Node Patterns

From Callbacks to Observer

The one true #JavaScript exception handler pattern

The one true Node exception handler pattern

```
process.on('uncaughtException',
  e => require('opn')(`http://stackoverflow.com/search?q=[node.js ]+${e.message}`)
)
```

Why Turn off Your IM and Care?

1. You want to write and organize code better
2. You want to become a go-to Node person in your team
3. You want to understand Node things a bit deeper

Slides 

https://github.com/azat-co/node-patterns

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

About Presenter

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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

Node Basics

- JavaScript, but not "==="
- Asynchronous + Event Driven
- Non-Blocking I/O

JavaScript? 😒

» Async code is hard

» Code complexity grows exponentially

» Good code organization is important

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

```
// 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
```

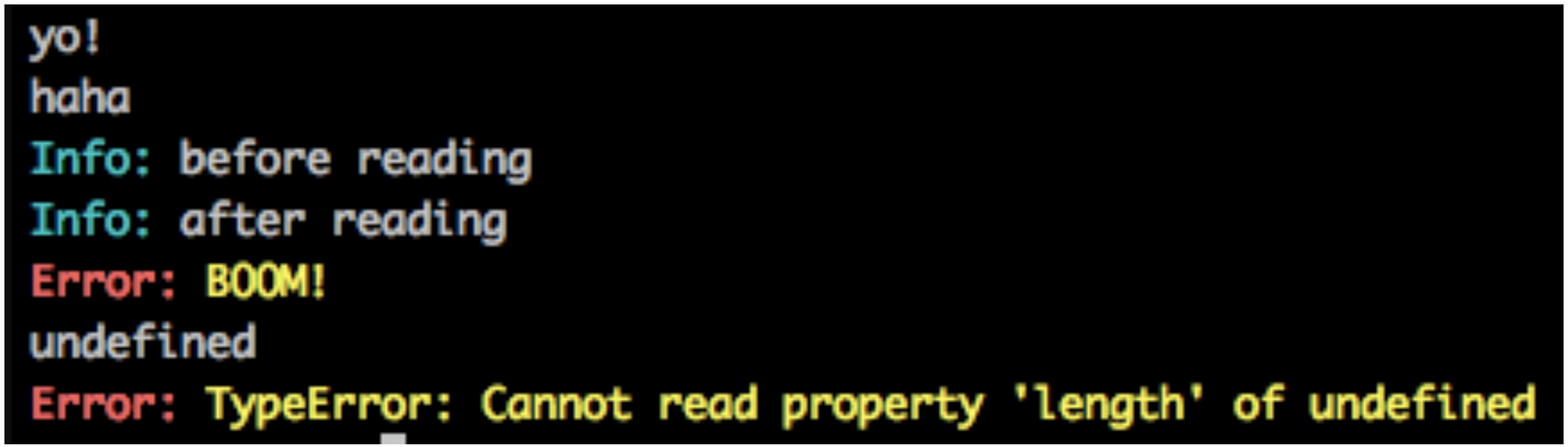
or

```
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)
}
require('./logs.js')
```

Color Logs

```
global.error = global.console.error = msg =>
  console.log( '\x1b[31m\x1b[1mError:\x1b[22m \x1b[93m' + msg + '\x1b[0m' )
global.info = global.console.info = msg =>
  console.log( '\x1b[31m\x1b[36mInfo:\x1b[22m \x1b[93m\x1b[0m' + msg )
global.log = console.log
```



global is powerful… anti-pattern

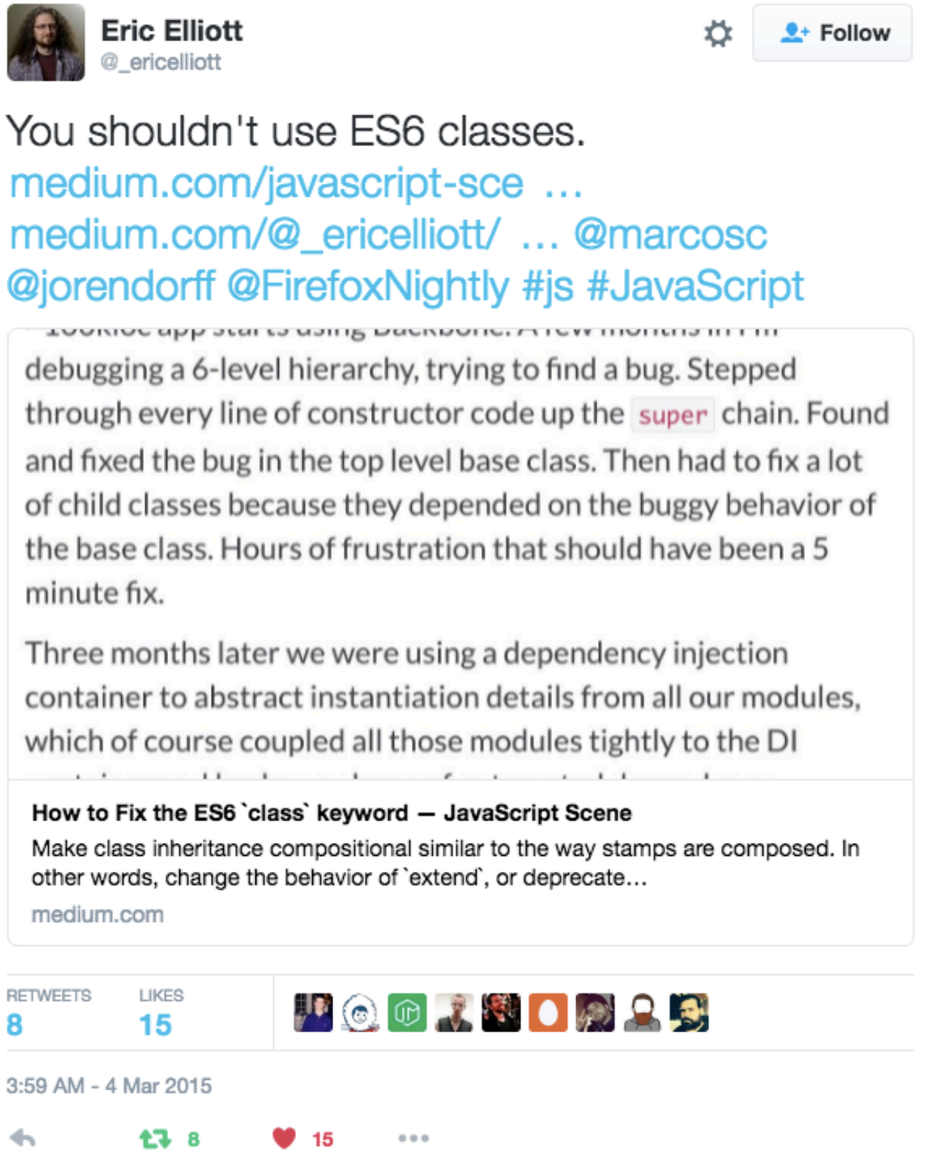
similar `window.jQuery = jQuery`

use it sparringly

Problem: How to organize your modular code into classes?

» ES5 Classes are too complex (new, prototype, this)

» ES6 Classes don't allow define property and other issues



Sidenote: Prototypes

Objects inherit from other objects

Functions are objects too.

Solution

Function factory for objects

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

Solution 2

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

Problem

Enhance functionality "on the fly"

Decorator: An enhance an object

```
let userModel = function(options = {}) {
 return {
   getUsers: function() {},
   findUserById: function(){},
   limit: options.limit || 10
 }
}
let user = userModel()
console.log(user.limit)
let adminModel = (userModel) => {
  userModel.limit += 20
  userModel.removeUser = ()=> {}
  userModel.addUser = ()=>{}
  return userModel
}
console.log(adminModel(user).limit)
```

// 10 30

Problem

How to enhance classes defined wit prototypal inheritance?

Prototype Decorator: Enhance global object

```
Object.prototype.toPrettyJSON = function() {
  console.log(this)
  return JSON.stringify(this, null, 2)
}
let obj = new Object({a: 1})
console.log(obj.toPrettyJSON())
```

Should: https://github.com/shouldjs/should.js

Problem

Non-blocking I/O can be blocked 😢

Have you ever seen this code?

```
setTimeout(function timeout() {
  console.log('Hello Node')
}, 0)
```

```
// setimmediate.js
setImmediate(function A() {
  setImmediate(function B() {
    console.log('Step 1')
  })
  setImmediate(function C() {
    console.log('Step 2')
    setImmediate(function F() { console.log('Step 3') })
    setImmediate(function G() { console.log('Step 4') })
  })
})
console.log('Step 0')
setTimeout(function timeout() {
  console.log('Timeout!')
}, 0)
console.log('Step 0.5')
```

// 0, 0.5, Timeout!, 1, 2, 3, 4

```
process.nextTick(function A() {
  process.nextTick(function B() {
    console.log('Step 1')
  })
  process.nextTick(function C() {
    console.log('Step 2')
    process.nextTick(function F() { console.log('Step 3') })
    process.nextTick(function G() { console.log('Step 4') })
  })
})
console.log('Step 0')
setTimeout(function timeout() {
  console.log('Timeout!')
}, 0)
console.log('Step 0.5')
```

// 0, 0.5, Step 1, Step 2, Step 3, Step 4, Timeout!

othiym23 commented on Jul 5, 2013

I think that if we swapped the names of nextTick and setImmediate, most of the confusion would go away.

Problem

Insure continuity

Node.js Middleware Pattern

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
}
```

Express Example

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()
})
```

Problems

- Callbacks are still hard to manage even in modules!
- Callbacks fire just once
- Callbacks fire only at the end
- No way to remove a callback or add a new one "on the fly"

No it's not promises. 😉

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)
```

More Async

- `async` and `neo-async`
- `co` and `bluebird`
- Promises - not really helping much
- Generators - promising
- Async await - nice wrapper for promises

Let's leave managing async for another talk.

Dependency Injection
Express Middleware

```
var express = require('express')
var app = express()
var session = require('express-session')


app.use(session({
  store: require('connect-session-knex')()
}))
```

Hapi

```
server.views({
  engines: {
    html: require('handlebars')
  },
  relativeTo: __dirname,
  path: 'templates'
})
```

Express Routes

```
// server.js
var app = express()
//...
app.use(logger('dev'))
//...
app = require('./routes')(app)
app.listen(3000)
```

```
// routes/index.js
module.exports = function(app) {
  app.get('/users', require('./users.js').getUsers)
  app.post('/order', require('./orders.js').addOrder)
  //...
  return app
}
```

Problem

```
let f = ?
let a = f('Portland')
let b = f('Oakland')
console.log(a('Hi')) // Hi Portland
console.log(b('Hey')) // Hey Oakland
```

Function which returns a function (monad?)

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

Useful modules

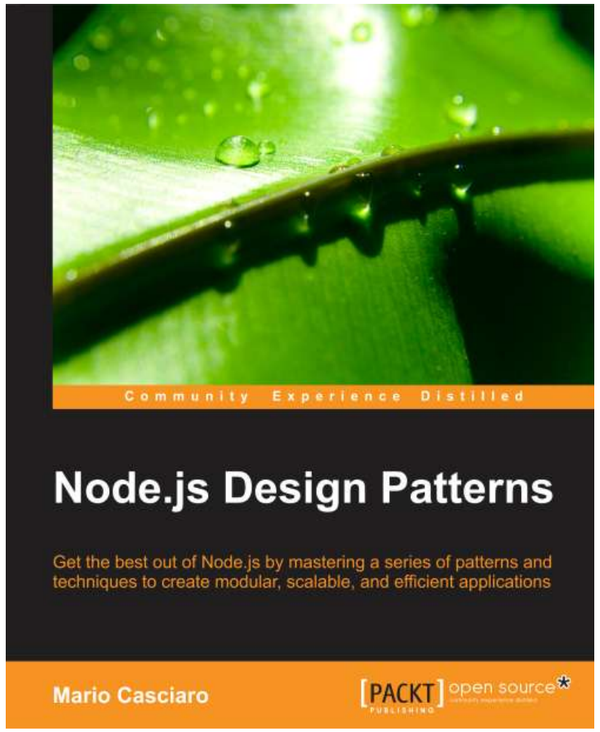
» `hooks`

» `require-dir`, `require-directory` and `require-all`

» `opn`

There are more patterns!

Node Patterns by Mario Casciaro



http://amzn.to/21hXxTy

30-second Summary

1. Callbacks
2. Observer
3. Singleton
4. Plugins
5. Middleware
6. Bunch of other stuff 💥

THE END

1. Start with what you need
2. Try and see what works for you (func vs. proto)
3. Don't over engineers following the latest fad — stick to fundamentals!

Don't fight with JavaScript/Node, use it!

Rate This Talk 👍

Scale 1-10 (10 is highest)

Anyone below 8?

This is your chance ask a question to make it 10!
(If you don't ✋, then you rate 8+, right?)

Code and Slides

https://github.com/azat-co/node-patterns/issues

Twitter: @azat_co
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Also, checkout NodeProgram.com