POWERING
POTENTIAL

Asynchronous JavaScript

→ JavaScript Fundamentals

OVERVIEW

- What is Asynchronous JavaScript?
- Asynchronous JavaScript-enabling technologies
- Client and Server architecture
- JSON
- Promises
- The Fetch API
- Async/Await
- Appendix - XMLHttpRequest

What is asynchronous JavaScript?

- A methodology for creating rich Internet applications
  - Used to create highly responsive applications
  - Rich content and interactions
- A client-focused model
  - Uses client-side technologies – JavaScript, CSS, HTML
- A user-focused model
  - Asynchronous behaviour based on user interactions
  - User-first' development model
- An asynchronous model
  - Communications with the server are made asynchronously
  - User activity is not interrupted

Four principles of asynchronous JavaScript

- The browser hosts an application
  - A richer document is sent to the browser
  - JavaScript manages the client-side interaction with the user
- The server delivers data
  - Requests for data - not content - are sent to the server
  - Less network traffic and greater responsiveness
- User interaction can be continuous and fluid
  - The client is able to process simple user requests
  - Near instantaneous response to the user

Client-centric development model

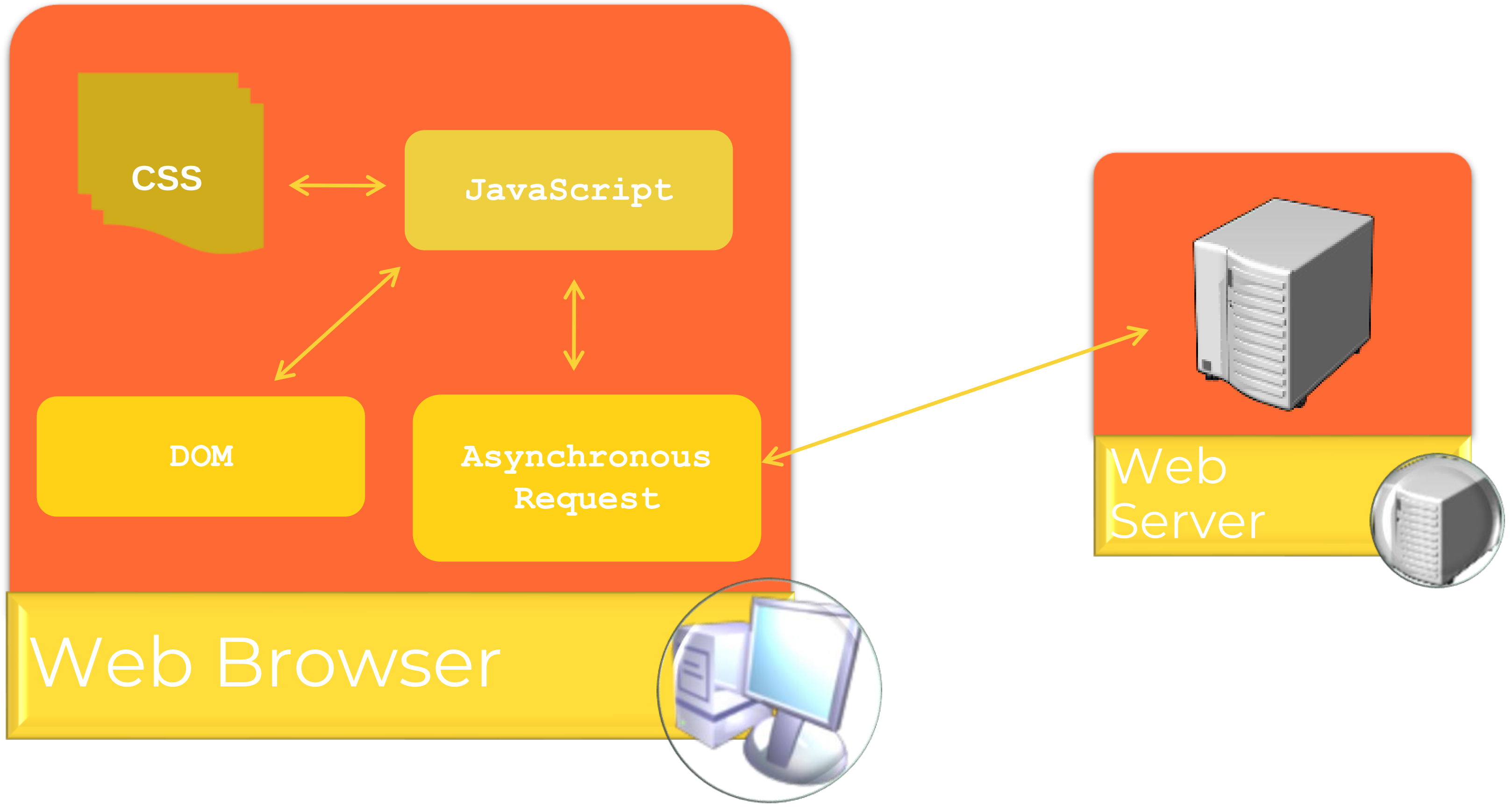
- Primarily implemented on the client
  - Presentation layer driven from client script
  - Uses HTML, CSS, and JavaScript
- This means:
  - First request
    - A smarter, more interactive application is delivered from the server
- Subsequently:
  - Less interaction between the browser and the server
- Which:
  - Encourages greater interaction with the user
  - Provides a richer, more intuitive experience

Server-centric development model

- Primarily implemented on the server
  - Application logic and most UI decisions remain on the server
- This means:
  - First request
    - A regular page is retrieved from the server
- Subsequently:
  - Incremental page updates are sent to the client
- Which:
  - Reduces latency and increases interactivity
  - Gives the opportunity to keep core UI and application logic on the server

Asynchronous JavaScript - enabling technologies

- CSS, DOM, JavaScript and an Asynchronous Request API



JSON

JavaScript Fundamentals

JavaScript Object Notation (JSON)

- Lightweight data-interchange format
  - Compared to XML
- Simple format
  - Easy for humans to read and write
  - Easy for machines to parse and generate
- JSON is a text format
  - Programming language independent
  - Conventions familiar to programmers of the C-family of languages, including C# and JavaScript

JSON structures

- Universal data structures supported by most modern programming languages
- A collection of name/value pairs
  - Realised as an object (associative array)
- An ordered list of values
  - Realised as an array
- JSON object
  - Unordered set of name/value pairs
  - Begins with { (left brace) and ends with } (right brace)
  - Each name followed by a : (colon)
  - Name/Value pairs separated by a , (comma)

```json
{
  "results": [
    {
      "home": "React Rangers",
      "homeScore": 3,
      "away": "Angular Athletic",
      "awayScore": 0
    },
    {
      "home": "Ember Town",
      "homeScore": 2,
      "away": "React Rangers",
      "awayScore": 2
    }
  ]
}
```

JSON and JavaScript

JSON is a subset of the object literal notation of JavaScript.

- Can be used in the JavaScript language with no problems

```
let myJSONObject = {
    "searchResults": [
        {
            "productName": "Aniseed Syrup",
            "unitPrice": 10
        },
        {
            "productName": "Alice Mutton",
            "unitPrice":
            39
        }
    ]
};
```

The JSON object

- The JSON object is globally available
  - The **`parse`** method takes a string and parses it into JavaScript objects
  - The **`stringify`** method takes JavaScript objects and returns a string
- Makes working with JSON data a trivial affair

```
let obj = JSON.parse('{"name":"Adrian"}');
console.log(obj.name); //returns Adrian
```

```
let str = JSON.stringify({ name: "John" });
```

RESTful services

RESTful services are commonly used to supply data to web applications.

- **RE**presentational **S**tate **T**ransfer
  - Essentially they are a server, possibly attached to a Database that returns the requested data:
- Make a request to a URL – can CRUD
  - Create
  - Read
  - Update
  - Delete
- Response will be in the form of JSON

Mocking a RESTful service

- json-server is an npm package that allows you to:

“Get a full fake REST API with zero coding in less than 30 seconds”

- Need to install the package (globally if it will be used frequently)
- Need to supply it with a properly-formed .json file
- Runs on http://localhost:3000 by default (can be changed when spinning up)
- Allows full CRUD requests and saves changes to .json file

https://www.npmjs.com/package/json-server

QuickLab 24a – create some JSON

- Generate a small JSON file to use with json-server
- Install and run json-server

POWERING POTENTIAL

Promises

→ JavaScript Fundamentals

WHAT IS A PROMISE?

A placeholder for some data that will be available: immediately, some time in the future, or possibly not at all.

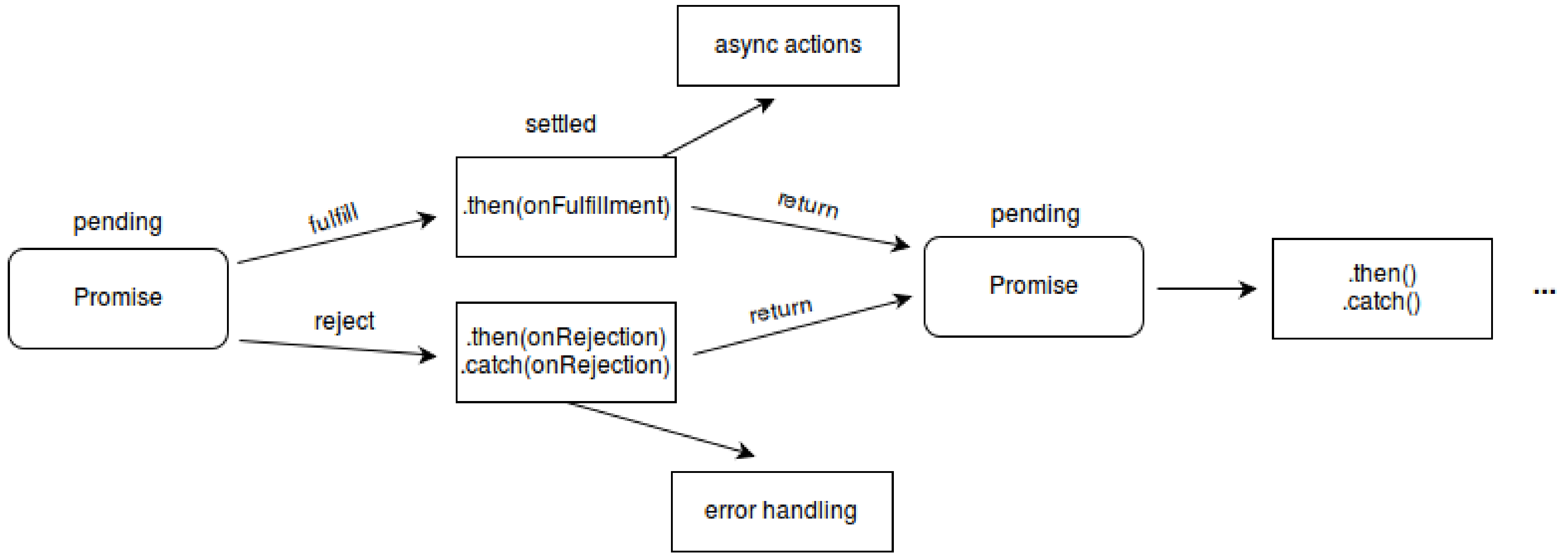
- JavaScript is executed from the top down
  - Each line of code evaluated and executed in turn

What happens if needed data is potentially not available immediately?

- Most commonly we may be waiting for some data to come from a remote endpoint
- Need some way to be able to execute code when the data is available or deal with the fact that it will never be available
- **This is the job of a promise**

Promises

- A promise is the representation of an operation that will complete at some unknown point in the future
- We can associate handlers to the operation's eventual success (or failure)
- Exposes .then and .catch methods to handle resolution or rejection



Promises

Construct a new promise passing in an ‘executor’ function which will be immediately evaluated and is passed both resolve and reject functions as arguments.

```
let newPromise = new Promise((resolve, reject) => { });
```

The promise is in one of three states:

- Pending
- Fulfilled - Operation completed successfully
- Rejected - Operation failed

Which we can attach associated handlers to:

- **`.then(onFulfilled, onRejected)`** appends handlers to the original promise, returning a promise resolving to the return of the called handler or the original settled value if the called handler is undefined
- **`.catch(onRejected)`** same as then but only handles the rejected condition

Promises: example

```
let aPromise = new Promise((resolve, reject) => {
    let delayedFunc = setTimeout(() => {
//whether it resolves or rejects is unknown
        (Math.random() < 0.5) ? resolve("resolved") : reject("rejected");
    }, Math.random() * 5000); //function will return sometime: 0-5s
});

aPromise
    .then(
        //resolved
        data => {
            console.log(v);
        },
        //rejected
        error => {
            console.log(v);
        }
    );
```

QuickLab 24b – Promises

- Experiment with promises

POWERING POTENTIAL

Fetch

→ JavaScript Fundamentals

Fetch

- “The Fetch API provides a JavaScript interface for accessing and manipulating parts of the HTTP pipeline, such as requests and responses. It also provides a global `fetch()` method that provides an easy, logical way to fetch resources asynchronously across the network”
- In short, **Fetch** provides the functionality hitherto provided by `XMLHttpRequest`
- It greatly simplifies making requests and dealing with responses
- **Fetch** requests return **Promises**
- **Fetch** is supported by Chrome 42, Edge 14, Firefox 39, Safari 10.1, Opera 29

Fetch

- Making a **`fetch`** request can be as simple as passing a URL and chaining appropriate .then and .catch methods onto the return

```
fetch('https://www.qa.com/courses.json')
    .then(response => response.json())
    .then(myJson => console.log(myJson))
    .catch(err=> console.error(err))
```

- We don't have to use **`JSON.parse`**, as 'response' objects have a **`.json()`** method. This method returns a **`Promise`** which contains the parsed JSON body text.
- By default, a **`fetch`** request is of type **`GET`**

Fetch – full example

We can make more complex requests using the second argument, an init object that allows us to control a number of aspects of the request – including any data we wish to include with it

```
fetch(url, {
    body: JSON.stringify(data),
    // must match 'Content-Type' header
    cache: 'no-cache',
    // *default, no-cache, reload, force-cache, only-if-cached
    credentials: 'same-origin', // include, same-origin, *omit
    headers: {
        'content-type': 'application/json'
    },
    method: 'POST',            // *GET, POST, PUT, DELETE, etc
    mode: 'cors',              // no-cors, cors, *same-origin
    redirect: 'follow',        // manual, *follow, error
    referrer: 'no-referrer', // *client, no-referrer
})
.then(response => response.json())
.then(myJSON => console.log(myJSON))
.catch(err => console.log(err));
```

Fetch

- A **`fetch`** promise does not **`reject`** on receiving an error code from the server (such as 404). Instead, it **`resolves`** and will have a property **`response.ok = false`**.
- To correctly handle **`fetch`** requests, we would need to also check whether the server responded with a **`response.ok === true`**

```
fetch(url)
    .then(response => {
        if (response.ok) {
            //do things
        }
        else {
            //handle error
        }
    });
```

QuickLab 24c – fetch

- Use the Fetch API to send and receive data

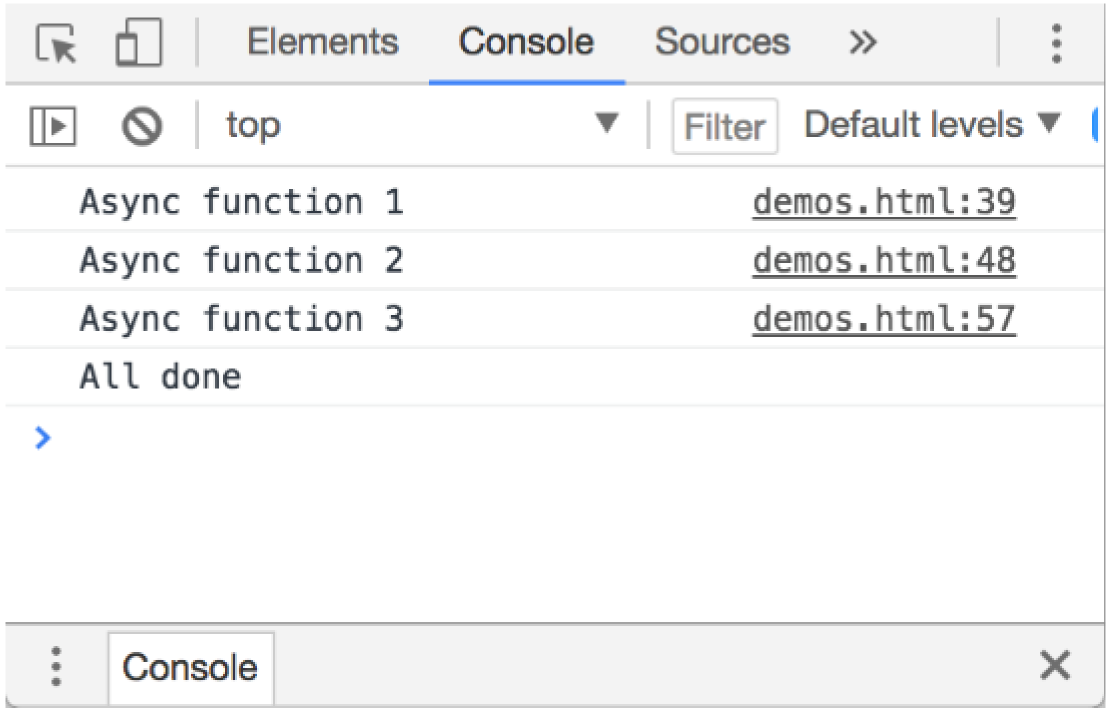
Async functions

- An `async` function will return a `Promise` which **resolves** with the value returned by the function, or is **rejected** with any uncaught exceptions
- An `async` function can contain an `await` expression which **pauses** the execution of the `async` function until completion of the `Promise` and then resumes

Async Functions

```
async function doThings() {
    await asyncFunc1();
    await asyncFunc2();
    await asyncFunc3();
    return "All done";
}

doThings().then(console.log);
```



```
Async function 1                demos.html:39
Async function 2                demos.html:48
Async function 3                demos.html:57
All done
```

```
async function asyncFunc1() {
    return new Promise((resolve,reject)=>{
        setTimeout(()=>{
            console.log('Async function 3');
            resolve();
        },3000);
    });
}

async function asyncFunc2() {
    return new Promise((resolve,reject)=>{
        setTimeout(()=>{
            console.log('Async function 3');
            resolve();
        },2000);
    });
}

async function asyncFunc3() {
    return new Promise((resolve,reject)=>{
        setTimeout(()=>{
            console.log('Async function 3');
            resolve();
        },1000);
    });
}
```

QuickLab 24d – async/await

- Use async/await to be able to send and receive data

REVIEW

Asynchronous JavaScript is…

- A methodology for creating rich internet applications
- A client and user-focused model
- A methodology that enables asynchronous requests
- **Fetch API**
- **`async` functions and the `await` declaration**