Thomas Watson

@wa7son

github.com/watson

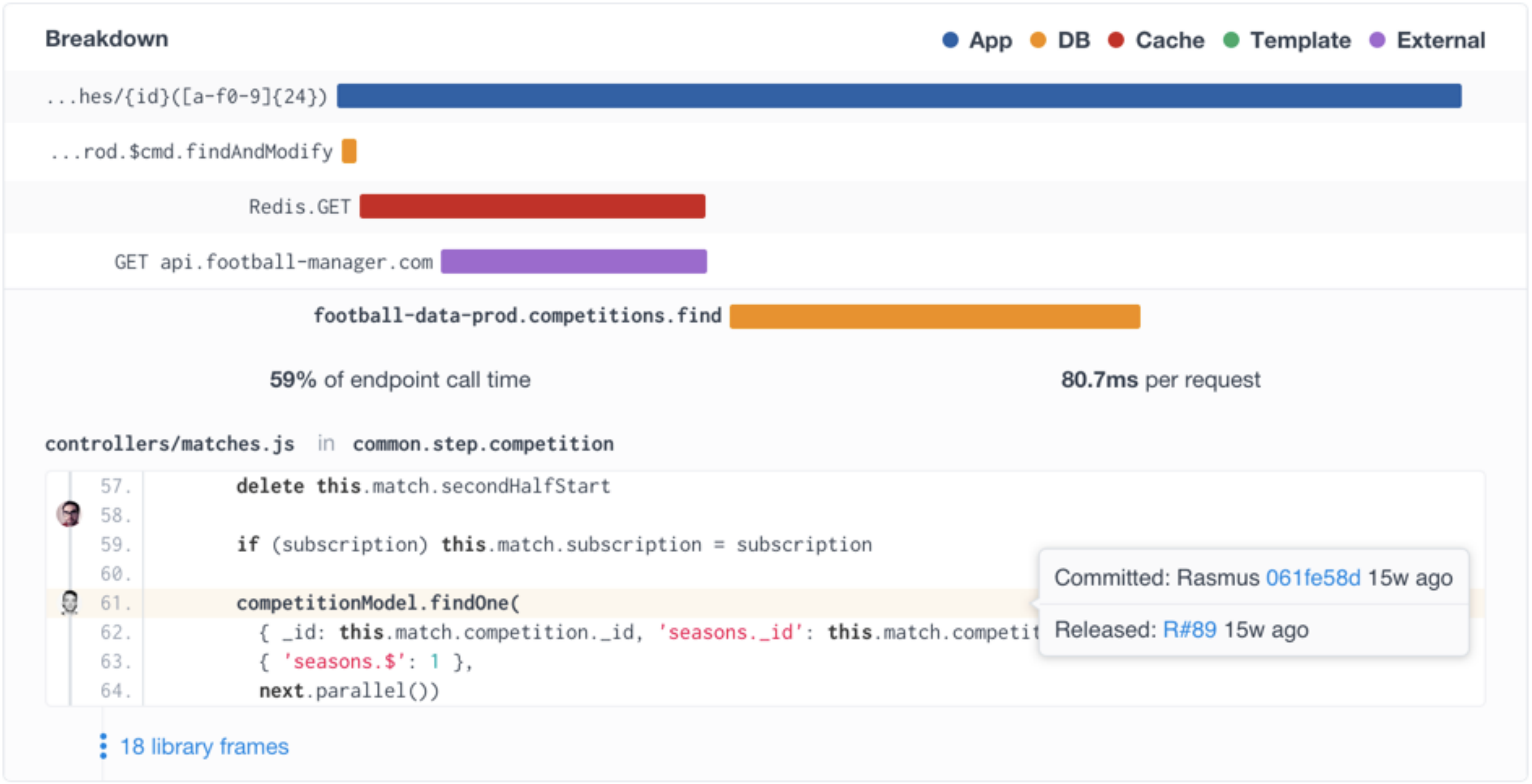
OH YEAH
THE BEACH
WAS GREAT
quickmeme.com

Instrumenting Node.js in production

opbeat

Detailed activity breakdown

Simple performance breakdown that shows you where your app needs optimizing, like SQL queries, MongoDB queries, http requests to other services, etc.



Breakdown
● App ● DB ● Cache ● Template ● External
...hes/{id}([a-f0-9]{24})
...rod.$cmd.findAndModify
Redis.GET
GET api.football-manager.com
football-data-prod.competitions.find

59% of endpoint call time

80.7ms per request

controllers/matches.js in **common.step.competition**

```
      delete this.match.secondHalfStart

      if (subscription) this.match.subscription = subscription

      competitionModel.findOne(
        { _id: this.match.competition._id, 'seasons._id': this.match.competit
        { 'seasons.$': 1 },
        next.parallel())
```

Committed: Rasmus 061fe58d 15w ago

Released: R#89 15w ago

18 library frames

us pbeat
o

Vocabulary

- A **trace** is a measure of how long something takes, e.g. a database query or a network request
- A **transaction** is a group of traces, e.g. all traces associated with an incoming HTTP request

Let’s create an instrumentation module

Goals

- Create a new transaction when a new HTTP request occurs
- Group traces under transactions
- Instrument I/O
- Instrument potential CPU expensive operations
- Associate exceptions with HTTP requests
- Almost no overhead
- Don’t manually pass state around in the app
- Plug’n’play
- *(Keep context across requests to microservices)*

Problems

- Multiple HTTP requests active at the same time
- No API to pass state across the async boundary
- Associate thrown errors with origin HTTP request

Solution

Automagically pass state across the async boundary

Solution

1. Record state when a callback is queued on the event loop

2. Restore state when the callback is de-queued from the event loop

Solution

```
global.currentTransaction = new Transaction(req)
```

1. Record state when a callback is queued on the event loop
2. Restore state when the callback is de-queued from the event loop

Solution

global.currentTransaction = new Transaction(req)

1. Record state when a callback is queued on the event loop

global.currentTransaction

2. Restore state when the callback is de-queued from the event loop

Patch **every** async operation

- Timers
- process.nextTick
- Promise (native)
- libuv…

Show some real code

Other solutions?

- Domains
- AsyncWrap

AsyncWrap

https://github.com/nodejs/tracing-wg

```
var asyncWrap = process.binding('async_wrap')
```

```javascript
var asyncWrap = process.binding('async_wrap')

asyncWrap.setupHooks(init, pre, post, destroy)
asyncWrap.enable()
```

```
var asyncWrap = process.binding('async_wrap')

asyncWrap.setupHooks(init, pre, post, destroy)
asyncWrap.enable()

function init (uid, provider, parentUid, parentHandle) {
  log('async_wrap: init')
}
function pre (uid) {
  log('async_wrap: pre')
}
function post (uid) {
  log('async_wrap: post')
}
function destroy (uid) {
  log('async_wrap: destroy')
}
```

```
function post (uid) {
  log('async_wrap: post')
}
function destroy (uid) {
  log('async_wrap: destroy')
}

var fs = require('fs')

log('user: before')
fs.open(__filename, 'r', function (err, fd) {
  log('user: done')
})
log('user: after')
```

```
var asyncWrap = process.binding('async_wrap')

asyncWrap.setupHooks(init, pre, post, destroy)
asyncWrap.enable()

function init (uid, provider, parentUid, parentHandle) {
  log('async_wrap: init')
}
function pre (uid) {
  log('async_wrap: pre')
}
function post (uid) {
  log('async_wrap: post')
}
function destroy (uid) {
  log('async_wrap: destroy')
}

var fs = require('fs')

log('user: before')
fs.open(__filename, 'r', function (err, fd) {
  log('user: done')
})
log('user: after')
```

```
user: before
async_wrap: init
user: after
async_wrap: pre
user: done
async_wrap: post
async_wrap: destroy
```

```javascript
var asyncWrap = process.binding('async_wrap')

asyncWrap.setupHooks(init, pre, post, destroy)
asyncWrap.enable()

function init (uid, provider, parentUid, parentHandle) {
  console.log('async_wrap: init')
}
function pre (uid) {
  console.log('async_wrap: pre')
}
function post (uid) {
  console.log('async_wrap: post')
}
function destroy (uid) {
  console.log('async_wrap: destroy')
}

var fs = require('fs')

console.log('user: before')
fs.open(__filename, 'r', function (err, fd) {
  console.log('user: done')
})
console.log('user: after')
```

```
var asyncWrap = process.binding('async_wrap')

asyncWrap.setupHooks(init, pre, post, destroy)
asyncWrap.enable()

function init (uid, provider, parentUid, parentHandle) {
  console.log('async_wrap: init')
}
function pre (uid) {
  console.log('async_wrap: pre')
}
fun
  c
}
function destroy (uid) {
  console.log('async_wrap: destroy')
}

var fs = require('fs')

console.log('user: before')
fs.open(__filename, 'r', function (err, fd) {
  console.log('user: done')
})
console.log('user: after')
```

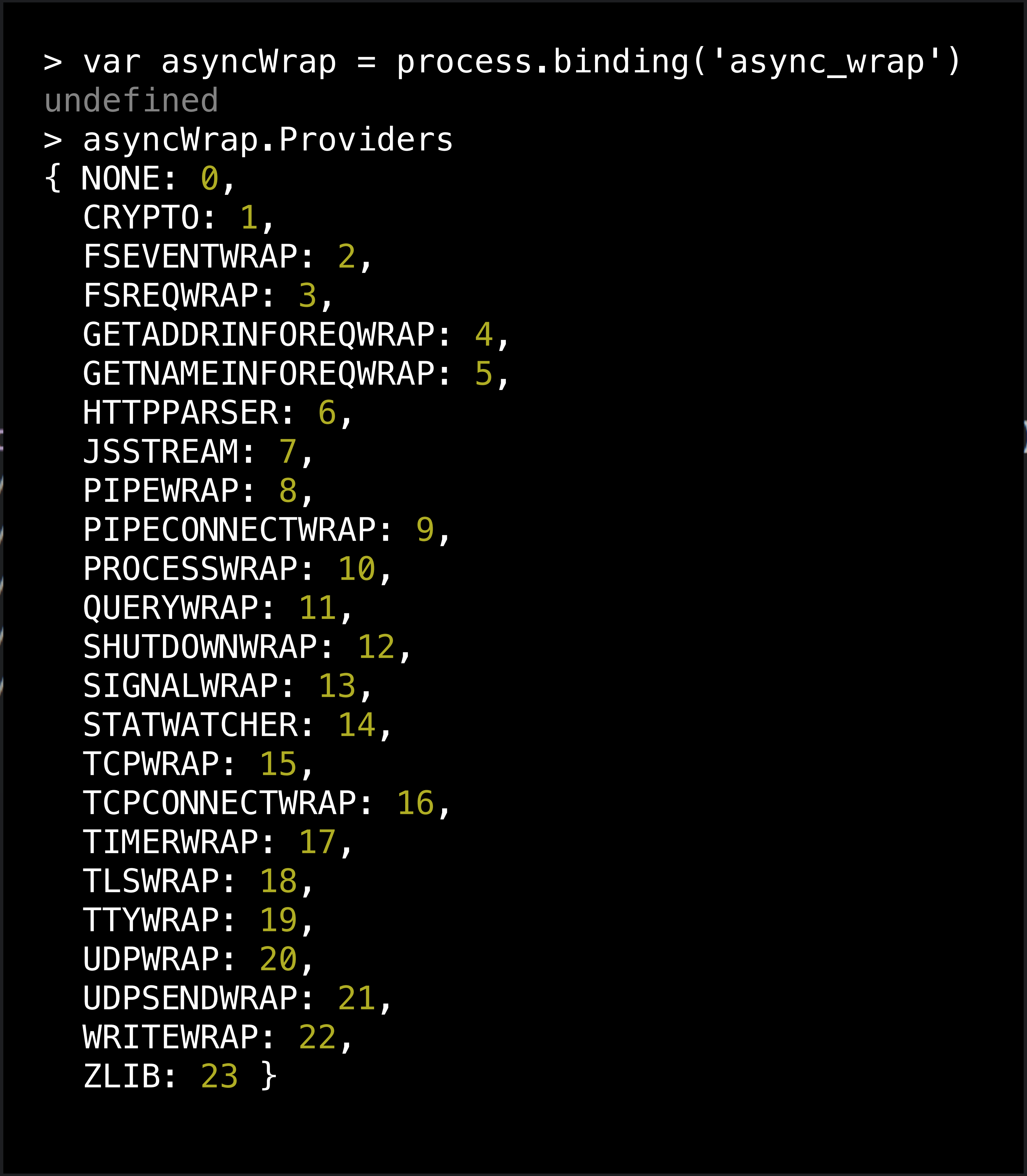
```
FATAL ERROR: node::AsyncWrap::AsyncWrap init hook threw
```

```
fs.writeSync(1, util.format('%s\n', msg))
fs.writeSync(1, util.format('%s\n', msg))

process._rawDebug(msg)
```

```js
var asyncWrap = process.binding('async_wrap')

asyncWrap.setupHooks(init, pre, post, destroy)
asyncWrap.enable()

function init (uid, provider, parentUid, parentHandle) {
  process._rawDebug('async_wrap: init')
}
function pre (uid) {
  process._rawDebug('async_wrap: pre')
}
function post (uid) {
  process._rawDebug('async_wrap: post')
}
function destroy (uid) {
  process._rawDebug('async_wrap: destroy')
}

var fs = require('fs')

process._rawDebug('user: before')
fs.open(__filename, 'r', function (err, fd) {
  process._rawDebug('user: done')
})
process._rawDebug('user: after')
```

```
user: before
async_wrap: init
user: after
async_wrap: pre
user: done
async_wrap: post
async_wrap: destroy
```

```
function init (uid, provider, parentUid, parentHandle) {
  // this         => current handle
  // uid          => 1, 2, 3...
  // provider     => 0 - 23 (asyncWrap.Providers)
  // parentUid    => 1, 2, 3...
  // parentHandle => parent `this`
}
```

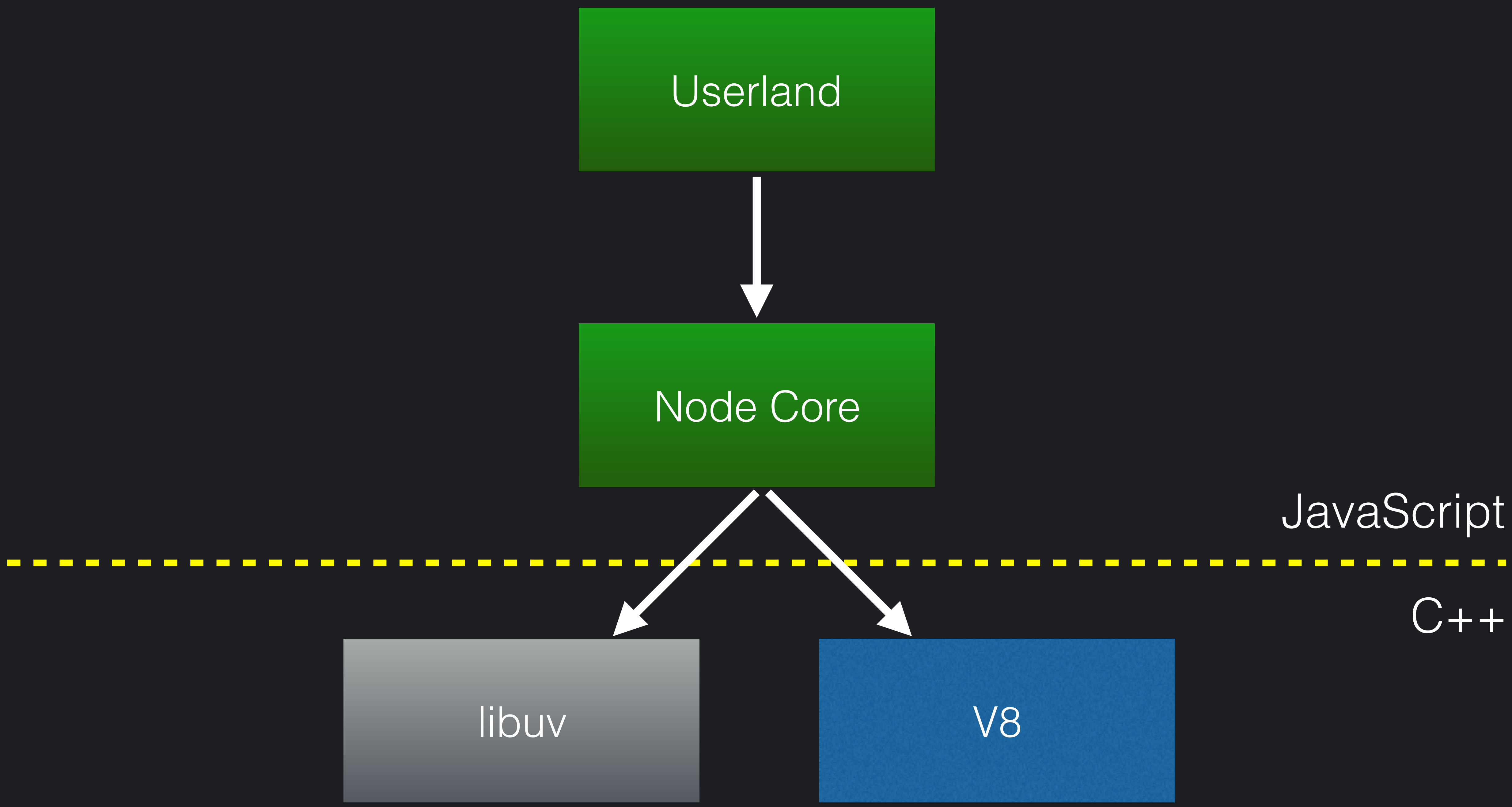


```
> var asyncWrap = process.binding('async_wrap')
undefined
> asyncWrap.Providers
{ NONE: 0,
  CRYPTO: 1,
  FSEVENTWRAP: 2,
  FSREQWRAP: 3,
  GETADDRINFOREQWRAP: 4,
  GETNAMEINFOREQWRAP: 5,
  HTTPPARSER: 6,
  JSSTREAM: 7,
  PIPEWRAP: 8,
  PIPECONNECTWRAP: 9,
  PROCESSWRAP: 10,
  QUERYWRAP: 11,
  SHUTDOWNWRAP: 12,
  SIGNALWRAP: 13,
  STATWATCHER: 14,
  TCPWRAP: 15,
  TCPCONNECTWRAP: 16,
  TIMERWRAP: 17,
  TLSWRAP: 18,
  TTYWRAP: 19,
  UDPWRAP: 20,
  UDPSENDWRAP: 21,
  WRITEWRAP: 22,
  ZLIB: 23 }
```

```
func                                   ) {
  //
  //
  //
  //
  //
}
```

```
function init (uid, provider, parentUid, parentHandle) {
  // this         => current handle
  // uid          => 1, 2, 3...
  // provider     => 0 - 23 (asyncWrap.Providers)
  // parentUid    => 1, 2, 3...
  // parentHandle => parent `this`
}
```

Handle Objects



Handle Objects

```
const TCPConnectWrap = process.binding('tcp_wrap').TCPConnectWrap;
const TCP = process.binding('tcp_wrap').TCP;

const req = new TCPConnectWrap();
req.oncomplete = oncomplete;
req.address = address;
req.port = port;

const socket = new TCP();
socket.onread = onread;
socket.connect(req, address, port);

// later
socket.destroy();
```

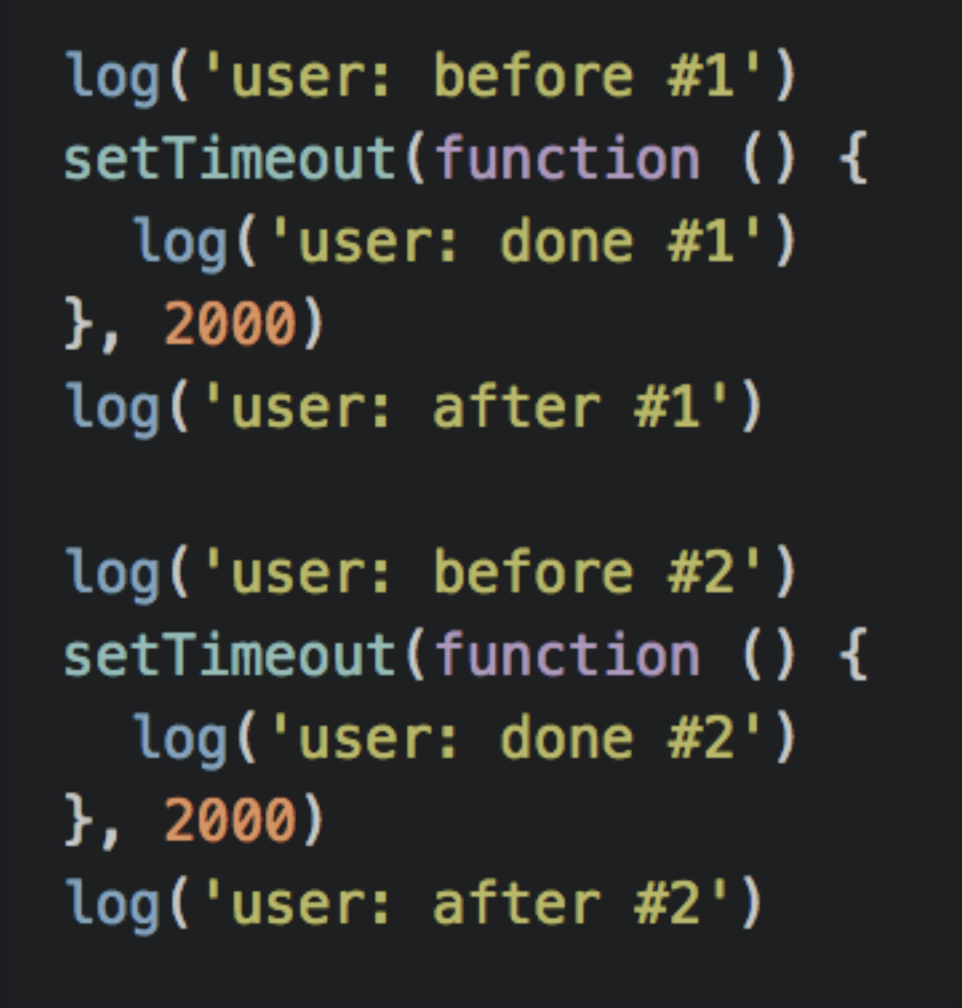
Handle Objects

```
const TCPConnectWrap = process.binding('tcp_wrap').TCPConnectWrap;
const TCP = process.binding('tcp_wrap').TCP;

const req = new TCPConnectWrap();
req.oncomplete = oncomplete;
req.address = address;
req.port = port;

const socket = new TCP();
socket.onread = onread;
socket.connect(req, address, port);

// later
socket.destroy();
```

req === this

socket === this

Timers



```
log('user: before #1')
setTimeout(function () {
  log('user: done #1')
}, 2000)
log('user: after #1')

log('user: before #2')
setTimeout(function () {
  log('user: done #2')
}, 2000)
log('user: after #2')
```

Timers

```
log('user: before #1')
setTimeout(function () {
  log('user: done #1')
}, 2000)
log('user: after #1')

log('user: before #2')
setTimeout(function () {
  log('user: done #2')
}, 2000)
log('user: after #2')
```

```
user: before #1
async_wrap: init
user: after #1
user: before #2
user: after #2
```

Timers

```
log('user: before #1')
setTimeout(function () {
  log('user: done #1')
}, 2000)
log('user: after #1')

log('user: before #2')
setTimeout(function () {
  log('user: done #2')
}, 2000)
log('user: after #2')
```

```
user: before #1
async_wrap: init
user: after #1
user: before #2
user: after #2

async_wrap: pre
user: done #1
user: done #2
async_wrap: post
async_wrap: destroy
```

AsyncWrap Gotchas

- Handle creation time
- console.log
- process.nextTick
- Timers
- Promises
- Multiple AsyncWrap’s

Thank you!

Any questions?

@wa7son

github.com/watson

opbeat