YOU DON'T KNOW NODE.JS

QUICK GUIDE TO THE BEST FEATURES

SLIDES 

Dear Kate,

Here's to the crazy ones. The misfits. The rebels. The troublemakers. The round pegs in the square holes. The ones who see things differently. They're not fond of rules. And they have no respect for the status quo. You can quote them, disagree with them, glorify or vilify them. About the only thing you can't do is ignore them. Because they change things. They push the human race forward. And while some may see them as the crazy ones, we see genius. Because the people who are crazy enough to think they can change the world, are the ones who do.

Take care.
John Appleseed

HTTPS://GITHUB.COM/AZAT-CO/YOU-DONT-KNOW-NODE

OR

PDF: HTTP://BIT.LY/1VJWPQK

OR

```
$ mkdir node_modules && npm install you-dont-know-node
```

KEY TAKEAWAYS

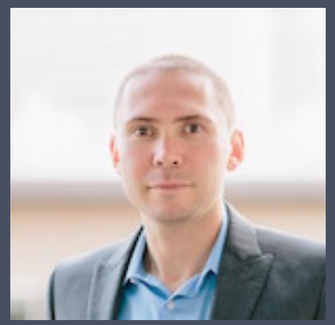
1. EVENT LOOP: BRUSH-UP ON THE CORE CONCEPT WHICH ENABLES NON-BLOCKING I/O
2. STREAMS AND BUFFERS: EFFECTIVE WAY TO WORK WITH DATA
3. GLOBAL AND PROCESS: HOW TO ACCESS MORE INFO

MORE KEY TAKEAWAYS

1. EVENT EMITTERS: CRASH COURSE IN THE EVENT-BASED PATTERN
2. CLUSTERS: FORK PROCESSES LIKE A PRO
3. HANDLING ASYNC ERRORS: ASYNCWRAP, DOMAIN AND UNCAUGHTEXCEPTION
4. C++ ADDONS: CONTRIBUTING TO THE CORE AND WRITING YOUR OWN C++ ADDONS

ABOUT PRESENTER

AZAT MARDAN



TWITTER: @AZAT_CO
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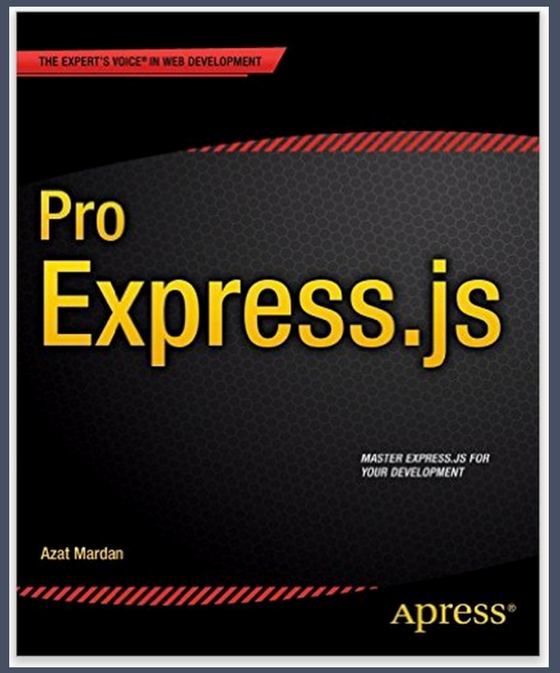
BLOG: WEBAPPLOG.COM

ABOUT PRESENTER

- TECHNOLOGY FELLOW AT CAPITAL ONE
- EXPERIENCE: FDIC. NIH. DOCUSIGN. HACKREACTOR AND STORIFY
- BOOKS: PRACTICAL NODE.JS. PRO EXPRESS.JS AND EXPRESS.JS API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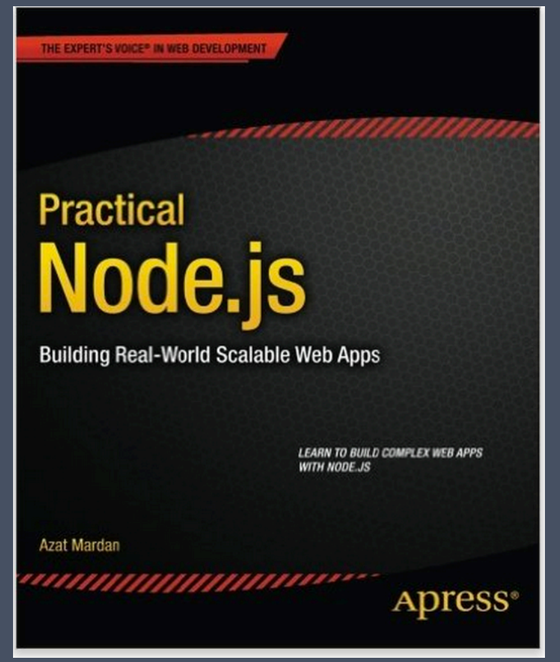
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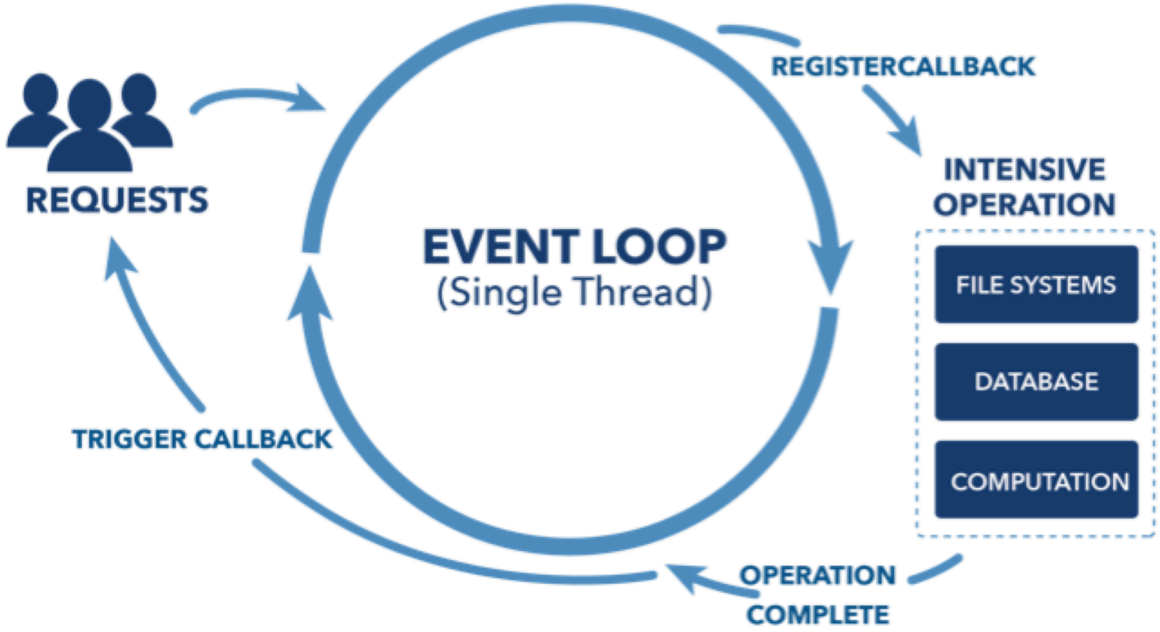
EVENT LOOP

TECH | # NON-BLOCKING I/O



BASIC EVENT LOOP EXAMPLE

```
System.out.println("Step: 1");
System.out.println("Step: 2");
Thread.sleep(1000);
System.out.println("Step: 3");
```

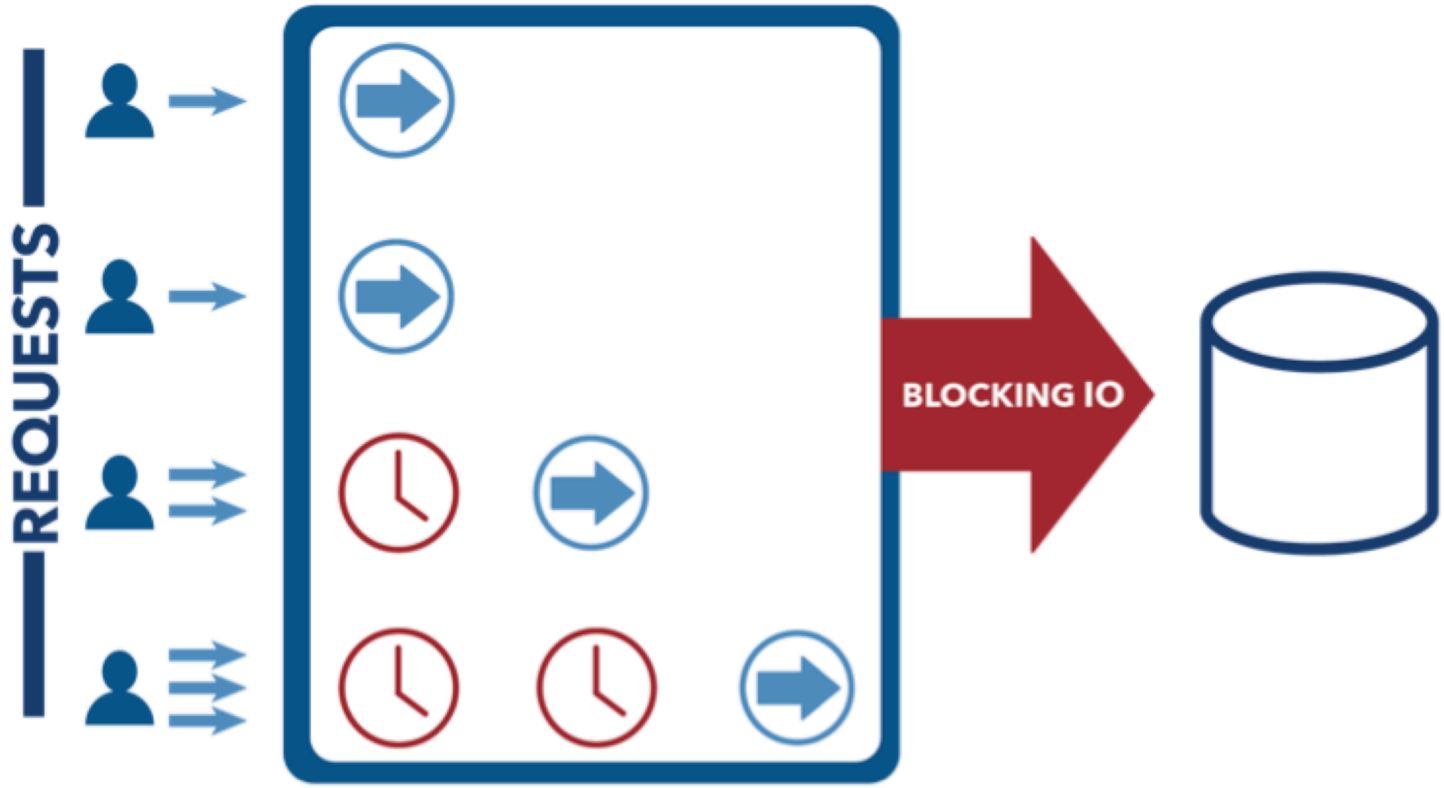
VS.

```
console.log('Step: 1')
setTimeout(function () {
  console.log('Step: 3')
}, 1000)
console.log('Step: 2')
```

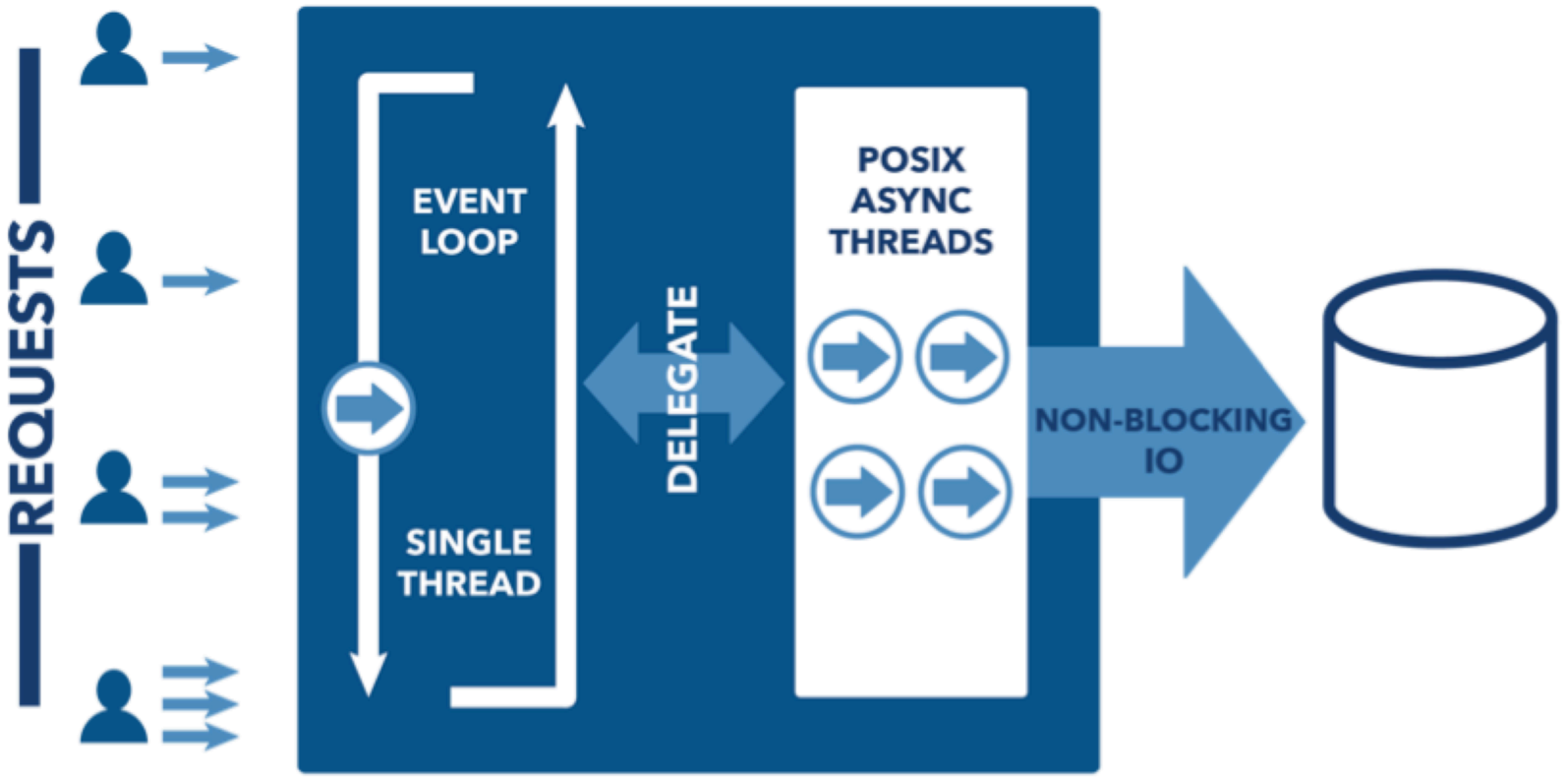
THINKING IN ASYNC CODE

```
console.log('Step: 1')
setTimeout(function () {
  console.log('Step: 3')
  // console.log('Step 5')
}, 1000);
console.log('Step: 2')
// console.log('Step 4')
```

TECH | # BLOCKING I/O



TECH | NON-BLOCKING I/O



IT'S STILL POSSIBLE TO WRITE BLOCKING CODE IN NODE.JS. 

BLOCKING NODE.JS CODE

```
var fs = require('fs');

var contents = fs.readFileSync('accounts.txt','utf8');
console.log(contents);
console.log('Hello Capital One\n');

var contents = fs.readFileSync('ips.txt','utf8');
console.log(contents);
console.log('Hello SECON!');
```

NON-BLOCKING NODE.JS CODE

```
var fs = require('fs');

var contents = fs.readFile('accounts.txt','utf8', function(err,contents){
   console.log(contents);
});
console.log('Hello Capital One\n');


var contents = fs.readFile('ips.txt','utf8', function(err,contents){
   console.log(contents);
});
console.log("Hello SECON!");
```

STREAMS AND BUFFERS

STANDARD STREAMS

STANDARD STREAMS ARE I/O CHANNELS BETWEEN AN APPLICATION AND ITS EXECUTION ENVIRONMENT.

THERE ARE THREE STANDARD STREAMS:

- STANDARD INPUT - `stdin`
- STANDARD OUTPUT - `stdout`

stdin

STANDARD INPUT STREAMS CONTAIN DATA GOING INTO APPLICATIONS.

THIS IS ACHIEVED VIA A READ OPERATION.

INPUT TYPICALLY COMES FROM THE KEYBOARD USED TO START THE PROCESS.

TO LISTEN IN ON DATA FROM STDIN, USE THE `data` AND `end` EVENTS:

```
process.stdin.resume();
process.stdin.setEncoding('utf8');

process.stdin.on('data', function (chunk) {
    console.log('chunk: ', chunk);
});

process.stdin.on('end', function () {
    console.log('--- END ---');
});
```

NOTES:

- `data` - INPUT FED INTO THE PROGRAM. DEPENDING ON THE SIZE OF THE INPUT. THIS EVENT CAN TRIGGER MULTIPLE TIMES
- AN `end` EVENT IS NECESSARY TO SIGNAL THE CONCLUSION OF THE INPUT STREAM
- `stdin` IS PAUSED BY DEFAULT. AND MUST BE RESUMED BEFORE DATA CAN BE READ FROM IT

stdout

THE STANDARD OUTPUT STREAMS CONTAIN DATA GOING OUT OF AN APPLICATION.

THIS IS DONE VIA A WRITE OPERATION.

DATA WRITTEN TO STANDARD OUTPUT IS VISIBLE ON THE COMMAND LINE.

TO WRITE TO `stdout`, USE THE `write` FUNCTION:

```
process.stdout.write('A simple message\n');
```

`stderr`

THE STANDARD ERROR STREAM IS AN OUTPUT STREAM LIKE `stdout`.

IT IS USED PRIMARILY TO LOG MESSAGES AND ERRORS FOR THE PURPOSE OF DEBUGGING.

WRITING TO `stderr` IS DONE SIMILARLY TO `stdout`:

```
process.stderr.write('An error message\n');
```

NOTE THAT `stdout` AND `stderr` ARE SPECIAL STREAMS IN NODE AS THEY ARE BLOCKING!

TELETYPE CONTEXT

TO CHECK IF THE APPLICATION IS BEING RUN IN TTY CONTEXT. USE THE `isTTY` PROPERTY:

```
$ node teletype.js
// process.stdin.isTTY === true
// process.stdout.isTTY === true

$ echo "hello world" | node teletype.js
// process.stdin.isTTY === false

$ node teletype.js | cat
// process.stdout.isTTY === false
```

BUFFERS

BINARY DATA TYPE. TO CREATE:

- `new Buffer(size)`
- `new Buffer(array)`
- `new Buffer(buffer)`
- `new Buffer(str[, encoding])`

DOCS: HTTP://BIT.LY/11EACZ1

```
buf = new Buffer(26);
for (var i = 0 ; i < 26 ; i++) {
  buf[i] = i + 97; // 97 is ASCII a
}
buf // <Buffer 61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f 70 71 72 73 74 75 76 77 78 79 7a>
```

BUFFER CONVERTION:

```
buf.toString('ascii'); // outputs: abcdefghijklmnopqrstuvwxyz
buf.toString('ascii', 0, 5); // outputs: abcde
buf.toString('utf8', 0, 5); // outputs: abcde
buf.toString(undefined, 0, 5); // encoding defaults to 'utf8', outputs abcde
```

REMEMBER FS?

```
fs.readFile('/etc/passwd', function (err, data) {
  if (err) throw err;
  console.log(data);
});
```

`data` **IS BUFFER!**

BUFFER METHODS AND PROPERTIES

- `buf.length`
- `buf.write(string[, offset][, length][, encoding])`
- `buf.toString([encoding][, start][, end])`
- `buf.toJSON()`

BUFFER METHODS AND PROPERTIES

- `buf.equals(otherBuffer)`
- `buf.compare(otherBuffer)`
- `buf.copy(targetBuffer[, targetStart][, sourceStart][, sourceEnd])`
- `buf.slice([start][, end])`
- `buf.fill(value[, offset][, end])`

ENCODINGS

- `ascii` - FOR 7 BIT ASCII DATA ONLY. VERY FAST. STRIPS THE HIGH BIT IF SET.
- `utf8` - MULTIBYTE ENCODED UNICODE CHARACTERS. STANDARD FOR THE WEB.
- `utf16le` - 2 OR 4 BYTES. LITTLE-ENDIAN ENCODED UNICODE CHARS.

ENCODINGS

- `ucs2` - ALIAS OF 'UTF16LE'.
- `base64` - BASE64 STRING ENCODING.
- `binary` - (DEPRECATED) RAW BINARY DATA INTO STRINGS BY USING ONLY THE FIRST 8 BITS OF EACH CHAR.
- `hex` - ENCODE EACH BYTE AS TWO HEXADECIMAL CHARACTERS.

STREAMS AND BUFFER DEMO

SERVER-STREAM.JS:

```
app.get('/stream1', function(req, res) {
  var stream = fs.createReadStream(largeImagePath)
  stream.pipe(res)
})

$ node server-stream
```

HTTP://LOCALHOST:3000/STREAM1
HTTP://LOCALHOST:3000/NON-STREAM

STREAM RESOURCES

HTTPS://GITHUB.COM/SUBSTACK/STREAM-ADVENTURE

```
$ sudo npm install -g stream-adventure
$ stream-adventure
```

HTTPS://GITHUB.COM/SUBSTACK/STREAM-HANDBOOK

GLOBAL AND PROCESS

GLOBAL

```
> global.process
> global.__filename
> global.__dirname
> global.module
> global.require
```

PROCESS

```
> process.pid
> process.versions
> process.arch
> process.argv
> process.env
```

MORE PROCESS

```
> process.uptime()
> process.memoryUsage()
> process.cwd()
> process.exit
> process.on()
```

EVENT EMITTERS

EVENT EMITTERS

EVENT EMITTER IS SOMETHING THAT TRIGGERS AN EVENT TO WHICH ANYONE CAN LISTEN.

HTTPS://NODEJS.ORG/API/EVENTS.HTML

IN NODE.JS AN EVENT CAN BE DESCRIBED SIMPLY AS A STRING WITH A CORRESPONDING CALLBACK.

EVENT EMITTERS

- EVENT HANDLING IN NODE USES THE OBSERVER PATTERN
- AN EVENT, OR SUBJECT, KEEPS TRACK OF ALL FUNCTIONS THAT ARE ASSOCIATED WITH IT
- THESE ASSOCIATED FUNCTIONS, KNOWN AS OBSERVERS, ARE EXECUTED WHEN THE GIVEN EVENT IS TRIGGERED

USING EVENT EMITTERS

```
var events  = require('events');
var emitter = new events.EventEmitter();

emitter.on('knock', function {
    console.log("Who's there?");
});

emitter.on('knock', function {
    console.log("Go away!");
});

emitter.emit('knock');
```

INHERITING FROM EVENTEMITTER

```
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;
```

INHERITING FROM EVENTEMITTER

```
var job = new Job();

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

job.process();
```

LISTENERS

```
emitter.listeners(eventName);

emitter.on(eventName, listener);

emitter.once(eventName, listener);

emitter.removeListener(eventName, listener);
```

CLUSTERS

CLUSTERS

```
var cluster = require('cluster');
if (cluster.isMaster) {
  for (var i = 0; i < numCPUs; i++) {
    cluster.fork();
  };
} else if (cluster.isWorker) {
… // your server code
})
```

CLUSTER DEMO

1. RUN `code/cluster.js` WITH NODE (`node cluster.js`).
2. INSTALL `loadtest` WITH NPM: `$ npm install -g loadtest`
3. RUN LOAD TESTING WITH: `$ loadtest  http://localhost:3000 -t 20 –c 10`

PRESS CONTROL+C ON THE SERVER TERMINAL

CLUSTER LIBRARIES

- CORE CLUSTER
- STRONG-CLUSTER-CONTROL (HTTPS://GITHUB.COM/STRONGLOOP/STRONG-CLUSTER-CONTROL). OR `$ slc run`
- PM2 (HTTPS://GITHUB.COM/UNITECH/PM2)

PM2

https://github.com/unitech/pm2

http://pm2.keymetrics.io

ADVANTAGES:

- LOAD-BALANCER AND OTHER FEATURES
- OS RELOAD DOWN-TIME. I.E., FOREVER ALIVE

PM2 DEMO: TYPICAL EXPRESS SERVER

```
var express = require('express');
var port = 3000;
global.stats = {}
console.log('worker (%s) is now listening to http://localhost:%s',
 process.pid, port);
var app = express();
app.get('*', function(req, res) {
  if (!global.stats[process.pid]) global.stats[process.pid] = 1
  else global.stats[process.pid] += 1;
  var l ='cluser '
    + process.pid
    + ' responded \n';
  console.log(l, global.stats);
  res.status(200).send(l);
})
app.listen(port);
```

PM2 DEMO

USING `server.js`:

```
$ pm2 start server.js -i 0
```

IN A NEW WINDOW:

```
$ loadtest  http://localhost:3000 -t 20 -c 10
$ pm2 list
```

SPAWN VS FORK VS EXEC

- `require('child_process').spawn()` - LARGE DATA. STREAM. NO NEW V8 INSTANCE
- `require('child_process').fork()` - NEW V8 INSTANCE. MULTIPLE WORKERS
- `require('child_process').exec()` - BUFFER. ASYNC. ALL THE DATA AT ONCE

SPAWN EXAMPLE

```
fs = require('fs');
process = require('child_process');
var p = process.spawn('node','program.js');
p.stdout.on('data', function(data)) {
 console.log('stdout: ' + data);
});
```

FORK EXAMPLE

```
fs = require('fs');
process = require('child_process');
var p = process.fork('program.js');
p.stdout.on('data', function(data)) {
 console.log('stdout: ' + data);
});
```

EXEC EXAMPLE

```
fs = require('fs');
process = require('child_process');
var p = process.exec('node program.js', function (error, stdout, stderr) {
if(error)
 console.log(error.code);
});
```

HANDLING ASYNC ERRORS

EVENT LOOP: ASYNC ERRORS ARE HARDER TO HANDLE/DEBUG. BECAUSE SYSTEM LOSES CONTEXT OF THE ERROR. THEN. APPLICATION CRASHES.

TRY/CATCH IS NOT GOOD ENOUGH.

SYNCHRONOUS ERROR IN NODE

```
try {
  throw new Error('Fail!');
} catch (e) {
  console.log('Custom Error: ' + e.message);
}
```

FOR SYNC ERRORS TRY/CATCH WORKS FINE.

ASYNC ERROR EXAMPLE

```
try {
   setTimeout(function () {
        throw new Error("Fail!");
   }, Math.round(Math.random()*100));
} catch (e) {
   console.log('Custom Error: ' + e.message);
}
```

ASYNC ERRORS

THE APP CRASHES! HOW TO DEAL WITH IT?

BEST PRACTICES FOR ASYNC ERRORS?

- LISTEN TO ALL "ON ERROR" EVENTS
- LISTEN TO `uncaughtException`
- USE `domain` (SOFT DEPRECATED) OR ASYNCWRAP
- LOG, LOG, LOG & TRACE
- NOTIFY (OPTIONAL)
- EXIT & RESTART THE PROCESS

ON('ERROR')

ANYTHING THAT INHERITS FROM OR CREATES AN INSTANCE OF THE ABOVE: EXPRESS. LOOPBACK. SAILS. HAPI. ETC.

```
server.on('error', function (err) {
  console.error(err)
})
```

ON('ERROR') CHAINED METHOD EXAMPLE

```
var http = require(‘http’);
var server = http.createServer(app)
  .on('error', function(e) {
    console.log(‘Failed to create server’);
    console.error(e);
    process.exit(1);
  })
```

ON('ERROR') NAMED VARIABLE EXAMPLE

```
var req = http.request(options, function(res) {
  // … processing the response
});

req.on('error', function(e) {
  console.log('problem with request: ' + e.message);
});
```

UNCAUGHTEXCEPTION

`uncaughtException` IS A VERY CRUDE MECHANISM FOR EXCEPTION HANDLING. AN UNHANDLED EXCEPTION MEANS YOUR APPLICATION - AND BY EXTENSION NODE.JS ITSELF - IS IN AN UNDEFINED STATE. BLINDLY RESUMING MEANS ANYTHING COULD HAPPEN.

UNCAUGHTEXCEPTION

ALWAYS LISTEN TO `uncaughtException`!

```
process.on(‘uncaughtException’, handle)
```

OR

```
process.addListener('uncaughtException', handle)
```

UNCAUGHTEXCEPTION EXPANDED EXAMPLES

```
process.on('uncaughtException', function (err) {
  console.error('uncaughtException: ', err.message);
  console.error(err.stack);
  process.exit(1);
});
```

OR

```
process.addListener('uncaughtException', function (err) {
  console.error('uncaughtException: ', err.message);
  console.error(err.stack);
  process.exit(1);
```

DOMAIN

THIS MODULE IS SOFTLY DEPRECATED IN 4.0 (MOST LIKEY WILL BE SEPARATE FROM CORE MODULE). BUT THERE'S NO ALTERNATIVES IN CORE AS OF NOW.

DOMAIN EXAMPLE

```
var domain = require('domain').create();
domain.on('error', function(error){
  console.log(error);
});
domain.run(function(){
  throw new Error('Failed!');
});
```

DOMAIN WITH ASYNC ERROR DEMO

DOMAIN-ASYNC.JS:

```
var d = require('domain').create();
d.on('error', function(e) {
    console.log('Custom Error: ' + e);
});
d.run(function() {
  setTimeout(function () {
    throw new Error('Failed!');
  }, Math.round(Math.random()*100));
});
```

C++ ADDONS

NODE AND C++

CREATE THE `hello.cc` FILE:

```
#include <node.h>

namespace demo {

using v8::FunctionCallbackInfo;
using v8::HandleScope;
using v8::Isolate;
using v8::Local;
using v8::Object;
using v8::String;
using v8::Value;
```

NODE AND C++

CREATE THE `hello.cc` FILE:

```
void Method(const FunctionCallbackInfo<Value>& args) {
  Isolate* isolate = args.GetIsolate();
  args.GetReturnValue().Set(String::NewFromUtf8(isolate, "capital one"));
}

void init(Local<Object> exports) {
  NODE_SET_METHOD(exports, "hello", Method);
}

NODE_MODULE(addon, init)

}  // namespace demo
```

CREATING binding.gyp

CREATE binding.gyp:

```
{
  "targets": [
    {
      "target_name": "addon",
      "sources": [ "hello.cc" ]
    }
  ]
}
```

NODE-GYP

```
$ npm install -g node-gyp
```

HTTPS://GITHUB.COM/NODEJS/NODE-GYP

CONFIGURING AND BUILDING

```
$ node-gyp configure
$ node-gyp build
```

CHECK FOR COMPILED .NODE FILES IN BUILD/RELEASE/

C++ ADDONS EXAMPLES

HTTPS://GITHUB.COM/NODEJS/NODE-ADDON-EXAMPLES

INCLUDING ADDON

CREATE `hello.js` AND INCLUDE YOUR C++ ADDON:

```
var addon = require('./build/Release/addon');
console.log(addon.hello()); // 'capital one'
```

Q&A 👍

SEND QUESTIONS TO

HTTPS://GITHUB.COM/AZAT-CO/YOU-DONT-KNOW-NODE/ISSUES

TWITTER: @AZAT_CO
EMAIL: HI@AZAT.CO