Node Program

Express.js

Node.js version: 5.1
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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/1StXFsG

🖥️ 🙁

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:

```javascript
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:

```javascript
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 Experss 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

```javascript
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

```javascript
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
```

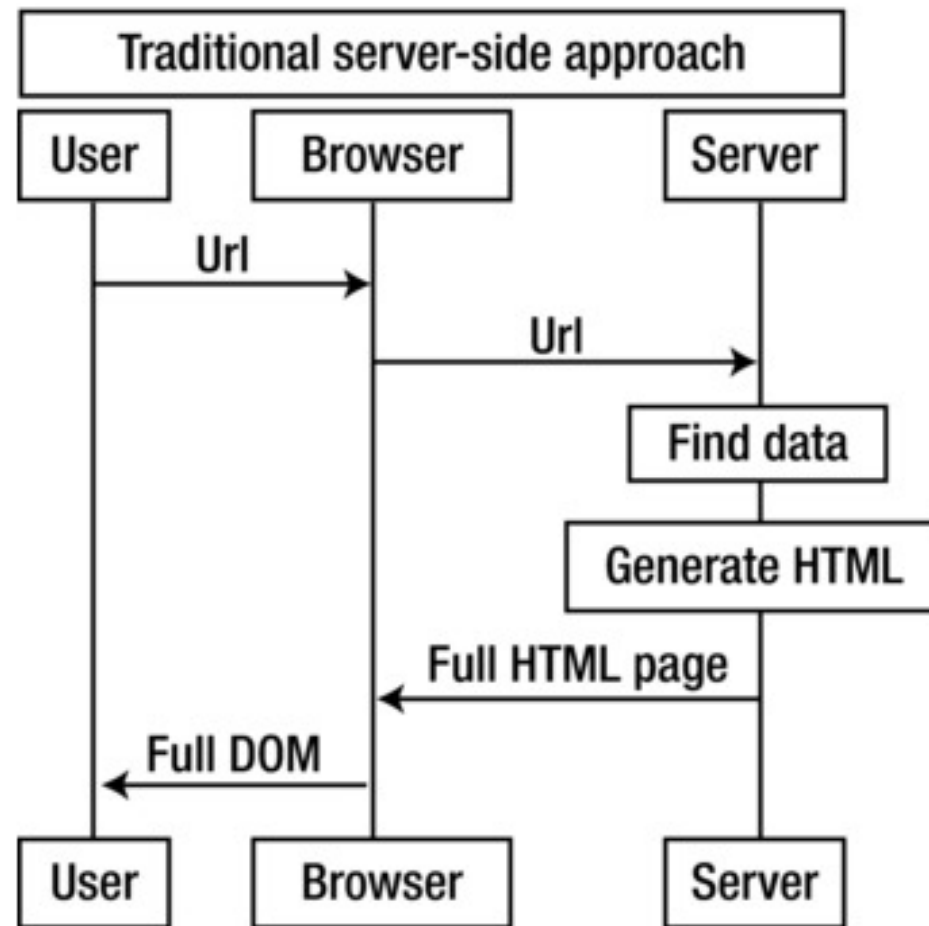https://github.com/azat-co/expressworks

Videos for solutions: YouTube ExpressWorks Playlist

or http://bit.ly/1jW1sBf

Building a RESTful API
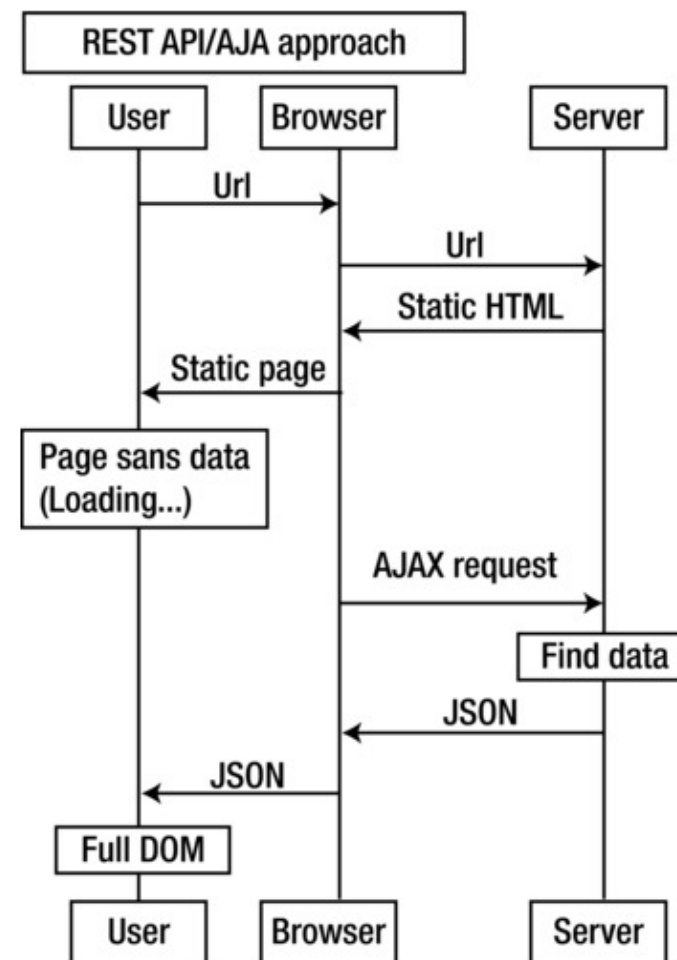
Traditional Web App

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
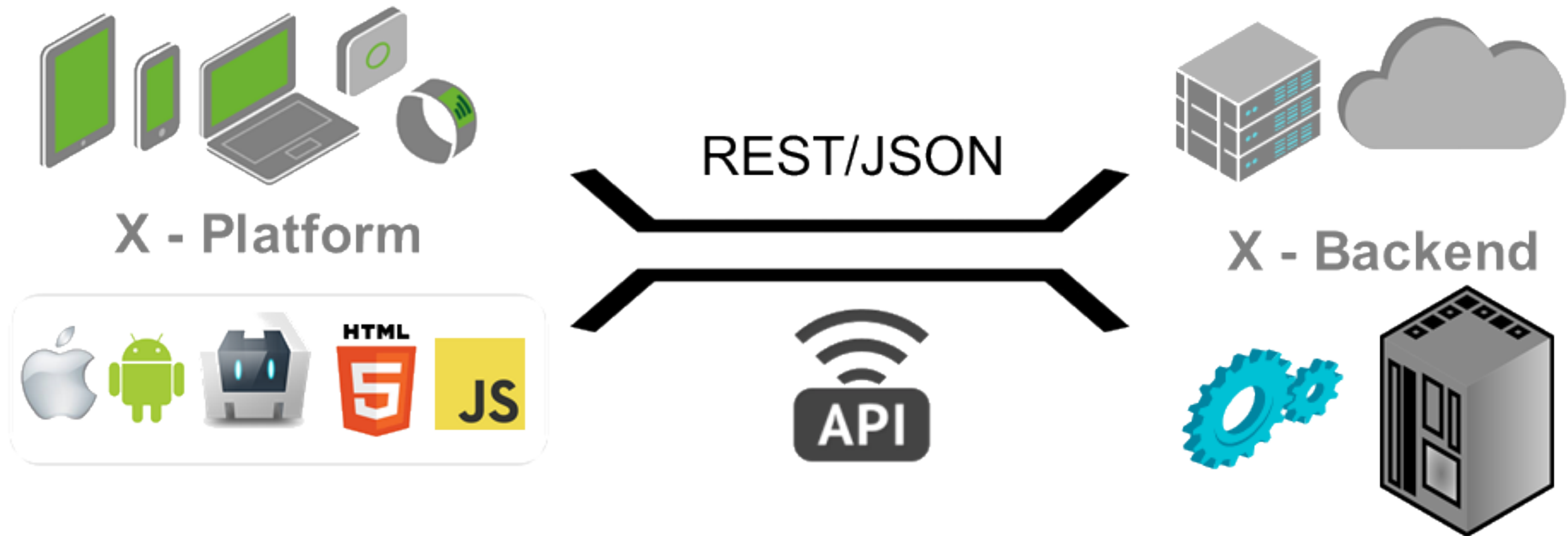
Also called thick client

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 middlware

- `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

```javascript
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)
  }
```

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

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

GET Route

```javascript
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/messapes
```

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)...

```javascript
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.cookiesParser())
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'
}))
```

Load-balancing

- Clusters

- Nginx

- HAProxy

- Varnish

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

? 🙋👍