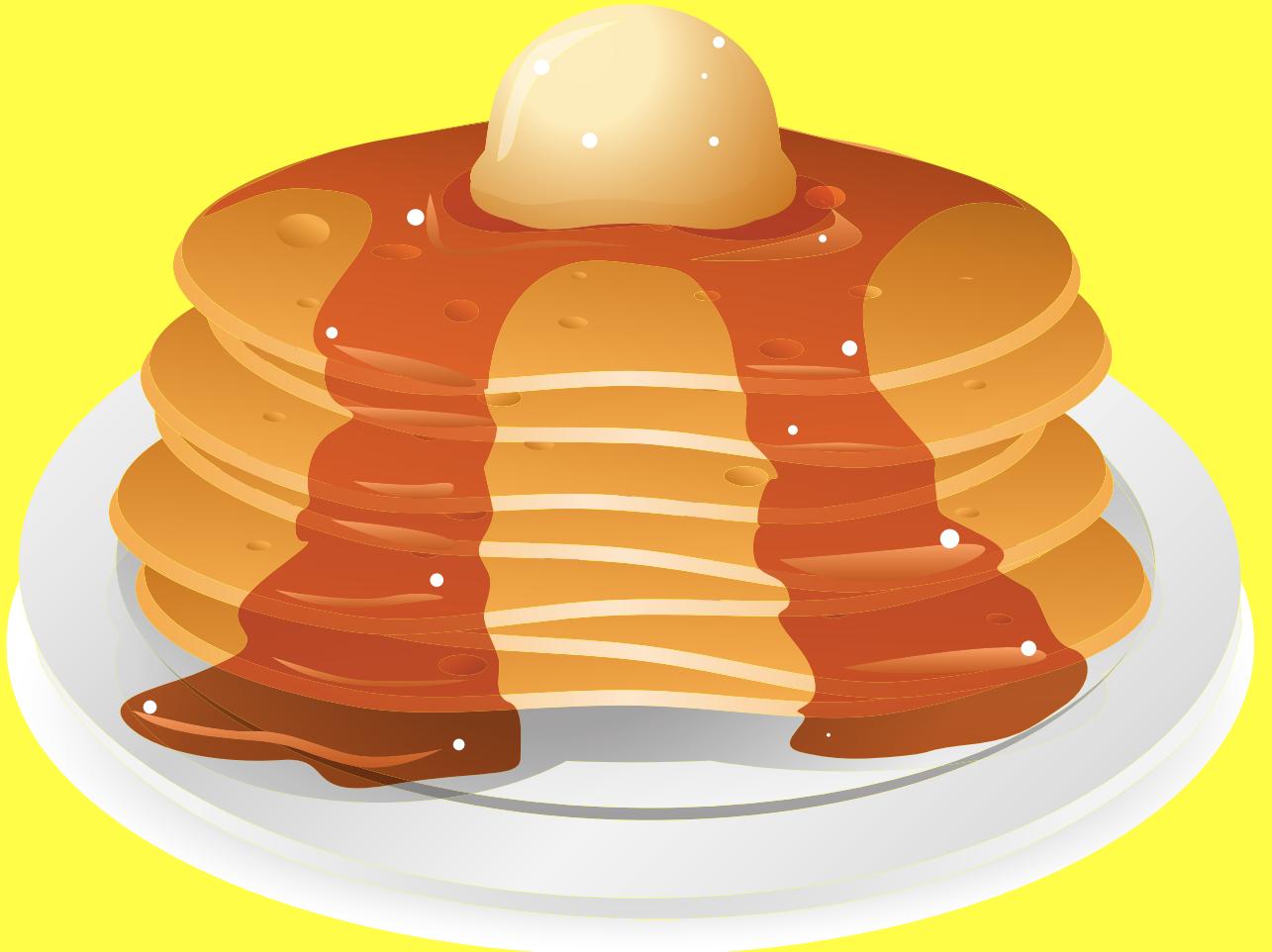


# THE CALL STACK

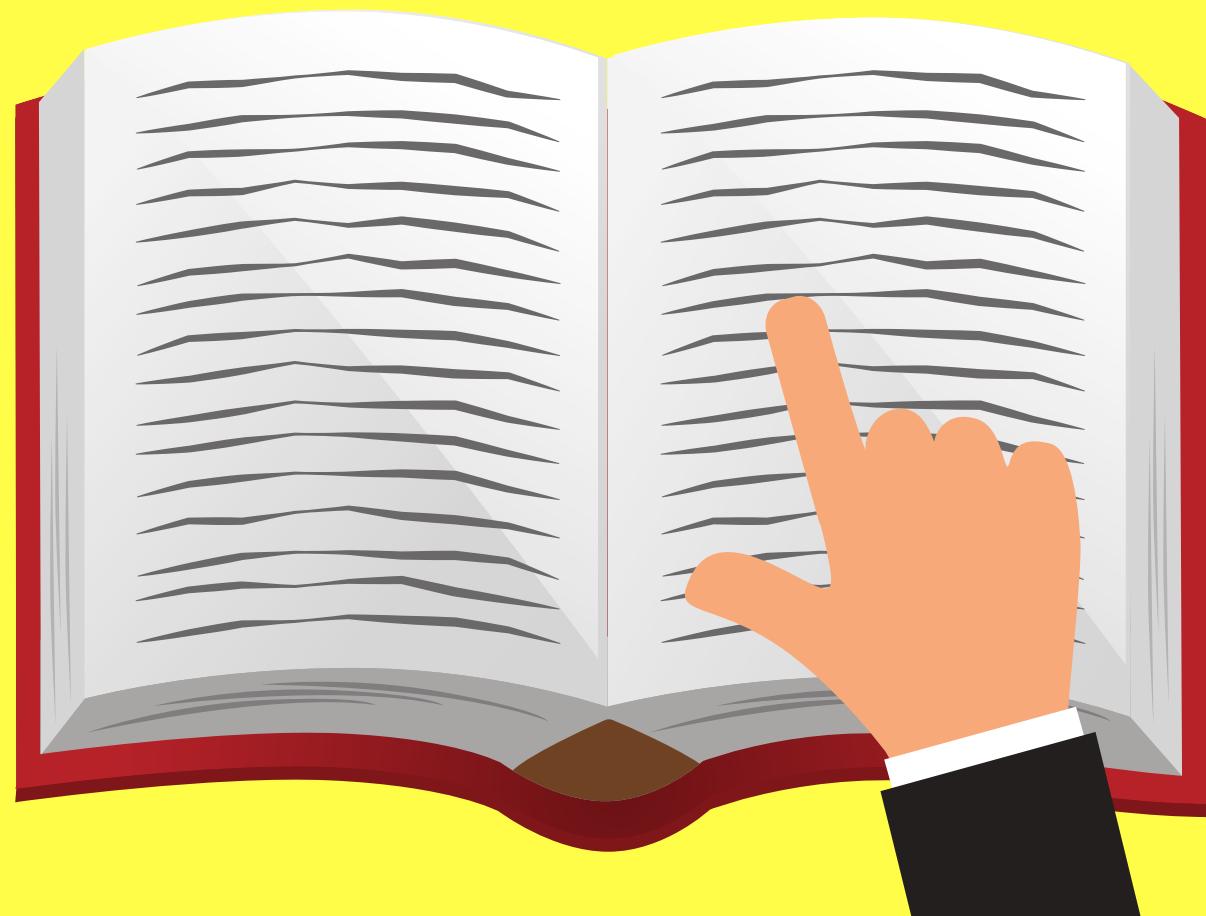


# CALL STACK

The mechanism the JS interpreter uses to keep track of its place in a script that calls multiple functions.

How JS "knows" what function is currently being run and what functions are called from within that function, etc.

# CALL STACK



Let's see...  
where was I? !

LAST  
THING  
IN...



FIRST  
THING  
OUT...



# HOW IT WORKS

- When a script calls a function, the interpreter adds it to the call stack and then starts carrying out the function.
- Any functions that are called by that function are added to the call stack further up, and run where their calls are reached.
- When the current function is finished, the interpreter takes it off the stack and resumes execution where it left off in the last code listing.



```
const multiply = (x, y) => x * y;
```

```
const square = (x) => multiply(x, x);
```

```
const isRightTriangle = (a, b, c) => {
  return square(a) + square(b) === square(c);
};
```

```
isRightTriangle(3, 4, 5);
```

isRightTriangle(3,4,5)  
square(3)+square(4)  
==== square(5)



```
const multiply = (x, y) => x * y;  
→const square = (x) => multiply(x, x);  
const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
isRightTriangle(3, 4, 5);
```

**square(3)**  
multiply(3,3)

**isRightTriangle(3,4,5)**  
square(3)+square(4)  
== square(5)

• • •

```
→ const multiply = (x, y) => x * y;  
  
const square = (x) => multiply(x, x);  
  
const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
  
isRightTriangle(3, 4, 5);
```

**multiply(3,3)**

9

**square(3)**

**multiply(3,3)**

**isRightTriangle(3,4,5)**  
**square(3)+square(4)**  
**== square(5)**



```
const multiply = (x, y) => x * y;  
→const square = (x) => multiply(x, x);  
const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
isRightTriangle(3, 4, 5);
```

**square(3)**

9

**isRightTriangle(3,4,5)**  
**square(3)+square(4)**  
**== square(5)**



```
const multiply = (x, y) => x * y;  
  
const square = (x) => multiply(x, x);  
  
→ const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
  
isRightTriangle(3, 4, 5);
```

isRightTriangle(3,4,5)  
9+square(4) === square(5)



```
const multiply = (x, y) => x * y;  
→ const square = (x) => multiply(x, x);  
const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
isRightTriangle(3, 4, 5);
```

**square(4)**

**multiply(4,4)**

**isRightTriangle(3,4,5)**

**9+square(4) === square(5)**



```
const multiply = (x, y) => x * y;  
  
const square = (x) => multiply(x, x);  
  
const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
  
isRightTriangle(3, 4, 5);
```

**multiply(4,4)**  
16

**square(4)**  
multiply(4,4)

**isRightTriangle(3,4,5)**  
9+square(4) === square(5)



```
const multiply = (x, y) => x * y;  
→ const square = (x) => multiply(x, x);  
const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
isRightTriangle(3, 4, 5);
```

**square(4)**

16

**isRightTriangle(3,4,5)**  
**9+square(4) === square(5)**



```
const multiply = (x, y) => x * y;  
  
const square = (x) => multiply(x, x);  
  
→ const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
  
isRightTriangle(3, 4, 5);
```

isRightTriangle(3,4,5)  
9+16 === square(5)



```
const multiply = (x, y) => x * y;  
→ const square = (x) => multiply(x, x);  
const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
isRightTriangle(3, 4, 5);
```

**square(5)**  
multiply(5,5)

**isRightTriangle(3,4,5)**  
9+16 === **square(5)**



```
const multiply = (x, y) => x * y;  
  
const square = (x) => multiply(x, x);  
  
const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
  
isRightTriangle(3, 4, 5);
```

multiply(5,5)  
25

square(5)  
multiply(5,5)

isRightTriangle(3,4,5)  
9+16 === square(5)



```
const multiply = (x, y) => x * y;  
→ const square = (x) => multiply(x, x);  
const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
isRightTriangle(3, 4, 5);
```

**square(5)**

**25**

**isRightTriangle(3,4,5)**  
 $9+16 === \text{square}(5)$



```
const multiply = (x, y) => x * y;  
  
const square = (x) => multiply(x, x);  
  
→ const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
  
isRightTriangle(3, 4, 5);
```

**isRightTriangle(3,4,5)**

9+16 === 25



```
const multiply = (x, y) => x * y;  
  
const square = (x) => multiply(x, x);  
  
→ const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
  
isRightTriangle(3, 4, 5);
```

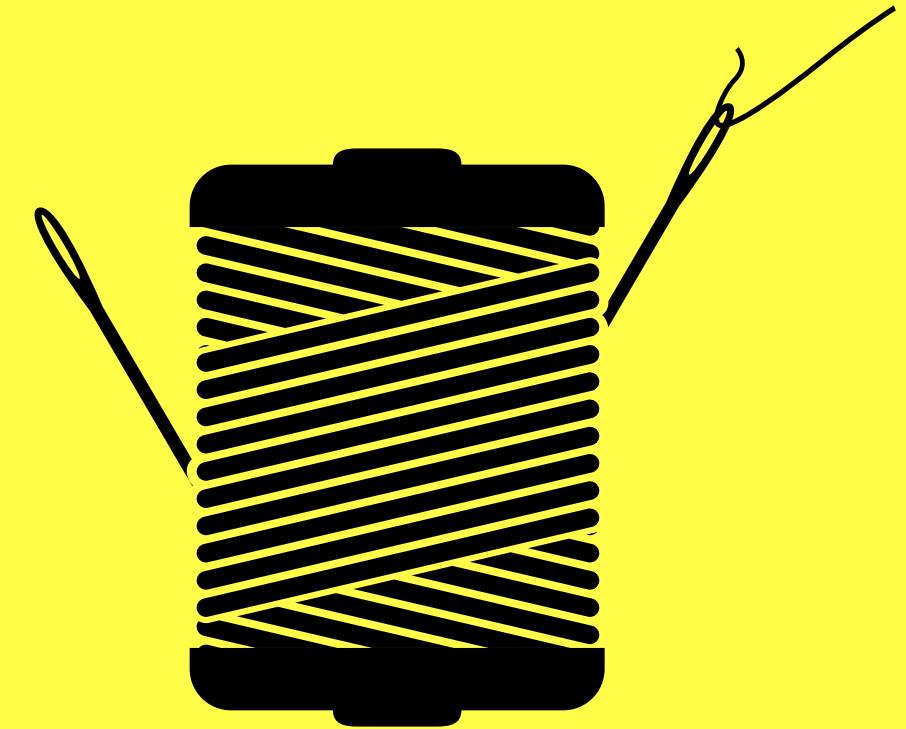
isRightTriangle(3,4,5)  
true



```
const multiply = (x, y) => x * y;  
  
const square = (x) => multiply(x, x);  
  
→ const isRightTriangle = (a, b, c) => {  
    return square(a) + square(b) === square(c);  
};  
  
isRightTriangle(3, 4, 5);
```

true

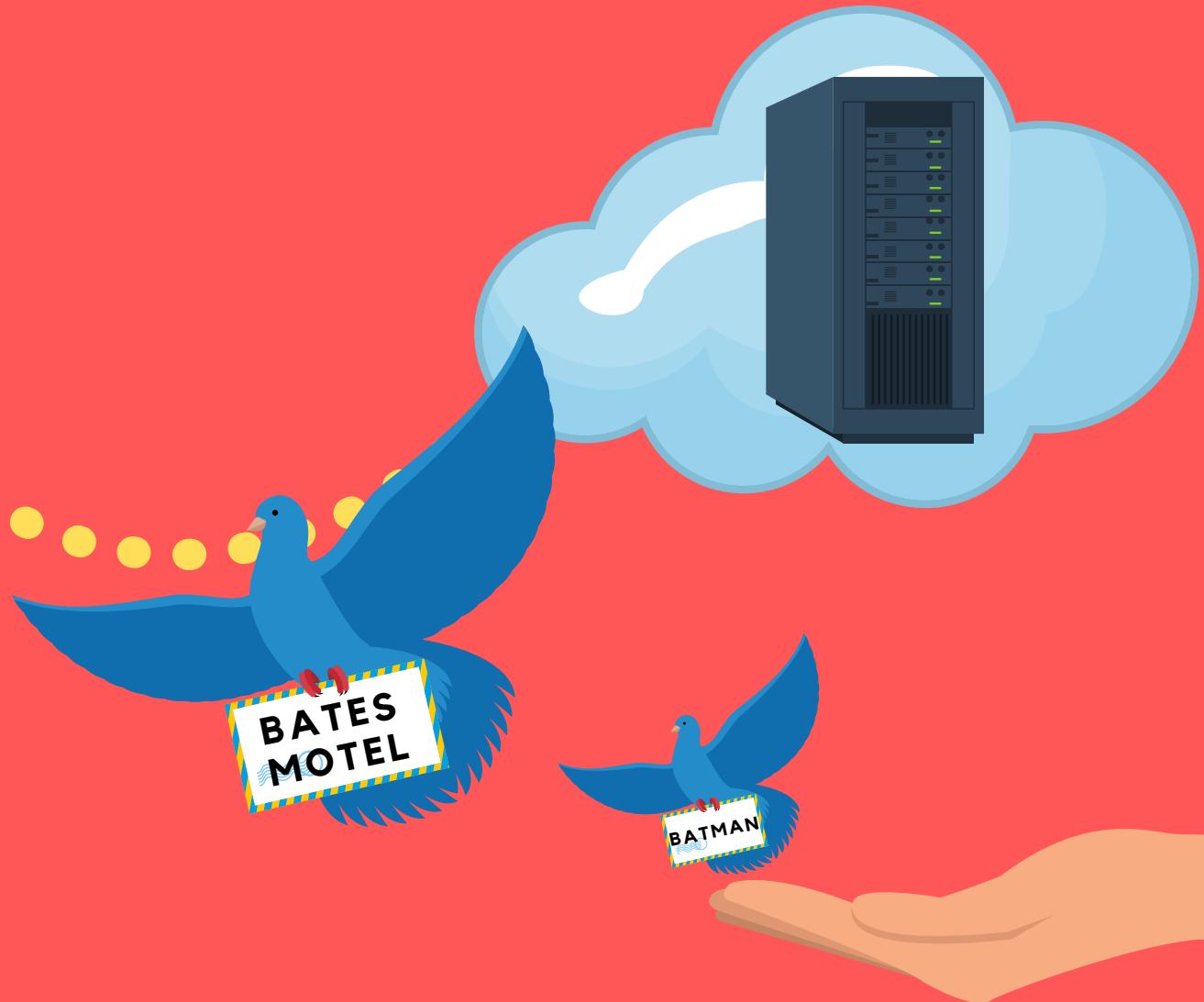
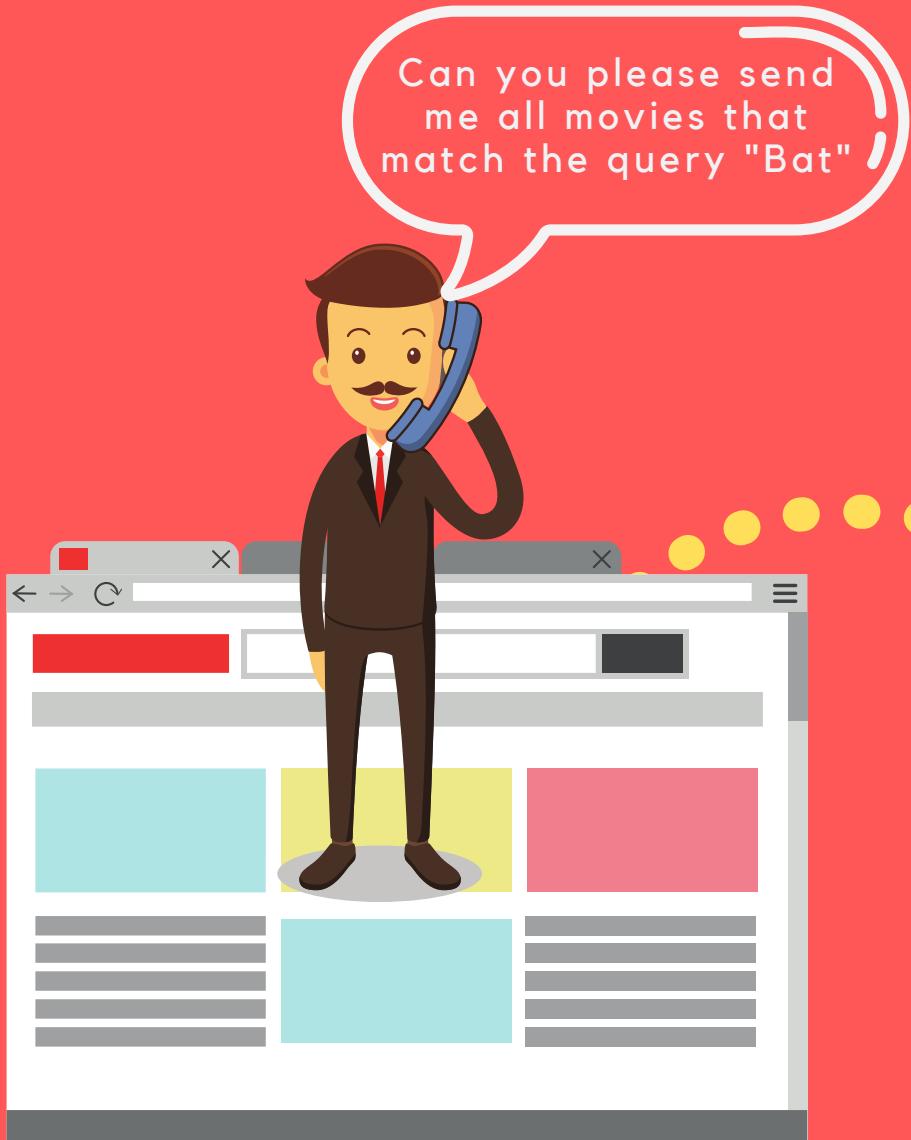
JS IS  
SINGLE  
THREADED

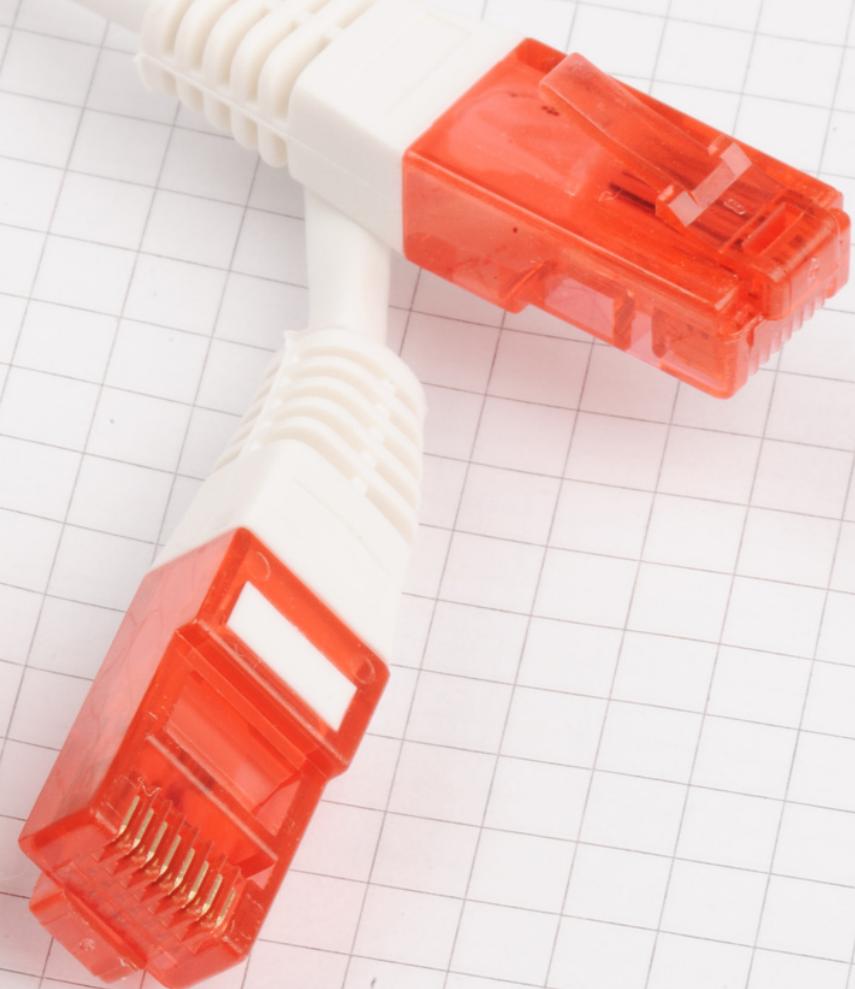


# **WHAT DOES THAT MEAN?**

At any given point in time, that single JS thread is running at most one line of JS code.







**THIS TAKES TIME**

**IS OUR APP  
GOING TO  
GRIND TO  
A HALT?**



# What happens when something takes a long time?



```
const newTodo = input.value; //get user input  
saveToDatabase(newTodo); //this could take a while!  
input.value = ''; //reset form
```

Fortunately...  
We have a workaround

```
● ● ●  
console.log('I print first!');  
setTimeout(() => {  
  console.log('I print after 3 seconds');  
, 3000);  
console.log('I print second!');
```



CALLBACKS????!

# HOW??



THE  
BROWSER  
DOES THE  
WORK!



# OK BUT HOW?

- Browsers come with Web APIs that are able to handle certain tasks in the background (like making requests or setTimeout)
- The JS call stack recognizes these Web API functions and passes them off to the browser to take care of
- Once the browser finishes those tasks, they return and are pushed onto the stack as a callback.

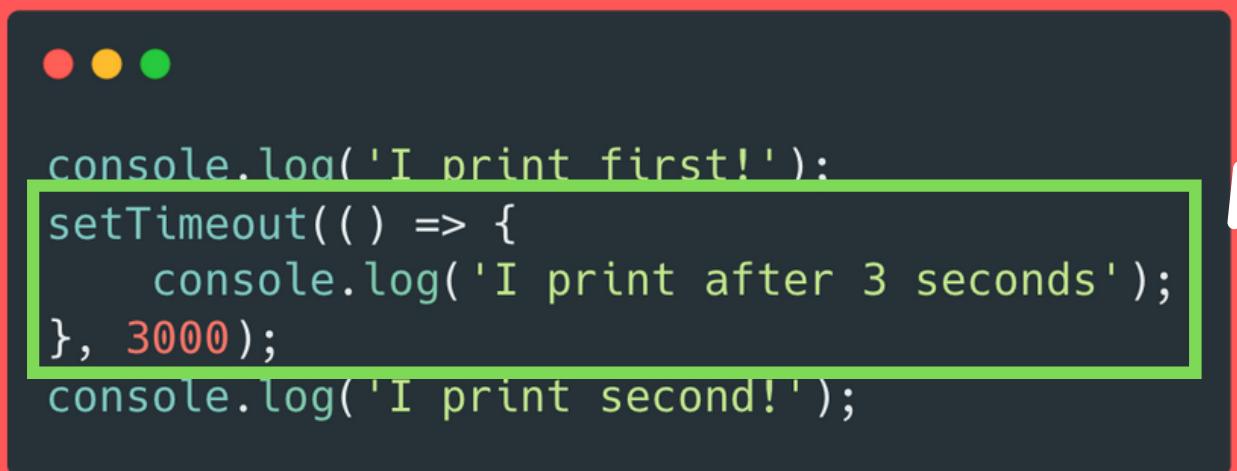


> I print first!

```
● ● ●  
console.log('I print first!');  
setTimeout(() => {  
    console.log('I print after 3 seconds');  
}, 3000);  
console.log('I print second!');
```



```
> I print first!
```



```
console.log('I print first!');  
setTimeout(() => {  
    console.log('I print after 3 seconds');  
}, 3000);  
console.log('I print second!');
```



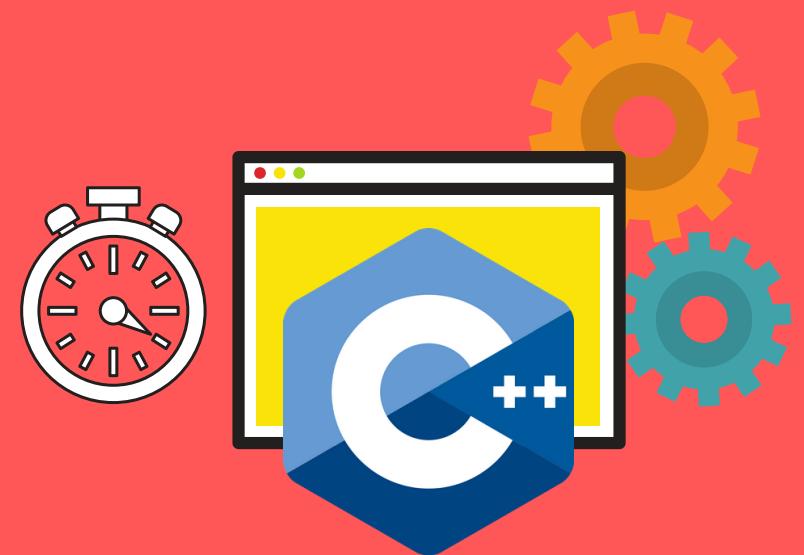
Hey browser, can you  
set a timer for 3  
seconds?

OKEEEDOKEEE



> I print first!  
> I print second!

```
● ● ●  
console.log('I print first!');  
setTimeout(() => {  
    console.log('I print after 3 seconds');  
}, 3000);  
console.log('I print second!');
```



- > I print first!
- > I print second!

```
● ● ●  
console.log('I print first!');  
setTimeout(() => {  
    console.log('I print after 3 seconds');  
, 3000);  
console.log('I print second!');
```



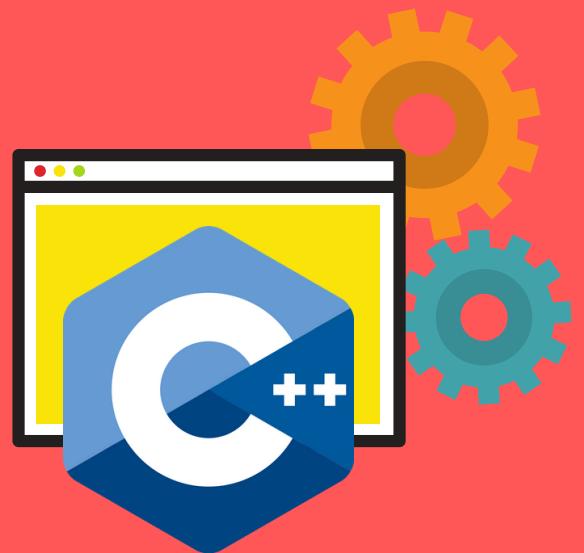
Will do!  
Thanks, browser!

Time's Up!!!  
Make sure you run  
that callback now!!



- > I print first!
- > I print second!
- > I print after 3 seconds!

```
● ● ●  
console.log('I print first!')  
setTimeout(() => {  
    console.log('I print after 3 seconds');  
}, 3000);  
console.log('I print second!');
```



```
fs.readdir(source, function (err, files) {
  if (err) {
    console.log('Error finding files: ' + err)
  } else {
    files.forEach(function (filename, fileIndex) {
      console.log(filename)
      gm(source + filename).size(function (err, values) {
        if (err) {
          console.log('Error identifying file size: ' + err)
        } else {
          console.log(filename + ' : ' + values)
          aspect = (values.width / values.height)
          widths.forEach(function (width, widthIndex) {
            height = Math.round(width / aspect)
            console.log('resizing ' + filename + 'to ' + height + 'x' + height)
            this.resize(width, height).write(dest + 'w' + width + '_' + filename,
function(err) {
  if (err) console.log('Error writing file: ' + err)
  })
  .bind(this))
}
})
})
})
})
```

# Callback Hell



# ENTER PROMISES

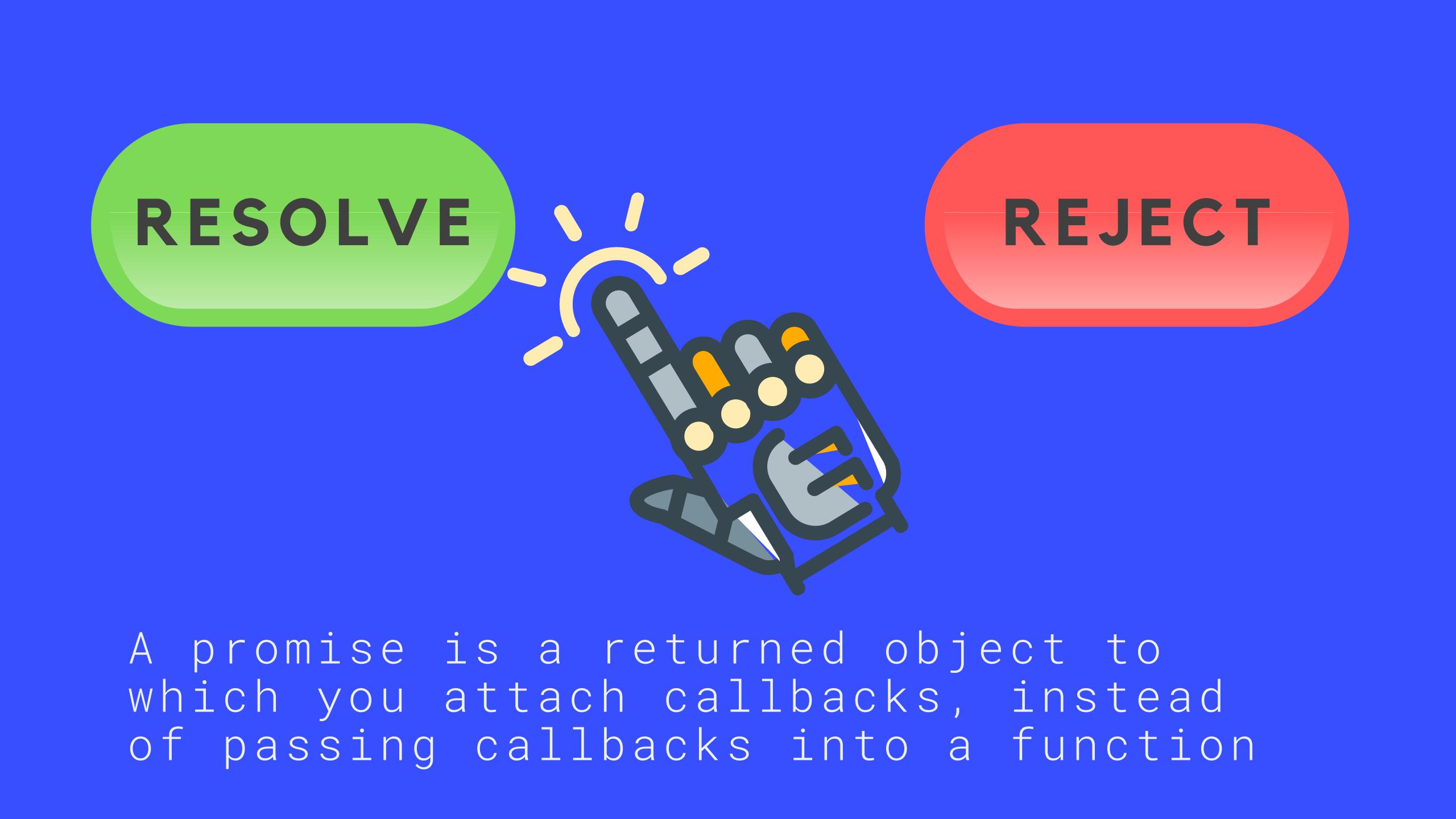
A Promise is an object representing the eventual completion or failure of an asynchronous operation



# PROMISES

A pattern  
for writing  
async code.





# RESOLVE

# REJECT

A promise is a returned object to which you attach callbacks, instead of passing callbacks into a function

loadRedditPosts (not shown)  
returns a promise



```
loadRedditPosts('/r/funny')
  //this runs if promise is resolved:
  .then((res) => {
    console.log(res.data);
  })
  //this runs if promise is rejected:
  .catch((err) => {
    console.log('Oh No!', err);
  });
}
```

This function returns a Promise which is randomly resolved/rejected.

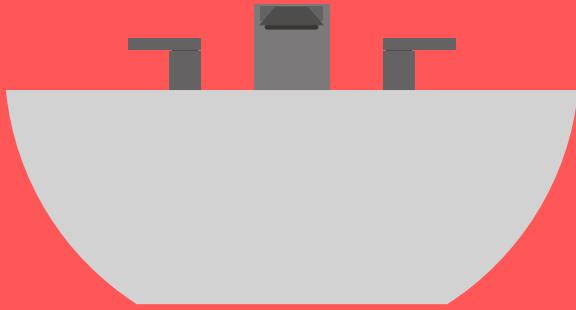


```
const makeFakeRequest = () => {
  return new Promise((resolve, reject) => {
    setTimeout(() => {
      const randNum = Math.random();
      if (randNum > 0.5) resolve({ data: 'lol', status: 200 });
      reject({ status: 404, data: 'NO DICE' });
    }, 1000);
  });
};
```

# ASYNC FUNCTIONS



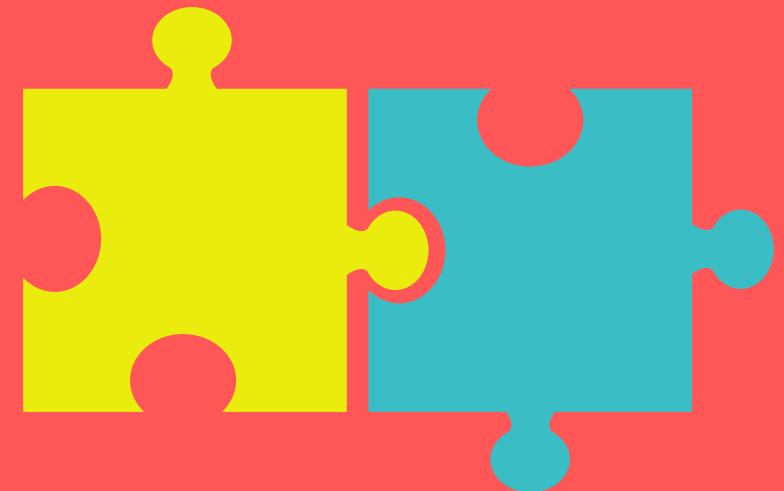
# ASYNC FUNCTIONS



A newer and cleaner syntax for  
working with async code!  
Syntax "*makeup*" for promises

# 2 PIECES

- ASYNC
- WAIT



# The `async` keyword

- Async functions always return a promise.
- If the function returns a value, the promise will be resolved with that value
- If the function throws an exception, the promise will be rejected



```
async function hello() {  
    return 'Hey guy!';  
}  
hello();  
// Promise {<resolved>: "Hey guy!"}  
async function uhOh() {  
    throw new Error('oh no!');  
}  
uhOh();  
//Promise {<rejected>: Error: oh no!}
```

# The *await* keyword

- We can only use the `await` keyword inside of functions declared with `async`.
- `await` will pause the execution of the function, **waiting for a promise to be resolved**