NODE PATTERNS

FROM CALLBACKS TO OBSERVER

SLIDES 📄

[HTTPS://GITHUB.COM/AZAT-CO/NODE-PATTERNS](https://github.com/azat-co/node-patterns)

```
git clone https://github.com/azat-co/node-patterns
```

ABOUT PRESENTER

AZAT MARDAN

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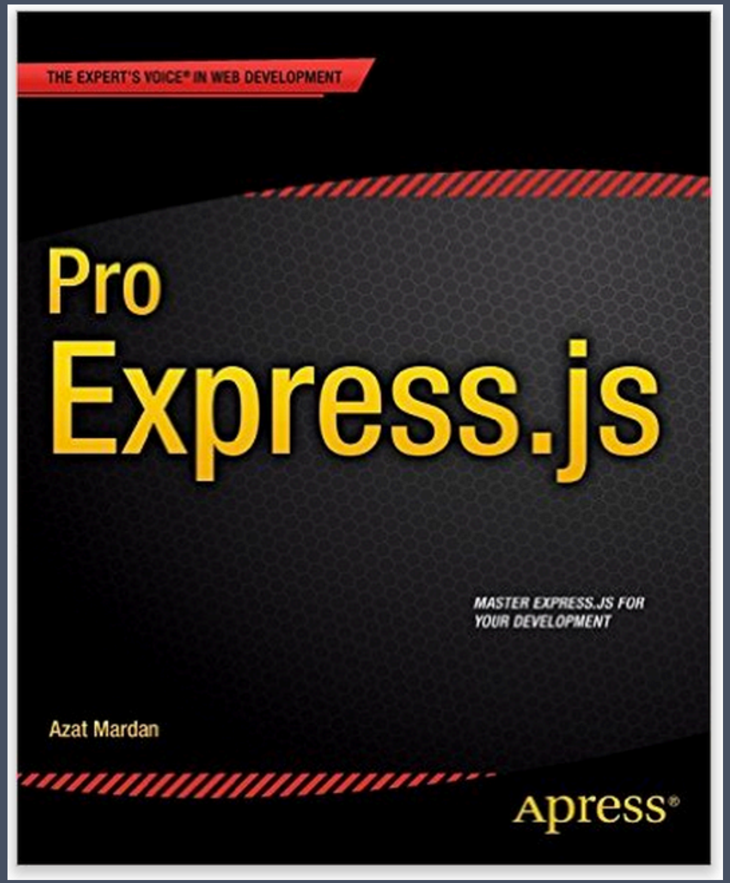
ABOUT PRESENTER

- WORK: TECHNOLOGY FELLOW AT CAPITAL ONE
- EXPERIENCE: FDIC, NIH, DOCUSIGN, HACKREACTOR AND STORIFY
- BOOKS: PRACTICAL NODE.JS, PRO EXPRESS.JS, EXPRESS.JS API AND 8 OTHERS
- TEACH: NODEPROGRAM.COM



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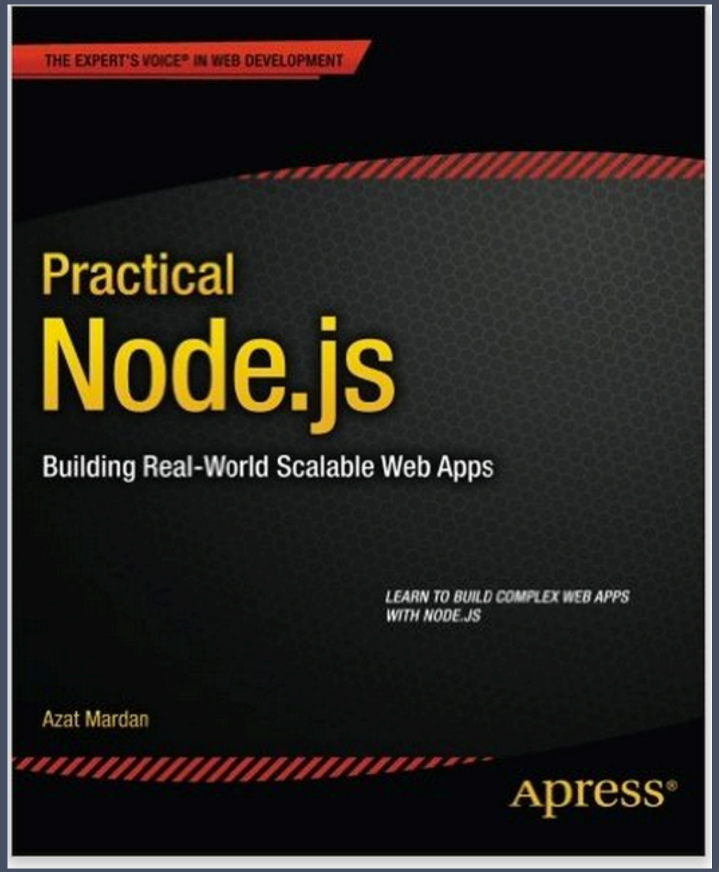

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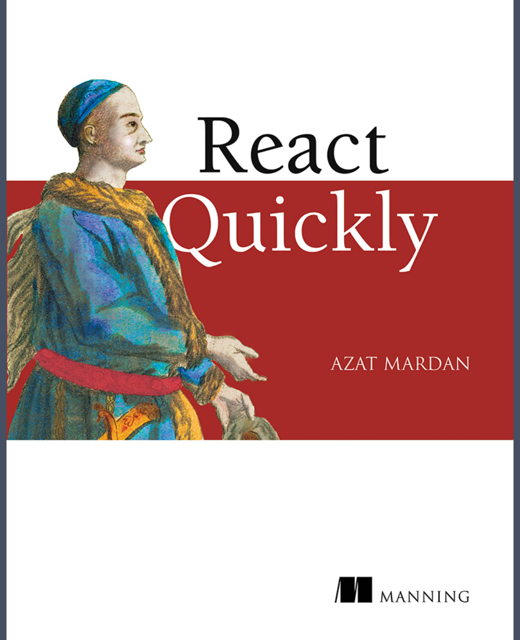

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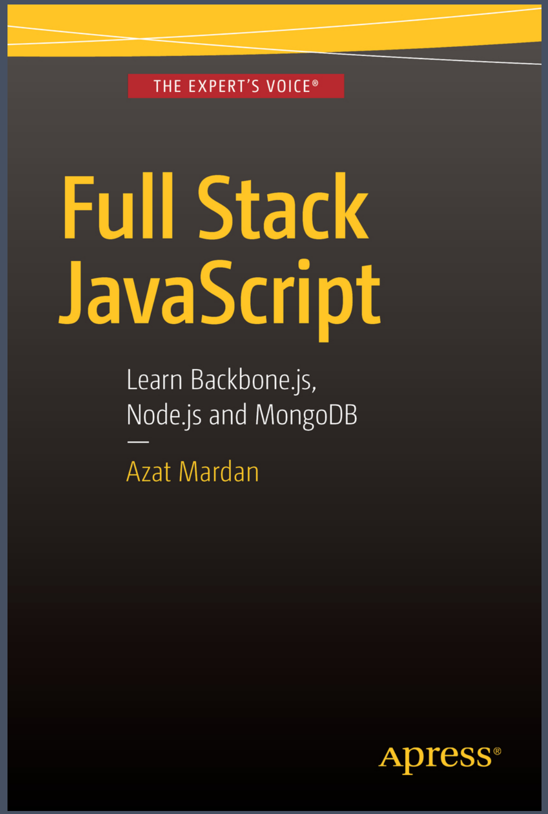

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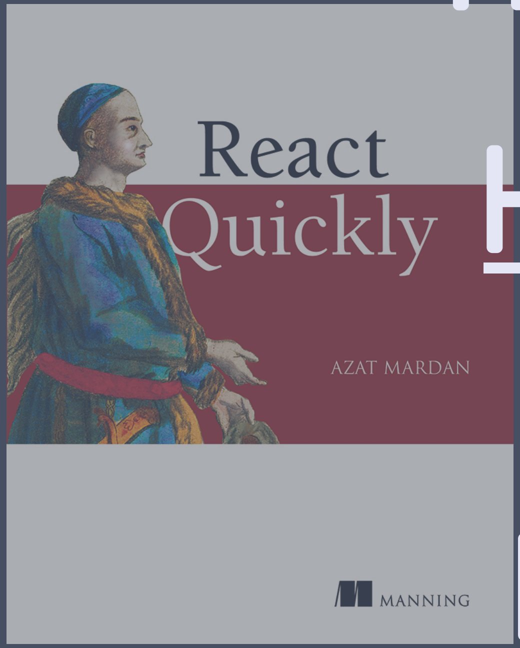


FREE: 7+ HOURS OF VIDEOS

HTTP://REACTQUICKLY.CO

AND

HTTP://BIT.LY/1UMNOPC

NODE BASICS

- JAVASCRIPT
- ASYNCHRONOUS + EVENT DRIVEN
- NON-BLOCKING I/O

WHY CARE?

- ASYNC CODE IS HARD
- CODE COMPLEXITY GROWS EXPONENTIALLY
- GOOD CODE ORGANIZATION IS IMPORTANT

JAVASCRIPT? 😒

PROBLEM

HOW TO SCHEDULE SOMETHING IN THE FUTURE?

CALLBACKS ALL THE WAY!

FUNCTIONS ARE FIRST-CLASS CITIZENS

```
var t = function(){...}
setTimeout(t, 1000)
```

T IS A CALLBACK

CALLBACK CONVENTION

```
var fs = require('fs')
var callback = function(error, data){...}
fs.readFile('data.csv', 'utf-8', callback)
```

CONVENTIONS

- `error` 1ST ARGUMENT, NULL IF EVERYTHING IS OKAY
- `data` IS THE SECOND ARGUMENT
- `callback` IS THE LAST ARGUMENT

NOTE

NAMING DOESN'T MATTER BUT ORDER MATTERS.

NODE.JS WON'T ENFORCE THE ARGUMENTS.

CONVENTION IS NOT A GUARANTEE. IT'S JUST A STYLE. - READ DOCUMENTATION OR SOURCE CODE.

PROBLEM

HOW TO ENSURE THE RIGHT SEQUENCE? CONTROL FLOW 😕

EXAMPLE

HTTP REQUESTS TO:

1. GET AN AUTH TOKEN
2. FETCH DATA
3. PUT AN UPDATE

THEY MUST BE EXECUTED IN A CERTAIN ORDER.

```
... // callback is defined, callOne, callTwo, and callThree are defined
callOne({...}, function(error, data1) {
    if (error) return callback(error, null)
    // work to parse data1 to get auth token
    // fetch the data from the API
    callTwo(data1, function(error, data2) {
        if (error) return callback(error, null)
        // data2 is the response, transform it and make PUT call
        callThree(data2, function(error, data3) {
            //
            if (error) return callback(error, null)
            // parse the response
            callback(null, data3)
        })
    })
})
```

WELCOME TO CALLBACK HELL

```
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

- HARD TO READ
- HARD TO MODIFY/MAINTAIN/ENHANCE
- EASY FOR DEVS TO MAKE BUGS
- CLOSING PARENS - 👿

CALLBACKHELL.COM

SOLUTIONS

- ABSTRACT INTO NAMED FUNCTIONS (HOISTED OR VARIABLES)
- USE OBVERVERS
- USE ADVANCED LIBRARIES AND TECHNIQUES

NAMED FUNCTIONS

```
callOne({...}, processResponse1)

function processResponse1(error, data1) {
  callTwo(data1, processResponse2)
}

function processResponse2(error, data2) {
  callThere(data2, processResponse3)
}

function processResponse3(error, data1) {
  ...
}
```

MODULAR FUNCTIONS

```
var processResponse1 = require('./response1.js')
callOne({...}, processResponse1)

// response1.js
var processResponse2 = require('./response2.js')
module.exports = function processResponse1(error, data1) {
  callTwo(data1, processResponse2)
}
```

```
// response2.js
var processResponse3 = require('./response3.js')
module.exports = function processResponse2(error, data2) {
  callThere(data2, processResponse3)
}

// response3.js
module.exports = function processResponse3(error, data3) {
  ...
}
```

PROBLEM

HOW TO MODULARIZE CODE PROPERLY?

- `module.exports = {...}`
- `module.exports.obj = {...}`
- `exports.obj = {...}`

NOTE: `exports = {...}` IS ANTI-PATTERN.

PROBLEM

HOW TO MODULARIZE DYNAMIC CODE OR WHERE TO INITIALIZE?

SOLUTION

- `module.exports = function(options) {...}`
- `module.exports.func = function(options) {...}`
- `exports.func = function(options) {...}`

IMPORT

```
// code A
module.exports = function(options){
  // code B
}
```

WHEN YOU `require`, CODE A IS RUN AND CODE B IS NOT. CODE A IS RUN ONLY ONCE, NO MATTER HOW MANY TIMES YOU `require`. YOU NEED TO INVOKE THE OBJECT TO RUN CODE B.

DEMO

```
node import-main
```

IMPORTING FOLDERS / PLUGIN PATTERN

```
// main.js
var routes = require('./routes')

// routes/index.js
module.exports = {
  users: require('./users.js'),
  accounts: require('./accounts.js')
  ...
}
```

SINGLETONS

- `require`: MODULES ARE CACHED

```javascript
// module.js
var a = 1 // Private
module.exports = {
  b: 2 // Public
}
```

```
// program.js
var m = require('./module')
console.log(m.a) // undefined
console.log(m.b) // 2
m.b ++
require('./main')
```

```
// main.js
var m = require('./module')
console.log(m.b) // 3
```

DEMO

```
node main.js
node program.js
```

PROBLEM

MODULES ARE CACHED ON BASED ON THEIR RESOLVED FILENAME.

FILENAME WILL BREAK THE CACHING

```
var m = require('./MODULE')
var m = require('./module')
```

OR DIFFERENT PATHS

SOLUTION

`global`

```
global.name
```

OR

```
GLOBAL.name
```

```
_log = global.console.log
global.console.log = function(){
  var args = arguments
  args[0] = '\033[31m' +args[0] + '\x1b[0m'
  return _log.apply(null, args)
}
```

GLOBAL IS POWERFUL... ANTI-PATTERN

SIMILAR `window.jQuery = jQuery`

USE IT SPARRINGLY

PROBLEM: NO CLASSES

HOW TO ORGANIZE YOUR MODULAR CODE INTO CLASSES?

PROTOTYPES

(AT LEAST IN ES5)

OBJECTS INHERIT FROM OTHER OBJECTS

FUNCTIONS ARE OBJECTS TOO.

SOLUTION

```
module.exports = function(options) {
  // initialize
  return {
    getUsers: function() {...},
    findUserById: function(){...},
    limit: options.limit || 10,
    // ...
  }
}
```

SOLUTION

```
require('util').inherits(child, parent)
```

CALLBACKS EXTREME

NODE.JS MIDDLEWARE PATTERN

WHAT IS MIDDLEWARE

MIDDLEWARE PATTERN IS A SERIES OF PROCESSING UNITS CONNECTED TOGETHER, WHERE THE OUTPUT OF ONE UNIT IS THE INPUT FOR THE NEXT ONE. IN NODE.JS, THIS OFTEN MEANS A SERIES OF FUNCTIONS IN THE FORM:

```
function(args, next) {
  // ... Run some code
  next(output) // Error or real output
}
```

CONTINUITY

REQUEST IS COMING FROM A CLIENT AND RESPONSE IS SENT BACK TO THE CLIENT.

```
request->middleware1->middleware2->...middlewareN->route->response
```

EXPRESS.JS MIDDLEWARE

```
app.use(function(request, response, next) {
  // ...
  next()
}, function(request, response, next) {
  next()
}, function(request, response, next) {
  next()
})
```

PROBLEM

CALLBACKS ARE STILL HARD TO MANAGE EVEN IN MODULES!

EXAMPLE

1. MODULE JOB IS PERFORMING A TASK.
2. IN THE MAIN FILE, WE IMPORT JOB.

HOW DO WE SPECIFY A CALLBACK (SOME FUTURE LOGIC) ON THE JOB'S TASK COMPLETION?

MAYBE:

```
var job = require('./job.js')(callback)
```

WHAT ABOUT MULTIPLE CALLBACKS?

NOT VERY SCALABLE 😢

SOLUTION

OBSERVER PATTERN WITH EVENT EMITTERS!

```
// module.js
var util = require('util')
var Job = function Job() {
  // ...
  this.process = function() {
    // ...
    job.emit('done', { completedOn: new Date() })
  }
}

util.inherits(Job, require('events').EventEmitter)
module.exports = Job
```

```
// main.js
var Job = require('./module.js')
var job = new Job()

job.on('done', function(details){
  console.log('Job was completed at', details.completedOn)
  job.removeAllListeners()
})

job.process()
```

```
emitter.listeners(eventName)

emitter.on(eventName, listener)

emitter.once(eventName, listener)

emitter.removeListener(eventName, listener)
```

DEPENDENCY INJECTION

```
// server.js
var app = express()
app.set(port, 3000)
...
app.use(logger('dev'))
...
var boot = require('./routes')(app)
boot({...}, function(){...})
```

FUNCTION WHICH RETURNS A FUNCTION

```
// routes/index.js
module.exports = function(app){
  return function(options, callback) {
    app.listen(app.get('port'), options, callback)
  }
}
```

THERE ARE MORE PATTERNS!

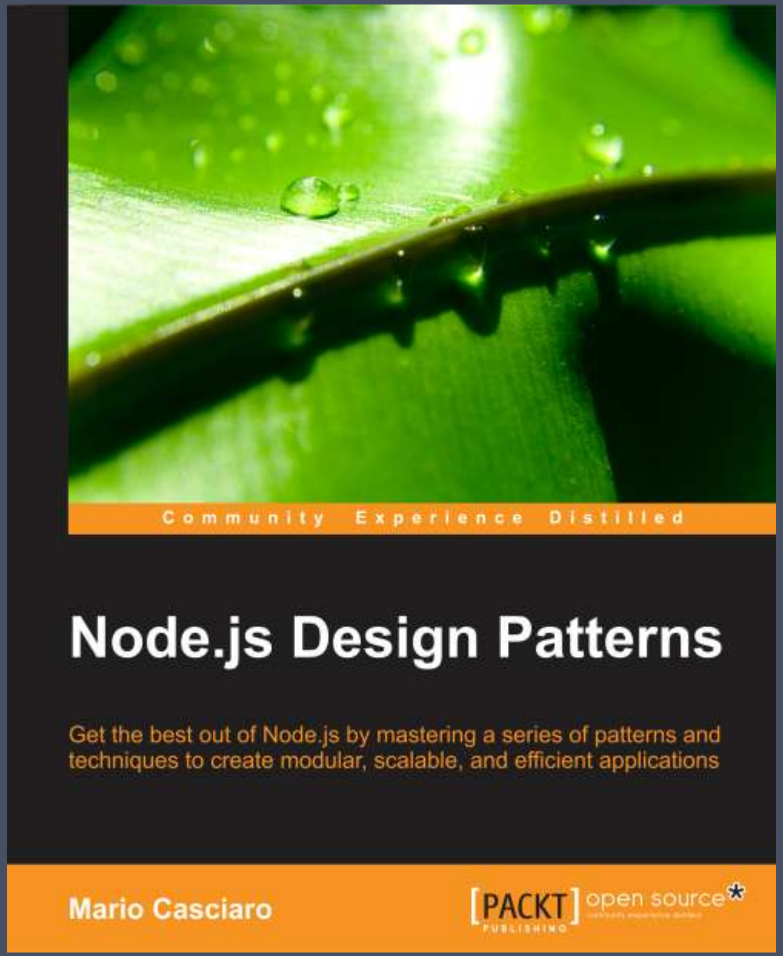
FURTHER ASYNC

- `async` AND `neo-async`
- PROMISES - NOT REALLY HELPING MUCH
- GENERATORS - PROMISING
- ASYNC AWAIT - NICE WRAPPER FOR PROMISES

FURTHER STUDY

- `hooks`
- `require-dir`, `require-directory` AND `require-all`

FURTHER READING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Mario Casciaro
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30-SECOND SUMMARY

1. CALLBACKS
2. OBSERVER
3. SINGLETON
4. PLUGINS
5. MIDDLEWARE
6. BUNCH OF OTHER STUFF 💥

THE END

I KNOW IT'S BEEN A LOT 😓 EVENT EMITTERS, MODULES AND CALLBACKS ARE AT THE CORE OF NODE. KNOW THY PATTERNS!

WE LOSE WHAT WE DON'T USE.

RATE THIS TALK 👍

SCALE 1-10 (10 IS HIGHEST)

ANYONE BELOW 8?

THIS IS YOUR CHANCE ASK A QUESTION TO MAKE IT 10!

Q&A ❓🙋👍

SEND BUGS 🐛 TO

[HTTPS://GITHUB.COM/AZAT-CO/NODE-PATTERNS/ISSUES](https://github.com/azat-co/node-patterns/issues)

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