Fullstack Academy of Code · Gabriel Lebec

Promises

Using, generating, and understanding deferral-style Javascript promises

What is a promise, anyway?

> “A *promise* represents the eventual result of an asynchronous operation.”
>
> –*The Promises/A+ Spec*

> "The point of promises is to give us back functional composition and error bubbling in the async world."

–Domenic Denicola, "You're Missing the Point of Promises"

- Pass into functions
- Assign to objects
- Export to modules
- Return values … from a callback!? (Yes.)
- Write just one error handler for a long chain of promises

Promises are Objects

state (pending, fulfilled, or rejected)

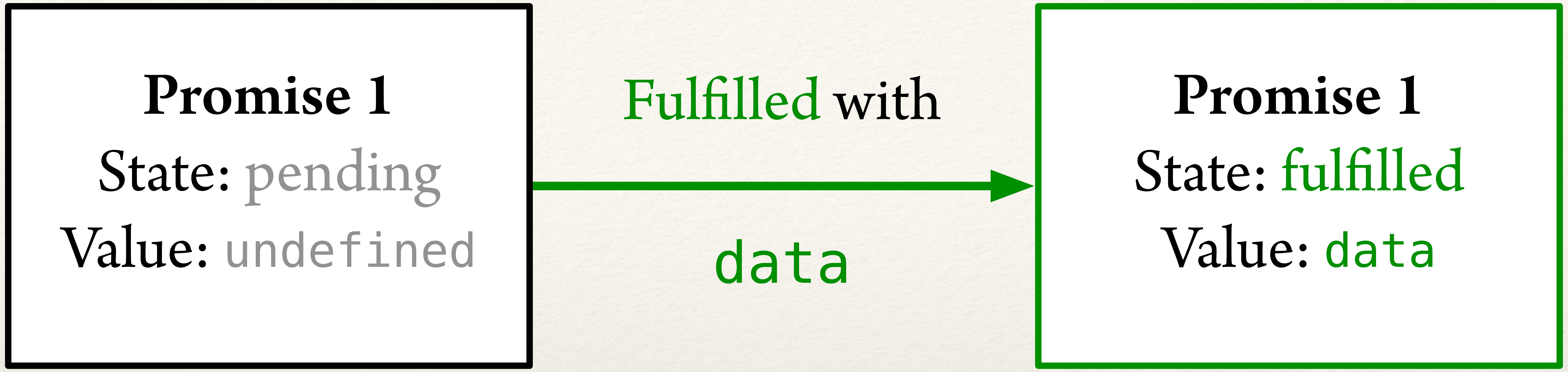
value (`data` or a `reason`)

} (via closure)

`.then()` (property)

Promises are Objects

- They have one (very important) property: the function `.then()`
- They encapsulate (usually via closure) two more crucial variables:
  - A current *state*, which starts as Pending and ends up as one of:
    - Fulfilled
    - Rejected
  - An eventual *value*, which ends up being one of the following:
    - fulfilled *data*
    - a rejection *reason*

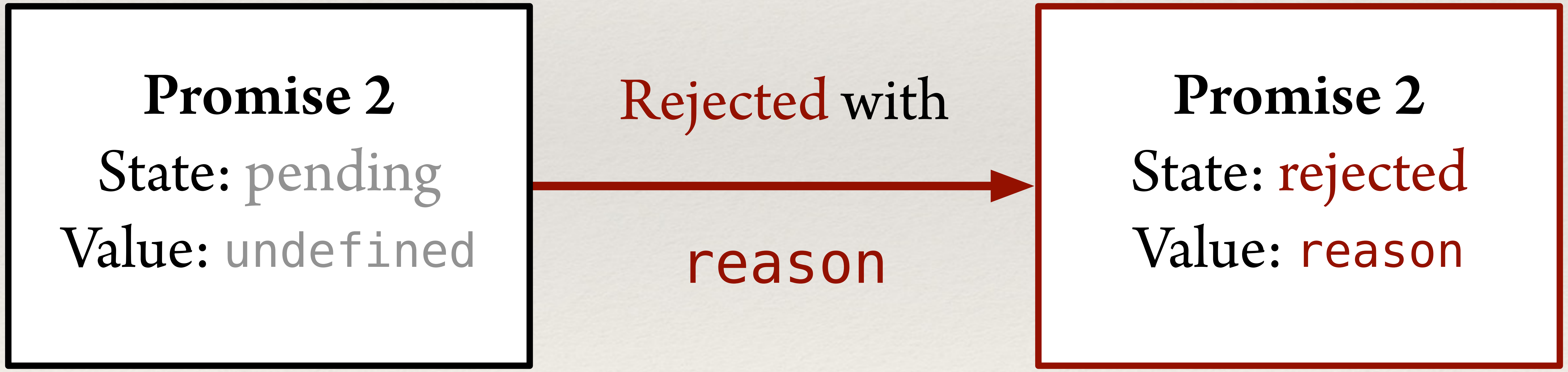


Promise 1
State: pending
Value: `undefined`

Fulfilled with `data`

Promise 1
State: fulfilled
Value: `data`

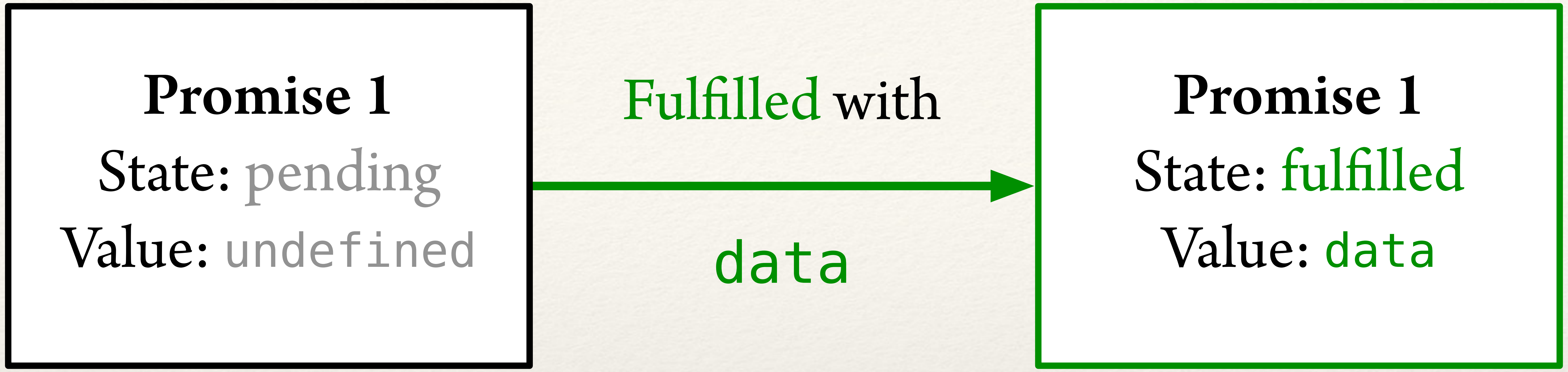
Promises can only change state while pending



Promise 2
State: pending
Value: `undefined`

Rejected with `reason`

Promise 2
State: rejected
Value: `reason`

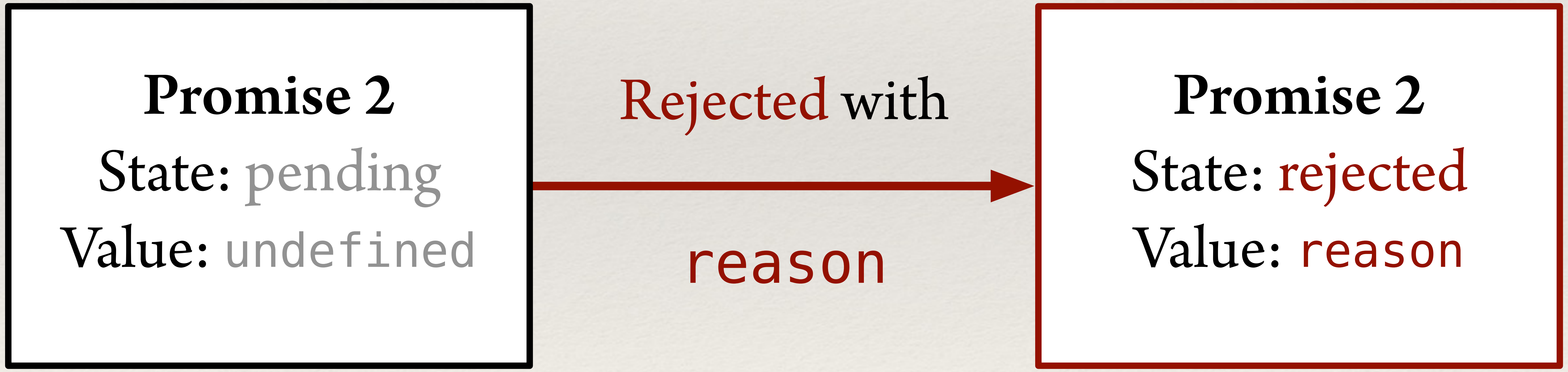


Promise 1
State: pending
Value: `undefined`

Fulfilled with
`data`

Promise 1
State: fulfilled
Value: `data`

```
.then( successFunction, errorFunction )
```



Promise 2
State: pending
Value: `undefined`

Rejected with
`reason`

Promise 2
State: rejected
Value: `reason`

What does this solve?

```
// Basic async callback pattern.
// asyncFetchUser asks a server for some data.
// Internally, it gets a response: { name: 'Kim' }.
// That response is then passed to the receiving callback.

asyncFetchUser( 123, function received( response ) {
  console.log( response.name ); // output: Kim
});
```

```javascript
// Callback Hell

var userID = 'a72jd3720h';
getUserData( userID, function got( userData ) {
  getMessage( userData.messageIDs[0], function got( message ) {
    getComments( message, function got( comments ) {
      console.log( comments[0] );
    });
  });
});
```

```
// Callback Hell… with error handling, for extra hellishness

var userID = 'a72jd3720h';
getUserData( userID, function got( userData, err ) {
  if (err) console.log('user fetch err: ', err);
  else getMessage( userData.messageIDs[0], function got( message, err ) {
    if (err) console.log('message fetch err: ', err);
    else getComments( message, function got( comments, err ) {
      if (err) console.log('comment fetch err: ', err);
      else console.log( comments[0] );
    });
  });
});
```

```
// Sneak preview: .then chaining and .catch

promiseForThing
  .then( function thingSuccess (thing) {
    // run some code
    return promiseForNewStuff;
  })
  .then(function stuffSuccess (newStuff) {
    // run some code
    return promiseForMoreData;
  })
  .then(function moreSuccess (moreData) {
    // etc.
  })
  .catch(function oops (error) {
    // handle the error
  });
```

```
// This will not work!

var person = asyncGetGroup( 123, function got( group ) {
  return group.users[0];
});
```

```
// This also will not work

var person;
asyncGetGroup( 123, function got( group ) {
  person = group.users[0];
});

// somewhere else
var headline = person.name; // might be undefined!
```

```
// Fantasy solution

var containerA = new Container();
asyncGetData( function got( asyncData ) {
  containerA.save( asyncData ); // once async completes
});

// …somewhere else…
containerA.whenSaved( function use( savedData ) {
  console.log( savedData ); // once containerA.save() happens
});
```

```
// Real version with deferral-style promise

myDeferral = $q.defer();
asyncGetData( function got( asyncData ) {
  myDeferral.resolve( asyncData );
});
var myPromise = myDeferral.promise;

// …somewhere else…
myPromise.then( function use( resolvedData ) {
  console.log( resolvedData );
});
```

Fragmented Landscape

- Multiple proposed standards · CommonJS
- One leading standard · Promises/A+
- Upcoming native ES6 promises (already working in some browsers)

- Two different approaches for generating new promises:
  - CommonJS-style **deferrals** (one extra entity)
  - ES6-style **constructors** (simplified)

- jQuery gurus beware! `$.Deferred` differs from current standards and is considered flawed. See Kris Kowal's guide.

Deferral-style

```
var myDeferral = $q.defer();
someAsyncCall( function (data, err) {
  if (err) myDeferral.reject( err );
  else myDeferral.resolve( data );
});
var myPromise = myDeferral.promise;

// elsewhere
myPromise.then( mySuccessHandler, myErrorHandler );
```

Constructor-style

```
var myPromise = new Promise( function (resolve, reject) {
  someAsyncCall( function (data, err) {
    if (err) reject( err );
    else resolve( data );
  });
});

// elsewhere
myPromise.then( mySuccessHandler, myErrorHandler );
```

So Why Deferrals … ?

AngularJS: `$q`

Server-side: `Q`

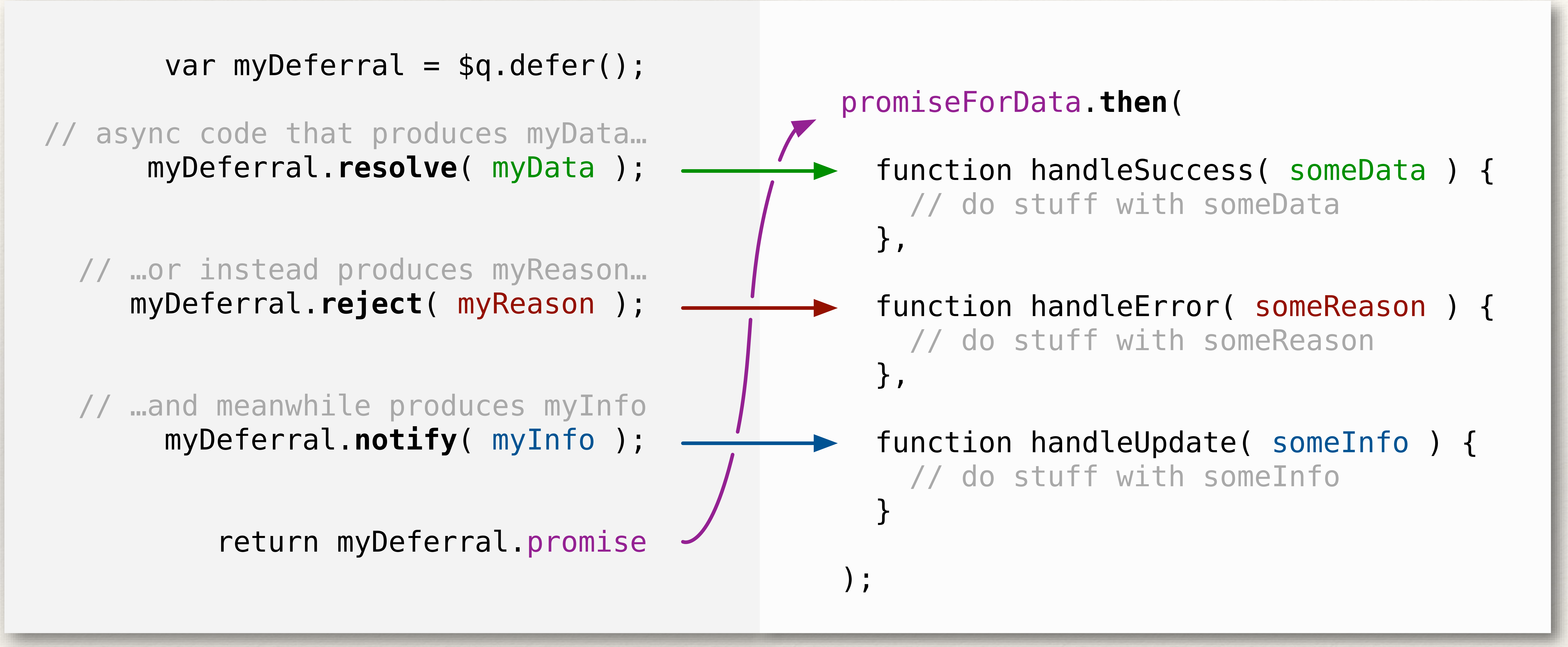
(each has a bias for deferral model)

`.notify()`

Advanced: makes the resolver portable.

Meta: if you get deferrals, you can get ES6-style.

A deferral controls its promise's state. Promises attach callbacks to an eventual value.



```
           var myDeferral = $q.defer();

// async code that produces myData…
        myDeferral.resolve( myData );


  // …or instead produces myReason…
       myDeferral.reject( myReason );


  // …and meanwhile produces myInfo
           myDeferral.notify( myInfo );


              return myDeferral.promise
```

```
promiseForData.then(

  function handleSuccess( someData ) {
    // do stuff with someData
  },

  function handleError( someReason ) {
    // do stuff with someReason
  },

  function handleUpdate( someInfo ) {
    // do stuff with someInfo
  }

);
```

The async code can exist in a service …

… and return a promise for myData to a controller!

`.then()` always returns a new promise.

```
promiseB = promiseA.then( successHandler, errorHandler );
```

.then() always returns a new promise.

```
promiseB = promiseA.then( successHandler, errorHandler );
```

```
promiseForThing
  .then( doStuff )
  .then( doOtherStuff )
  .then( doMoreStuff )
  .catch( handleErr );
```

This is why we can chain .then

.then() always returns a new promise.

```
promiseB = promiseA.then( successHandler, errorHandler );
```

```
promiseForThing
  .then( doStuff )
  .then( doOtherStuff )
  .then( doMoreStuff )
  .catch( handleErr );
```

```
return promiseForThing
  .then( function thingSuccess (thing) {
    // run some code
    return someOtherThing;
  })
```

And why we can return from a handler

.then() always returns a new promise.

```
promiseB = promiseA.then( successHandler, errorHandler );
```

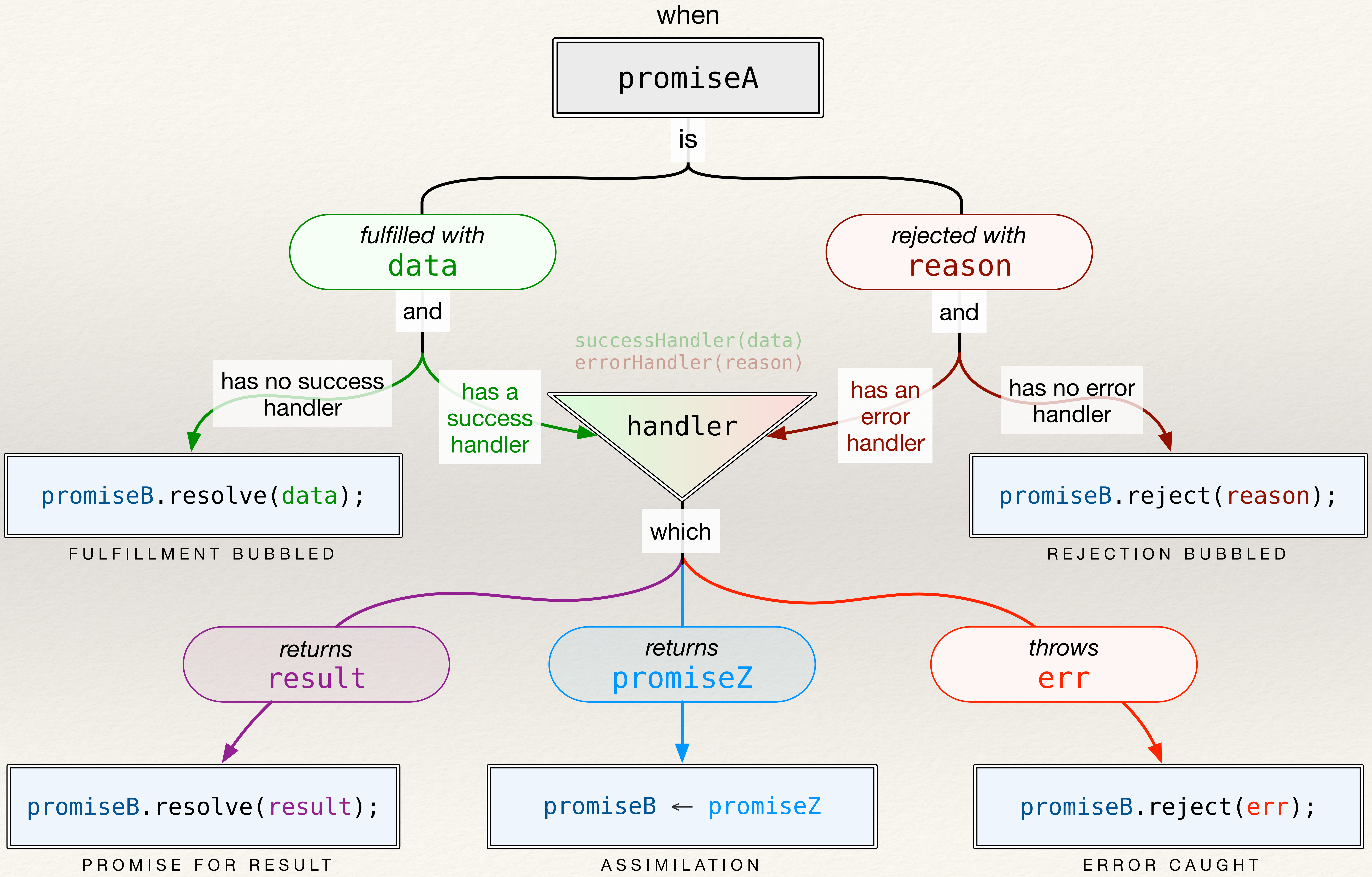
```
promiseForThing
  .then( doStuff )
  .then( doOtherStuff )
  .then( doMoreStuff )
  .catch( handleErr );
```

```
return promiseForThing
  .then( function thingSuccess (thing) {
    // run some code
    return someOtherThing;
  })
```

So what actually happens to promiseB?

`.then()` always returns a new promise. What happens to that promise?

```
promiseB = promiseA.then( [successHandler], [errorHandler] );
```



when

promiseA

is

fulfilled with
data

and

has no success handler

promiseB.resolve(data);

FULFILLMENT BUBBLED

has a success handler

successHandler(data)
errorHandler(reason)

handler

rejected with
reason

and

has an error handler

has no error handler

promiseB.reject(reason);

REJECTION BUBBLED

which

returns
result

promiseB.resolve(result);

PROMISE FOR RESULT

returns
promiseZ

promiseB ← promiseZ

ASSIMILATION

throws
err

promiseB.reject(err);

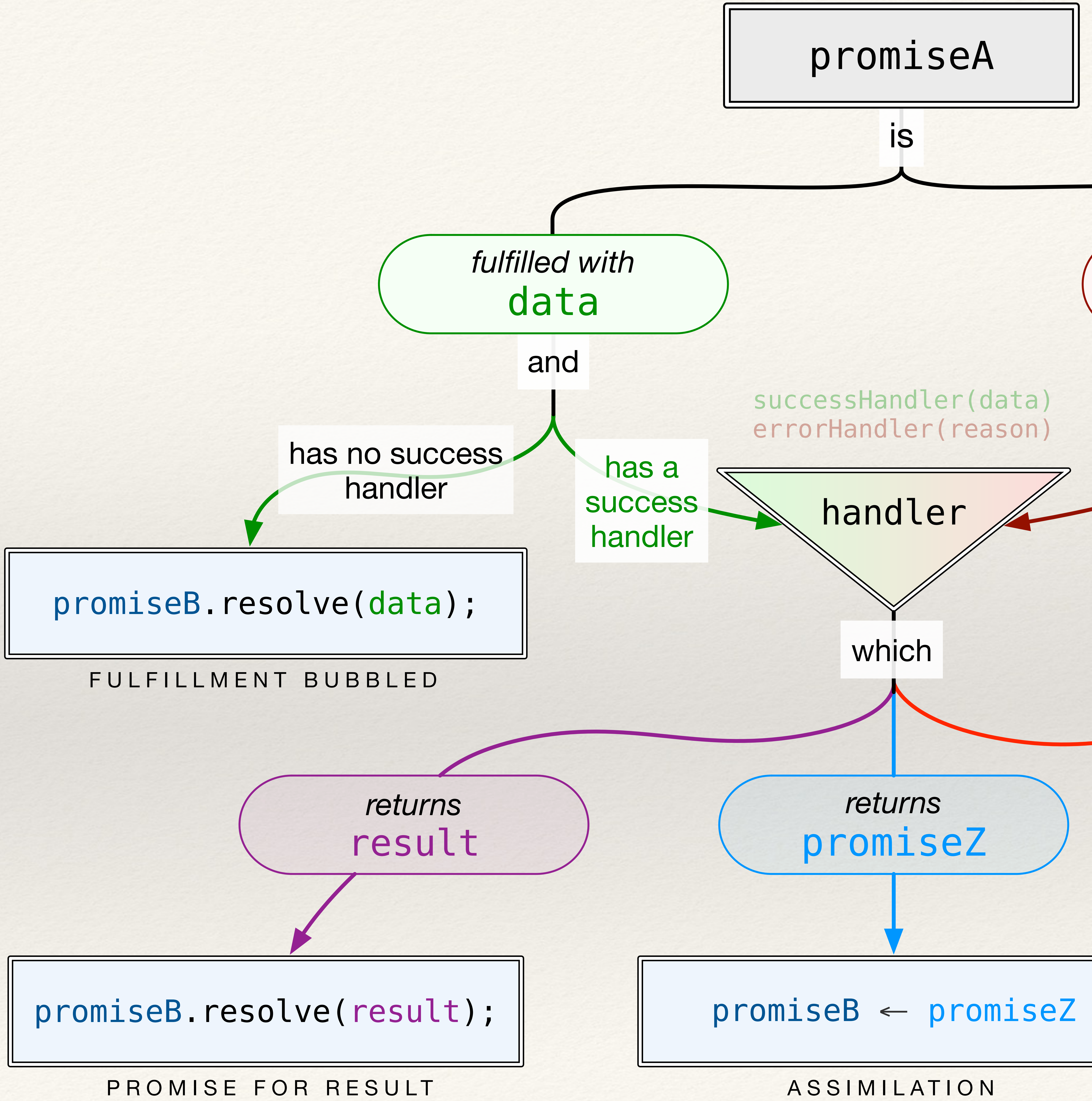
ERROR CAUGHT

```
// promise0 is fulfilled with
'Hey there.'

promise0
   .then() // -> p1
   .then() // -> p2
   .then() // -> p3
   .then() // -> p4
   .then() // -> p5
   .then(console.log);
```

Fulfillment bubbled down to first available success handler:

Console log reads “Hey there.”



promiseA

is

fulfilled with
data

and

has no success handler

has a success handler

successHandler(data)
errorHandler(reason)

handler

`promiseB.resolve(data);`

FULFILLMENT BUBBLED

which

returns
result

returns
promiseZ

`promiseB.resolve(result);`

PROMISE FOR RESULT

promiseB ← promiseZ

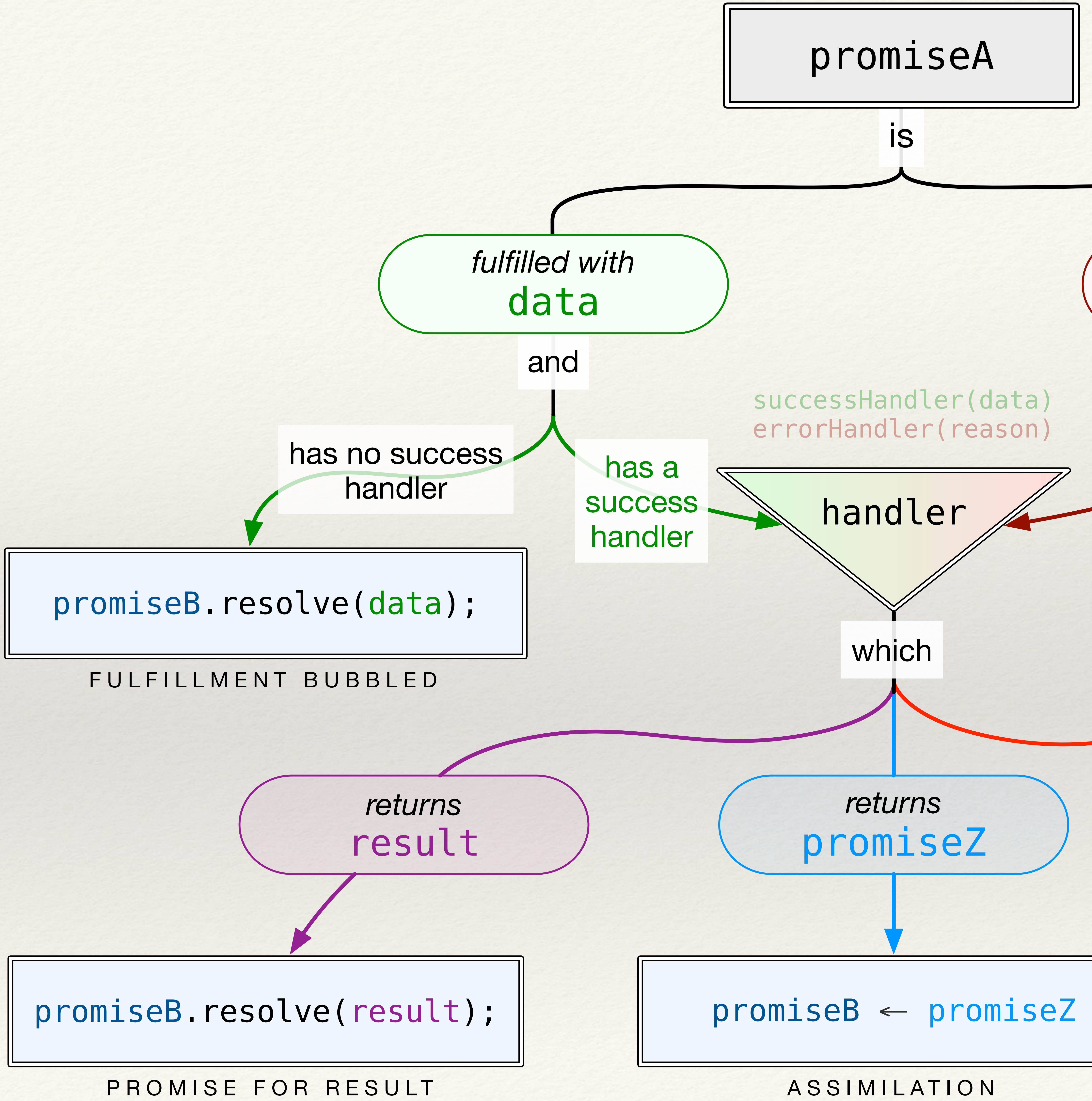
ASSIMILATION

```
// promise0 is fulfilled with
'Hey there.'

promise0
   .then(null, warnUser) // -> p1
   .then() // -> p2
   .then() // -> p3 etc.
   .then(null, null, updateDom)
   .then()
   .then(console.log);
```

Same thing! Fulfillment bubbles down to first available success handler.

Console log reads “Hey there.”



promiseA

is

fulfilled with
data

and

has no success handler

has a success handler

successHandler(data)
errorHandler(reason)

handler

which

returns
result

returns
promiseZ

promiseB.resolve(data);

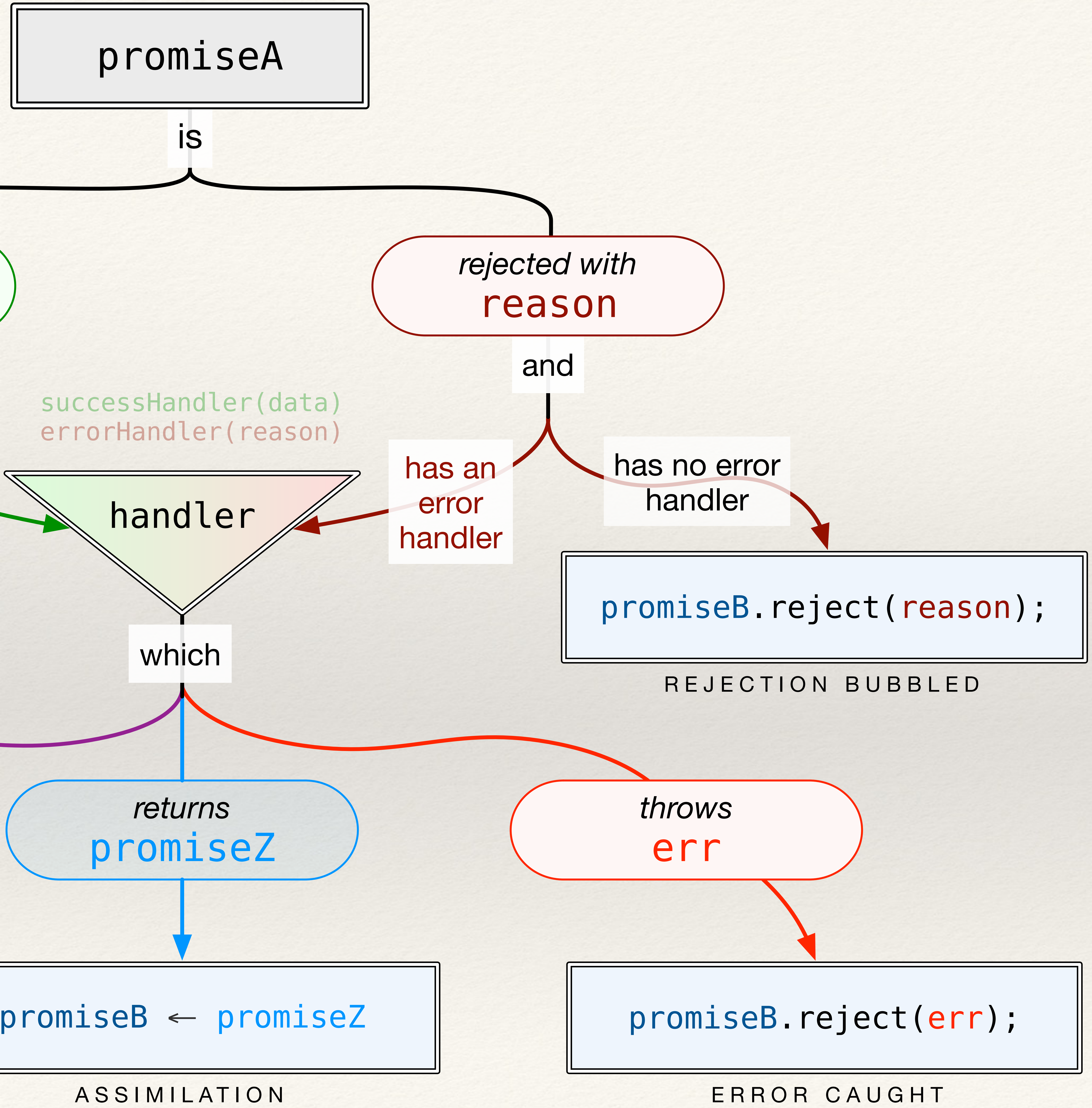
FULFILLMENT BUBBLED

promiseB.resolve(result);

PROMISE FOR RESULT

promiseB ← promiseZ

ASSIMILATION



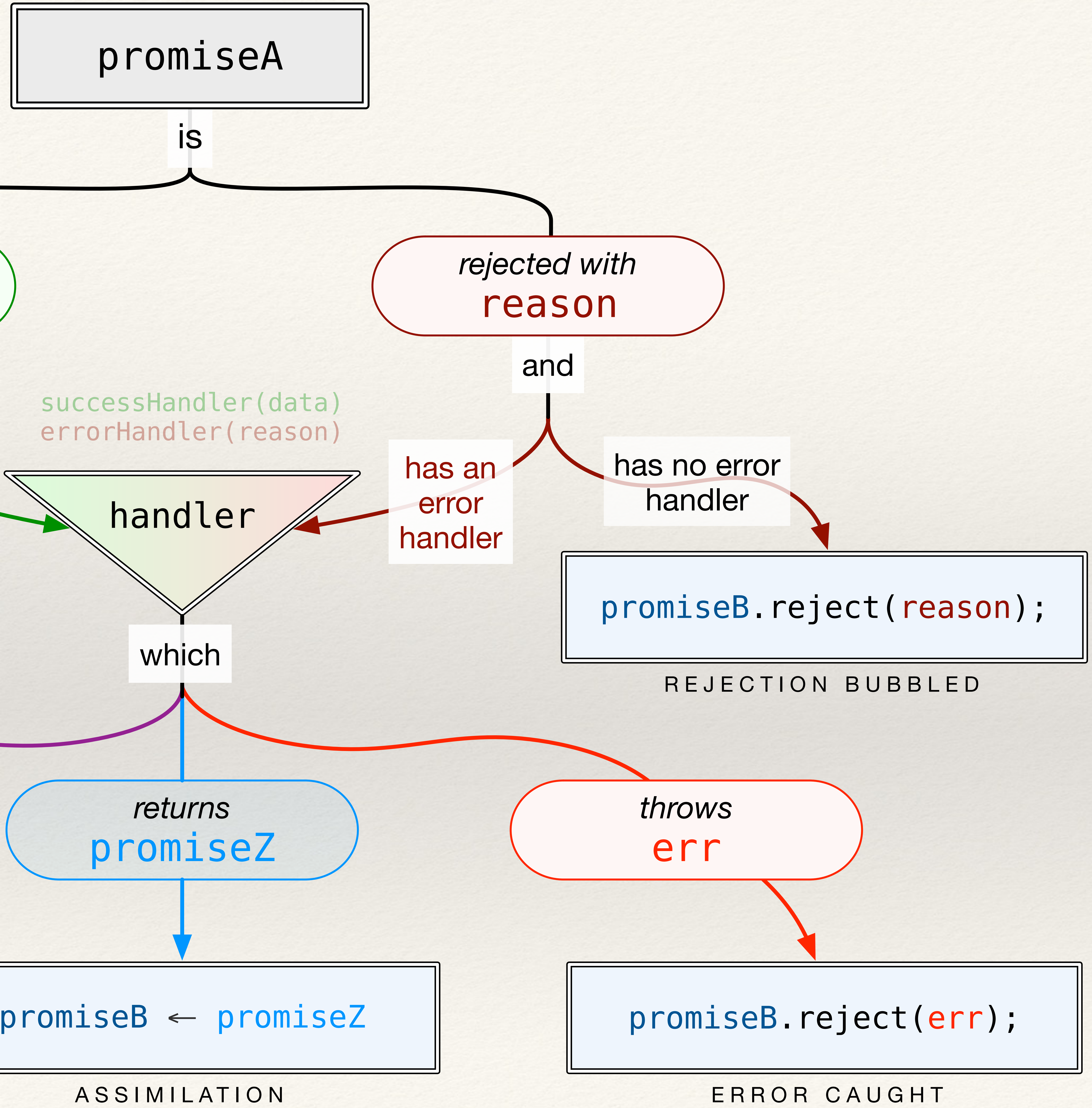
```
function logNormal (input) {
  console.log(input);
}
function logYell (input) {
  console.log(input+'!');
}

// promise0 rejected with 'Sorry'

promise0
  .then() // -> p1
  .then() // -> p2 and so on
  .then()
  .then(null, logNormal);
```

Rejection bubbles down to the first available error handler.

Console log is "Sorry".



promiseA

is

rejected with
reason

and

successHandler(data)
errorHandler(reason)

has an error handler

has no error handler

handler

promiseB.reject(reason);

REJECTION BUBBLED

which

returns
promiseZ

throws
err

promiseB ← promiseZ

ASSIMILATION

promiseB.reject(err);

ERROR CAUGHT

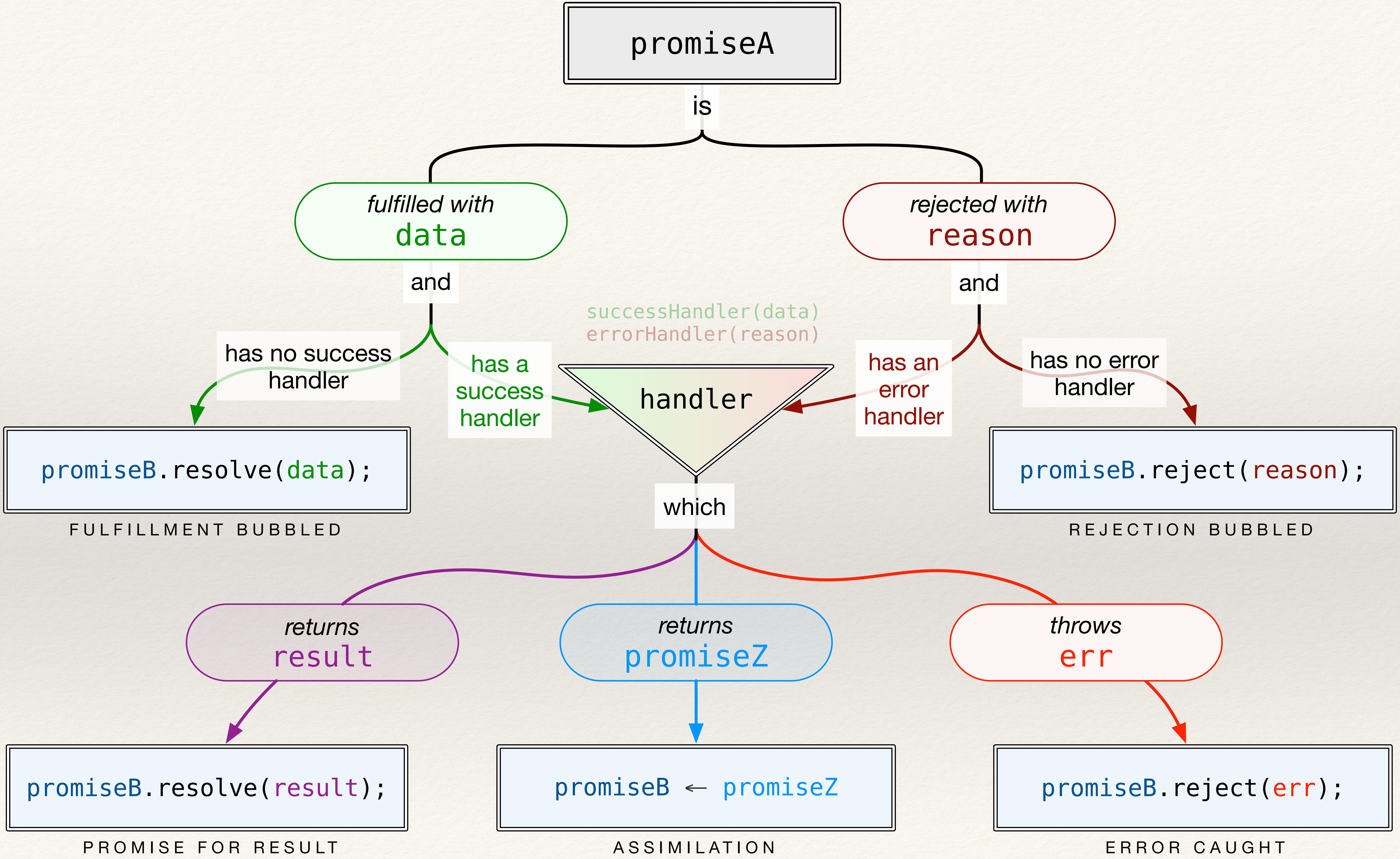
```
function logNormal (input) {
  console.log(input);
}
function logYell (input) {
  console.log(input+'!');
}

// promise0 rejected with ‘Sorry'

promise0
  .then(logNormal)
  .then(null, null, logNormal)
  .then()
  .then(null, logYell);
```

Again, rejection bubbles down to the first available **error** handler.

Console log is “Sorry!”



promiseA

is

fulfilled with
data

and

has no success handler

promiseB.resolve(data);

FULFILLMENT BUBBLED

has a success handler

successHandler(data)
errorHandler(reason)

handler

has an error handler

rejected with
reason

and

has no error handler

promiseB.reject(reason);

REJECTION BUBBLED

which

returns
result

promiseB.resolve(result);

PROMISE FOR RESULT

returns
promiseZ

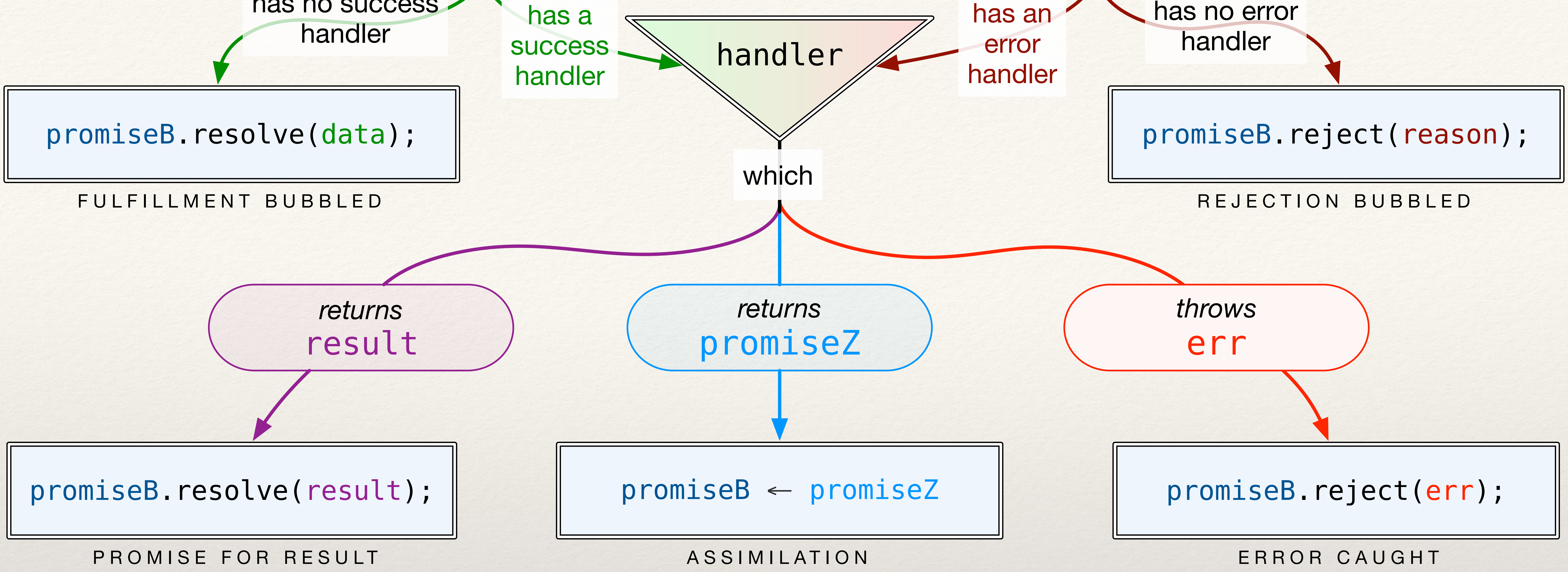
promiseB ← promiseZ

ASSIMILATION

throws
err

promiseB.reject(err);

ERROR CAUGHT



has no success handler

has a success handler

handler

has an error handler

has no error handler

`promiseB.resolve(data);`

FULFILLMENT BUBBLED

which

`promiseB.reject(reason);`

REJECTION BUBBLED

returns `result`

returns `promiseZ`

throws `err`

`promiseB.resolve(result);`

PROMISE FOR RESULT

`promiseB ← promiseZ`

ASSIMILATION

`promiseB.reject(err);`

ERROR CAUGHT

Live examples …

MEAN stack:

- Some Angular methods already generate promises for you (`$http`, `$timeout`)

```
var promiseForUser = $http.get('users/1').then(function(resp) {return resp.data});
```

- Dependency-inject the [$q service]() if you need to generate your own promise:

```
angular.module('myApp').service('myService', function ($q) { … });
```

- Install the Q library and require q in modules to generate promises on the server:

```
npm install q --save                    var Q = require('q');
```

- Use .exec() to turn Mongoose queries into promises:

```
var promiseForCentenarians = User.find({age: 100}).exec();
```

```
// array of API calls to make
var apiCalls = [
  '/api1/',
  '/api2/',
  '/api3/'
];
// map each url to a promise for its call result
apiCallPromises = apiCalls.map( function makeCall (url) {
  return $http.get(url).then( function got (response) {
    return response.data;
  });
});
// make a promise for an array of results once all arrive:
var thingsPromise = $q.all( apiCallPromises );
// use it:
thingsPromise.then( function got (results) {
  results.forEach( function print (result) {
    console.log(result);
  });
});
```

External Resources for Further Reading

- **AngularJS documentation for $q**
- Kris Kowal & Domenic Denicola: Q (the library $q mimics; great examples & resources)
- The Promises/A+ Standard (with use patterns and an example implementation)
- HTML5 Rocks: Promises (deep walkthrough with use patterns)
- Xebia: Promises and Design Patterns in AngularJS
- AngularJS Corner: Using promises and $q to handle asynchronous calls
- DailyJS: Javascript Promises in Wicked Detail (build an ES6-style implementation)
- MDN: ES6 Promises (upcoming native functions)
- Promise Nuggets (use patterns)