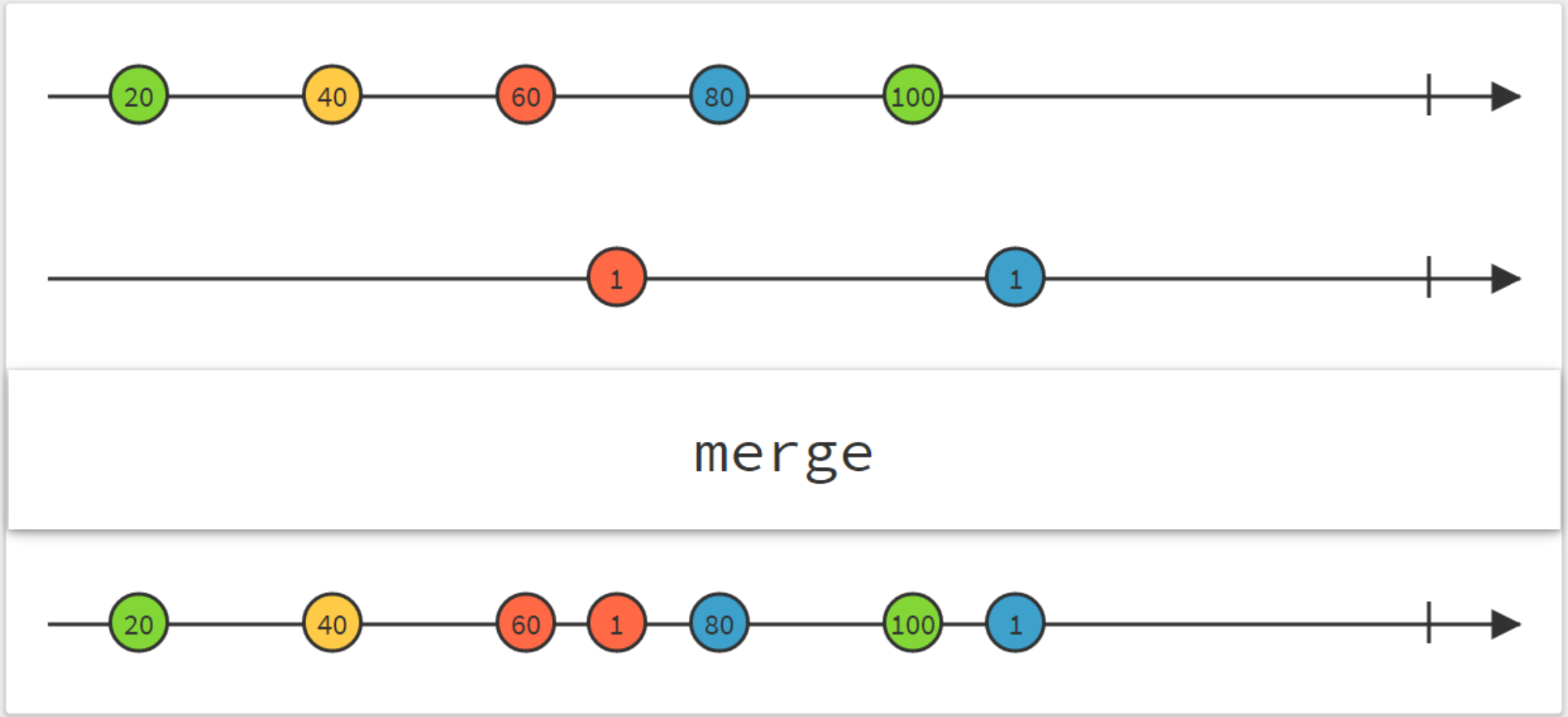
- delay
- delayWithSelector
- findIndex
- map
- scan
- throttle
- throttleWithSelector

COMBINING OPERATORS

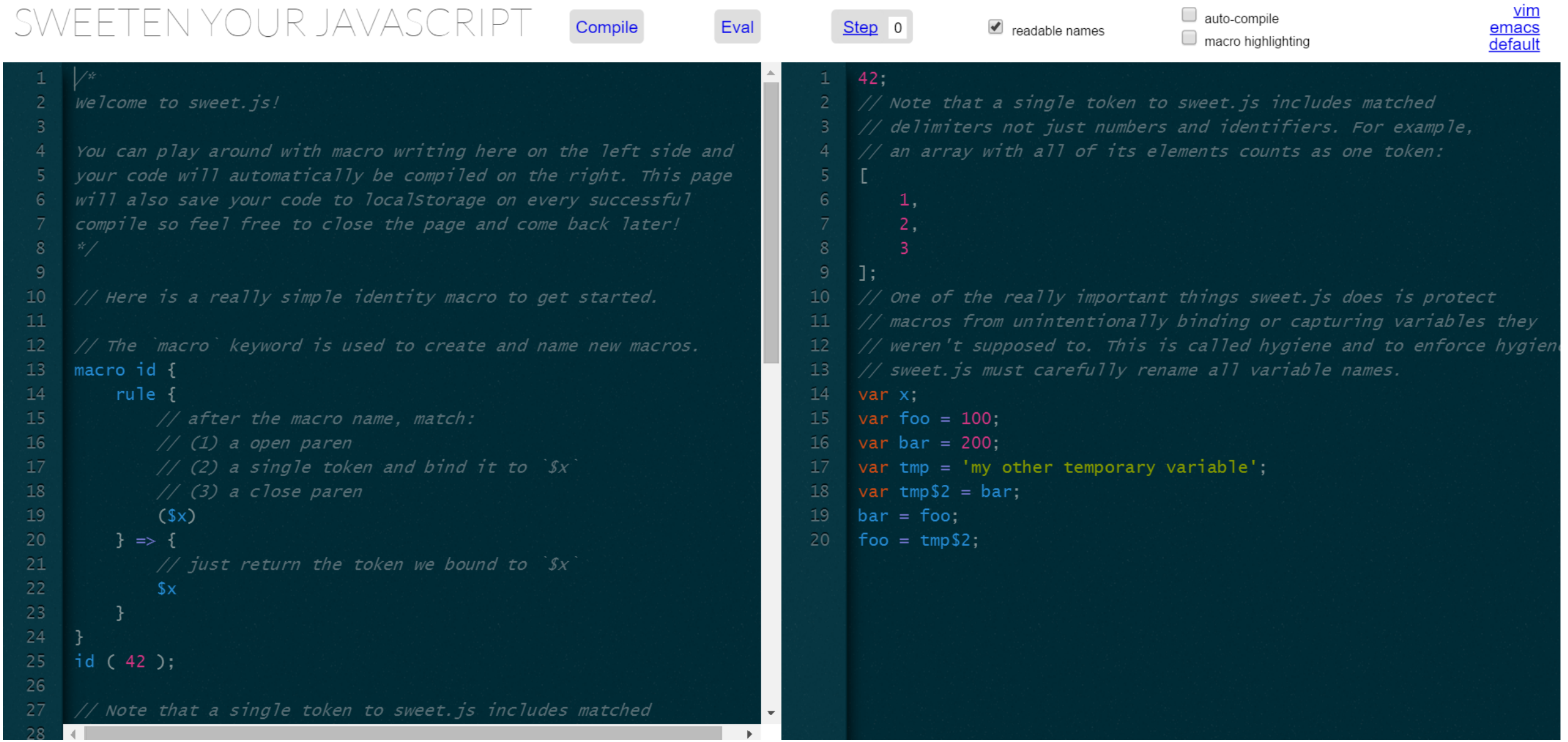
- combineLatest
- concat
- merge
- sample
- startWith
- zip

FILTERING OPERATORS

- distinct
- distinctUntilChanged
- elementAt
- filter



http://www.rxmarbles.com/



http://sweetjs.org/editor.html