Node Program

Express.js

Node.js version: 5.1
Last updated: Jan 2016

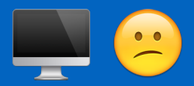
Express

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:

```
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 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 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

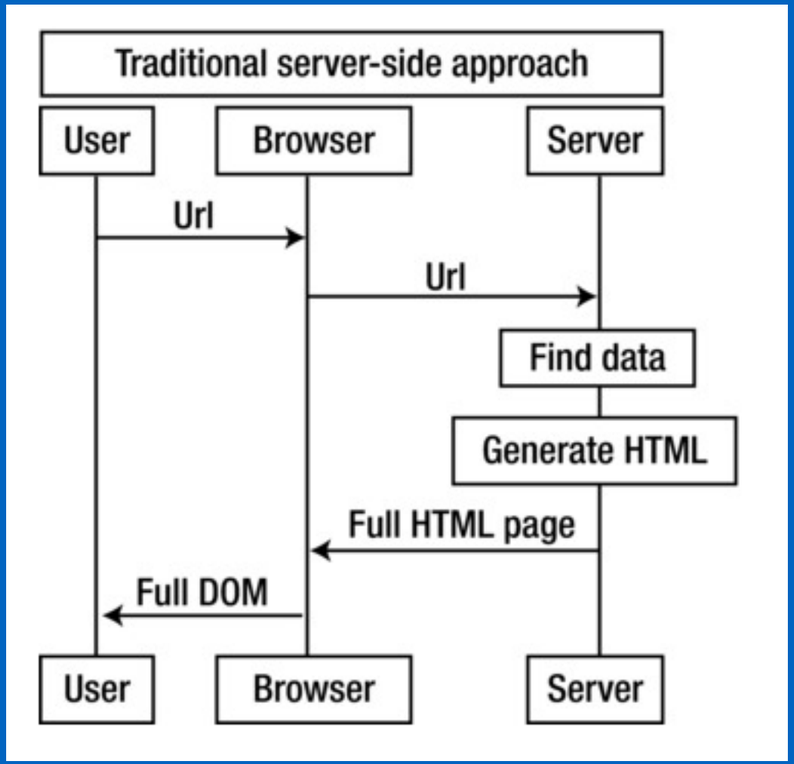
```
$ node server
$ nodemon server
$ node-dev server
$ forever server
$ pm2 server
```

Express is awesome! 🚀

Building a RESTful API

Traditional Web App

Also called thick server.

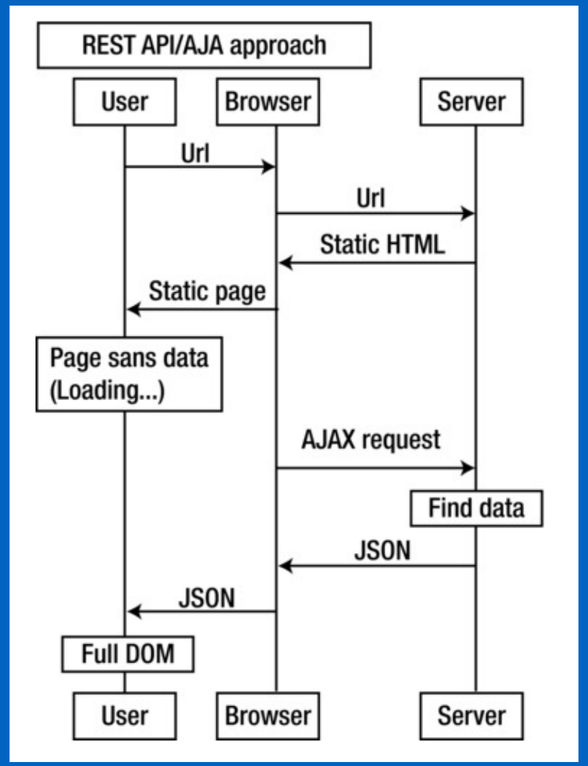


Traditional Web App Problems

- 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



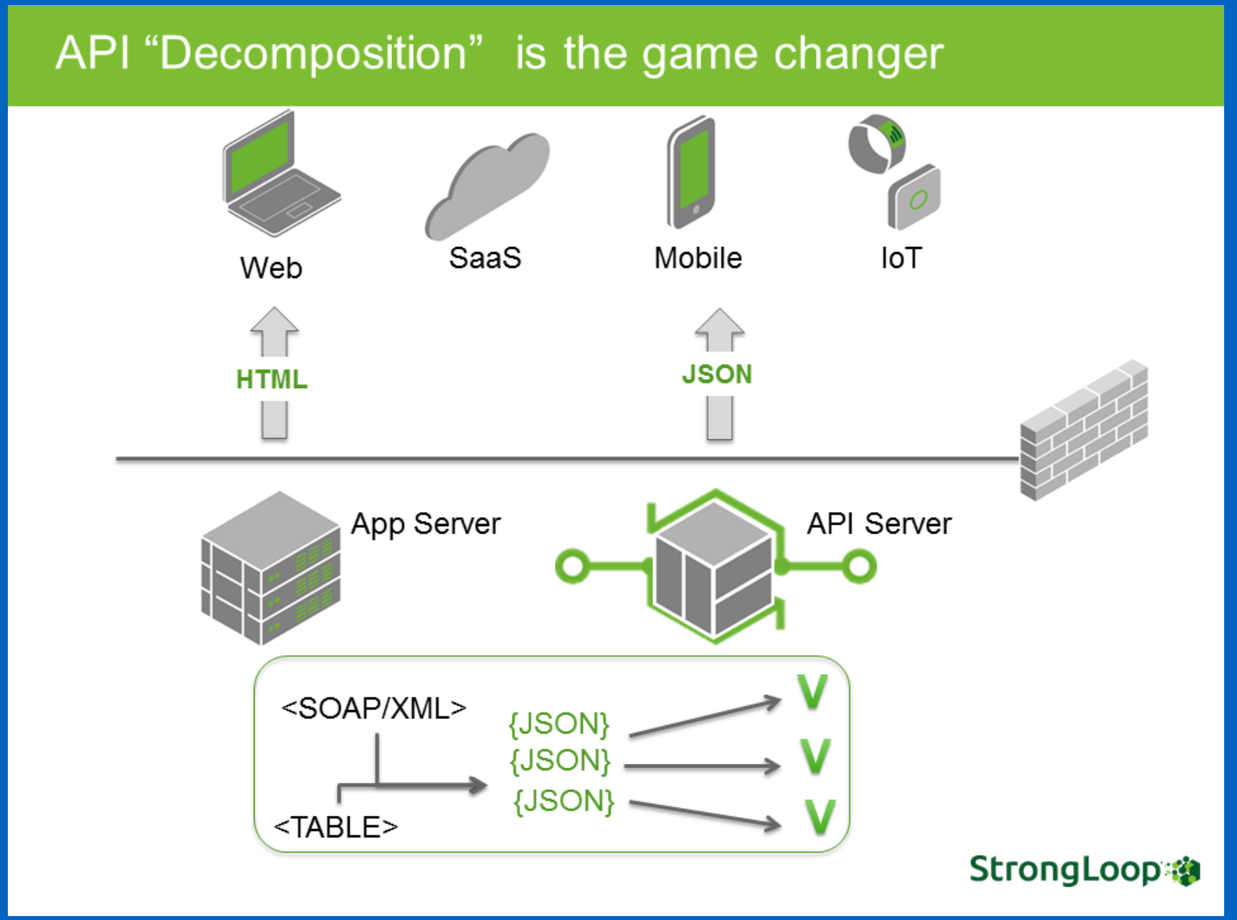
Advantages of a Thick Client

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

Node, SPAs and REST

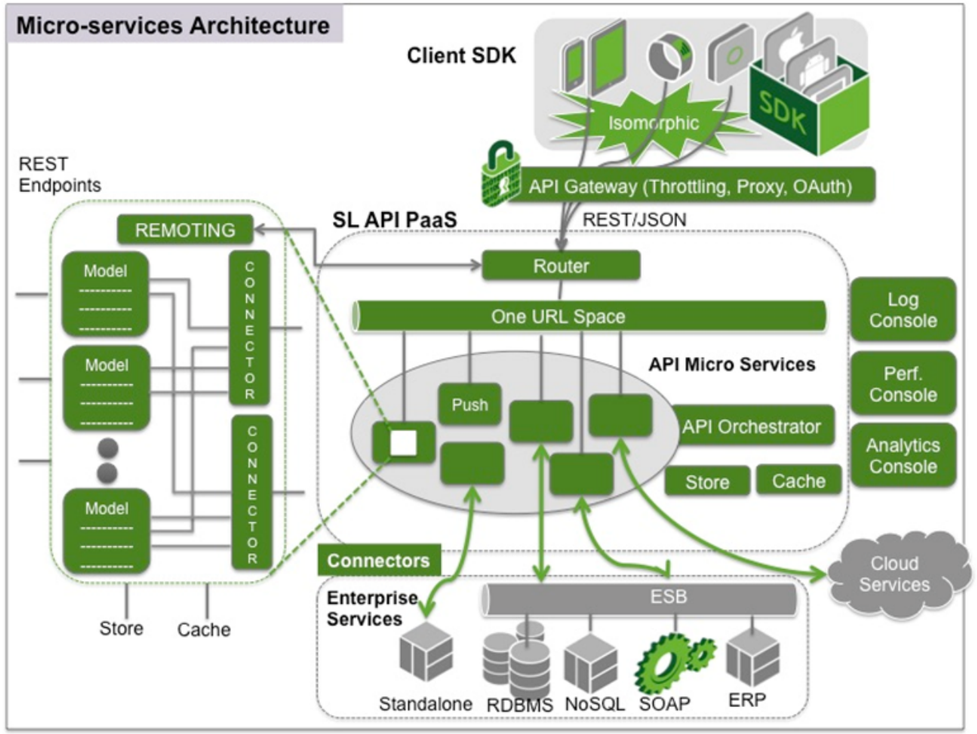
Build an API once and use everywhere

API Decomposition



Microservices

Micro-services have arrived



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?
```

"Resources"

Resources are entities that can be stored on a computer, such as:

- Files
- Database entries
- Processed output from functions

"Resources"

REST uses HTTP requests and responses to provide **representations** of resources

For example, the current version of a file available for download via its URL is a representation of a file resource

Modifying a resource, such as changing the contents of a file or deleting it, is also a resource state that can be represented via requests and responses in a REST system

REST API Examples

Handlers Signatures

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

GET Route

```
app.get('/users', function (request, response) {
  // Code to retrieve users
  response.send(user)
})
```

Accessing URL Parameters

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

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

These dynamic parameters can then be accessed via the request's **params** object

GET /users/:id

```
request.params.id
```

Multiple URL Parameters

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

```
request.params.id
request.params.some
request.params.filter
```

GET

To allow retrieval by id...

```
app.get('/users/:id', function (request, response) {
  var id = request.params.id
  // Code to retrieve a single user
  response.send(user)
})
```

GET

GET handlers can also be used to retrieve a collection of resources

```
app.get('/users', function (request, response) {
  // Code to retrieve multiple users
  response.send(users)
})
```

POST

To create a resource...

```
app.post('/users', function (request, response) {
  var username = request.body.username
  var email = request.body.email
  // ...
  // Code to create a new user
  response.send(user)
});
```

Or maybe just send back the endpoint to get the user...

```
response.send('/api/user/' + user.id)
```

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"
```

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.

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

Parsing JSON

Parse various different custom JSON types as JSON

```
app.use(bodyParser.json({ type: 'application/*+json' }))
```

Parsing Buffer

Parse some custom thing into a Buffer

```
app.use(bodyParser.raw({ type: 'application/vnd.custom-type' }))
```

Parsing HTML

Parse an HTML body into a string

```
app.use(bodyParser.text({ type: 'text/html' }))
```

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

```
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

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

DEMO

RESTful API with Express: https://github.com/azat-co/rest-api-express

🖥😁

```
$ git clone https://github.com/azat-co/rest-api-express.git
$ cd rest-api-express
$ npm install
$ node express.js
```

Alternatives

- Sails
- LoopBack 👈
- Meteor
- Hapi
- Restify

More Alternatives

Registry of hand-picked Node frameworks: nodeframework.com

Questions and Exercises

Workshop

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

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

Videos for solutions: YouTube ExpressWorks Playlist

or http://bit.ly/1jW1sBf