JavaScript Promises and Async Await

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Recap -Javascript Characteristics

- JavaScript is single threaded
  - shares a thread with a load of other stuff
- JavaScript is event driven
  - Events happen – we write code to deal with them
- JavaScript can be Asynchronous
  - Order of operation results may differ from order they were called

Recap - Async Code

What will be the console output be:

```
console.log('setTimeout');
   for(var i = 0; i < 5; i++) {

    setTimeout(()=> {console.log('i: '+i)}, 1);

  }
```

Hint: the for loop will finish before the 1st callback.

What have Events ever done for us...

- Great for things that can happen multiple times
- Great if you don't really care about what happened before you attached the listener
- Great if it's a straight-forward, stand-alone event with a quick resolution time

E.g. key press event on control.

document.getElementById("demo").addEventListener("keypress", myFunction);

- But...

The Callback

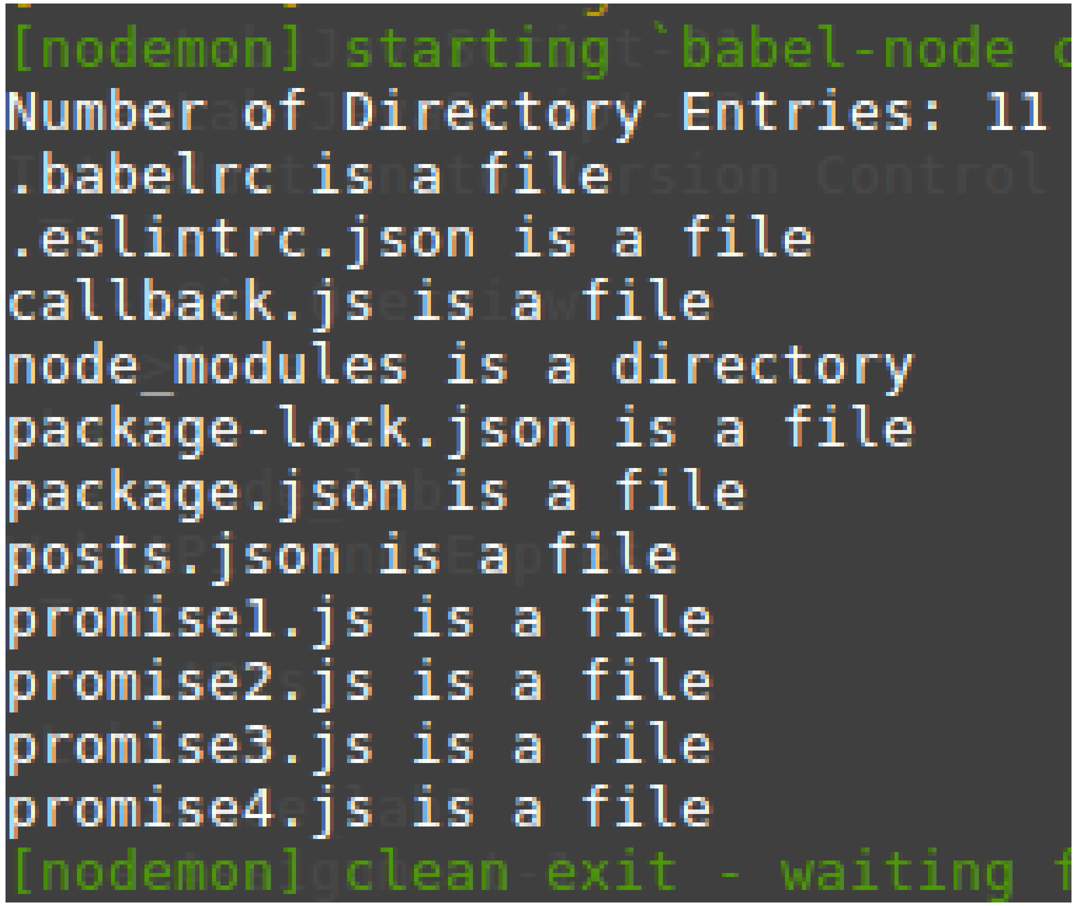
- The traditional way of handling asynchronous events
  - Function that is registered as the event handler for something we're fairly sure will happen in the future

```
componentDidMount : ()=> {
        request.get('http://0.0.0.0:3000/friends')
          .end( (error, response) => { . . . Callback code ...}
    }
    …….
    filterFriends : (event) => { . . . Callback . . . .}
    render: ()=>{
         . . . . . . . .
         <input type="text”  …. onChange={this.filterFriends} />
```

Callbacks in Node

Display info on a directory's contents

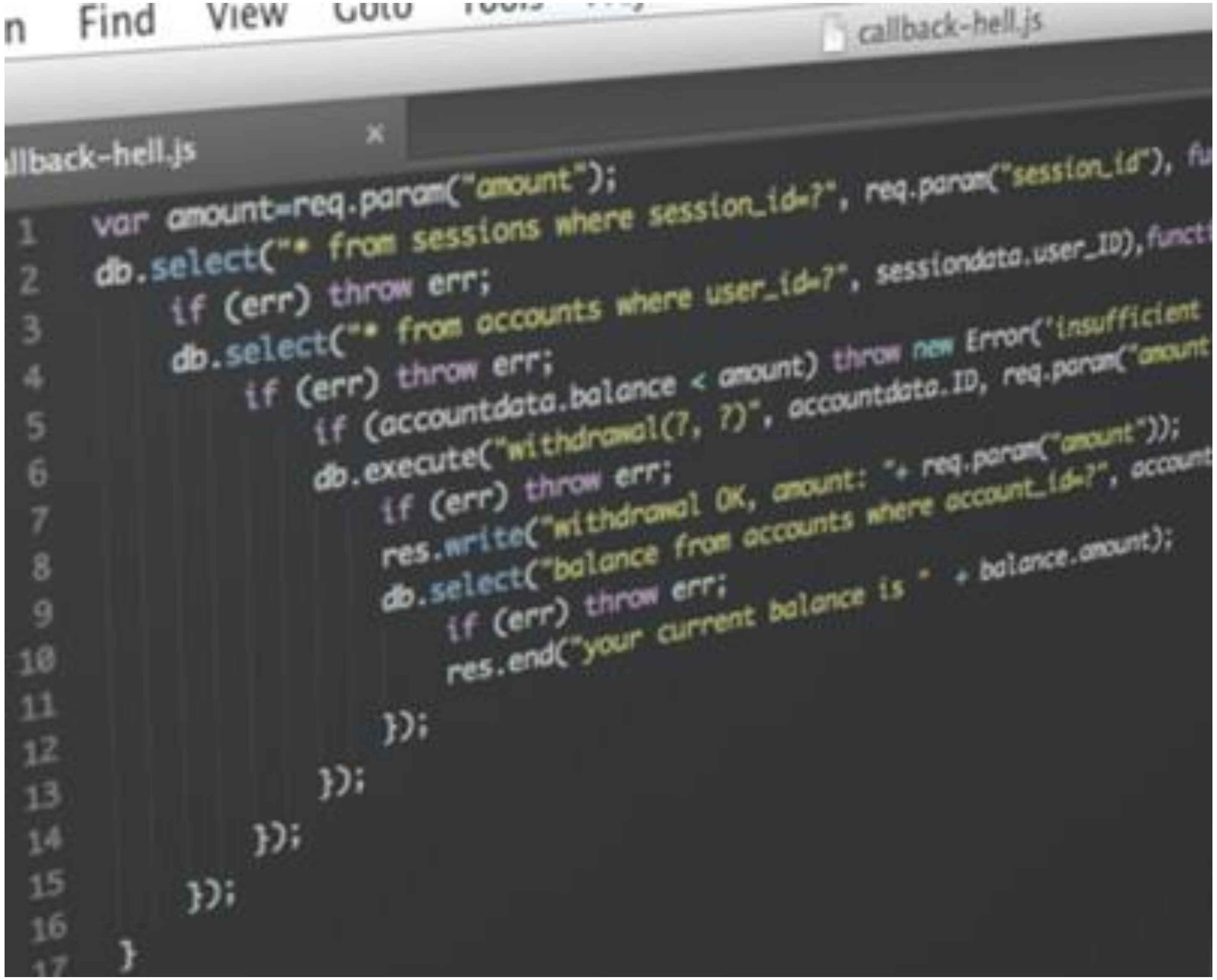
```
import fs from 'fs';
fs.readdir('.', (err, filenames) => {
 if (err) throw err;
 console.log(`Number of Directory Entries:
   ${filenames.length}`);
 filenames.forEach((name) => {
  fs.stat(name, (err, stats) => {
   if (err) throw err;
   let result = stats.isFile() ? 'file' : 'directory';
   console.log(name, 'is a', result);
  });
 });
});
```



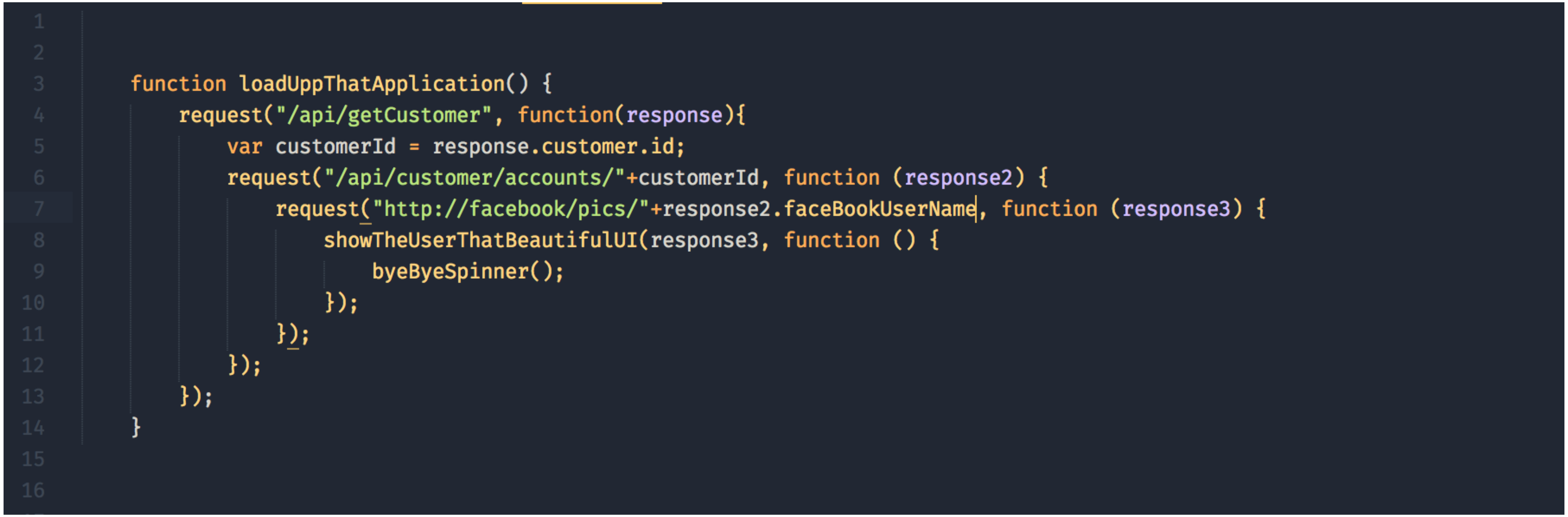
```
[nodemon] starting `babel-node c
Number of Directory Entries: 11
.babelrc is a file
.eslintrc.json is a file
callback.js is a file
node_modules is a directory
package-lock.json is a file
package.json is a file
posts.json is a file
promise1.js is a file
promise2.js is a file
promise3.js is a file
promise4.js is a file
[nodemon] clean exit - waiting f
```

Callback Hell

- One aspect of callback hell is code readability / understandability
- Each new callback causes another level of indentation
- And this is typically the “success path”
    - It gets more complicated if you want to handle errors.



```
var amount=req.param("amount");
db.select("* from sessions where session_id=?", req.param("session_id"), fu
    if (err) throw err;
    db.select("* from accounts where user_id=?", sessiondata.user_ID),funct
        if (err) throw err;
            if (accountdata.balance < amount) throw new Error('insufficient
            db.execute("withdrawal(?, ?)", accountdata.ID, req.param("amount
                if (err) throw err;
                res.write("withdrawal OK, amount: "+ req.param("amount"));
                db.select("balance from accounts where account_id=?", account
                    if (err) throw err;
                    res.end("your current balance is " + balance.amount);

                });
            });
        });
    });
}
```



```javascript
function loadUppThatApplication() {
    request("/api/getCustomer", function(response){
        var customerId = response.customer.id;
        request("/api/customer/accounts/"+customerId, function (response2) {
            request("http://facebook/pics/"+response2.faceBookUserName, function (response3) {
                showTheUserThatBeautifulUI(response3, function () {
                    byeByeSpinner();
                });
            });
        });
    });
}
```

Callback Hell – Multiple requests

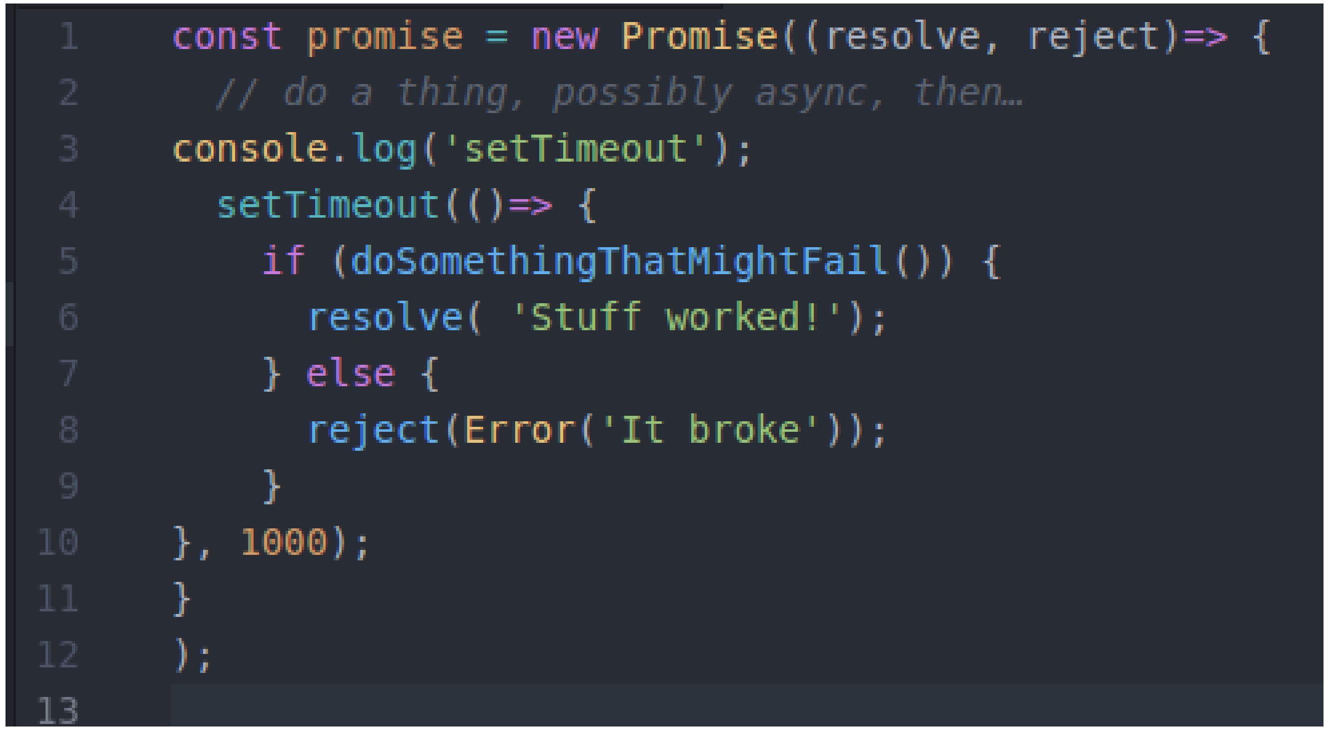
Promises

- A promise is the eventual result of an asynchronous operation or computation.
- Promises are:
  - an abstraction useful in async programming
  - an associated API that allows us to use this abstraction in our programs.
- A promise can be:
  - **fulfilled** - The action relating to the promise succeeded
  - **rejected** - The action relating to the promise failed
  - **pending** - Hasn't fulfilled or rejected yet
  - **settled** - Has fulfilled or rejected

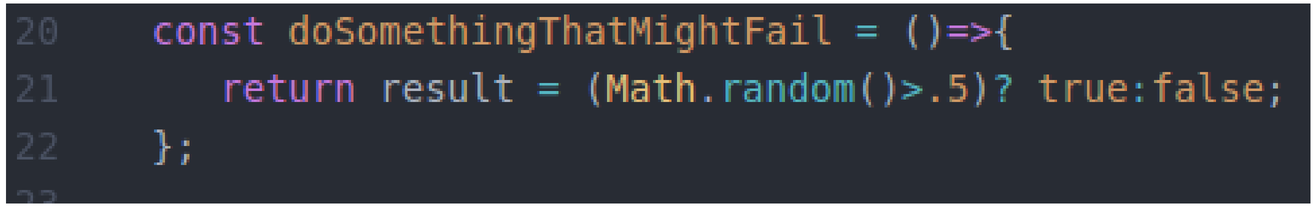
Promise Genealogy

- Nothing new...
  - First proposed in 1976 by Daniel P. Friedman and David Wise, and Peter Hibbard called it eventual. A similar concept, termed future, was introduced in 1977 in a paper by Baker and Carl Hewitt
- Native support in Javascript now but 3rd party libraries have been around for a while:
  - Q,when,WinJS,RSVP.js
- Although APIs can differ, Promise implementations follow a standardized behaviour (Promises/A+)
  - As does Javascript.

JavaScript promise dummy implementation

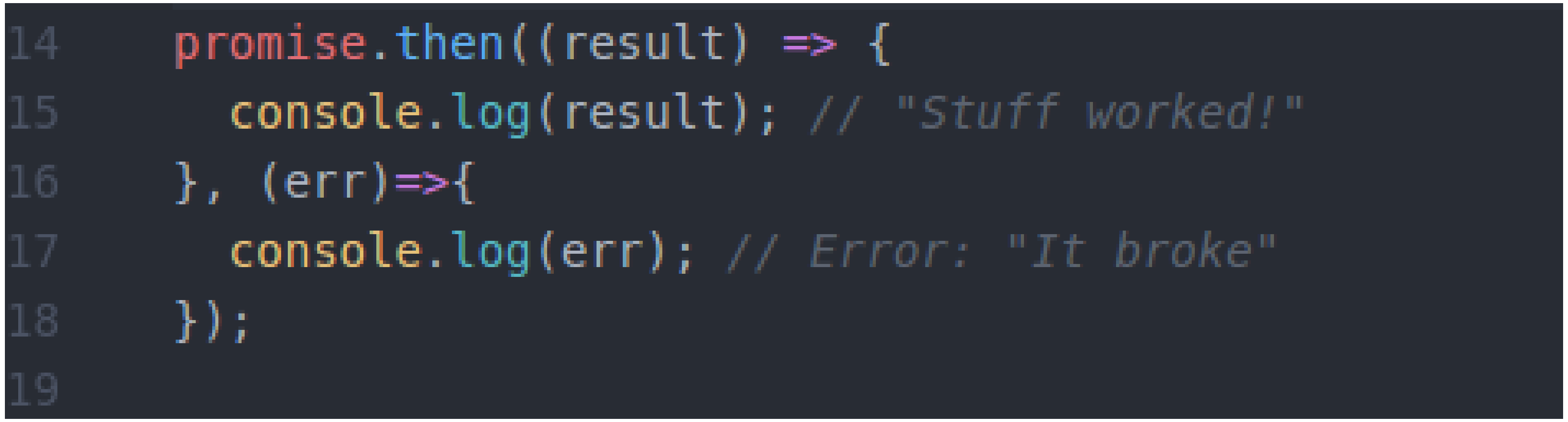


```
const promise = new Promise((resolve, reject)=> {
  // do a thing, possibly async, then…
console.log('setTimeout');
  setTimeout(()=> {
    if (doSomethingThatMightFail()) {
      resolve( 'Stuff worked!');
    } else {
      reject(Error('It broke'));
    }
}, 1000);
}
);
```



```
const doSomethingThatMightFail = ()=>{
   return result = (Math.random()>.5)? true:false;
};
```

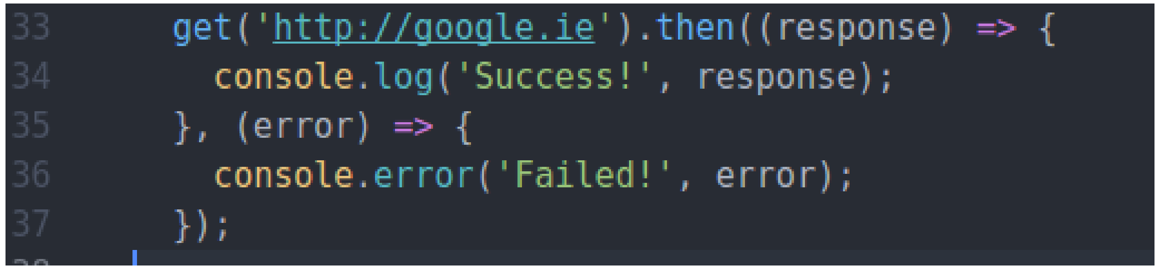
JavaScript Dummy implementation



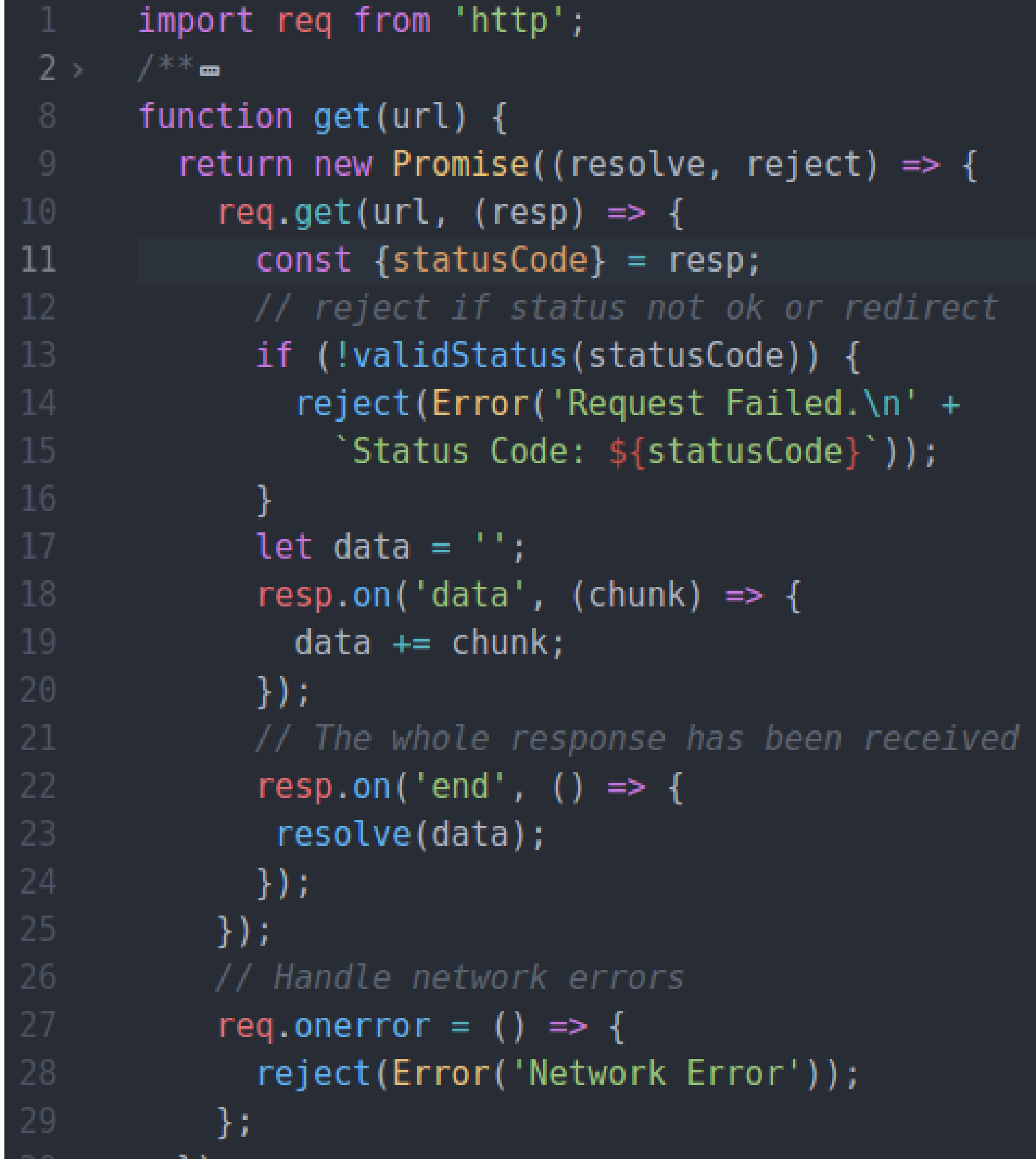
```
promise.then((result) => {
  console.log(result); // "Stuff worked!"
}, (err)=>{
  console.log(err); // Error: "It broke"
});

```

HTTP Request Promise

- Node HTTP API updated to use a promise.
- The *get(…) function* makes HTTP requests by abstracting the http module.
- Http module isn't very user friendly compared to other solutions. Can now make a request like this:



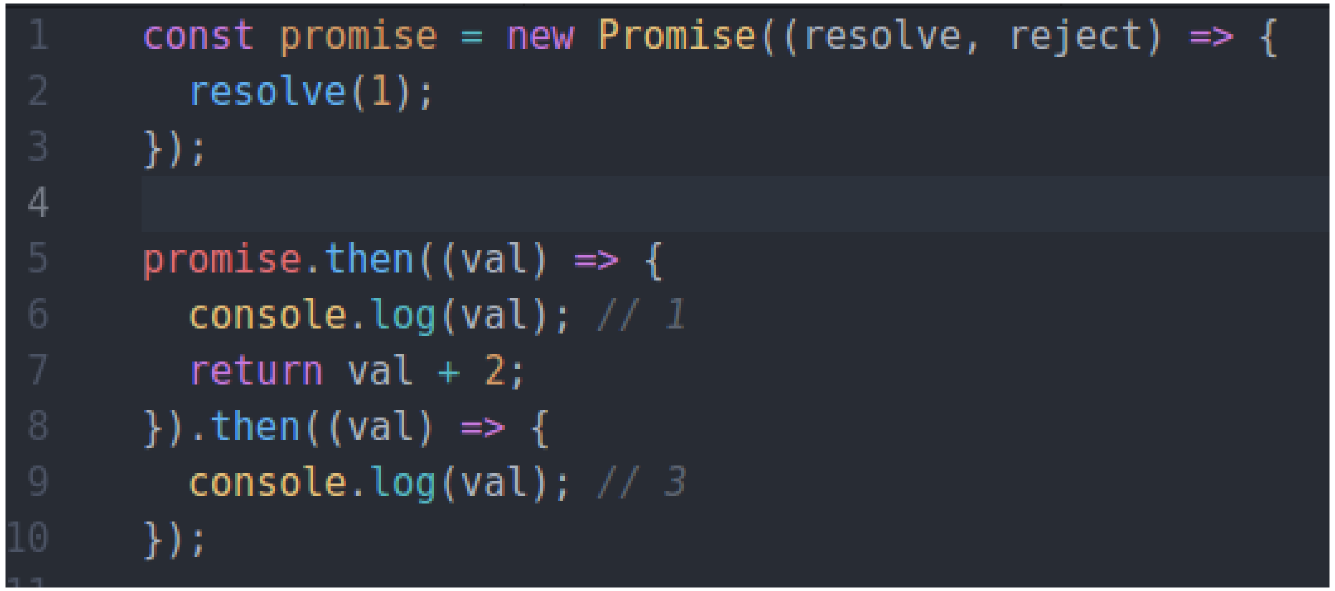
```
get('http://google.ie').then((response) => {
  console.log('Success!', response);
}, (error) => {
  console.error('Failed!', error);
});
```



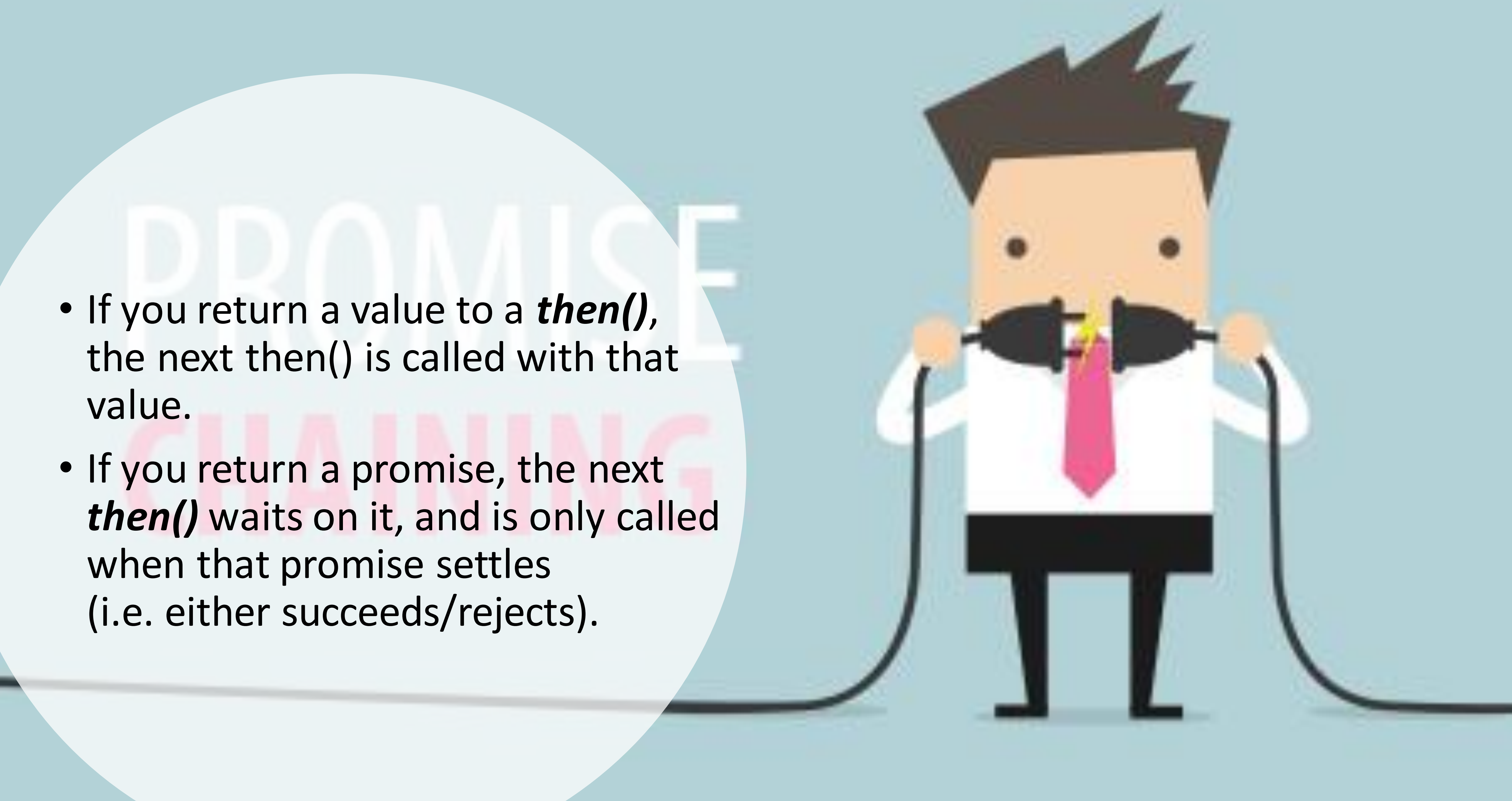
```
import req from 'http';
/**
function get(url) {
  return new Promise((resolve, reject) => {
    req.get(url, (resp) => {
      const {statusCode} = resp;
      // reject if status not ok or redirect
      if (!validStatus(statusCode)) {
        reject(Error('Request Failed.\n' +
          `Status Code: ${statusCode}`));
      }
      let data = '';
      resp.on('data', (chunk) => {
        data += chunk;
      });
      // The whole response has been received
      resp.on('end', () => {
       resolve(data);
      });
    });
    // Handle network errors
    req.onerror = () => {
      reject(Error('Network Error'));
    };
```

Chaining

- you can chain thens together to transform values or run additional async actions one after another.
- The alternative to "Callback Hell"



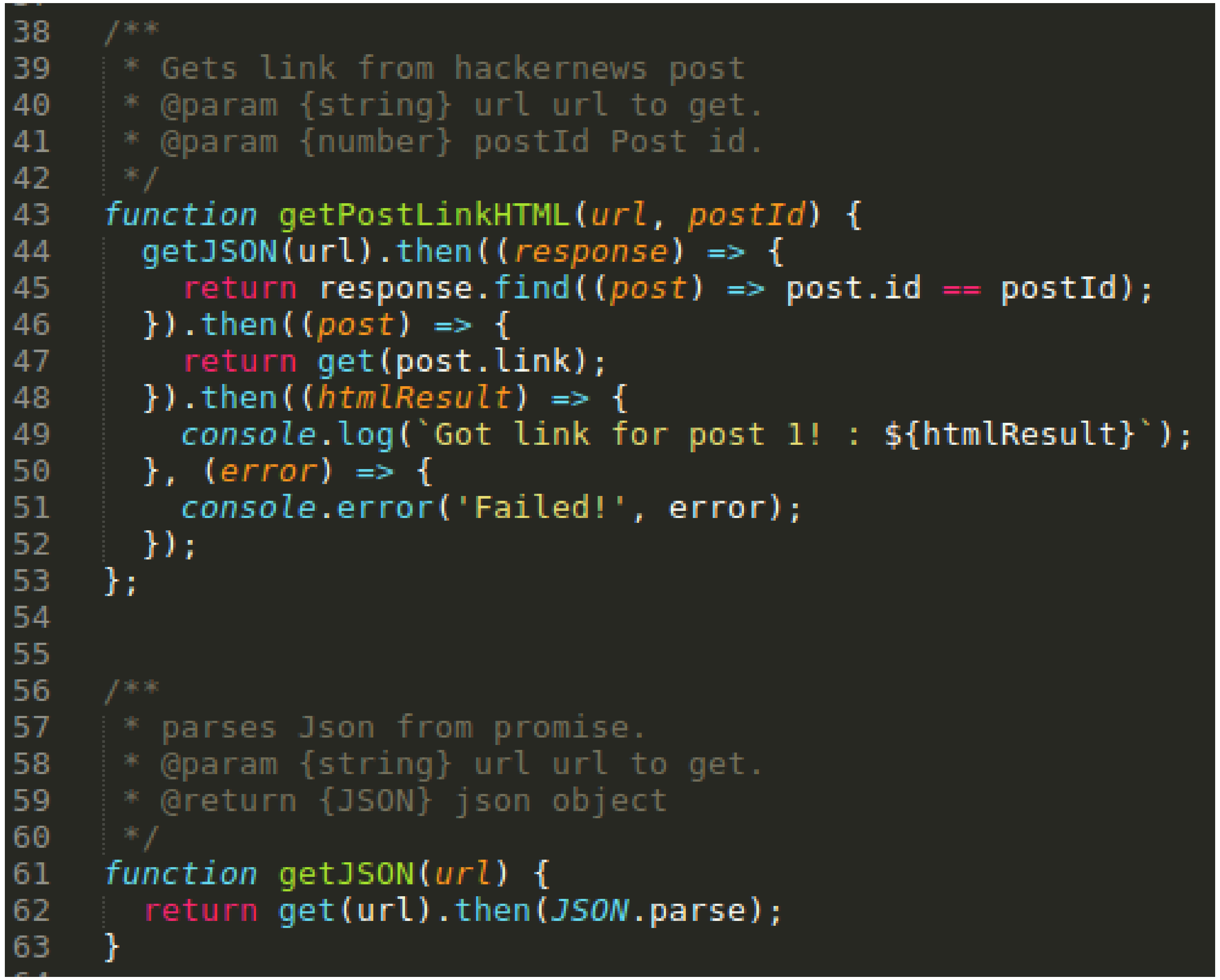
```javascript
const promise = new Promise((resolve, reject) => {
  resolve(1);
});

promise.then((val) => {
  console.log(val); // 1
  return val + 2;
}).then((val) => {
  console.log(val); // 3
});
```



- If you return a value to a ***then()***, the next then() is called with that value.
- If you return a promise, the next ***then()*** waits on it, and is only called when that promise settles
(i.e. either succeeds/rejects).

Chaining

- Problem: Request Hacker News Posts, then request link for a specific post (e.g. id ==1), then display link
- **NOTE: error callback applies to whole chain**
    - No need to specify error handler for each promise.



```
/**
 * Gets link from hackernews post
 * @param {string} url url to get.
 * @param {number} postId Post id.
 */
function getPostLinkHTML(url, postId) {
  getJSON(url).then((response) => {
    return response.find((post) => post.id == postId);
  }).then((post) => {
    return get(post.link);
  }).then((htmlResult) => {
    console.log(`Got link for post 1! : ${htmlResult}`);
  }, (error) => {
    console.error('Failed!', error);
  });
};


/**
 * parses Json from promise.
 * @param {string} url url to get.
 * @return {JSON} json object
 */
function getJSON(url) {
  return get(url).then(JSON.parse);
}
```

Error Handling

- **then()** function takes two arguments, one for fulfillment(success), one for rejection(failure)

```
get('story.json').then((response) => {
  console.log("Success!", response);
}, (error) => {
  console.log("Failed!", error);
})
```

Error Handling - catch(...)

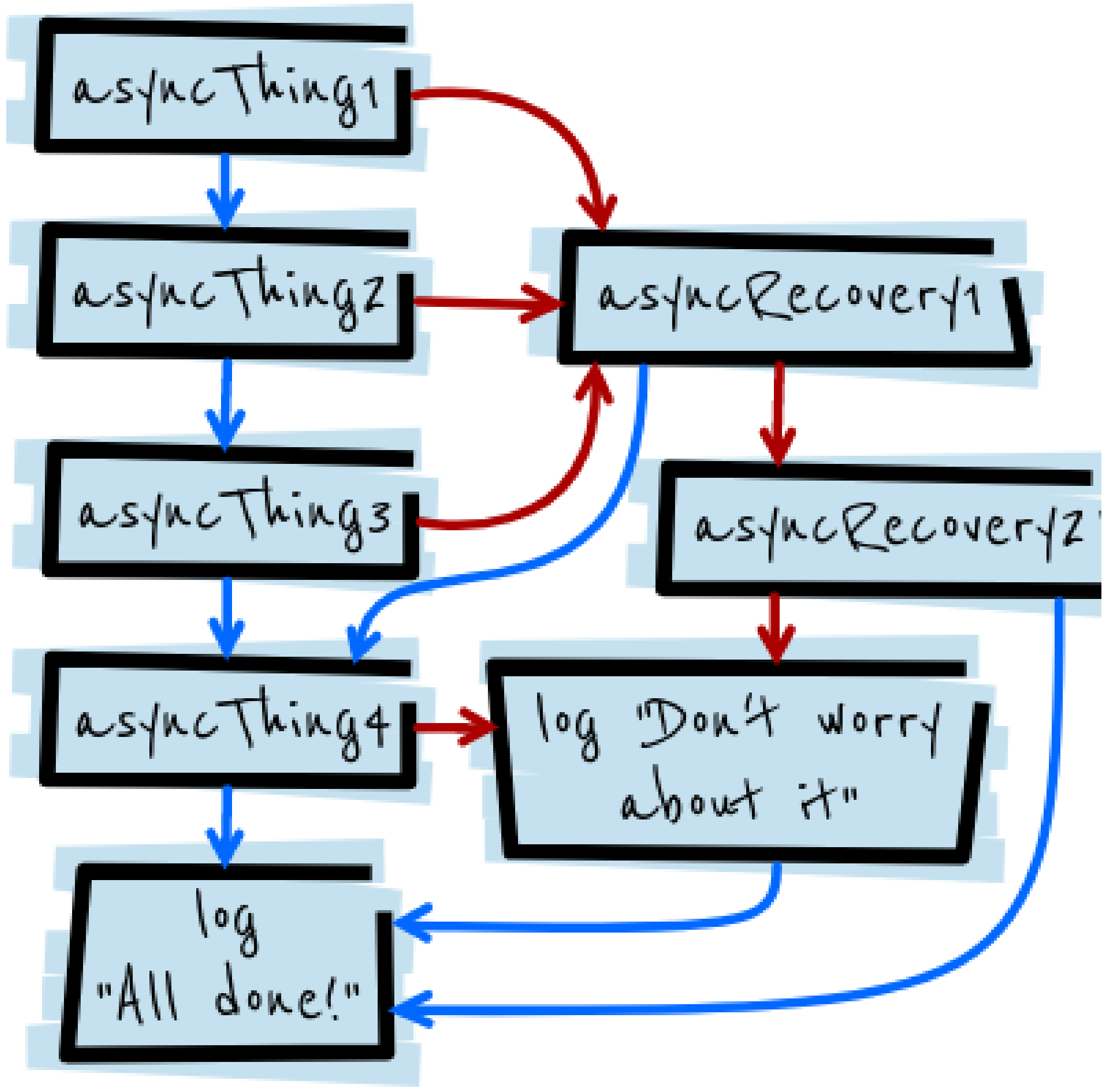
- You can also use catch() to handle promise rejects:
- Reacts slightly different to previous...

```
promise.then((result) => {
  console.log(result); // "Stuff worked!"
}).catch((err)=>{
  console.log(err); // Error: "It broke"
});
```

Rejection forwarding

- A Promise rejection will skip forward to the next then() with a rejection callback (or catch()):

```
asyncThing1().then(function()  {
    return asyncThing2();
   }).then(function() {
    return asyncThing3();
   }).catch(function(err) {
    return asyncRecovery1();
   }).then(function() {
    return asyncThing4();
   }, function(err) {
    return asyncRecovery2();
   }).catch(function(err) {
    console.log("Don't worry about it");
   }).then(function() {
    console.log("All done!");
   })
```



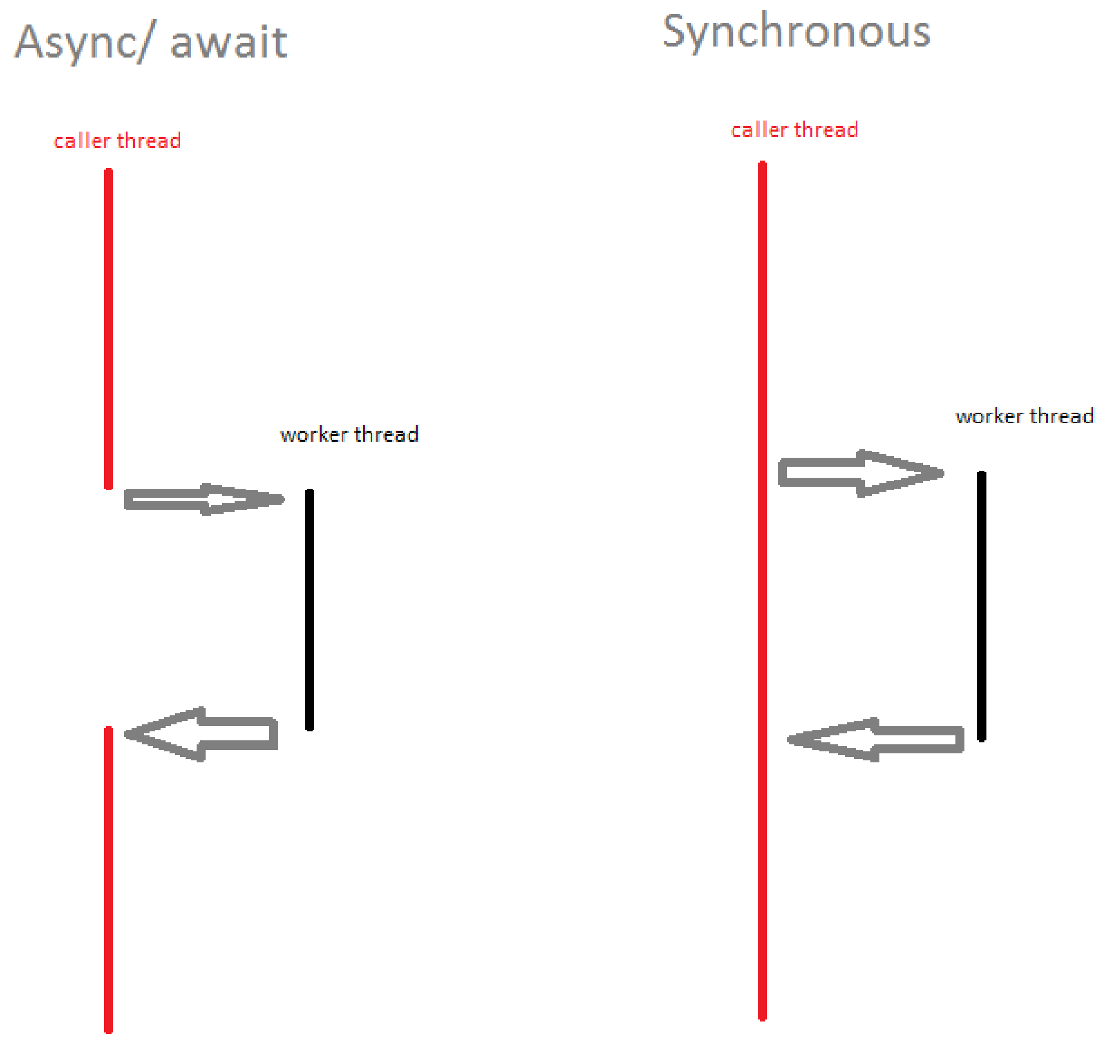
https://developers.google.com/web/fundamentals/primers/promises#error_handlingck to add text

Async Functions

using async/await

Hot off the press(ish): Async/Await !

- **async/await** and **promises** are essentially the same under the hood
- **async** is a keyword
  - Used in function declaration
- **await** is used during the promise handling
  - must be used within an **async function**
- **async** functions return a promise, regardless of what the return value is within the function
- **Available now** in most good browsers as well as Node.js



Promise vs. Async Await

Promise

```
promise.then((result) => {
  console.log(result); // "Stuff worked!"
}, (err)=>{
  console.log(err); // Error: "It broke"
});
```

Async

```
async function doSomethingAsync() {
  try{
    let result = await promise();
    console.log(result);
  }catch (err){
    console.log(err);
  }
}
```

Wrapper Function

- As an Async function always returns a Promise.
  - can *wrap* the async function to catch errors...
  - Can drop try/catch.
- Makes code more readable.

```
const asyncWrapper = fn => {
    return Promise.resolve(fn)
      .catch(err => {return err.message});
};


async function doSomethingAsync() {
    const result = await asyncWrapper(promise());
    console.log(result);
}
```

Example: HackerNews with async await

```
async function getJSON(url) {
  return JSON.parse(await get(url));
}
```

```
async function getPostLinkHTML(url,
    postId) {
  const posts = await getJSON(url);
  const post = posts.find((post) =>
    post.id == postId);
  const htmlResult = await get(post.link);
  console.log(`Got link for post 1! :
    ${htmlResult}`);
}


getPostLinkHTML('http://localhost:8080
    /api/posts', 1);
```

Parallelism

- Previous example needed to be sequential
  - Had to get data back from API **BEFORE** getting link URL
- Should only be sequential if you need to be...

Takes 1000ms

```
async function series() {
  await wait(500); // Wait 500ms…
  await wait(500); // …then wait another 500ms.
  return "done!";
}
```

Takes ~500ms

```
async function parallel() {
  const wait1 = wait(500); // Start a 500ms timer asynchronously…
  const wait2 = wait(500); // this timer happens in parallel.
  await wait1; // Wait 500ms for the first timer…
  await wait2; // …by which time this timer has already finished.
  return "done!";
}
```

Sources

- https://developers.google.com/web/fundamentals/primers/promises
- https://stackoverflow.com/questions/2069763/difference-between-event-handlers-and-callbacks
- https://medium.com/@Abazhenov/using-async-await-in-express-with-node-8-b8af872c0016