

Node Program

Express.js



Node.js version: 7
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Express

Express is the most popular web application framework for Node. It is easy to work with as it ties into Node's functional paradigm.

- » Deliver static content (or consider using nginx)
- » Modularize business logic
- » Construct an API
- » Connect to various data sources

DEMO

Core http module API: <http://bit.ly/1StXF8G>



With Express you can
develop APIs faster!

Express vs. http

- » URL params and query strings parsing
- » Automatic response headers
- » Routes and better code organization
- » Myriads of plugins (called middleware)
- » Request body parsing (with a module)
- » Authentication, validation, session and more! (with modules)

Installing Dependency

```
$ npm install express --save
```

```
$ npm install express@4.13.3 --save
```

Installing Scaffolding

Install Express.js command-line generator:

```
$ npm install -g express-generator
```

Using the Generator

```
$ express todo-list-app  
$ cd todo-list-app  
$ npm install  
$ node app
```

Structure

- » `app.js`: main file, houses the embedded server and application logic
- » `/public`: contains static files to be served by the embedded server
- » `/routes`: houses custom routing for the embedded server
- » `/views`: contains templates that can be processed by a template engine

app.js

1. Imports and instantiations
2. Configurations
3. Middleware
4. Routes
5. Bootup

Configuring Express

The Express server needs to be configured before it can start

Manage configuration via the set method:

```
var express = require('express')
var app = express()
app.set('port', process.env.PORT || 3000)
app.set('views', 'templates') // The directory the templates are stored in
app.set('view engine', 'jade')
```

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

Organizing Code

database in `app.js`, but we need it in `routes/users.js` where our `/users` routes are located

How to pass the database reference? Something like this?

```
var users = require('./routes/users.js')(database)
```

There is a better way!

Connect Framework

Express leverages the Connect framework to provide the middleware functionality. Middleware are used to manage how a request should be handled.

Applying Connect/Express Middleware

Example:

```
var express = require('express')
var app = express()
//... Define middleware1-N
app.use(middleware1)
app.use(middleware2)
...
app.use(middlewareN)
...
```

Middleware Order

Middleware are executed in the order specified:

```
var logger = require('morgan')
var bodyParser = require('body-parser')

...
app.use(logger('dev'))
app.use(bodyParser.json())
```

Two Categories of Express Middleware

1. npm modules, e.g., body-parser
2. Custom middleware

Creating Middleware

Custom middleware is easy to create with a reference:

```
var middleware = function (request, response, next) {  
    // Modify request or response  
    // Execute the callback when done  
    next()  
}  
  
app.use(middleware)
```

Creating Middleware

Or with anonymous function definition:

```
app.use(function (request, response, next) {  
    // Modify request or response  
    // Execute the callback when done  
    next()  
})
```

Passing References

request is **always** the same object in the lifecycle of a single client request to the Express server

This solves the database reference problem:

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

Most Popular and Useful Connect/Express Middleware

```
$ npm install <package_name> --save  
-> body-parser request payload  
-> compression gzip  
-> connect-timeout set request timeout  
-> cookie-parser Cookies  
-> cookie-session Session via Cookies store
```

Connect/Express Middleware

- >> csurf CSRF
- >> errorhandler error handler
- >> express-session session via in-memory or other store
- >> method-override HTTP method override
- >> morgan server logs
- >> response-time

Connect/Express Middleware

- >> serve-favicon favicon
- >> serve-index
- >> serve-static static content
- >> vhost

Other Popular Middleware

- >> cookies and keygrip: analogous to cookieParser
- >> raw-body
- >> connect-multiparty, connect-busboy
- >> qs: analogous to query
- >> st, connect-static analogous to staticCache

Other Popular Middleware

- » express-validator: validation
- » less: LESS CSS
- » passport: authentication library
- » helmet: security headers
- » connect-cors: CORS
- » connect-redis

Template Engine

Setting the `view engine` variable to `jade` for instance, would trigger the following function call internally

```
app.set('view engine', 'jade') // Shorthand
```

```
// Does the same as the above
```

```
app.engine('jade', require('jade').__express)
```

Template Engine

Custom callbacks can be defined to parse templates

```
app.engine([format], function (path, options, callback) {  
  // Template parsing logic goes here  
})
```

Note: custom callbacks are useful if the template engine doesn't export an __express function

Express Route

```
app.get('/', function(req, res) {  
  res.end()  
})
```

Express Bootup

```
var http = require('http'),  
    express = require('express')  
  
var app = express()  
  
// ... Configurations, middleware and routes  
  
var server = http.createServer(app)  
server.listen(app.get('port'), function () {  
    // Do something... maybe log some info?  
})
```

Bootup 2

```
var http = require('http'),  
    express = require('express')  
  
var app = express()  
  
// ... Configurations, middleware and routes  
  
app.listen(app.get('port'), function () {  
    // Do something... maybe log some info?  
})
```

Launching the App

\$ node server

\$ nodemon server

\$ node-dev server

\$ forever server

\$ pm2 server

Express is awesome!



Workshop



```
$ npm i -g expressworks
```

<https://github.com/azat-co/expressworks>

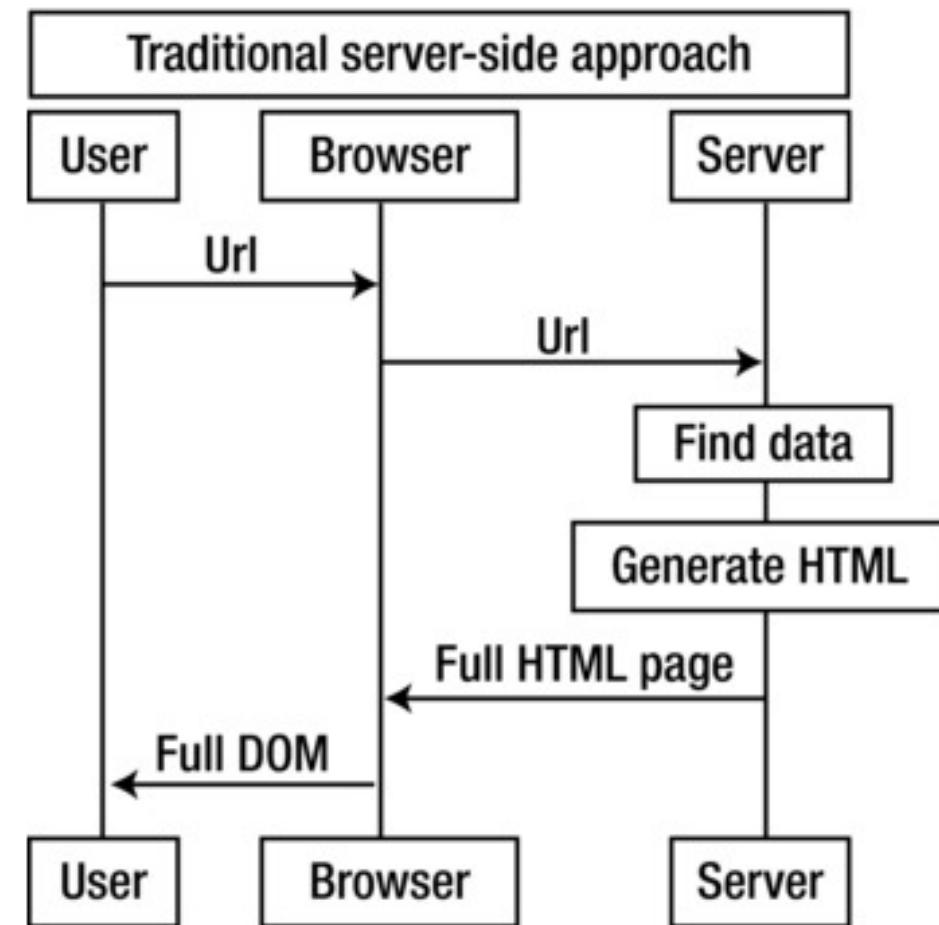
Videos for solutions: [YouTube ExpressWorks Playlist](#)

or <http://bit.ly/1jW1sBf>

Building a RESTful API

Traditional Web App

Also called thick server.

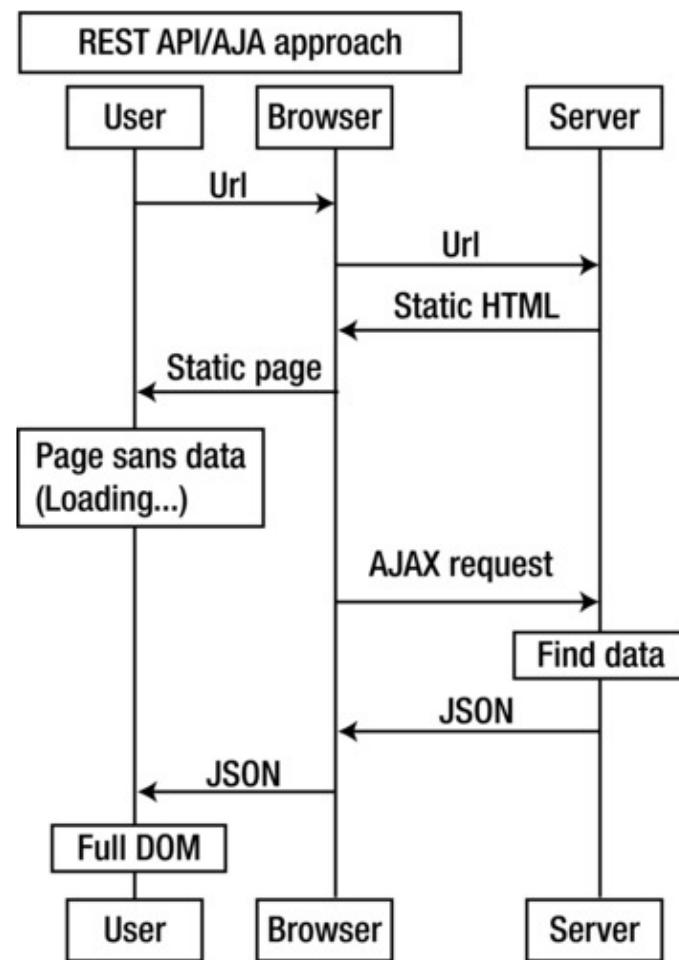


Traditional Web App Problems

- » Slow and single-tasked (not multitasking)
- » Poor and unresponsive UX (user experience)
- » Duplication of data hogs bandwidth (HTML)

API + AJAX/XHR Web App

Also called thick client

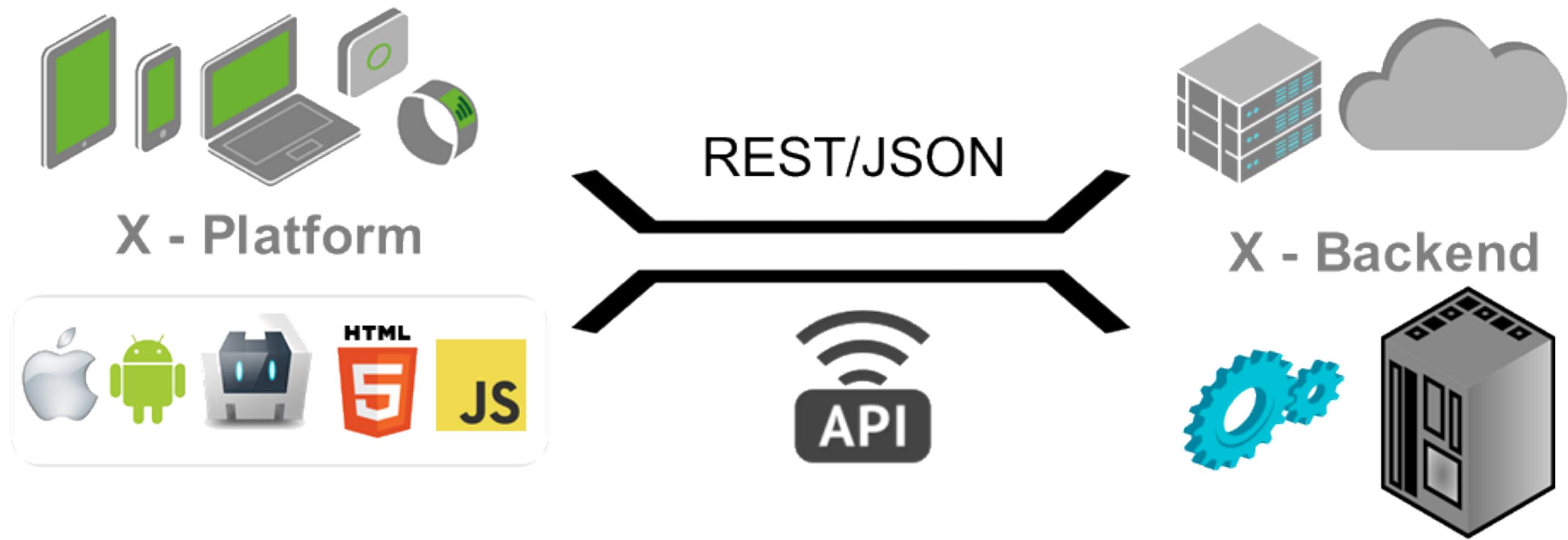


Advantages of a Thick Client

- » Responsive interface and UX
- » Only data is transmitted (JSON)
- » Re-use of the core functionality
- » Asynchronous tasks
- » Real-time apps

Node, SPAs and REST

Build an API once and use everywhere



REST Basics

REpresentational State Transfer (REST) is an architectural pattern for developing network applications

REST systems aim to keep things simple when connecting to and exchanging data between machines

Why HTTP?

HTTP is the ideal protocol for REST, given its stateless nature and client-server architecture

- » REST is far simpler compared to Remote Procedure Calls (RPC) and Web Services (SOAP, UDDI, etc)
- » RPCs and Web services rely on complex vocabularies for communication
- » Each new operation is a new vocabulary entry, increasing code complexity

REST Verbs

REST uses HTTP requests (and verbs) for CRUD operations

>> GET

>> PUT

>> POST

>> DELETE

REST Verbs

And sometimes...

>> PATCH

>> HEAD

>> OPTIONS

Common Endpoints

GET /tickets - Retrieve a list of tickets

GET /tickets/12 - Retrieve a specific ticket

POST /tickets - Create a new ticket

PUT /tickets/12 - Update ticket #12

DELETE /tickets/12 - Delete ticket #12

PATCH /tickets/12 - Partially update ticket #12

OPTIONS /tickets/12 - What can I do to ticket #12?

HEAD /tickets/12 - What headers would I get if I tried to get ticket #12?

Handlers Signatures

- » `function(request, response, next) {}:` request handler signature
- » `function(error, request, response, next) {}:` error handler signature

HTTP Verbs and Routes

```
>> app.get(urlPattern, requestHandler[,  
           requestHandler2, ...])  
  
>> app.post(urlPattern, requestHandler[,  
            requestHandler2, ...])  
  
>> app.put(urlPattern, requestHandler[,  
           requestHandler2, ...])  
  
>> app.delete(urlPattern, requestHandler[,  
             requestHandler2, ...])
```

HTTP Verbs and Routes

```
>> app.all(urlPattern, requestHandler[,  
         requestHandler2, ...])  
  
>> app.param([name,] callback):  
  
>> app.use([urlPattern,] requestHandler[,  
           requestHandler2, ...])
```

Request

- >> `request.params`: parameters middleware
- >> `request.param`: extract one parameter
- >> `request.query`: extract query string parameter
- >> `request.route`: return route string

Request

- >> request.cookies: cookies, requires cookieParser
- >> request.signedCookies: signed cookies, requires cookie-parser
- >> request.body: payload, requires body-parser

Request Header Shortcuts

- >> `request.get(headerKey)`: value for the header key
- >> `request.accepts(type)`: checks if the type is accepted
- >> `request.acceptsLanguage(language)`: checks language
- >> `request.acceptsCharset(charset)`: checks charset
- >> `request.is(type)`: checks the type
- >> `request.ip`: IP address

Request Header Shortcuts

- » `request.ips`: IP addresses (with trust-proxy on)
- » `request.path`: URL path
- » `request.host`: host without port number
- » `request.fresh`: checks freshness
- » `request.stale`: checks staleness
- » `request.xhr`: true for AJAX-y requests

Request Header Shortcuts

- >> `request.protocol`: returns HTTP protocol
- >> `request.secure`: checks if protocol is https
- >> `request.subdomains`: array of subdomains
- >> `request.originalUrl`: original URL

HTTP Responses

The response object is also accessible via routing handlers in Express

It is the second argument in the handler's callback

```
app.get('/users/:id', function (request, response) {  
  // 'response' is the enhanced response from http  
})
```

The response object can be used to modify an HTTP response before sending it out

Express Response Method

- >> response.redirect(status, url): redirect request
- >> response.send(status, data): send response
- >> response.json(status, data): send JSON and force proper headers

Express Response Method

- » `response.sendFile(path, options, callback)`: send a file
- » `response.render(templateName, locals, callback)`: render a template
- » `response.locals`: pass data to template

HTTP Status Codes

To specify a status code, use the response object's **status** function

```
app.get('/user/:id', function (request, response) {
  // Logic to check for user
  if (!exists) {
    response.status(404)
  } else if (authorized) {
    response.status(200)
  } else {
    response.status(401)
  }
  // ...
});
```

HTTP Status Codes

- » 2XX: for successfully processed requests
- » 3XX: for redirections or cache information
- » 4XX: for client-side errors
- » 5XX: for server-side errors

Note: for 3xx status codes, the client must take additional action following the completion of the current request

Sending a Response

Use the response object's **send** function to send the client a response

```
app.get('...', function (request, response) {  
  response.send('Hello World!')  
})
```

Sending a Response

The content-type is determined given the type of argument passed

```
response.send('Hello World!')          // Content-type: text/plain  
response.send([ 5, 7, 9 ])              // Content-type: application/json  
response.send({ name: 'John Doe' })    // Content-type: application/json
```

Sending a Response

The content-type can also be hardcoded

```
response.set('Content-Type', 'text/plain')
```

```
response.send('Just regular text, no html expected!')
```

Sending an Empty Response

```
response.status(404).end()
```

Sessions

HTTP is a stateless protocol – information about a client is not retained over subsequent requests

Use sessions to overcome this problem

Enable the `cookieParser` and `session` middleware to process cookies

Request Body

Enable the json() and urlencoded() middleware to convert raw form data into JSON

```
$ npm install body-parser --save
```

Parsing Request Body

Import middleware:

```
var bodyParser = require('body-parser')
```

Parse application/json

```
app.use(bodyParser.json())
```

Usage: single-page applications and other JSON REST clients.

Parsing Request Body

Parse application/x-www-form-urlencoded

```
app.use(bodyParser.urlencoded({extended: false}))
```

Usage: web forms with action attribute.

REST API Example

Code along side!

Goal: build RESTful API with MongoDB

Message Board API

>> POST /messages

>> GET /messages

App

Create index.js and start implementing the server.

```
var express = require('express'),  
  mongodb = require('mongodb'),  
  app = express(),  
  bodyParser = require('body-parser'),  
  validator = require('express-validator'),  
  logger = require('morgan'),  
  errorHandler = require('errorhandler'),  
  compression = require('compression'),  
  url = 'mongodb://localhost:27017/board'
```

```
mongodb.MongoClient.connect(url, function(err, db) {  
  if (err) {  
    console.error(err)  
    process.exit(1)  
  }  
})
```

```
app.use(compression())
app.use(logger('combined'))
app.use(errorHandler())
app.use(bodyParser.urlencoded({extended: true}))
app.use(bodyParser.json())
app.use(validate())
app.use(express.static('public'))
```

```
app.use(function(req, res, next){  
  req.messages = db.collection('messages')  
  return next()  
})
```

GET Route

```
app.get('/messages', function(req, res, next) {
  req.messages.find({}, {sort: {_id: -1}}).toArray(function(err, docs){
    if (err) return next(err)
    return res.json(docs)
  })
})
```

```
app.post('/messages', function(req, res, next){  
  console.log(req.body)  
  req.checkBody('message', 'Invalid message in body').notEmpty()  
  req.checkBody('name', 'Invalid name in body').notEmpty()  
  var errors = req.validationErrors()  
})
```

```
if (errors) return next(errors)

req.messages.insert(req.body, function (err, result) {
  if (err) return next(err)

  return res.json(result.ops[0])
})
})
```

```
app.get('*', function(req, res, next){  
  res.send('Server provides two endpoints GET\  
  /messages and POST /messages.\n Use Postman, curl or\  
  another client to make HTTP requests.')  
})
```

```
app.listen(3000)  
})
```

Run it!

Test with CURL or Postman

```
curl localhost:3000/messages  
curl -H "Content-Type: application/json" -X POST -d '{"message":"hi","name":"Bob"}' localhost:3000/messages
```

Official Solution

<https://github.com/azat-co/react/blob/master/ch6/board/index.js>

Accessing URL Parameters

A URI segment can be parameterized by prefixing it with a semi-colon

```
app.get('/users/:id', function (request, response) {  
  request.params.id  
})
```

GET /users/572611d856b11dcec61651bb

Multiple URL Parameters

GET /users/:id/:some/:filter

request.params.id

request.params.some

request.params.filter

PUT

To update a resource (or create if it doesn't exist, perhaps)...

```
app.put('/users/:id', function (request, response) {
  var id = request.params.id
  // Check if the user exists
  ...
  if (exists) {
    // Code to modify the user
  } else {
    // Code to create the user
  }
  response.send(user)
})
```

DELETE

To delete a resource, create a DELETE handler for the desired URI

```
app.delete('/users/:id', function (request, response) {  
  var id = request.params.id  
  // code to delete the user  
  response.send(user) // or maybe the URL to create a new user?  
})
```

Note: del is deprecated.

HTTP Requests

A client's HTTP request is accessible from within routing handlers

It is the first argument in the handler's callback

```
app.get('/users/:id', function (request, response) {  
  // 'req' is the enhanced http request object  
});
```

Note: access to the request object grants insight into the client's HTTP request, providing data on the request header, body, et al.

Query Strings

Express converts a URL's query string into JSON

It can be accessed via the request's **query** object

GET http://localhost:3000/?name=Bruce+Wayne&age=40&occupation=Batman

request.query.name // "Bruce Wayne"

request.query.age // "40"

request.query.occupation // "Batman"

Accessing Form Data

Form data is then accessible via the request's **body** object
(ulrencoded)

```
// POST name=Bruce+Wayne&age=40&occupation=Your+Average+Businessman  
request.body.name  
request.body.age  
request.body.occupation
```

File Uploads

File uploads from web forms (multipart/form-data) can be parsed with these libraries:

- >> <https://github.com/expressjs/multer>
- >> <https://github.com/yahoo/express-busboy>
- >> <https://github.com/mscdex/connect-busboy>
- >> <https://github.com/andrewrk/node-multiparty>

Sessions

```
app.use(express.cookieParser())
app.use(express.session({ secret: 'notastrongsecret' }))
```

The session is now accessible via `request.session`

```
app.get('...', function (request, response) {
  var session = request.session
})
```

Redis Store with Express

```
$ npm install connect-redis express-session

var session = require('express-session'),
    RedisStore = require('connect-redis')(session)

app.use(session({
  store: new RedisStore(options),
  secret: 'keyboard cat'
}))
```

Node in Production

- » Docker: FROM argon
- » Clusters: pm2, slc, nodemon
- » Nginx, HAProxy, Varnish

Cloud

- » FaaS: AWS Lambdas and API Gateways, Azure Functions
- » IaaS: use Linux package managers to install Docker, Git, Node
- » PaaS: Azur App Services, Heroku mostly use Git and
package.json

For more info on Node in production follow [Node.University](#)

Alternatives

- >> Sails
- >> LoopBack 
- >> Meteor
- >> Hapi
- >> Restify

More Alternatives

Registry of hand-picked Node frameworks: nodeframework.com

Project Time!



Free JSON RESTful API

<https://github.com/azat-co/rest-api-express>

Download express.test.js and package.json

```
$ npm install
```

Questions and Exercises

