Before we begin...

- Open up these slides:
  - https://goo.gl/NgwFtR

Functions & Async Programming

Learning Objectives

- **Identify** higher-order functions, their role and benefits
- **Create** and use higher-order functions effectively
- **Identify** approaches to asynchronous programming
- **Work** with callbacks effectively
- **Understand** promises
- **Create** and **use** promises effectively

Agenda

- Higher-Order Functions
- Callbacks
- Promises

A quick review

- *this*
- Prototypes
- Factories
- Constructors

Higher-Order Functions

What are they?

- A higher-order function (H.O.F) is a function that operates on other functions
  - Either by receiving it as a parameter, or by returning a function

Why would you use them?

- Creating utility functions
- Leads to D.R.Y code (**D**on't **R**epeat **Y**ourself)
- Creates more *declarative programming*
  - You describe patterns
  - The opposite is *imperative programming*, where you describe every single step
- Leads to more *maintainable*, *readable* and *composable* code
- Very common for libraries (like Lodash)

Functions as Input

```
function regularlyCalled() {
    console.log("Named function");
}

setInterval(regularlyCalled, 1000);

setTimeout(function () {
    console.log("Anonymous Function");
}, 1000);
```

Functions as Input

```
function repeatLog(num) {
    for (var i = 0; i < num; i += 1) {
        console.log(i);
    }
}

repeatLog(10);

repeatLog(4);
```

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Functions as Input

```
function forEach(arr, callback) {
    for (var i = 0; i < arr.length; i += 1) {
        callback( arr[i], i );
    }
}

function handler(item, index) {
    console.log(item, index);
}

forEach(["one", "two", "three"], handler);

forEach(["one", "two", "three"], function (item, index) {
    console.log(item, index);
});
```

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Functions as Output

```
function creator() {
    return function () {
        console.log("Returned function");
    }
}

var created = creator();
created();
```

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Functions as Output

```
function createGreeting(start) {
    return function(name) {
        console.log(start + ", " + name);
    }
}

var hi = createGreeting("Hi");
hi("Jane");

var hello = createGreeting("Hello");
hello("Jeff");
```

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Functions as Output

```
function makeAdder(x) {
    return function (y) {
        return x + y;
    }
}

var addTen = makeAdder(10);

console.log( addTen(25) );
console.log( addTen(116) );
```

Exercise

- Make a repeat function that runs any arbitrary function
- Create an unless statement
- Create your own filter function for arrays
- Create your own reduce function for arrays
- Create your own map function for arrays
- Create anything else you see here

Promises

GENERAL ASSEMBLY

What are promises?

- Promises represent eventual results of an **asynchronous** operation
- "A Promise is an object representing the eventual completion or failure of an **asynchronous** operation"
- It's an object that may produce a single piece of data at some point in the future
  - Either a **resolved** value
  - Or a **rejection** (an error that tells us why it wasn't resolved)

States & Fates

- Promises have three mutually exclusive potential states:
  - **Fulfilled:** The action relating to the promise succeeded
  - **Rejected:** The action relating to the promise failed
  - **Pending:** Hasn't fulfilled or rejected yet
- We say that a promise is "**settled**" if it isn't pending

States & Fates

- Promises have two mutually exclusive potential fates:
    - **Resolved**: Finished (or locked into a thenable or another promise)
    - **Unresolved**: If trying to resolve or reject will make an impact

A little like event listeners...

But...

- A promise can only succeed or fail once
- If a promise has succeeded or failed and you later add a success/failure callback, the correct callback will be called (even though the event happened earlier)

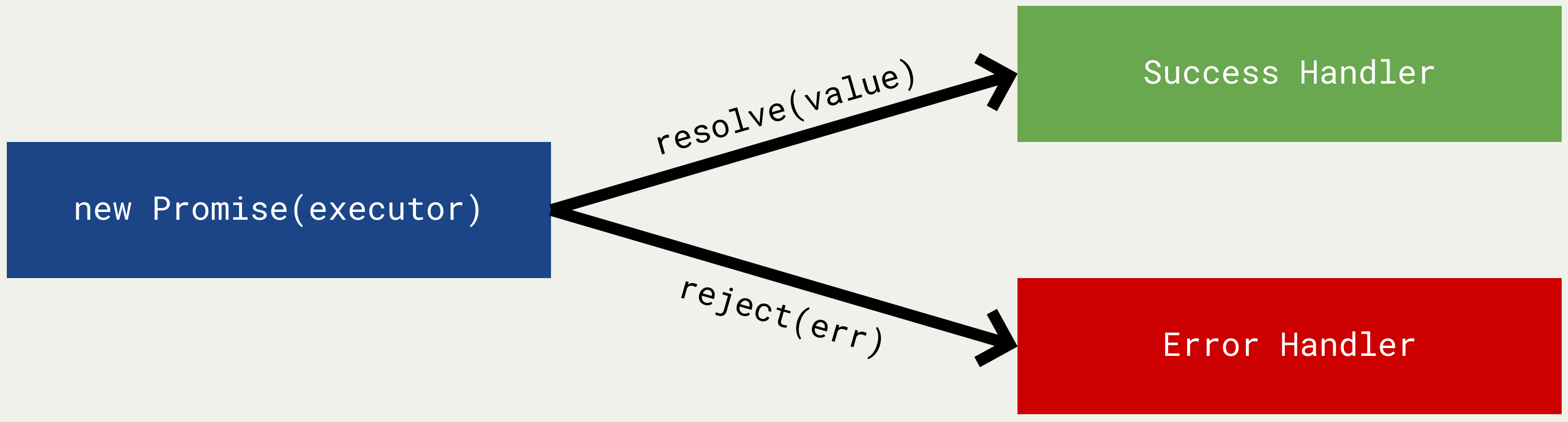
Why use promises?

- They help us write readable code
- They help us deal with the complexities of asynchronous programming
- They help us avoid "callback hell" || "the pyramid of doom"
- They are the backbone of some of the newer features coming out with JavaScript (e.g. async and await)
- Lots of libraries/frameworks/packages use promises (so we will have to be the consumers of them anyway)

Some Terminology

- **Executor**: A function that contains the producing code
- **Fulfilled**: Succeeded
- **Rejected**: Failed
- **Pending**: Waiting
- **Settled**: Not pending
- **Resolved**: Finished
- **Unresolved**: If trying to resolve or reject will make an impact
- **Thenable**: A piece of data that is promise-like (it has a .then method)

How do they work?



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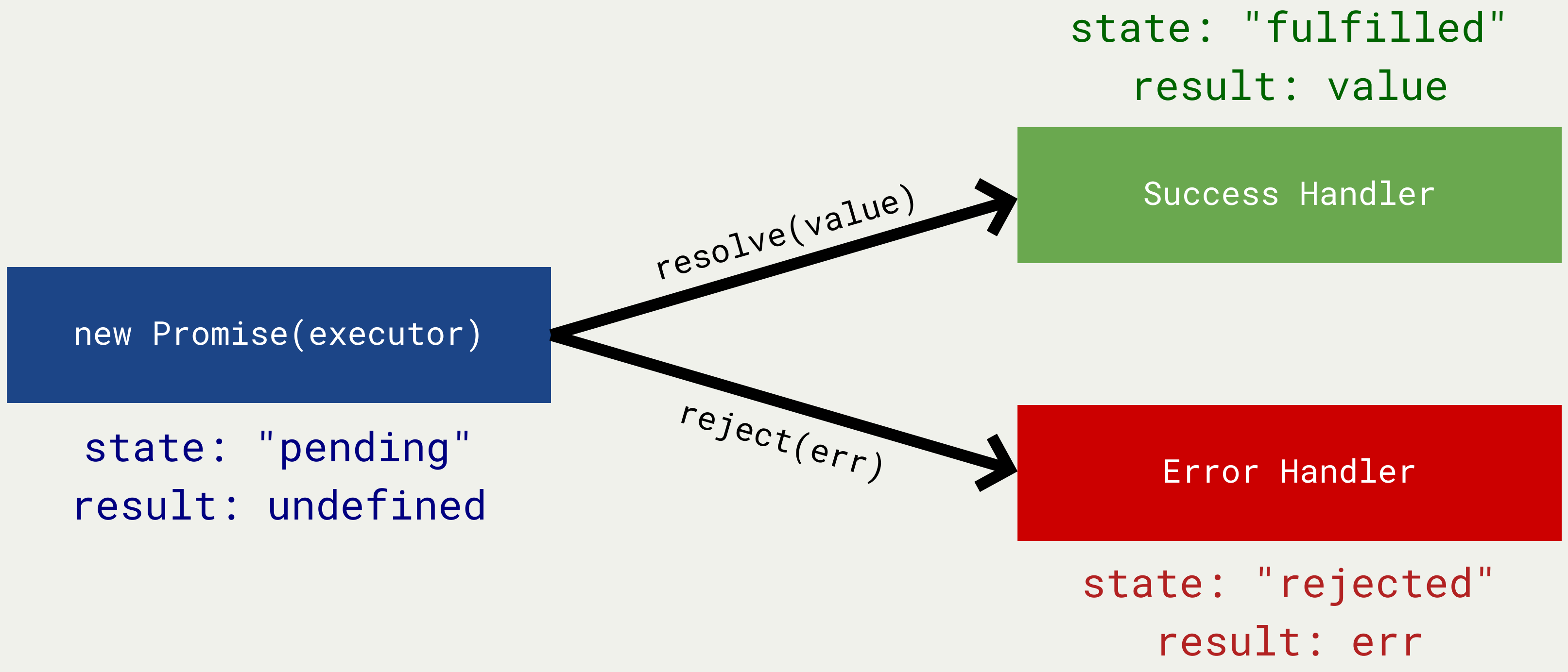
How do they work?



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Creating Promises

```
var promise = new Promise(function (resolve, reject) {
    if ( true ) {
        resolve("Will go to the .then");
    } else {
        reject("Will go to the .catch");
    }
});
```

The **executor** callback function automatically receives a **resolve** function and a **reject** function

Creating Promises + HOF

```
function createPromise() {
    return new Promise(function (resolve, reject) {
        if ( true ) {
            resolve("Will go to the .then");
        } else {
            reject("Will go to the .catch");
        }
    });
}
```

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Consuming Promises

```
var promise = new Promise(function (resolve, reject) {
    if ( true ) {
        resolve("Will go to the .then");
    } else {
        reject("Will go to the .catch");
    }
});

promise
    .then(function(data) { console.log(data); });
```

The data you provide to the **resolve** function will be passed to the .then callback function

Consuming Promises + HOF

```
function createPromise() {
    return new Promise(function (resolve, reject) {
        if ( true ) {
            resolve("Will go to the .then");
        } else {
            reject("Will go to the .catch");
        }
    });
}

createPromise()
    .then(function (data) { console.log(data); });
```

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Chaining Promises

```
function getNumbers() {
  return new Promise(function (resolve, reject) {
    resolve([1, 2, 3, 4, 5, 6, 7, 8, 9, 10]);
  });
}

function filterToEvenNumbers(nums) { /* ... */ }

function multiplyByFive(nums) { /* ... */ }

getNumbers().then(filterToEvenNumbers).then(multiplyByFive);
```

Handling Errors

```
var promise = new Promise(function (resolve, reject) {
  if ( false ) {
    resolve("Will go to the .then");
  } else {
    reject("Will go to the .catch");
  }
});
function successHandler() { /* ... */ }
function errorHandler() { /* ... */ }

promise.then(successHandler).catch(errorHandler);
```

The data you provide to the **reject** function will be passed to the .catch callback function

Exercise

Turn an event into a promise!

I want to be able to write something along these lines:

```
onClick("h1").then(/* ... */);

onClick("p").then(/* ... */);
```

Resources

- MDN: Promises and MDN: Using Promises
- Google Web Fundamentals: Promises
- JavaScript.info: Promises
- Scotch: JavaScript Promises
- David Walsh: Promises
- You Don't Know JS: Promises
- Exploring JS: Promises
- Eric Elliot: Promises
- Domenic: The Point of Promises

Homework

- Finish all exercises from class
- Upload your homework to GitHub
- Prepare for next lesson

Homework (Extra)

- Go through The Modern JavaScript Tutorial
- Read Eloquent JavaScript
- Read Speaking JavaScript

What's next?

- AJAX and APIs!

Questions?

Thanks!