ASYNCHRONOUS JAVASCRIPT

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PLAN

Async in JS	Promises	Promise magic	Async/Await
Events & Callbacks	Promise overview	.then(), .catch(), parallel execution	Write async code as sync!

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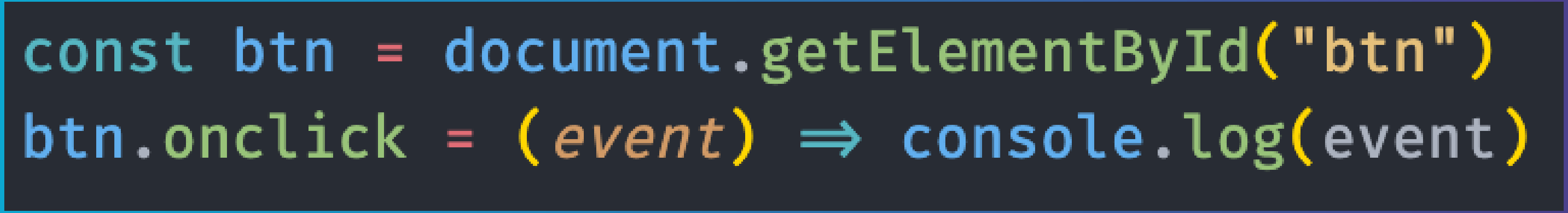
ASYNC IN JS

EVENTS

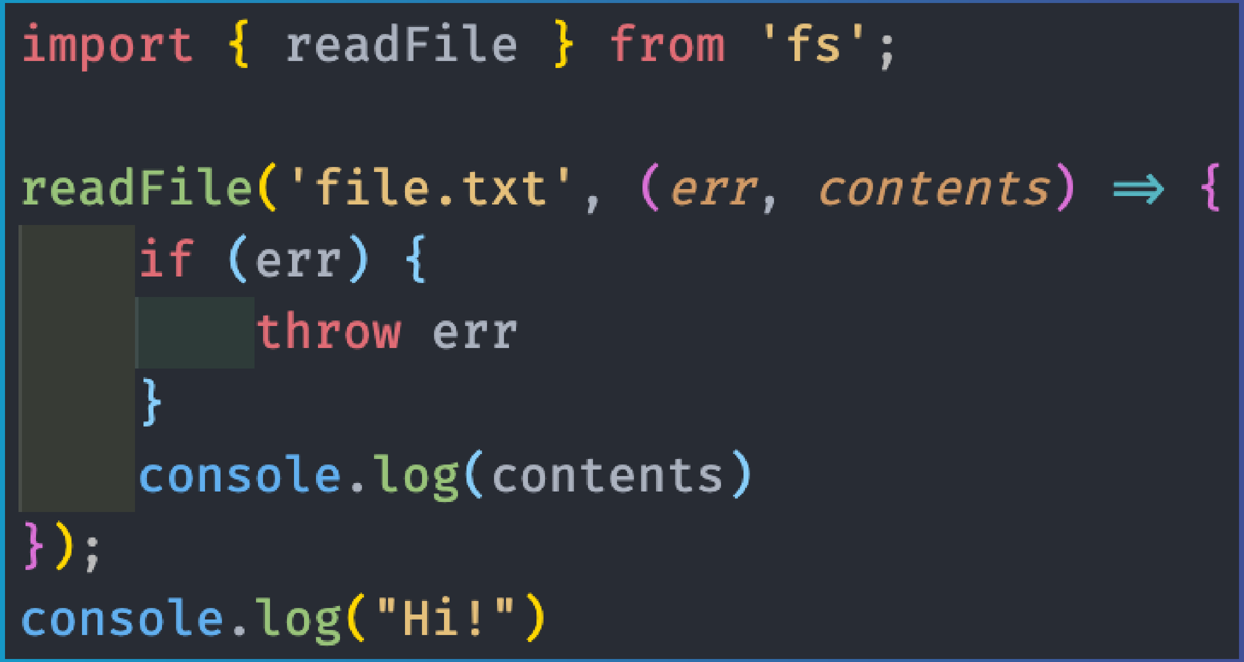
- The most basic form of asynchronous programming in JavaScript.



```javascript
const btn = document.getElementById("btn")
btn.onclick = (event) => console.log(event)
```

CALLBACKS: BASIC

- Functions that are called after an asynchronous operation
    - Usually are passed as arguments.



```
import { readFile } from 'fs';

readFile('file.txt', (err, contents) ⇒ {
    if (err) {
        throw err
    }
    console.log(contents)
});
console.log("Hi!")
```

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CALLBACKS: HARD

```
function getPart1(callback) {
   $.get('...', callback);
}

function getPart2(callback) {
   $.get('...', callback);
}

function getPart3(callback) {
   $.get('...', callback);
}

getPart1(function () {
    getPart2(function () {
        getPart3(function () {
            // Add value
        });
    });
});
```

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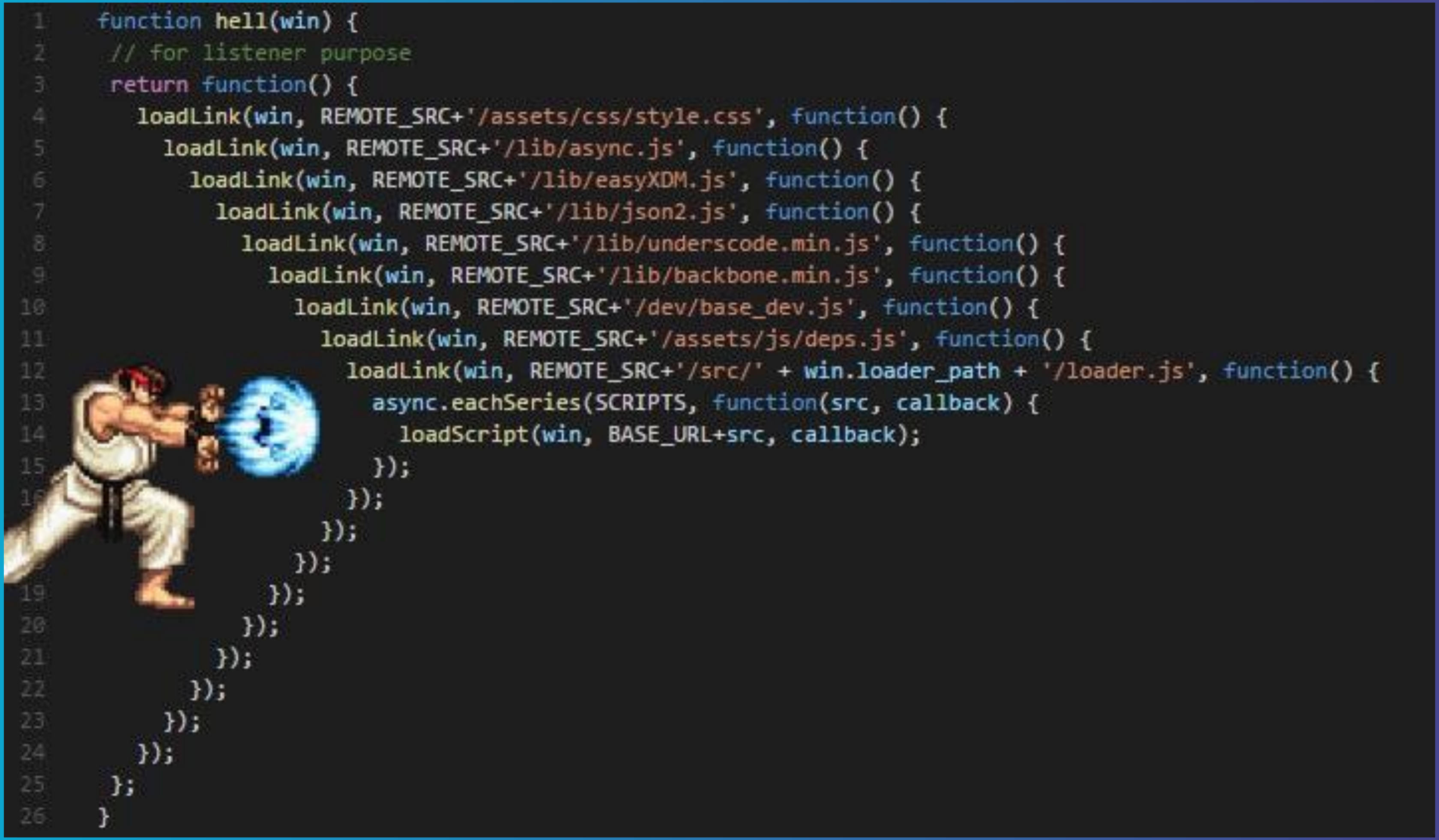
CALLBACKS: HELL



```
function hell(win) {
 // for listener purpose
 return function() {
   loadLink(win, REMOTE_SRC+'/assets/css/style.css', function() {
     loadLink(win, REMOTE_SRC+'/lib/async.js', function() {
       loadLink(win, REMOTE_SRC+'/lib/easyXDM.js', function() {
         loadLink(win, REMOTE_SRC+'/lib/json2.js', function() {
           loadLink(win, REMOTE_SRC+'/lib/underscode.min.js', function() {
             loadLink(win, REMOTE_SRC+'/lib/backbone.min.js', function() {
               loadLink(win, REMOTE_SRC+'/dev/base_dev.js', function() {
                 loadLink(win, REMOTE_SRC+'/assets/js/deps.js', function() {
                   loadLink(win, REMOTE_SRC+'/src/' + win.loader_path + '/loader.js', function() {
                     async.eachSeries(SCRIPTS, function(src, callback) {
                       loadScript(win, BASE_URL+src, callback);
                     });
                   });
                 });
               });
             });
           });
         });
       });
     });
   });
 };
}
```

PROMISES

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PROMISES

- Operation that will return its result some time later
- Multiple handlers of one result
- Complex compositions of asynchronous operations
- Easier to handle errors
- You can "recover" from an error

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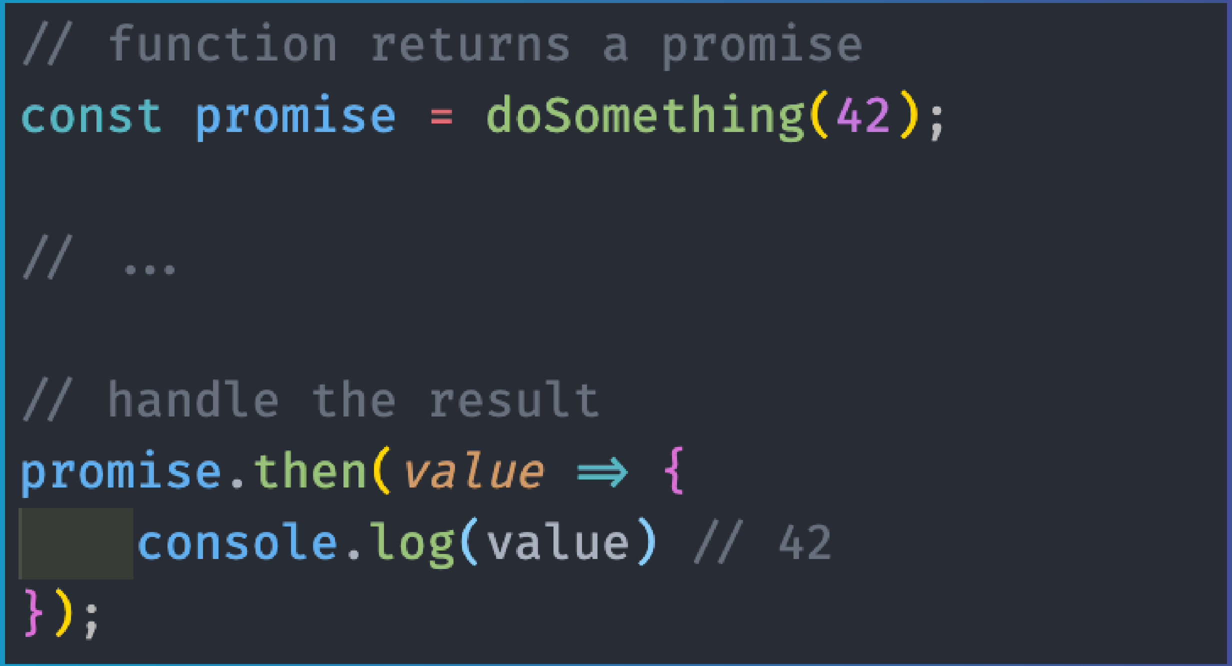
.THEN



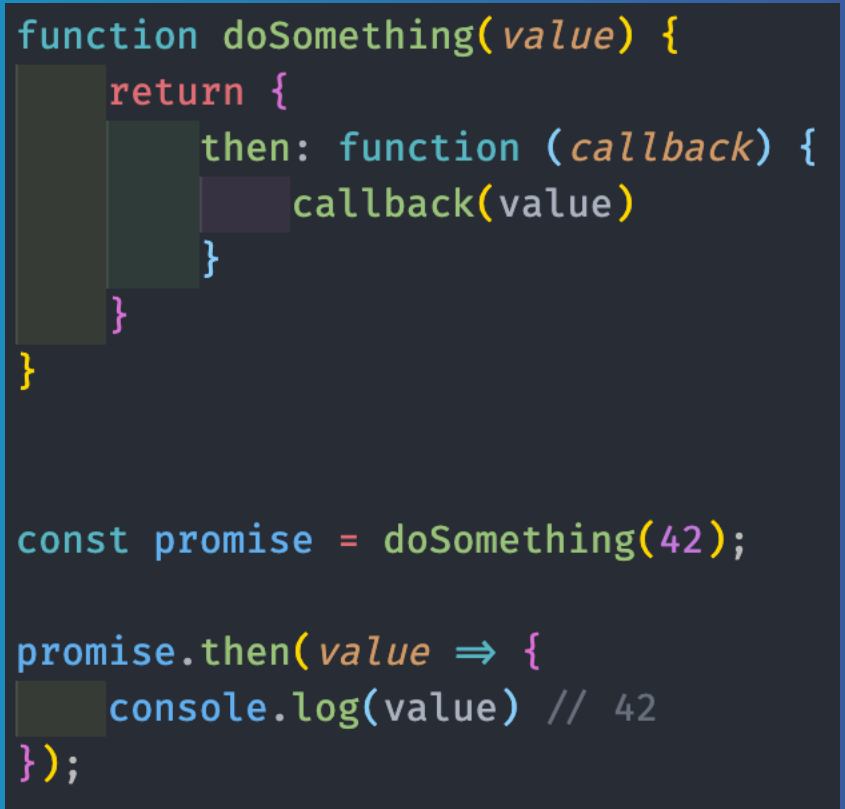
```
// function returns a promise
const promise = doSomething(42);

// ...

// handle the result
promise.then(value => {
    console.log(value) // 42
});
```

PROMISES & THENABLES

- **Promises** are objects whose behaviour conforms to the Promise / A + specification
- **Thenables** - objects that have the `.then` method.



```
function doSomething(value) {
    return {
        then: function (callback) {
            callback(value)
        }
    }
}


const promise = doSomething(42);

promise.then(value => {
    console.log(value) // 42
});
```

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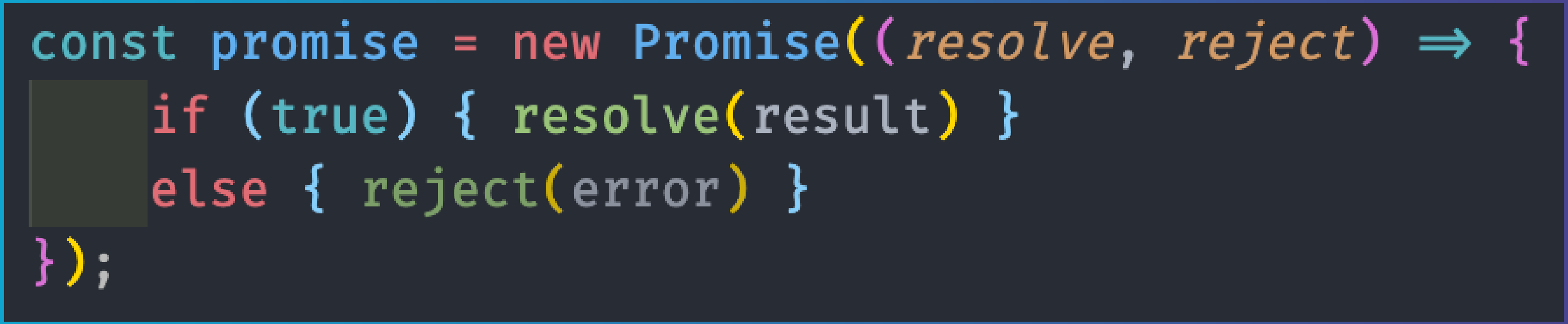
CONSTRUCTOR

- The function passed to **`new Promise()`** is called the ***executor***.
- .then () and resolve () are called independently.



```
const promise = new Promise((resolve, reject) => {
    if (true) { resolve(result) }
    else { reject(error) }
});
```

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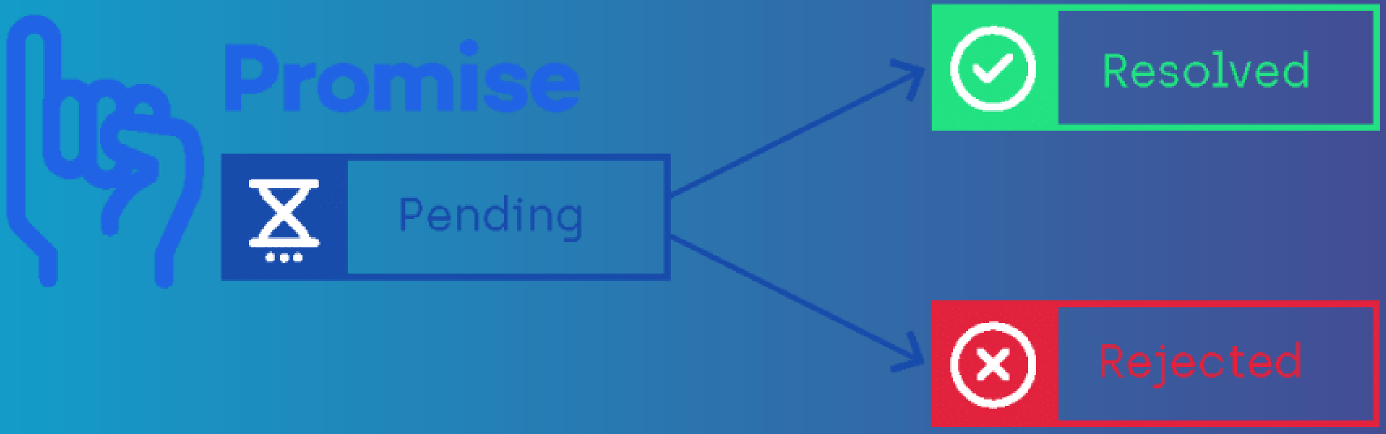
PROMISE STATES

- A Promise is in ***one of three states***:
  - **pending**: initial state, neither fulfilled nor rejected.
  - **fulfilled**: meaning that the operation completed successfully.
  - **rejected**: meaning that the operation failed.



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WORKING WITH PROMISES

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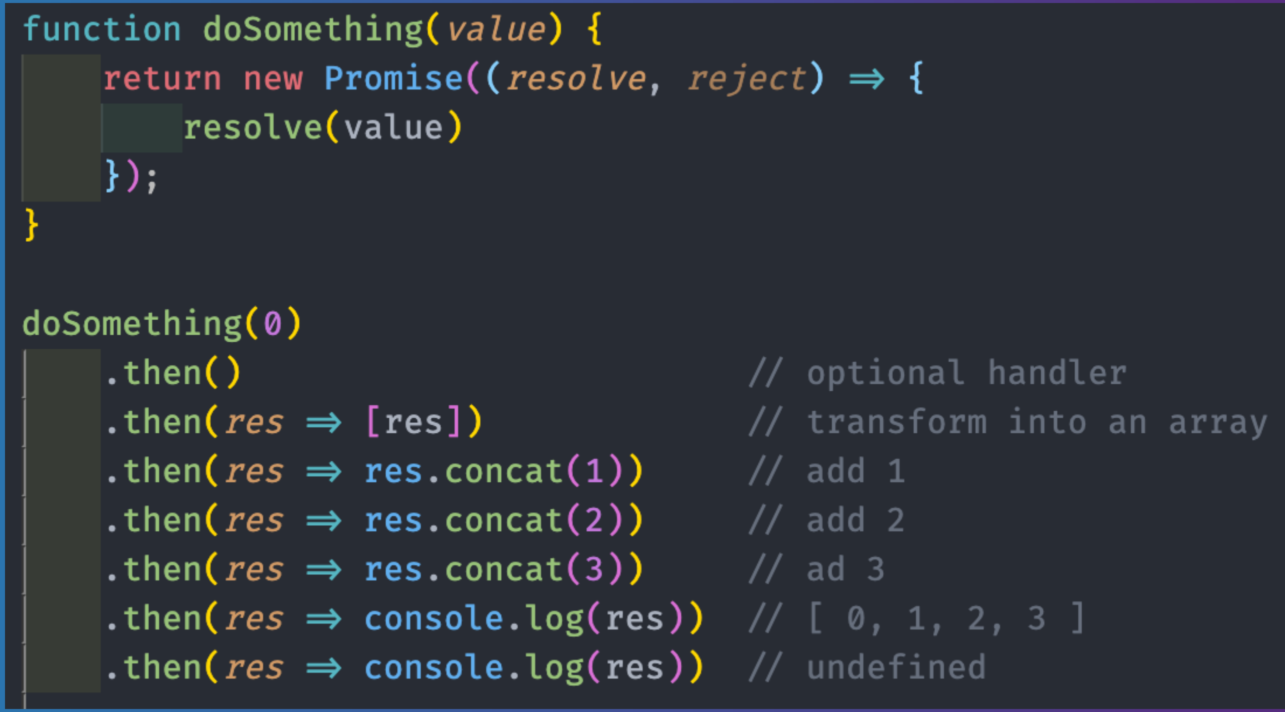
.THEN() MAGIC

- **.then()** always returns a new promise
  - This new promise is resolved when the previous one was either completed or rejected.
- **.then()** may not have a handler
  - The result is transferred to the next promise
- If you return a value from the handler in **.then(),** it will be the value of the next promise
  - You can transfer data from one promise to the next



```
function doSomething(value) {
    return new Promise((resolve, reject) ⇒ {
        resolve(value)
    });
}

doSomething(0)
    .then()                             // optional handler
    .then(res ⇒ [res])                  // transform into an array
    .then(res ⇒ res.concat(1))          // add 1
    .then(res ⇒ res.concat(2))          // add 2
    .then(res ⇒ res.concat(3))          // ad 3
    .then(res ⇒ console.log(res))       // [ 0, 1, 2, 3 ]
    .then(res ⇒ console.log(res))       // undefined
```

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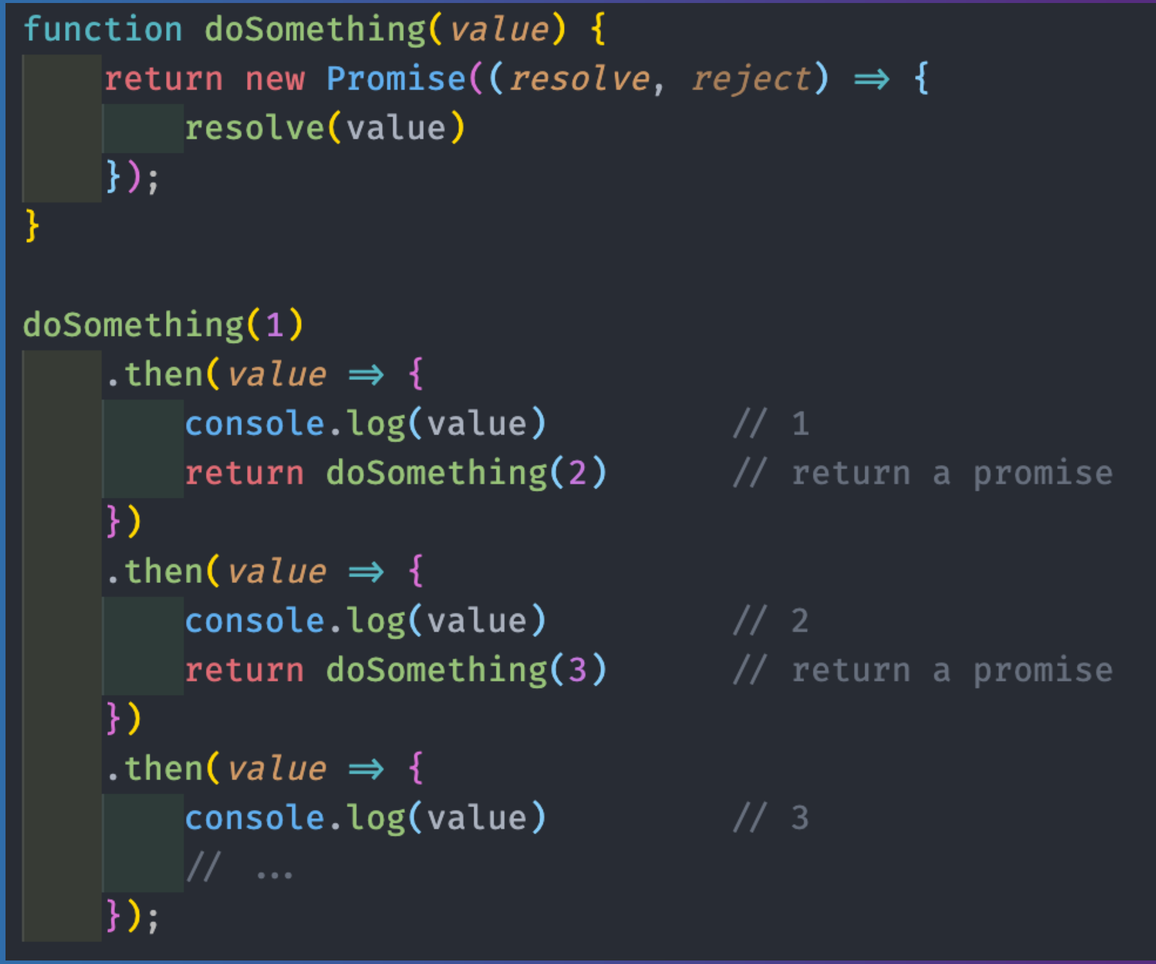
.THEN() & NEW PROMISE

- If you return a promise with .then (), it will be resolved
- The result will be wrapped in a new promise and will be available in the next .then()



```
function doSomething(value) {
    return new Promise((resolve, reject) => {
        resolve(value)
    });
}

doSomething(1)
    .then(value => {
        console.log(value)          // 1
        return doSomething(2)       // return a promise
    })
    .then(value => {
        console.log(value)          // 2
        return doSomething(3)       // return a promise
    })
    .then(value => {
        console.log(value)          // 3
        // ...
    });
```

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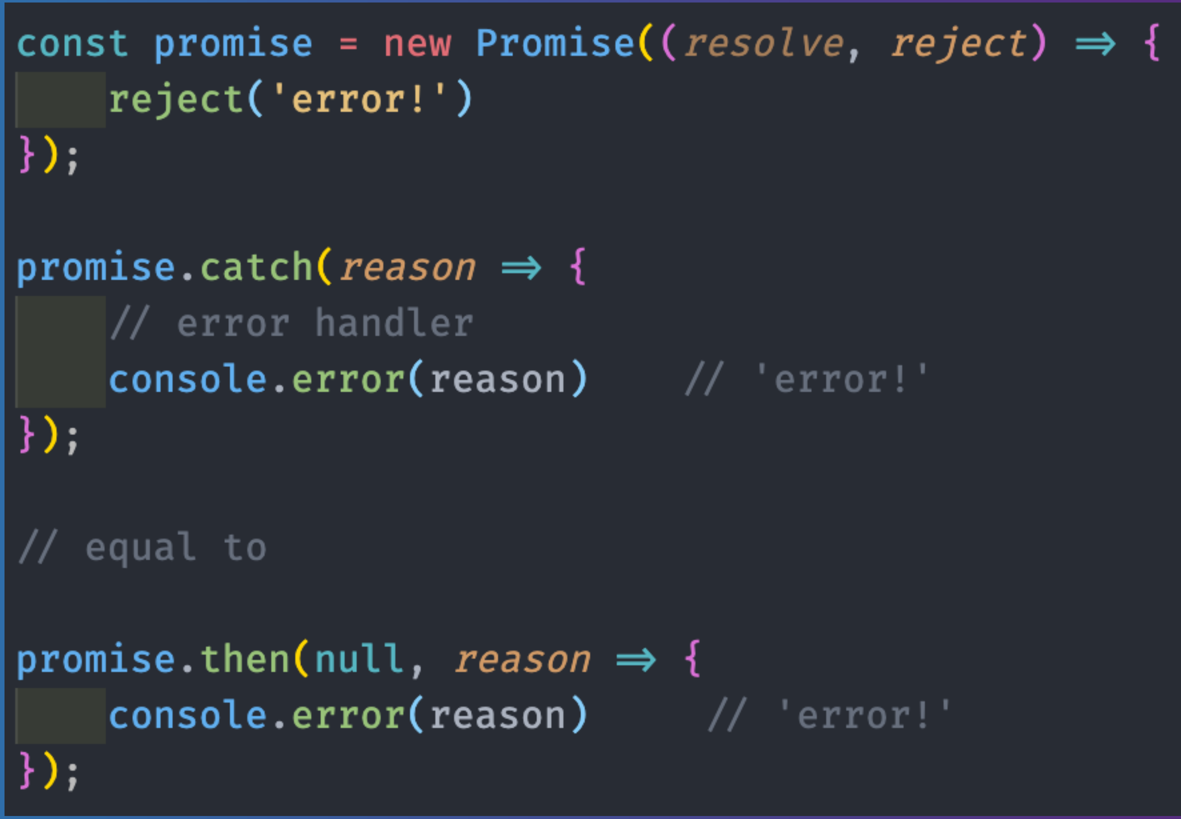
ERROR HANDLING

- Promises can be rejected with reason
  - As a second argument, the executor receives a function that rejects the promise
- .then() can receive an error handler as the second argument
  - Both the completion handler and error handler are optional.
- .catch() only accepts an error handler
  - .catch() is similar to .then() without a completion handler.



```
const promise = new Promise((resolve, reject) ⇒ {
    reject('error!')
});

promise.catch(reason ⇒ {
    // error handler
    console.error(reason)    // 'error!'
});

// equal to

promise.then(null, reason ⇒ {
    console.error(reason)     // 'error!'
});
```

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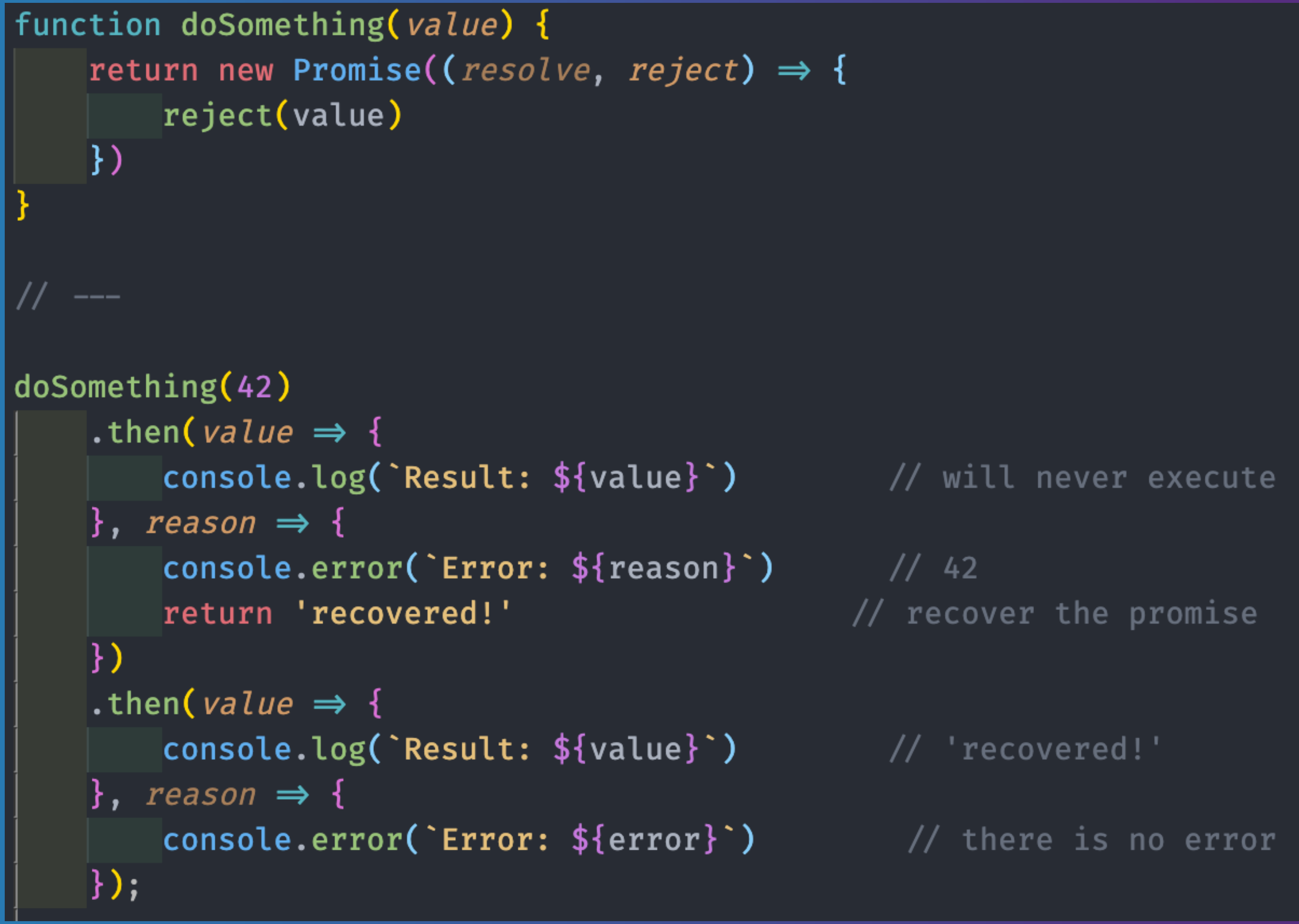
RECOVERY

- Promises are able to "recover"
  - If you return a value from the error handler, it will go to the completion handler of the next promise.



```
function doSomething(value) {
    return new Promise((resolve, reject) ⇒ {
        reject(value)
    })
}

// ---

doSomething(42)
    .then(value ⇒ {
        console.log(`Result: ${value}`)          // will never execute
    }, reason ⇒ {
        console.error(`Error: ${reason}`)        // 42
        return 'recovered!'                     // recover the promise
    })
    .then(value ⇒ {
        console.log(`Result: ${value}`)          // 'recovered!'
    }, reason ⇒ {
        console.error(`Error: ${error}`)          // there is no error
    });
```

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FAIL SILENTLY

- If an error occurs in a promise that does not have an error handler, the promise will "keep quiet" about the error.

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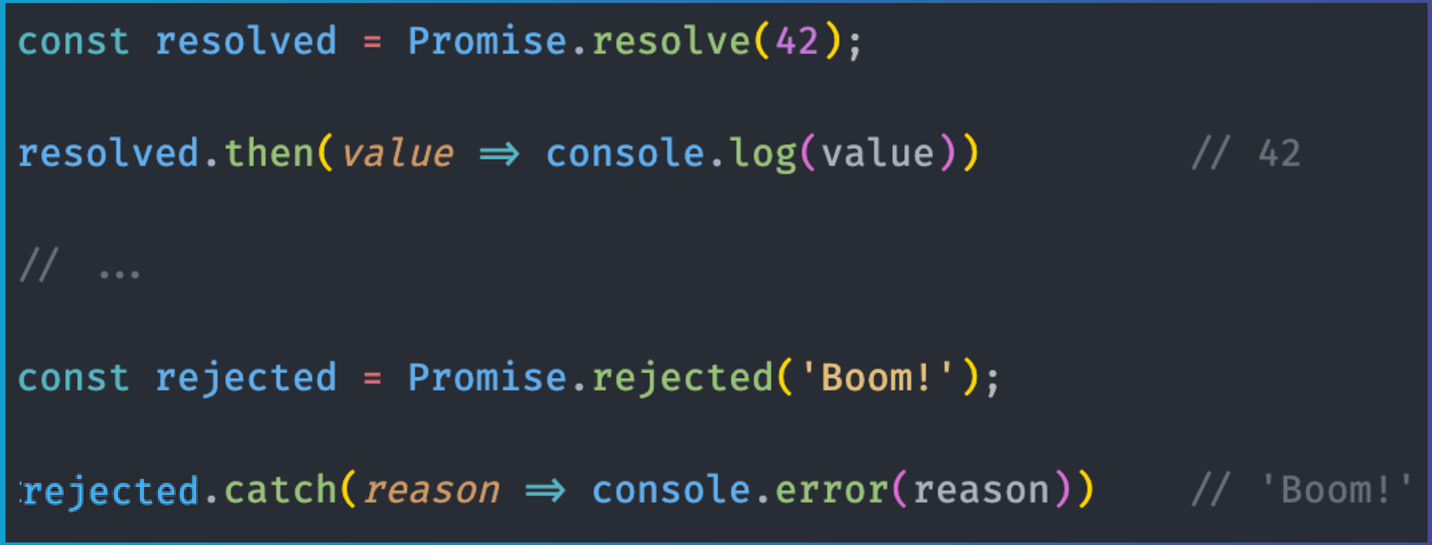
CREATING COMPLETED PROMISES

- Promise.resolve () and Promise.reject () allow you to create a completed promise
  - They can take primitives as an argument and wrap them in a promise.



```
const resolved = Promise.resolve(42);

resolved.then(value ⇒ console.log(value))          // 42

// ...

const rejected = Promise.rejected('Boom!');

rejected.catch(reason ⇒ console.error(reason))     // 'Boom!'
```

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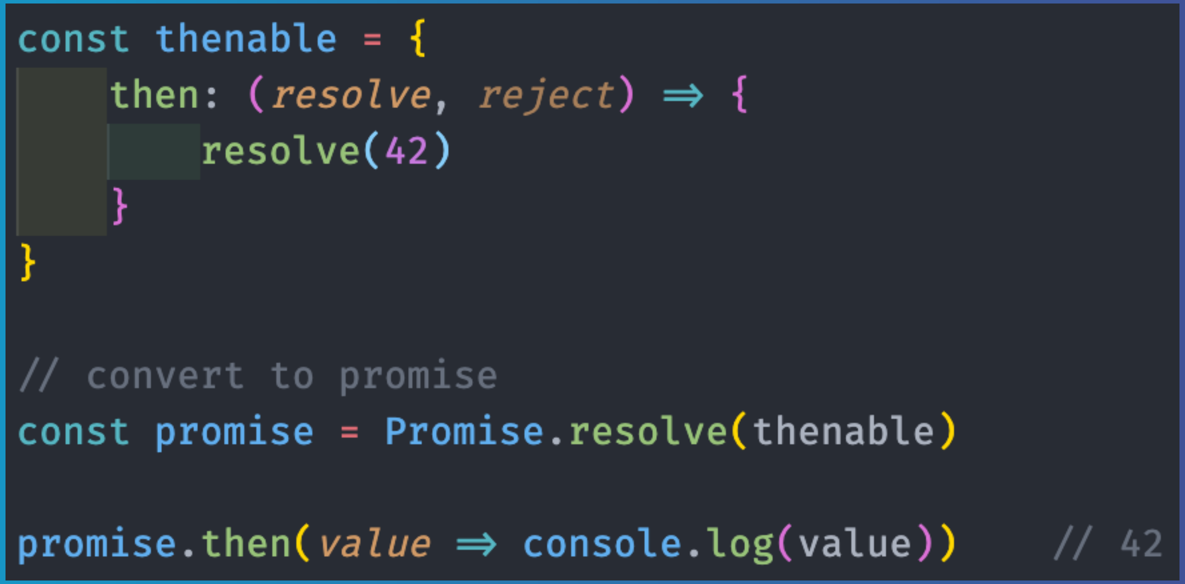
BACK TO THENABLES

- Promise.resolve () and Promise.reject () can take thenable arguments
    - They can turn thenables into real promises.



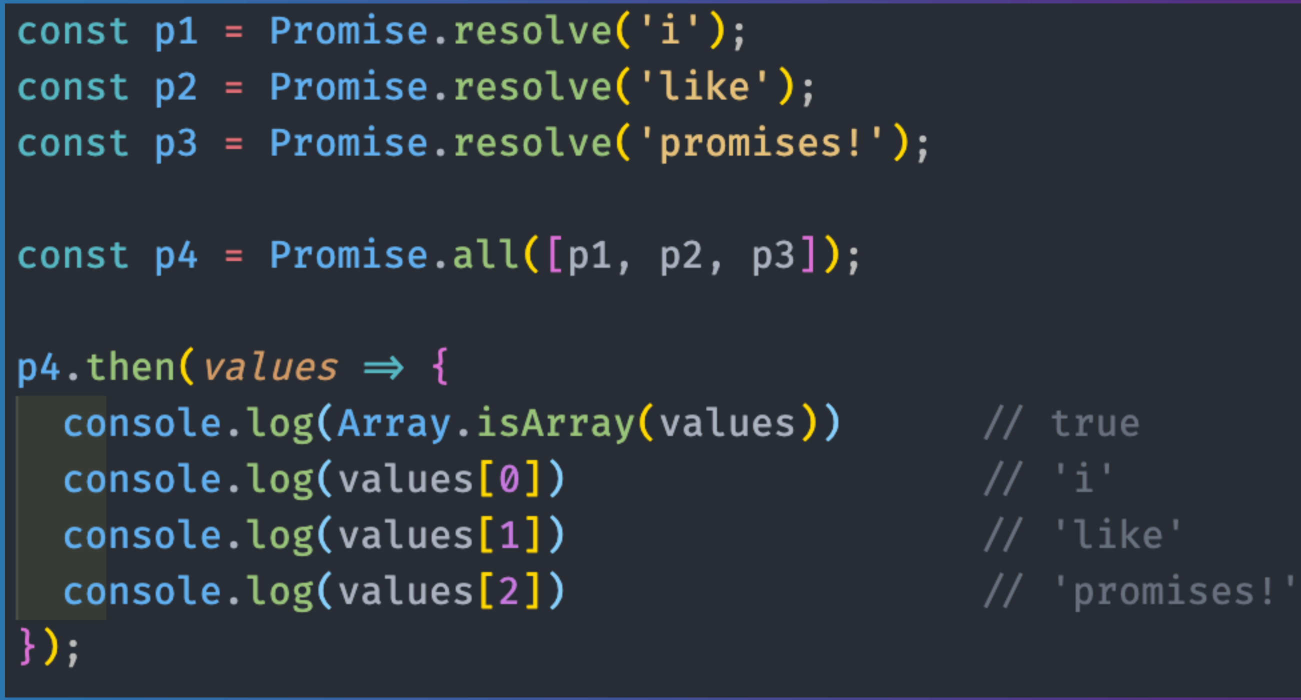
```
const thenable = {
    then: (resolve, reject) ⇒ {
        resolve(42)
    }
}

// convert to promise
const promise = Promise.resolve(thenable)

promise.then(value ⇒ console.log(value))     // 42
```

PARALLEL EXECUTION: ALL

- Promise.all() is waits for all promises to complete
  - Returns a new promise, which resolves when all promises are completed.



```
const p1 = Promise.resolve('i');
const p2 = Promise.resolve('like');
const p3 = Promise.resolve('promises!');

const p4 = Promise.all([p1, p2, p3]);

p4.then(values => {
  console.log(Array.isArray(values))      // true
  console.log(values[0])                  // 'i'
  console.log(values[1])                  // 'like'
  console.log(values[2])                  // 'promises!'
});
```

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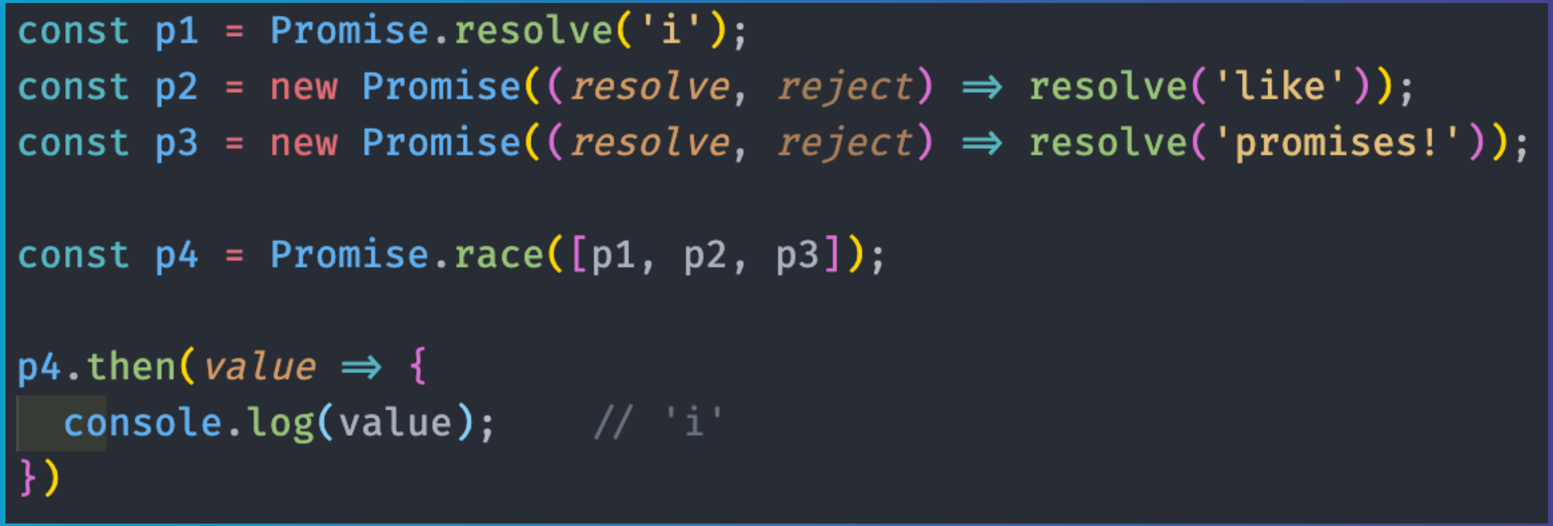
PARALLEL EXECUTION: RACE

- Promise.race () creates a race among promises
  - Returns a new promise, which completes when the fastest promise ends.



```
const p1 = Promise.resolve('i');
const p2 = new Promise((resolve, reject) ⇒ resolve('like'));
const p3 = new Promise((resolve, reject) ⇒ resolve('promises!'));

const p4 = Promise.race([p1, p2, p3]);

p4.then(value ⇒ {
  console.log(value);    // 'i'
})
```

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ASYNC/AWAIT

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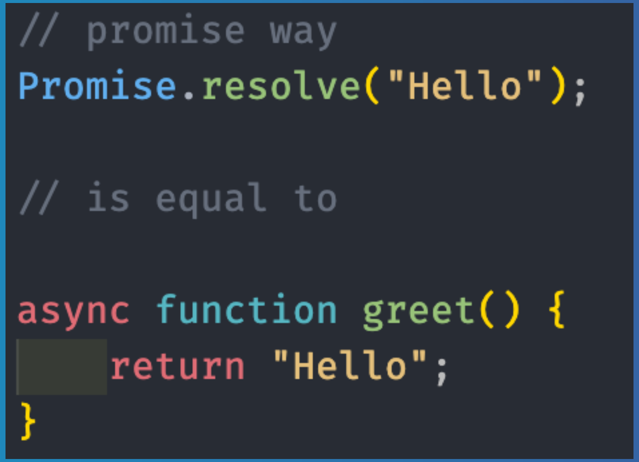
ASYNC/AWAIT

- ES7 introduced a new way to add async behaviour in JavaScript
  - Working with promises became easier
- New **async** and **await** keywords
  - **async** functions will implicitly return a **promise**.
  - Don't have to create new promises yourself.



```
// promise way
Promise.resolve("Hello");

// is equal to

async function greet() {
    return "Hello";
}
```

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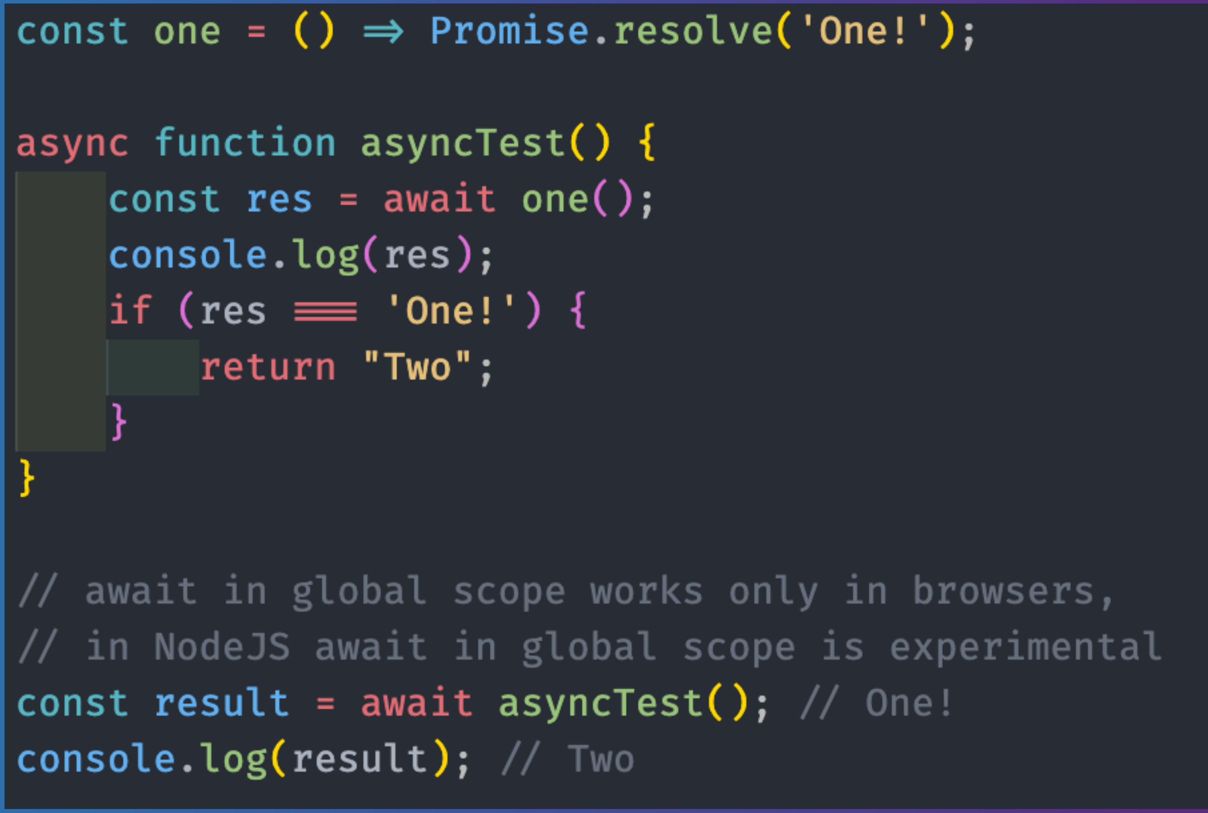
SUSPEND EXECUTION

- **await** keyword *suspends* the asynchronous function and waits for the awaited value return a resolved promise
- To get the value of this resolved promise just assign variables to the awaited promise value!
  - Like we previously did with the then() callback
- await doesn't work in global scope in NodeJS



```
const one = () ⇒ Promise.resolve('One!');

async function asyncTest() {
    const res = await one();
    console.log(res);
    if (res === 'One!') {
        return "Two";
    }
}

// await in global scope works only in browsers,
// in NodeJS await in global scope is experimental
const result = await asyncTest(); // One!
console.log(result); // Two
```

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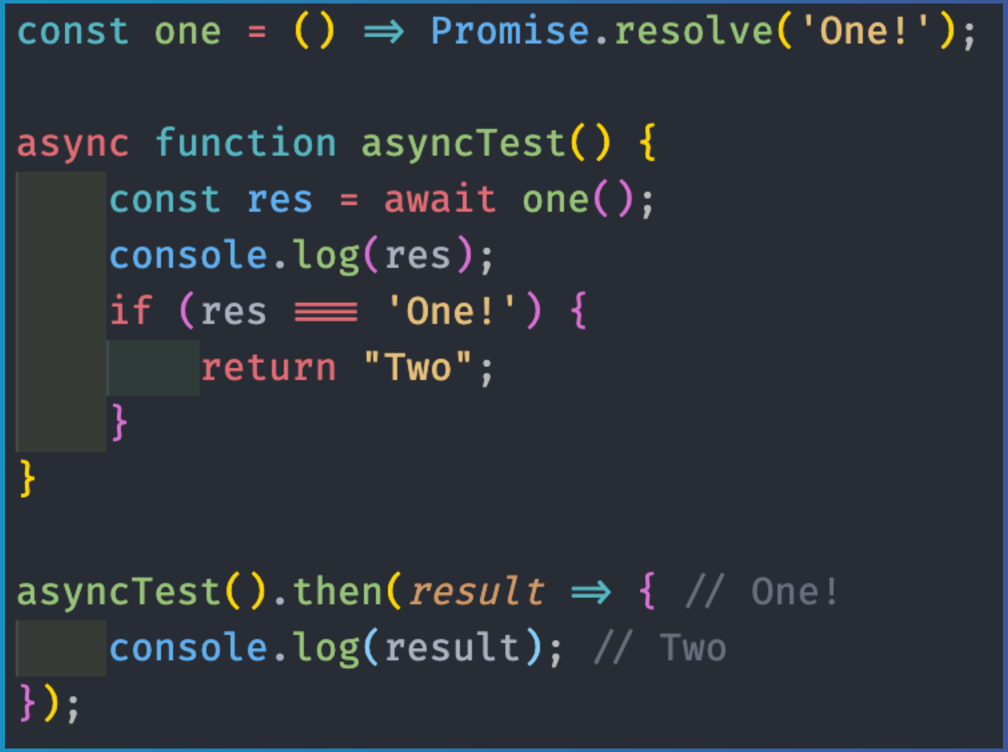
ADD SUGAR

- Async/Await is just syntactic sugar for promises, so you can treat async function like promises



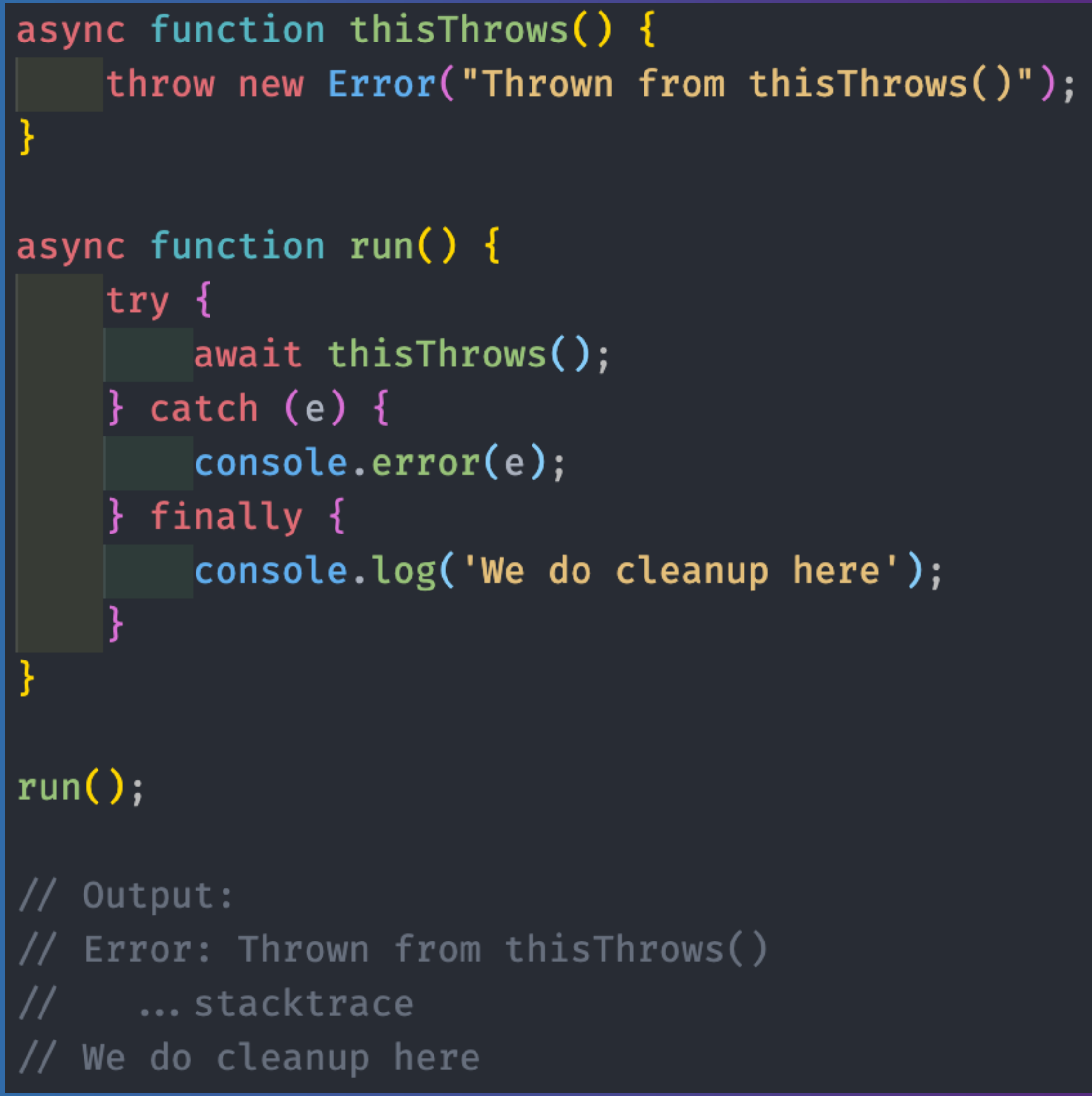
```javascript
const one = () => Promise.resolve('One!');

async function asyncTest() {
    const res = await one();
    console.log(res);
    if (res === 'One!') {
        return "Two";
    }
}

asyncTest().then(result => { // One!
    console.log(result); // Two
});
```

ERROR HANDLING

- Async/await allow us to handle errors the same way we do with synchronous code with **try…catch**



```
async function thisThrows() {
    throw new Error("Thrown from thisThrows()");
}

async function run() {
    try {
        await thisThrows();
    } catch (e) {
        console.error(e);
    } finally {
        console.log('We do cleanup here');
    }
}

run();

// Output:
// Error: Thrown from thisThrows()
//    ...stacktrace
// We do cleanup here
```

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TO
THE
FUTURE
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