Before we begin...

Open ⟶ https://bit.ly/jsd-class-async

Zoom ⟶ Videos On

Welcome!

Agenda

- Review
- Terminal
- Asynchronous Programming
- Synchronous Programming
- (Promises)
- (APIs)
- (AJAX)

Review

Terminal

What is the terminal?

- A way to manipulate and interact with your computer
- It's entirely text-based
    - As opposed to the regular way we interact with our computers - called WIMP (Windows, Icons, Menus and Pointers)

Why use the terminal?

- It's very fast
- It's automatable and flexible
- No interruptions
- Sometimes it is the only way
    - Command Line Interaction (CLI)
    - Web Servers
- It gives us access to tools we wouldn't have access to otherwise

How do we use the terminal?

- We will open up a Terminal application
  - Windows: Git Bash, Cygwin, WSL etc.
  - Mac: **iTerm2**, Terminal etc.
- Once there, we interact with a **shell** (we will be using the Bash shell)
  - This, more or less, sends commands directly to the k**ernel** (think of this as the hardware)

The Bash Shell?

- Bash is a regular program on your computer
- It was created to take commands from you
    - We talk to it using the **Bash Shell Language**

Are there other shells?

Yes!

- Bash (Bourne Again Shell)
- C Shell
- Z Shell (zsh)
- Korn Shell
- Bourne Shell
- Debian's Almquist Shell (dash)
- Plus many, many more

What can you do with it?

Anything!

- Run programs to make all sorts of changes
- Editing files and images
- Converting files between types
- Creating back-ups
- Interacting with databases
- Making and copying files and folders
- Downloading, compiling and running programs
- Plus anything else you can think of!

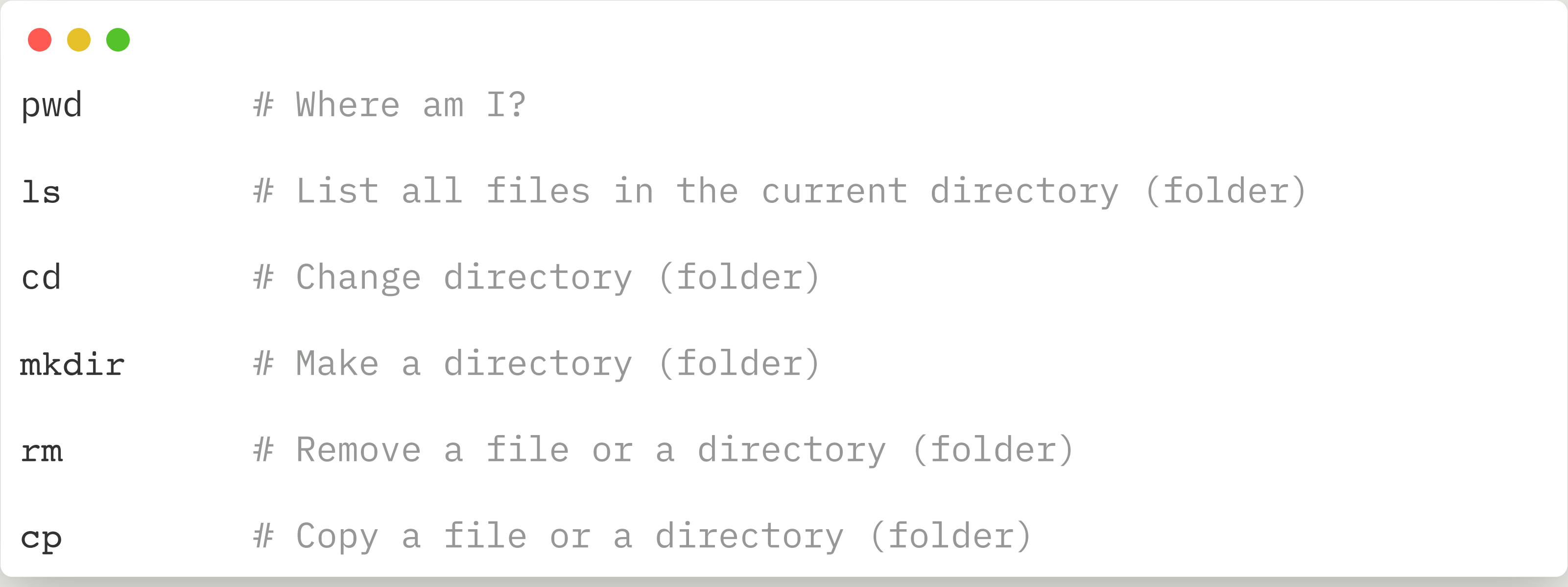
How do you work with it?

- **Interactively**
  - Opening up a REPL (like Git Bash or iTerm2)
- **Non-interactively**
  - Running scripts

Some Utilities

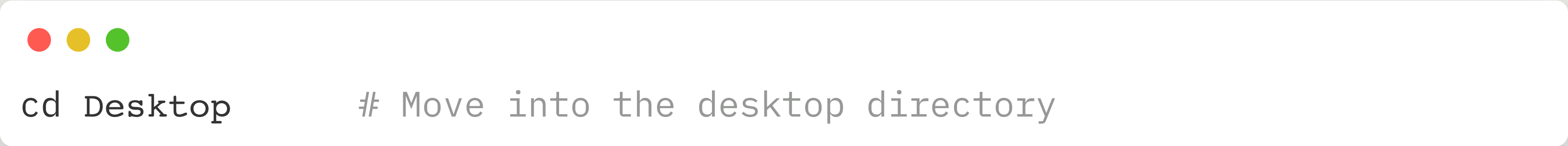
- Who am I?
- Where am I?
- Show me everything that is running?
- Show me the manual?
- Opening files

Common Commands



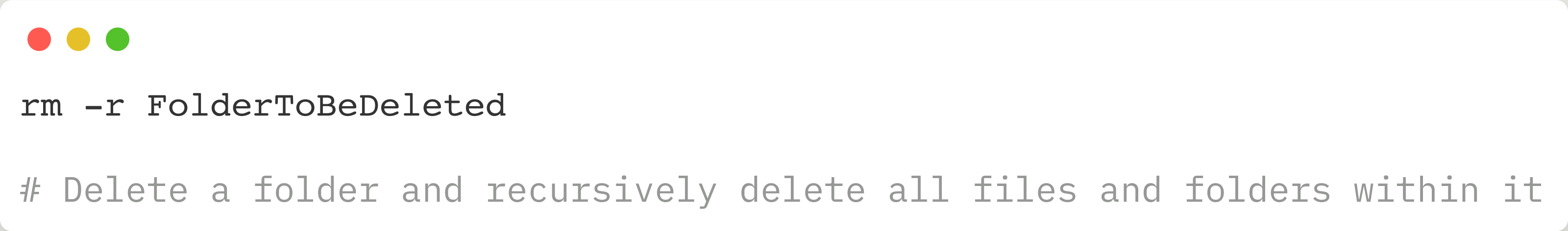
```
pwd        # Where am I?

ls         # List all files in the current directory (folder)

cd         # Change directory (folder)

mkdir      # Make a directory (folder)

rm         # Remove a file or a directory (folder)

cp         # Copy a file or a directory (folder)
```

Flags and Arguments



```
cd Desktop      # Move into the desktop directory
```

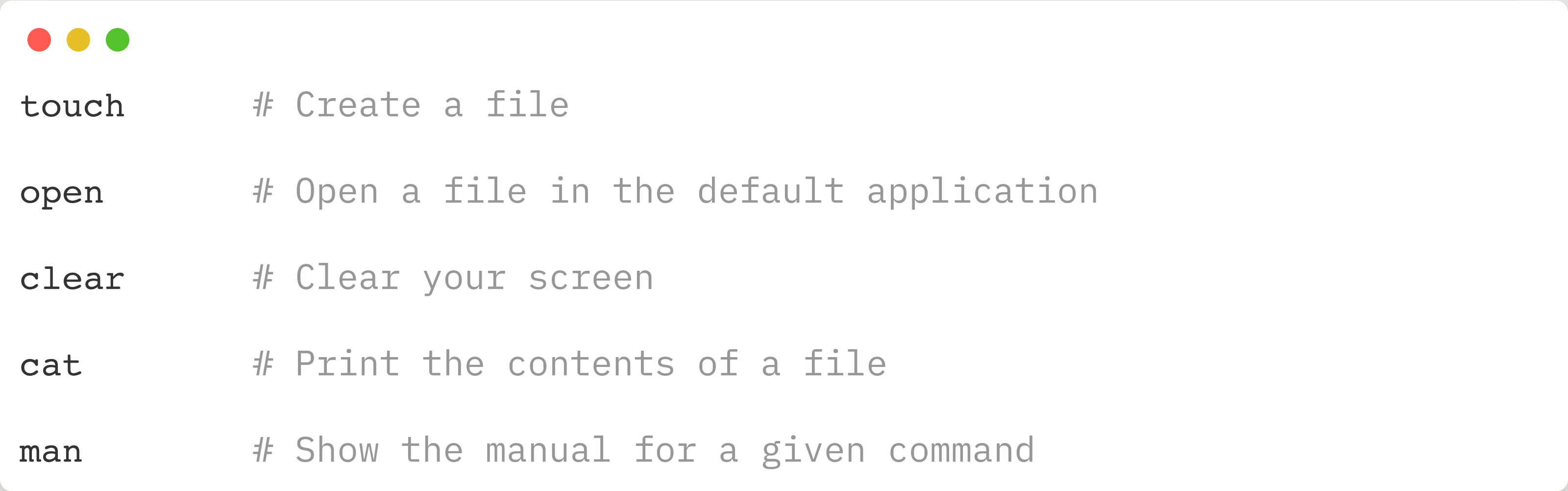
`Desktop`, in this case, is an argument



```
rm -r FolderToBeDeleted

# Delete a folder and recursively delete all files and folders within it
```

`-r`, in this case, is a flag. It gives the command a few more details on how to run

Common Commands



```
touch     # Create a file

open      # Open a file in the default application

clear     # Clear your screen

cat       # Print the contents of a file

man       # Show the manual for a given command
```

Resources

- Watch these Code Academy videos
- Read these
    - Quick Left's Tutorials - start from the bottom!
    - Learn CLI the Hard Way
- Track down the Terminal City Murderer
- Some other useful links
    - 40 Terminal Tricks and Tips
    - 25 Useful Find Examples
    - Terminal Cheatsheet

Asynchronicity

Asynchronous vs Synchronous

- Programming languages are either synchronous or asynchronous
- Synchronous languages are where tasks are performed one at a time. You need to wait for a task to finish before moving on
- Asynchronous languages allow you to move on to another task before the previous one finishes
- This is something we have to deal with in JavaScript (as it is asynchronous)
  - Because some things take time!

What takes time?

- API Calls
- Events
- User Interactions
- Animations

How do we deal with asynchronicity?

- Callbacks
  - We have seen them
- `Promise`
  - We are about to see them
- `async` and `await`*
  - A little too new for us to use straight away. We will see them later

Promises

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 and 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

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" or "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)

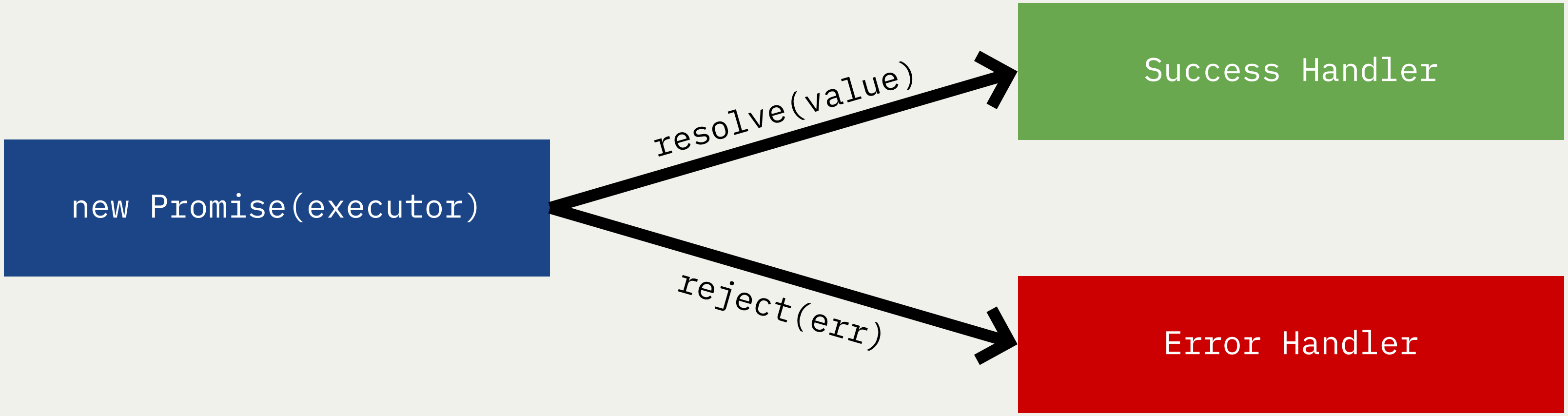
States and Fates

- 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

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?



new Promise(executor)

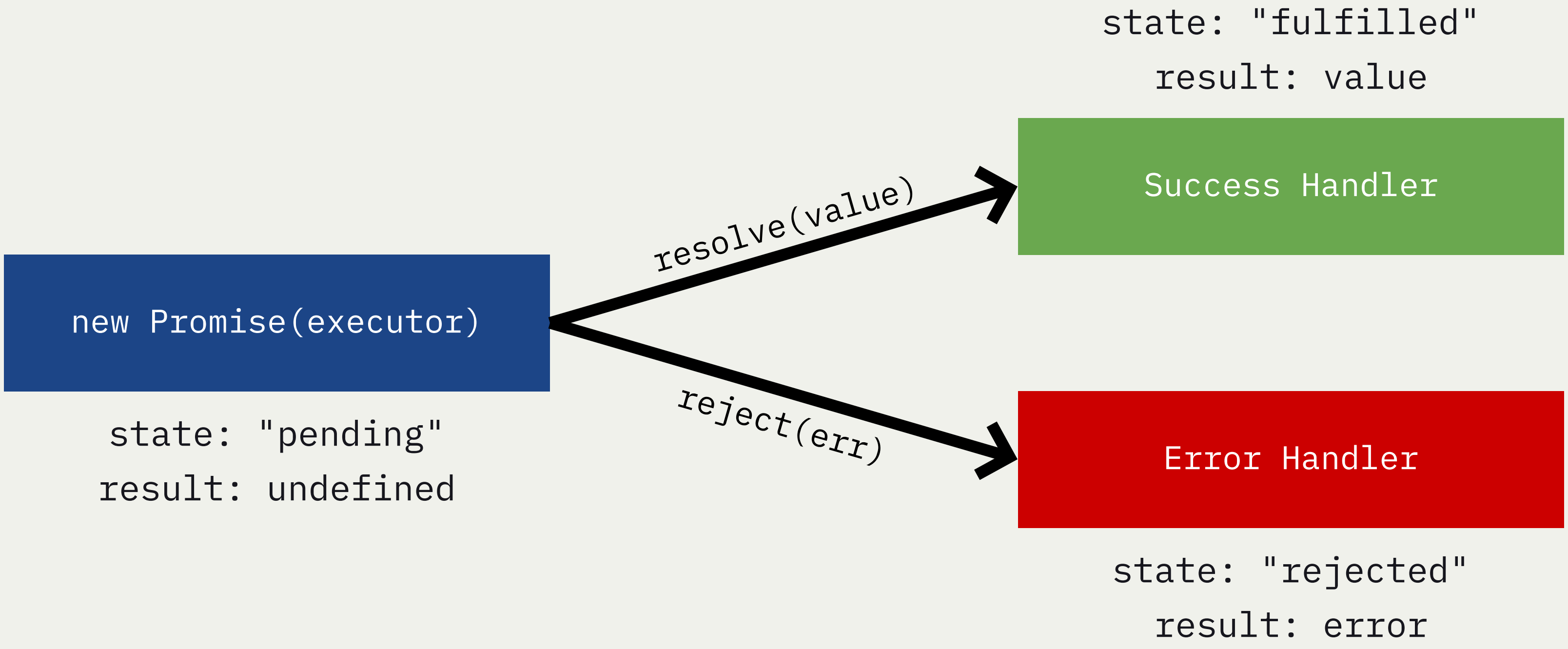
resolve(value)

Success Handler

reject(err)

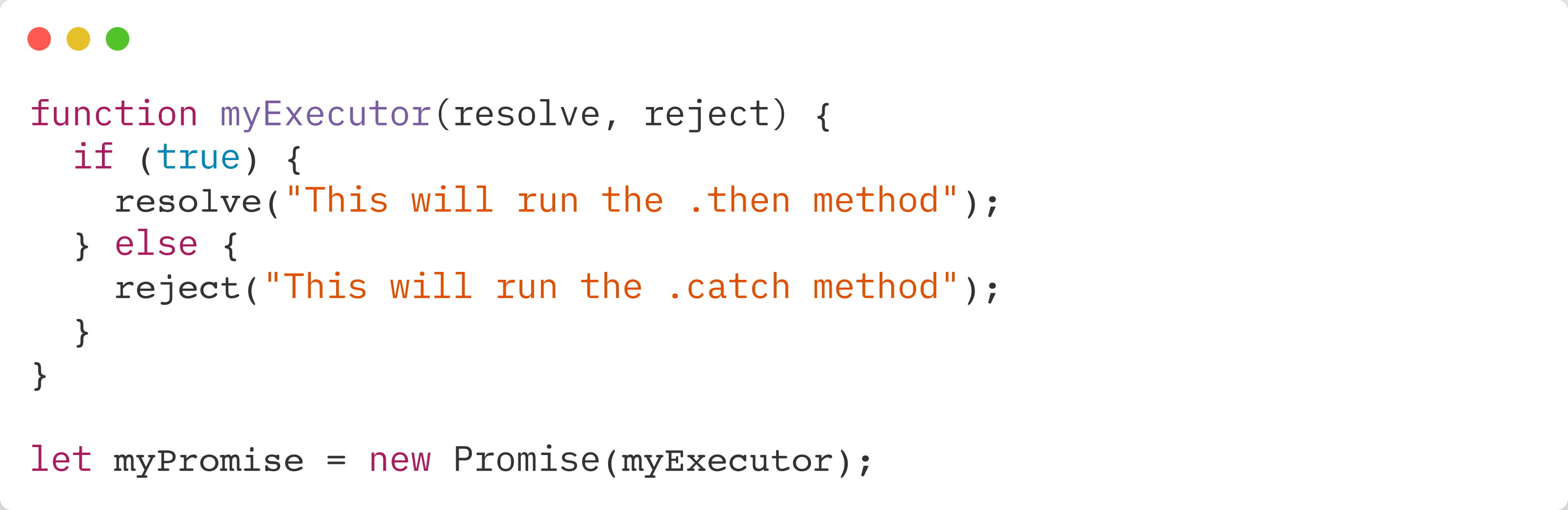
Error Handler

How do they work?



Creating Promises

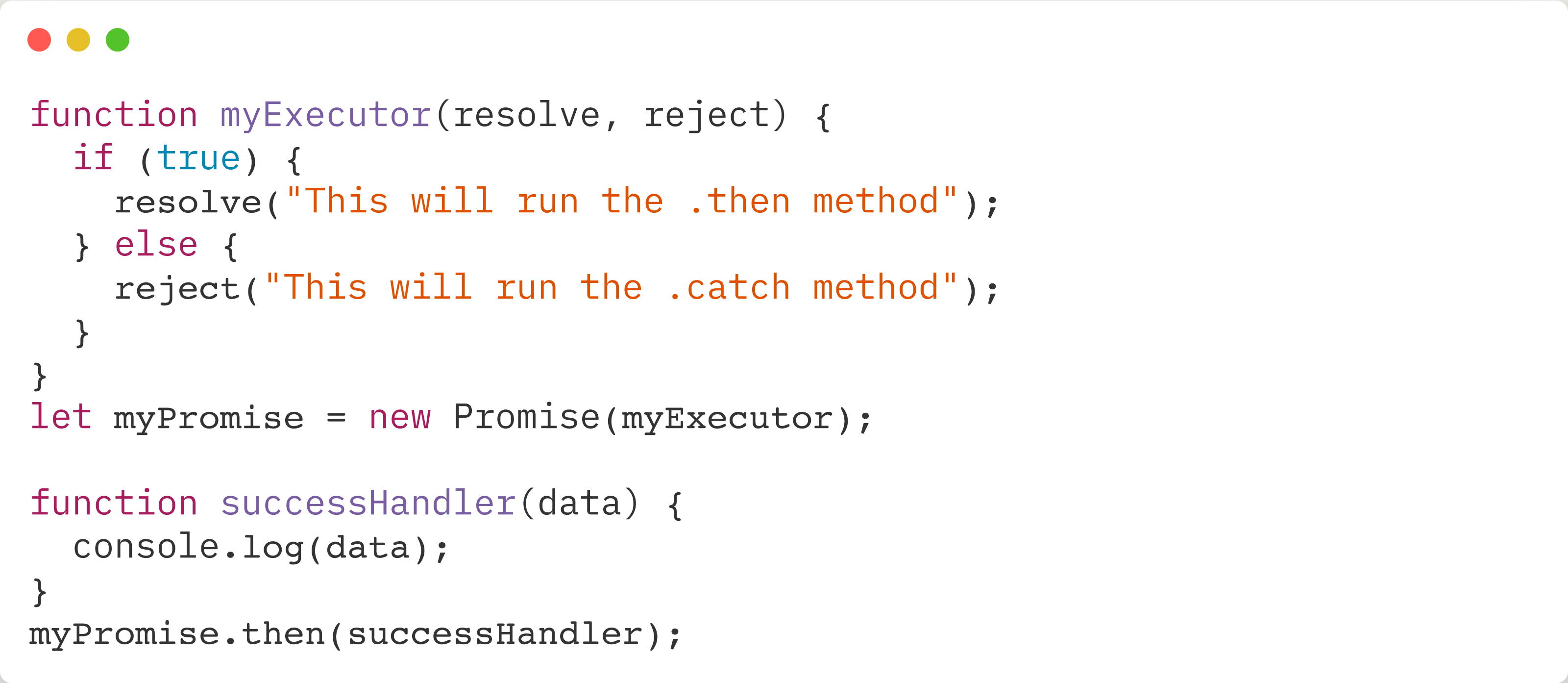
The executor callback function automatically receives a **`resolve`** function and a **`reject`** function



```
function myExecutor(resolve, reject) {
  if (true) {
    resolve("This will run the .then method");
  } else {
    reject("This will run the .catch method");
  }
}

let myPromise = new Promise(myExecutor);
```

Consuming Promises

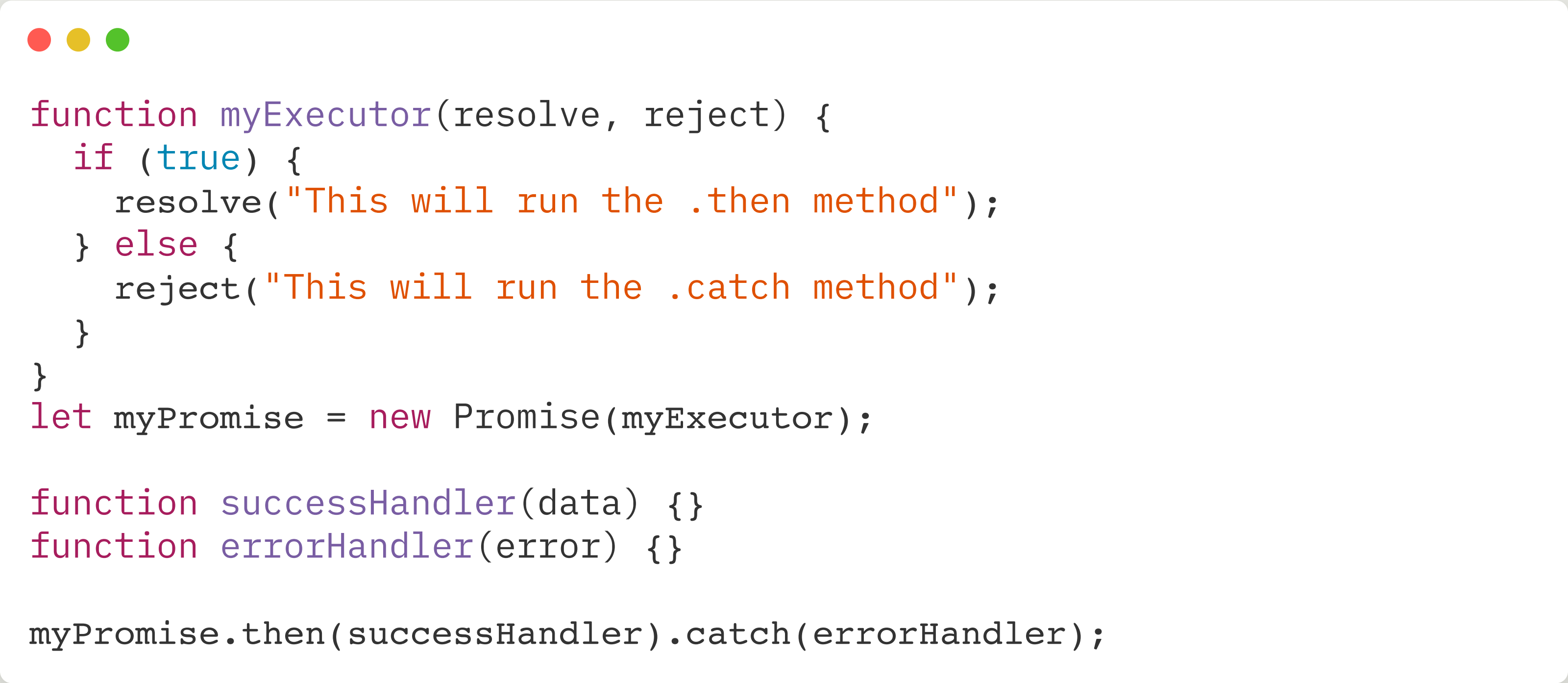
The data you provide to the **resolve** function will be passed to the `.then` callback function



```
function myExecutor(resolve, reject) {
  if (true) {
    resolve("This will run the .then method");
  } else {
    reject("This will run the .catch method");
  }
}
let myPromise = new Promise(myExecutor);

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

Consuming Promises

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



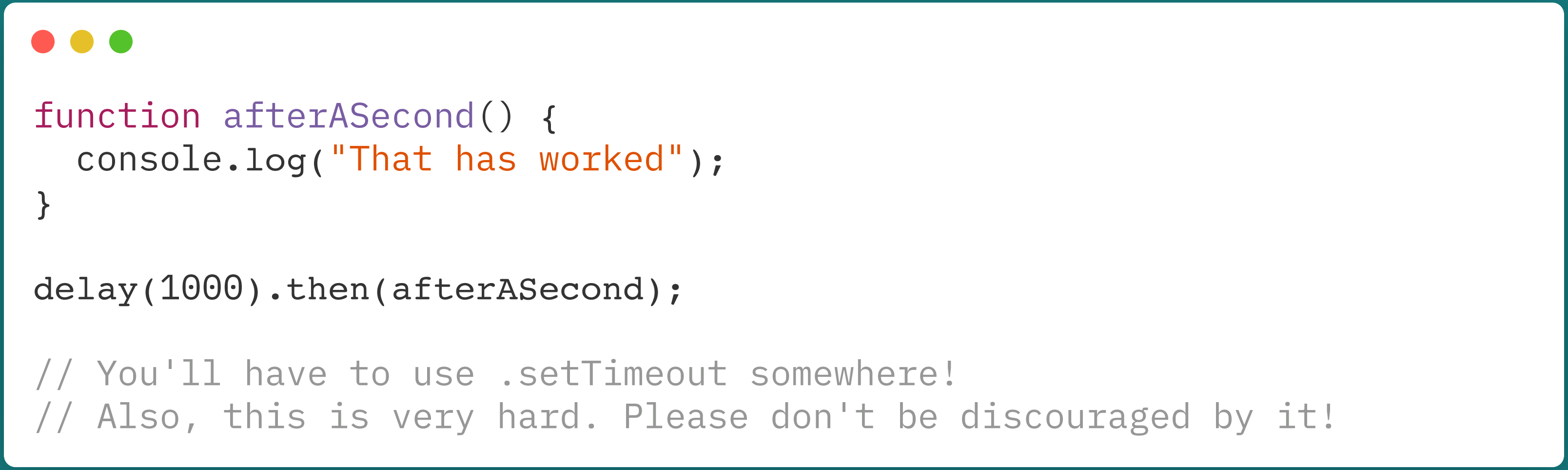
```
function myExecutor(resolve, reject) {
  if (true) {
    resolve("This will run the .then method");
  } else {
    reject("This will run the .catch method");
  }
}
let myPromise = new Promise(myExecutor);

function successHandler(data) {}
function errorHandler(error) {}

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

SOLO!

Exercise

Turn a timer into a promise.

I would like to be able to write the following lines of code:



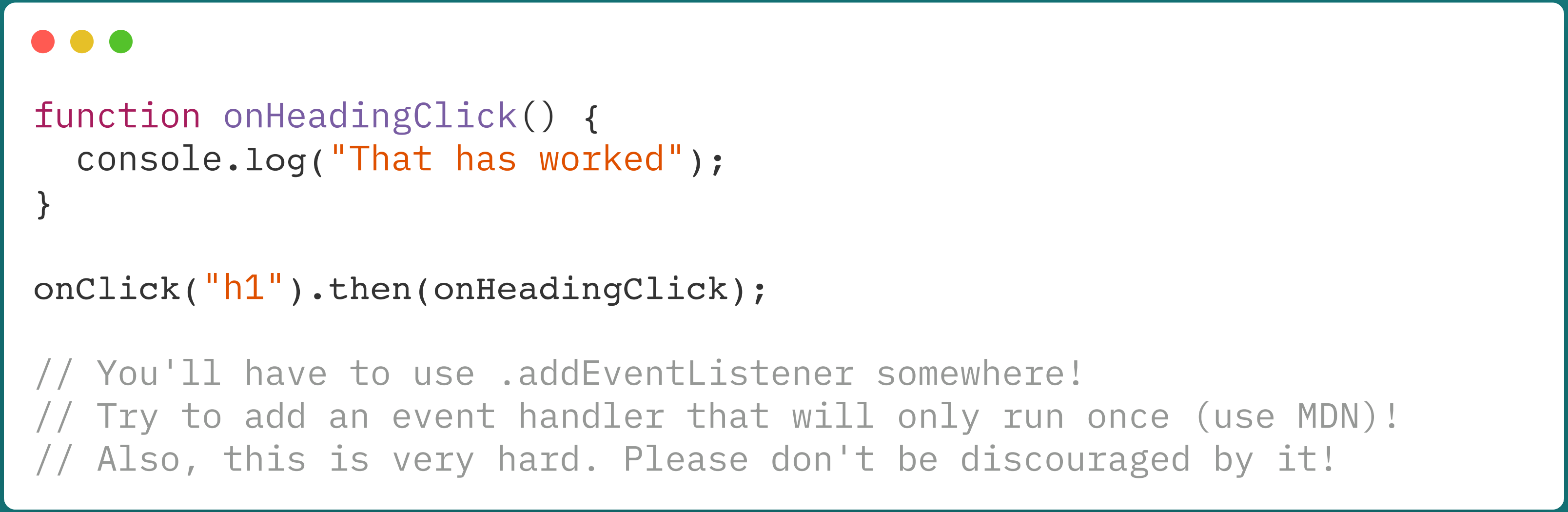
```
function afterASecond() {
  console.log("That has worked");
}

delay(1000).then(afterASecond);

// You'll have to use .setTimeout somewhere!
// Also, this is very hard. Please don't be discouraged by it!
```

SOLO!

Exercise

Turn an event into a promise.

I would like to be able to write the following lines of code:



```
function onHeadingClick() {
  console.log("That has worked");
}

onClick("h1").then(onHeadingClick);

// You'll have to use .addEventListener somewhere!
// Try to add an event handler that will only run once (use MDN)!
// Also, this is very hard. Please don't be discouraged by it!
```

My (biased) advice?

- You'll rarely have to make your own promises from scratch, but you will regularly consume promises
    - What I mean by this is to focus on the concept of Promises, and try to get used to writing and understanding `.then` and `.catch` handlers
    - We will get lots of practice with that in the following classes!

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

APIs

What are APIs?

- It stands for **A**pplication **P**rogramming **I**nterface (**API**)
- Software that allows two programs to communicate with each other
  - It all starts with shared data
- The principle of API abstraction allows for decoupling applications
- Can be private or public, internal or external, and paid or free

What are APIs?

- An API is a set of rules that allows one piece of software to talk to another

What is an API?

- **Application** - Any application
- **Programming** - The engineering part that translates given inputs into outputs
- **Interface** - The interface, the way we interact

Picture an ATM!

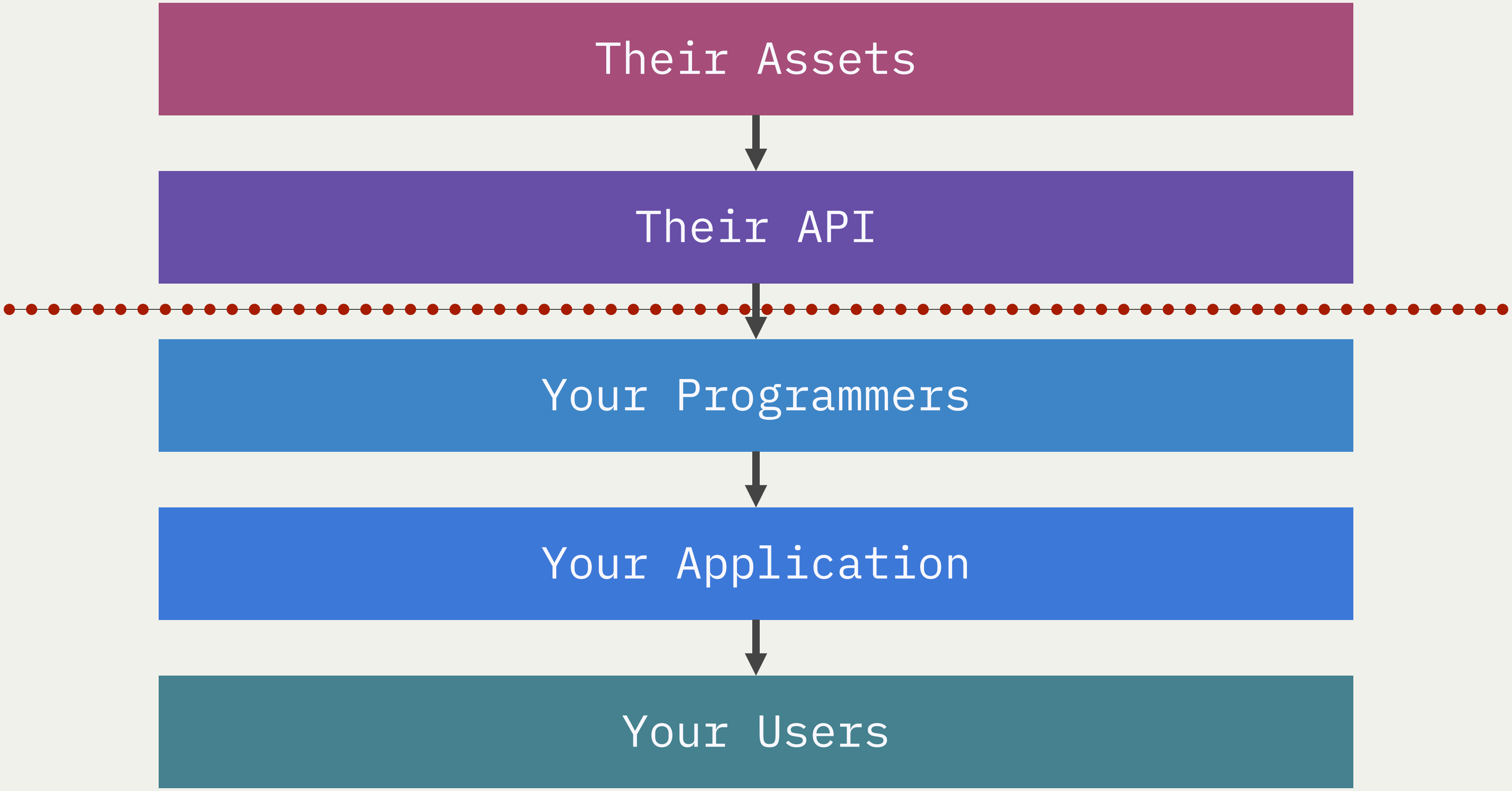
Types of APIs

- Operating Systems
- Remote APIs
- Libraries, Frameworks and Software Development Kits (we will focus on this)
- Web APIs (we will focus on this)

For us though?

- There are browser APIs (think things like the DOM API)
- There are third-party APIs - where we access data from a remote server

How do they work?



Their Assets

Their API

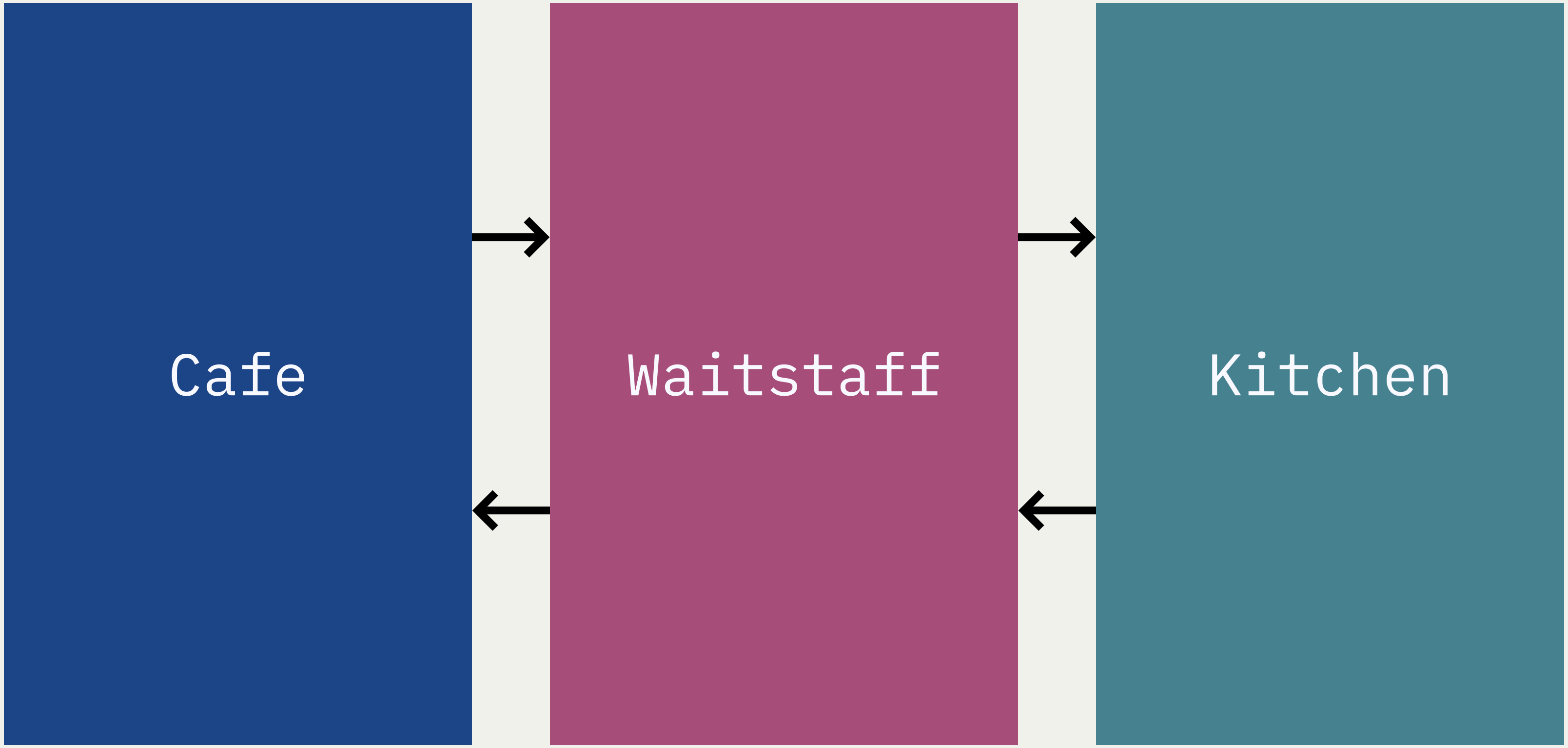
Your Programmers

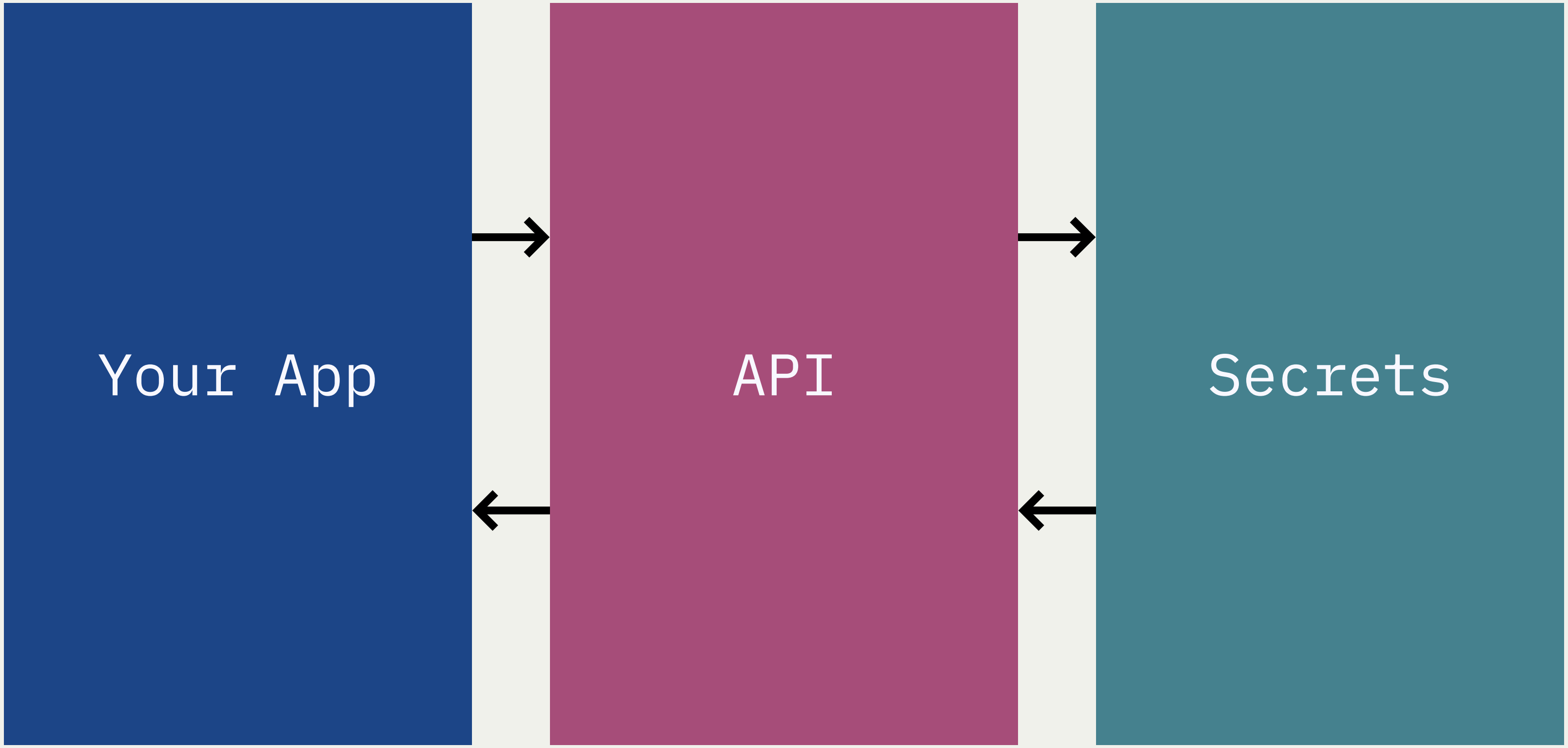
Your Application

Your Users

How do they work?

- **Assets** - Anything that is chosen to be shared (data, processes etc.)
- **API** - The gateway to those assets
- **Developers** - The API is exposed to your developers
- **Your Application** - Your developers code your application, and it is powered by the API
- **Your Users** - Your users use the app that is created and reap the benefits

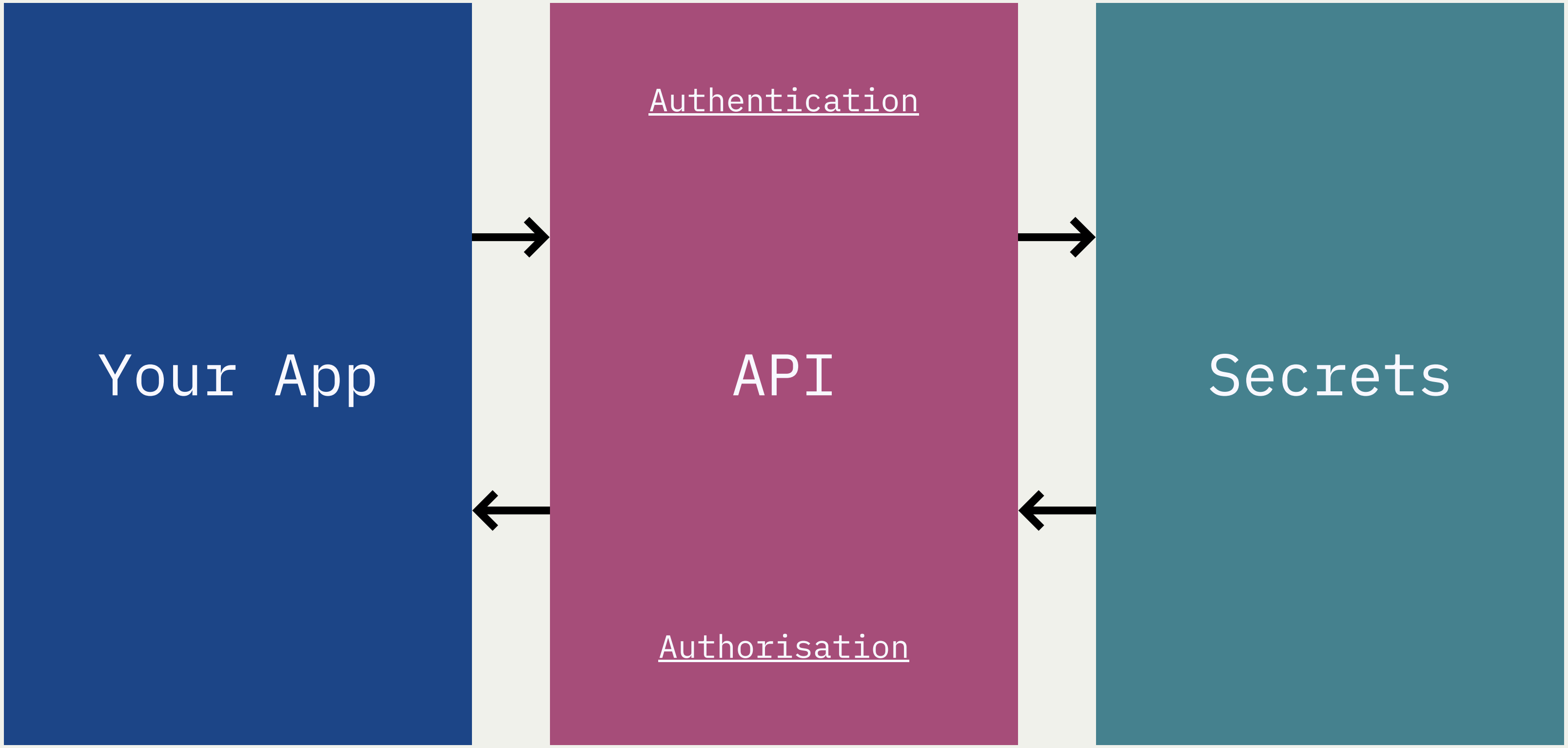

Cafe
Waitstaff
Kitchen



Your App

API

Secrets



Your App

Authentication

API

Authorisation

Secrets

Benefits of APIs for Providers

- APIs let you build one app off another
- APIs are like a universal plug
- APIs can be profitable
- APIs can allow you to decouple code - can make your applications more performant and finding developers easier
- APIs can essentially outsource complexity
- API providers can promote your application

Benefits of APIs for Consumers

- APIs can allow you to get data, and add features, that would otherwise be difficult and time-consuming
- APIs can make your app realtime
- APIs can introduce similar flows to an application (e.g. logins etc.)
- Apps using APIs can provide useful starting data for users

Downsides

- Building them
- Maintenance
- Hosting
- Documentation
- For developers - future support
- Reliance on other services

Authentication and Authorisation

Authentication

Are you allowed to access the system?

Authorisation

What can you access in the system?

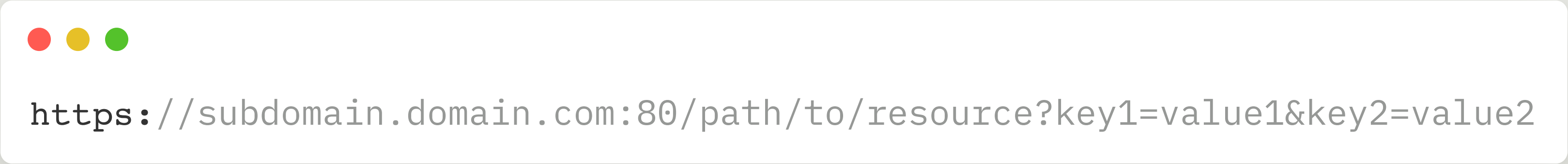
Often we need to sign up to APIs

Internal Workings

What do we need to talk to APIs?

- **The endpoint URL**
  - Where are we getting the data from?
- **HTTP Method**
  - Describes our intentions (e.g. are we asking to GET data, are we asking to POST data etc.)
- **HTTP Headers**
  - Key-value pairs that provide data to the client and the server (e.g. for authentication)
- **Body Data**
  - Any data that you wish to send

URLs (often called endpoints)



```
https://subdomain.domain.com:80/path/to/resource?key1=value1&key2=value2
```

- `https://` - Scheme
- `subdomain` - Subdomain (occasionally there)
- `domain.com` - Domain or Host
- `:80` - Port (not often there)
- `/path/to/resource` - Path
- `?key1=value1&key2=value2` - Query String or Parameters

HTTP Methods

- There are lots of different types of methods, but the main ones are:
    - **POST** - Creating data
    - **GET** - Reading data
    - **PUT / PATCH** - Updating data
    - **DELETE** - Deleting data
- This is called **CRUD** (Create, Read, Update, Delete)

HTTP Headers

- Key-value pairs
- Used to share information between the client and the server
- You can store things like cookies, metadata and authentication tokens in here
    - The most common though is to describe what data you'd like back using `"Content-Type"`
- Here is a list of all valid headers

Body Data

- The body contains any data that you'd like to provide to the server
  - Usually as a JSON-encoded string (more on that soon)

Responses

Once the request has been made the server will send back an HTTP response, which is made up of data and a status code. There are lots of different status codes, but they are somewhat organised:

- `100+`: Informational Response
- `200+`: Request has succeeded
- `300+`: Request has been redirected
- `400+`: An error on the client's end has occured
- `500+`: An error on the server's end has occured

AJAX

What is AJAX?

- **A**synchronous **J**avaScript & e**X**tensible **M**arkup Language
- It is a way to make your pages live
  - You can talk to other servers while you are still on the page
- It is a technique to send and retrieve information behind the scenes without needing to refresh the page

Where is AJAX used?

- In feeds (such as Twitter)
- Chat rooms and messaging apps
- For voting and rating
- Autocompletion
- Form submission and validation
- To access data that you don't have
- To show extra information
- In games (e.g. to save scores)

Why is AJAX so useful?

- It makes your pages live
- It is much faster
- It tends to give a greater user experience
- It is fancy
- It is popular in the workplace
- It is the foundation of things such as APIs

How do we work with it?

- XMLHttpRequest
- Fetch

One Thing!

- To make API requests, we need a server (AJAX doesn't work on a file URL)
- Install HTTP-Server (you'll need Node first!)
- Restart the terminal
- To start the server: run the following command in the directory you want to serve and open the URL it provides
  - `http-server .`

What is fetch?

- It is a way to make AJAX Requests
- It is a function that is defined automatically for us
- It is supported by all major browsers now
  - For those that don't support it, there is a polyfill

What is fetch?

- You make an *HTTP Request* with it
  - Specifying the URL, the method etc.
- It comes back with an *HTTP Response*
  - Most of the time, the data is returned as **JSON**
- That returns a *Promise*
  - We can work with the returned data in a ***.then***
  - We can handle errors in a .catch

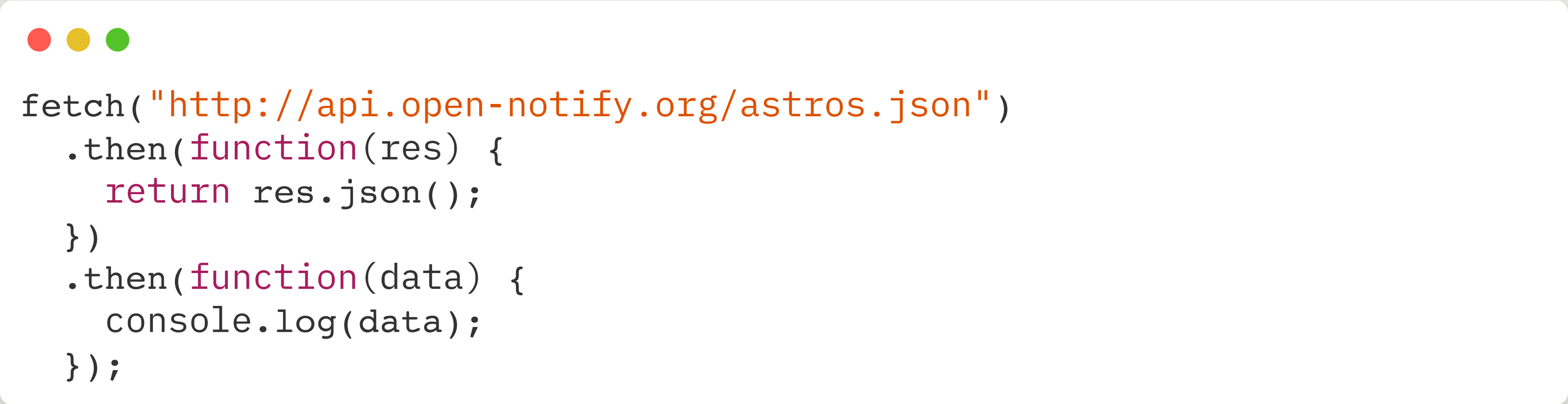
What is JSON?

- It stands for **J**ava**S**cript **O**bject **N**otation
- A format for storing and sharing information
- It looks almost exactly like JavaScript Objects
  - *But keys are quoted*
- It's a format that is really easy to work with, particularly in JavaScript:
  - We can convert an object into JSON using: `JSON.stringify(obj);`
  - We can convert JSON into an object using `JSON.parse(json);`

Using Fetch

```
fetch( URL, HTTP_OPTIONS? )
  .then( SUCCESS_HANDLER )
  .catch( ERROR_HANDLER );
```

Using Fetch

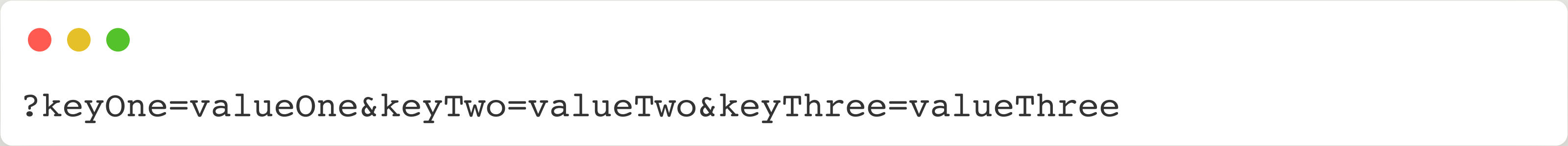


```
fetch("http://api.open-notify.org/astros.json")
  .then(function(res) {
    return res.json();
  })
  .then(function(data) {
    console.log(data);
  });
```

- We have make a Request to the API
- We parse the Response and turn it into a JS Object with .json() (this uses JSON.parse internally)
- We can then work with the data!

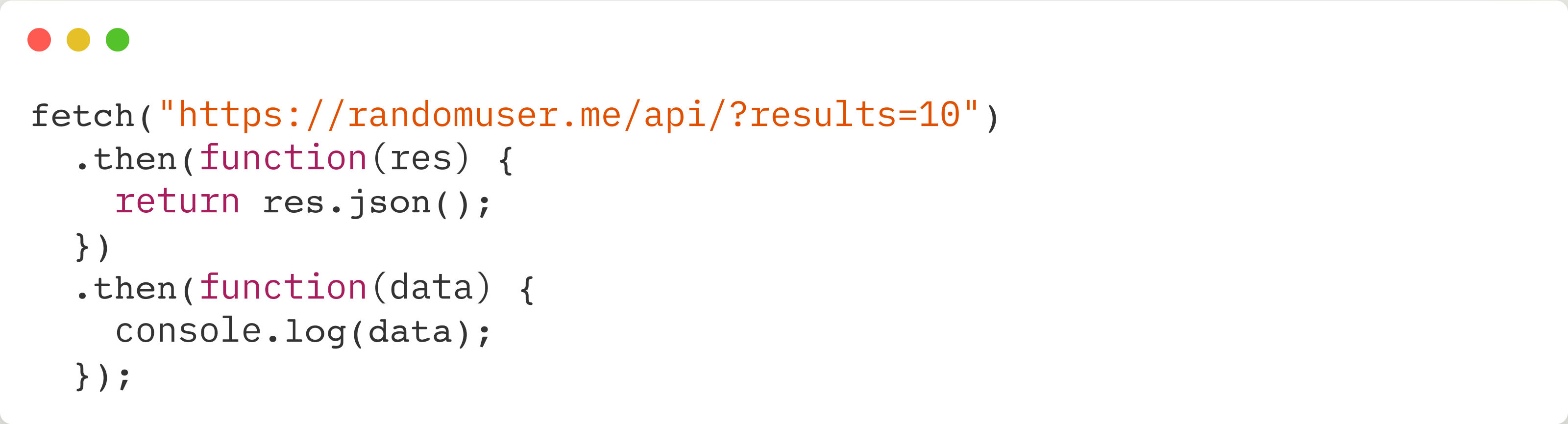
Parameters

- We can attach a Query String or Parameters to a URL
- This provides extra information to the API
- Works in a similar way to an object - query strings have keys and values
- Looks something like this:



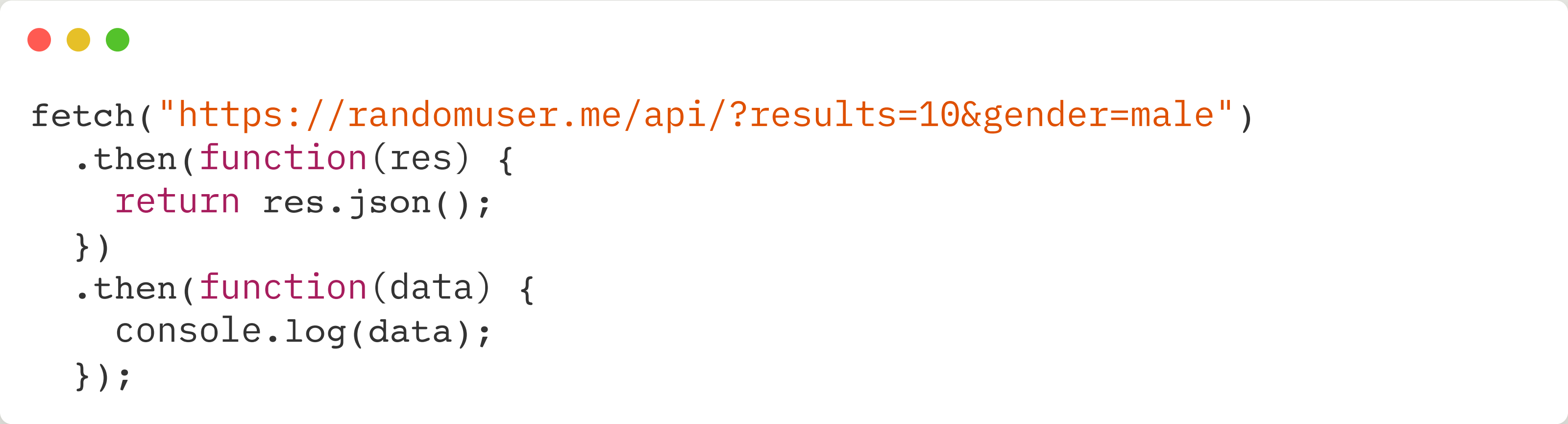
```
?keyOne=valueOne&keyTwo=valueTwo&keyThree=valueThree
```

Using Fetch



```
fetch("https://randomuser.me/api/?results=10")
  .then(function(res) {
    return res.json();
  })
  .then(function(data) {
    console.log(data);
  });
```

Using Fetch

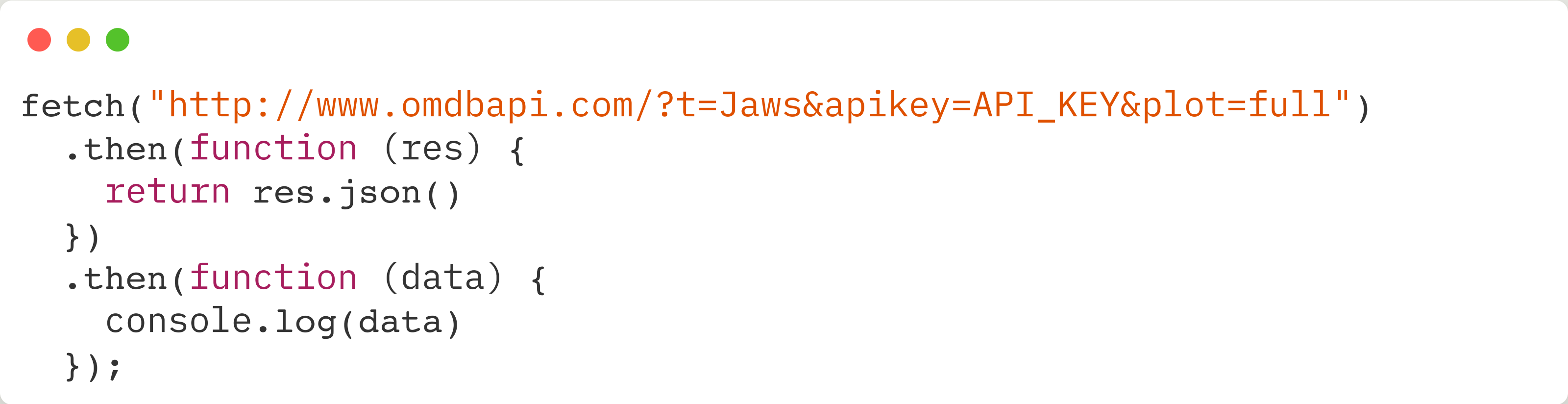


```
fetch("https://randomuser.me/api/?results=10&gender=male")
  .then(function(res) {
    return res.json();
  })
  .then(function(data) {
    console.log(data);
  });
```

OMDB API

- Go to OMDB API's Website
- Get an API Key from here and select Free
- Input your details
- Check your email
- Click the verify API key link
- Copy your API key from that email

OMDB API - Authentication

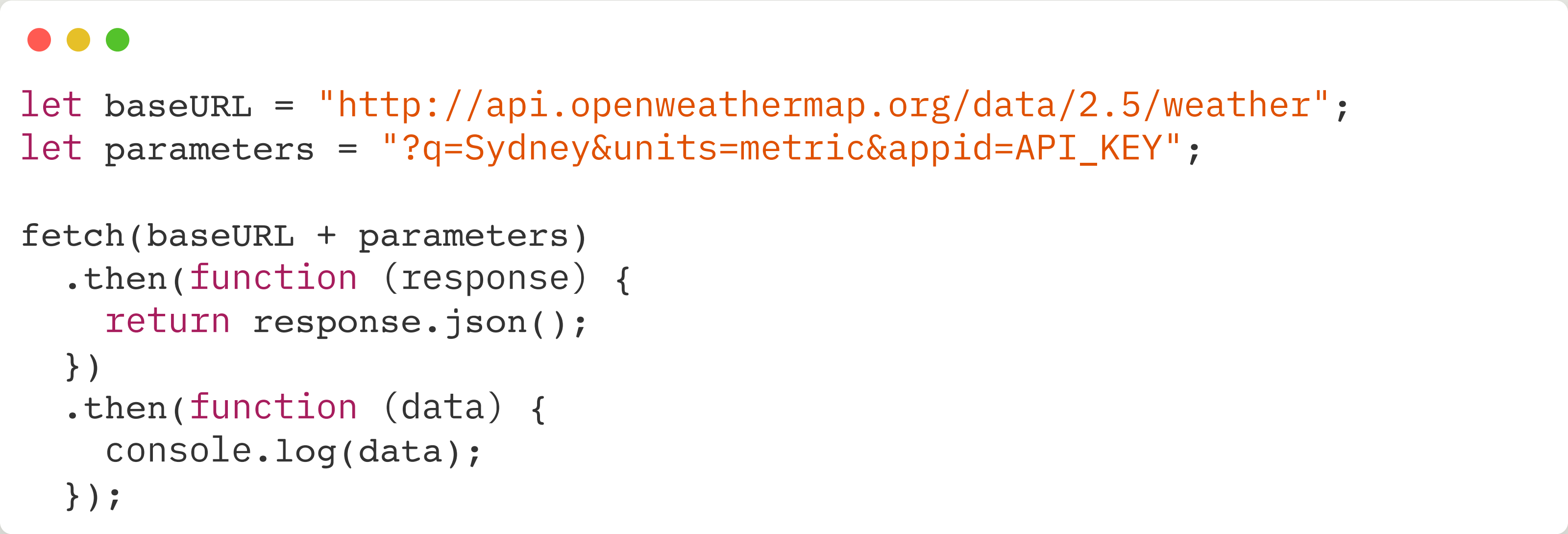


```
fetch("http://www.omdbapi.com/?t=Jaws&apikey=API_KEY&plot=full")
  .then(function (res) {
    return res.json()
  })
  .then(function (data) {
    console.log(data)
  });
```

OpenWeatherMap

- Go to the OpenWeatherMap API website
- Sign up for an API key here
- Fill in your details
- Log in
- Go to the API Key Tab on your settings page
- Copy the API Key
- It'll take ten minutes for the API Key to work

OpenWeatherMap



```
let baseURL = "http://api.openweathermap.org/data/2.5/weather";
let parameters = "?q=Sydney&units=metric&appid=API_KEY";

fetch(baseURL + parameters)
  .then(function (response) {
    return response.json();
  })
  .then(function (data) {
    console.log(data);
  });
```

Giphy API

- Open up the documentation here
- Create an account here
- Create an app here
    - Copy your API key!
- Looks at the Docs here

Yandex Translate API

- Open up the documentation here

Some other things

- Using Geolocation
    - getCurrentPosition
- Speech to Text, Text to Speech
    - SpeechRecognition
    - SpeechSynthesis
- Air Quality Index
- Rest Countries

Resources

- Rapid API
- MDN: Using Fetch
- CSS Tricks: Using Fetch
- Scotch.io: Fetch
- David Walsh: Fetch
- Google Developers: Fetch
- Google Developers: Working with the Fetch API
- MDN: Fetch API

Homework

- Do more with APIs!
- Track the International Space Station's Position
  - Using this API
  - Show the current location of it in your HTML
  - Bonus: Link it up to the Google Maps API!
- Or anything other API you want
- *Note: Don't use ones requiring OAuth*
  - We will be going through this later

What's next?

- More APIs
- More AJAX

Thank you!