~~7~~ Working with Web Frameworks

This chapter covers the following recipes:

- Creating an Express Web App
- Creating a Hapi Web App
- Creating a Koa Web App
- Adding a view layer
- Adding Logging
- Implementing Authentication

Introduction

Node core supplies a strong set of well balanced primitives that allow us to create all manner of systems, for service-based architectures, to realtime data server, to robotics there's just enough in the Node core for purpose built libraries to arise from the Node community and ecosystem.

Building web site infrastructure is a very common use case for Node,and several high profile web frameworks have grown to become staple choices for creating web applications.

In this chapter we're going to explore the popular frameworks, and look at common tasks such as implementing server logging, sessions, authentication and validation.

Creating an Express Web App

Express has long been the most popular choice of web framework, which is unsurprising since it was the first Node web framework of a high enough quality for mass consumption ~~while~~ also drawing from familiar paradigms presented in the Sinatra web framework for Ruby on Rails.

In this recipe we'll look at how to put together an Express web application.

Getting Ready

Let's create a folder called `app`, initialize it as a package, and install `express`:

```
$ mkdir app
$ cd app
$ npm install --save express
```

How to do it

Let's start by creating a few files:

```
$ touch index.js
$ mkdir routes public
$ touch routes/index.js
$ touch public/styles.css
```

Now let's open the `index.js` file in our favorite editor, and prepare to write some code.

At the top of the file we'll load the following dependencies:

```
const {join} = require('path')
const express = require('express')
const index = require('./routes/index')
```

We'll write the `routes/index.js` file shortly, but for now let's continue writing the `index.js` file. Next we'll instantiate an Express object, which we'll call `app` while also setting up some configuration:

```
const app = express()
const dev = process.env.NODE_ENV !== 'production'
const port = process.env.PORT || 3000
```

Next we'll register some Express middleware, like so:

```
if (dev) {
  app.use(express.static(join(__dirname, 'public')))
}
```

And mount our `index` route at the `/` path:

```
app.use('/', index)
```

We'll finish off the `index.js` file by telling the Express application to listen on the `port` which we defined earlier.

```
app.listen(port, () => {
  console.log(`Server listening on port ${port}`)
})
```

Our `index.js` file is requiring `./routes/index`, so let's write the `routes/index.js` file:

```
const {Router} = require('express')
const router = Router()

router.get('/', function (req, res) {
  const title = 'Express'
  res.send(`
    <html>
      <head>
        <title> ${title} </title>
        <link rel="stylesheet" href="styles.css">
      </head>
      <body>
        <h1> ${title} </h1>
        <p> Welcome to ${title} </p>
      </body>
    </html>
  `)
})

module.exports = router
```

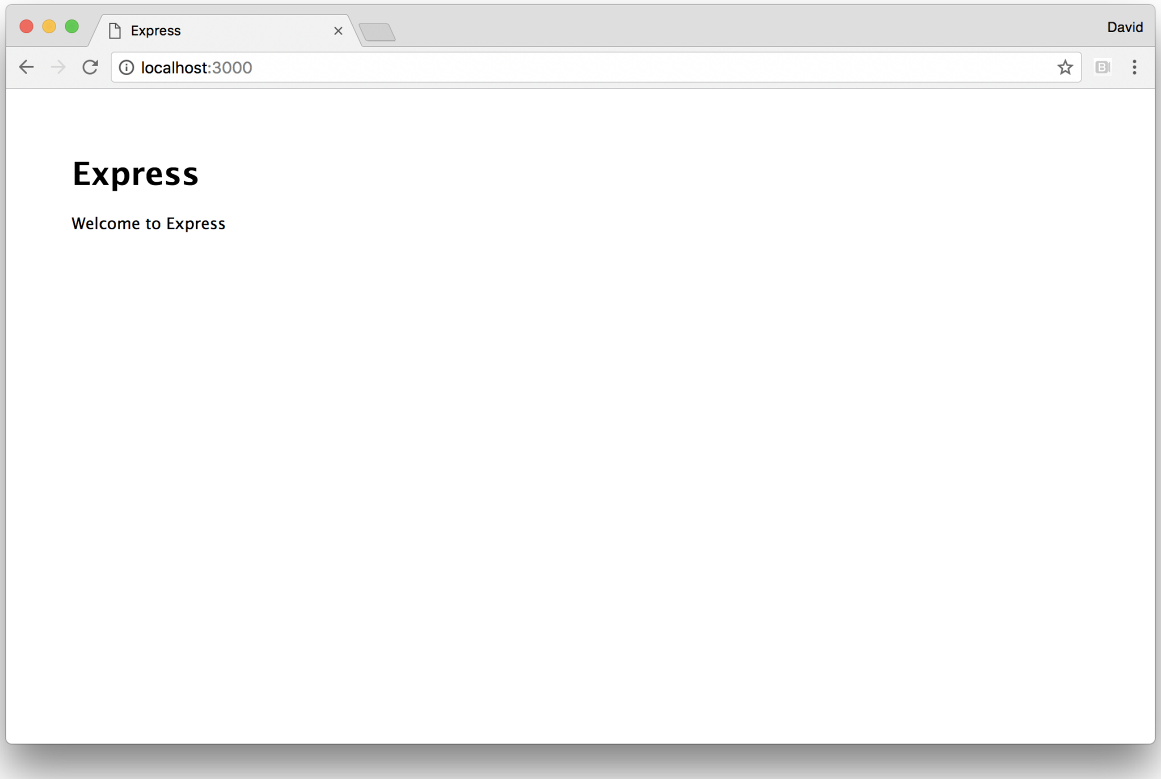
Now for a little bit of style. Let's complete the picture with a very simply CSS file in `public/styles.css`

```
body {
  padding: 50px;
  font: 14px "Lucida Grande", Helvetica, Arial, sans-serif;
}
```

We should be able to run our server with:

```
$ node index.js
```

If we access our server at http://localhost:3000 in a browser, we should see something like the following image:



Express

Welcome to Express

How it works

Express is a framework built on top of Node's core `http` (and `https` when relevant) module.

> ### The core `http` module
>
> See **Chapter 5 Wielding Web Protocols** for more on the Node's core `http` module.

Express decorates the `req` (`http.IncomingMessage`) and `res` (`http.ServerResponse`) objects which are passed to the `http.createServer` request handler function.

To explain this using code, at a very basic level Express essentially performs the following internally:

```
const http = require('http')
http.createServer((req, res) => {
  /* add extra methods and properties to req and res  */
}))
```

When we call the `express` function, it returns an instance which we called `app` which represents our Express server.

The `app.use` function allows us to register "middleware" which at a fundamental level is a function that is called from the same `http.createServer` request handling function.

Again, for a pseudo-code explanation:

```
const http = require('http')
http.createServer((req, res) => {
  /* call the middleware registered with app.use */
  /* wait for each piece of middleware to finish
     before calling the next (wait for the next cb) */
}))
```

Each piece of middleware may call methods on `req` and `res`, and extend the objects with additional methods or properties.

The `express.static` method comes bundled with Express. It returns a middleware function which is passed into `app.use`. This function will attempt to locate a file based on supplied configuration (in our case, we set the root directory to the `public` folder) for a given route. Then it will create a write stream from the file and stream it to the request object (`req`). If it can't find a file it will pass control to the next middleware by calling the `next` callback.

We only use the static middleware in development mode (based on the value of the `dev` reference, which is assigned based on whether the `NODE_ENV` environment variable is set to "production"). This assumes a production scenario where a reverse proxy (such as Nginx or Apache or, even better a CDN) handles static file serving. While Node has come a long way in recent years, Node's strength remains in generating dynamic content - it still doesn't usually make sense to use it for static assets in production.

The order of middleware is significant, because middleware executes in cascading fashion. For instance, if we register static file handling middleware before route handling middleware in the case of name collision (where a route could apply to a file or a dynamic route), the file handling middleware will take precedence. However, if the route handling middleware is first, the dynamic route takes will serve the request first instead.

The `app.use` function can accept a string as the first argument, which determines a "mount point" for a piece of middleware. This means instead of the middleware applying to all incoming requests it will only be called when there is a route match.

Route handlers are essentially the same mounted middleware, but are constructed with Express' `Router` utility for cleaner encapsulation. In our `routes/index.js` file we create a router object which we called `router`. Router objects have methods which correspond to the HTTP verbs (such as GET, PUT, POST, PATCH, DELETE) in relevant specification (rfc7231).

Most commonly we would use `GET` and `POST` for web facing applications. We use `router.get` to register a route (`/`), with and supply a route handling function (which is technically also middleware).

In our route handler, we pass `res.send` a string of HTML content to respond to the client.

The `res.send` method is added by Express, it's the equivalent of `res.end` but with additional features such as content type detection.

We export the `router` instance from the `routes/index.js`, then load it into the `index.js` file and pass it to `app.use` (as the second argument, after a mount point string argument (`/`)).

The `router` instance is itself, middleware. It's a function that accepts `req`, `res` and `next` arguments. When called, it checks its internal state based on any routers registered (via `get` etcetera), and responds accordingly.

The function we pass to `router.get` can also take a `next` callback function. We ignored the `next` callback function in our case (we didn't define it in the route handling functions parameters), because this route handler is a terminal point - there is nothing else to be done after sending the content. However, in other scenarios there may be cause to use the `next` callback and even pass it an error to propagate request handling the next piece of middleware (or route middleware, since a route registering method (like `get`) can be passed multiple subsequent route handling functions).

At the end of `index.js` we call `app.listen` and pass it a callback function. This will in turn call the `listen` method on the core `http` server instance which Express has created internally, and pass our supplied callback to it. Our callback simply logs that the server is now listening on the given port.

> ### What About SSL
>
> While Express can work with HTTPS, we recommend that the general approach should be to terminate SSL at the load balancer (or reverse proxy) for optimal efficiency.

There's more

Let's explore some more of the functionality offered by Express.

Production

Our Express server defines a `dev` reference, based on the value of the `NODE_ENV` environment variable. This is a standard convention in Node. In fact Express will behave differently when `NODE_ENV` is set to production - for instance views will be cached in memory.

We can check out production mode with

```
$ NODE_ENV=production node index.js
```

We should notice this removes styling from our app. This is because we only serve static assets in development mode, and the `<link>` tags in our views will be generating 404 errors in attempts to fetch the `public/styles.css` file.

Route Parameters and POST requests

Let's copy our `app` folder to `params-postable-app`, and then install the `body-parser` middleware module:

```
$ cp -fr app params-postable-app
$ cd params-postable-app
$ npm install --save body-parser
```

> ### CAUTION!
>
> This example is for demonstration purposes only! Never place user input directly into HTML output in production without sanitizing it first. Otherwise, we make ourselves vulnerable to XSS attacks. See *Guarding Against Cross Site Scripting (XSS)* in **Chapter 8 Dealing with Security** for details.

In the `index.js` file, we'll load the middleware and use it.

At the top of `index.js` file we'll require the body parser middleware like so:

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

Then we'll use it, just above the `port` assignment we'll add:

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

> ## Use `extended: false`
>
> We set `extended` to `false` because the `qs` module which provides the parsing functionality for `bodyParse.urlencoded` has options which could (without explicit validation) allow for a Denial of Service attack. See the **Anticipating Malicious in Chapter 8 Dealing with Security** for details.

Now in `routes/index.js` we'll alter our original GET route handler to the following:

```
router.get('/:name?', function (req, res) {
  const title = 'Express'
  const name = req.params.name
  res.send(`
    <html>
      <head>
        <title> ${title} </title>
        <link rel="stylesheet" href="styles.css">
      </head>
      <body>
        <h1> ${title} </h1>
        <p> Welcome to ${title}${name ? `, ${name}.` : ''} </p>
        <form method=POST action=data>
        Name: <input name=name> <input type=submit>
        </form>
      </body>
    </html>
  `)
})
```

We're using Express' placeholder syntax here to define a route parameter called `name`. The question mark in the route string indicates that the parameter is optional (which means the original functionality for the `/` route is unaltered). If the `name` parameter is present, we add it into our HTML content.

We've also added a form which will perform a POST request to the `/data` route. By default it will be of type `application/x-www-form-urlencoded` which is why we use the `urlencoded` method on the `body-parser` middleware.

Now to the bottom of `routes/index.js` we'll add a POST route handler:

```
router.post('/data', function (req, res) {
  res.redirect(`/${req.body.name}`)
})
```

Now let's start our server:

```
$ node index.js
```

Then load navigate our browser to http://localhost:3000 we should be able to supply a name to the input box, press the submit button and subsequently see our name in the URL bar and on the page.

> ## CAUTION!
>
> This example is for demonstration purposes only! Never place user input directly into HTML output in production without sanitizing it first. Otherwise, we make ourselves vulnerable to XSS attacks. See Anticipating Malicious Input *and* Guarding Against Cross Site Scripting (XSS) *in *Chapter 8 Dealing with Security* for details.

Creating Middleware

Middleware (functions which are passed to `app.use`) is a fundamental concept in Express (and other web frameworks).

If we need some custom functionality (for instance, business logic related), we can create our middleware.

Let's copy the `app` folder from our main recipe to the `custom-middleware-app` and create a middleware folder with an `answer.js` file:

```
$ cp -fr app custom-middleware-app
$ cd custom-middleware-app
$ mkdir middleware
$ touch middleware/answer.js
```

Now we'll place the following code in `middleware/answer.js`:

```
module.exports = answer

function answer () {
  return (req, res, next) => {
    res.setHeader('X-Answer', 42)
    next()
  }
}
```

Finally we need to modify the `index.js` file in two places. First at the top, we add our answer middleware to the dependency loading section:

```
const {join} = require('path')
const express = require('express')
const index = require('./routes/index')
const answer = require('./middleware/answer')
```

Then we can place our `answer` middleware at the top of the middleware section, just underneath the `port` assignment:

```
app.use(answer())
```

Now let's start our server:

```
$ node index.js
```

And hit the server with `curl -I` to make a `HEAD` request and view headers:

```
$ curl -I http://localhost:3000
```

We should see output similar to:

```
HTTP/1.1 200 OK
X-Powered-By: Express
X-Answer: 42
```

```
Content-Type: text/html; charset=utf-8
Content-Length: 226
ETag: W/"e2-olBsieaMz1W9hKepvcsDX9In8pw"
Date: Thu, 13 Apr 2017 19:40:01 GMT
Connection: keep-alive
```

With our `X-Answer` present.

Middleware isn't just for setting custom headers, there's a vast range of possibilities, parsing the body of a request and session handling to implementing custom protocols on top of HTTP.

See also

- *Hardening Headers in Web Frameworks* in **Chapter 8 Dealing With Security*
- *Creating an HTTP Server* in **Chapter 5 Wielding Web Protocols**
- *Anticipating Malicious Input* in **Chapter 8 Dealing with Security**
- *Guarding Against Cross Site Scripting (XSS)* in **Chapter 8 Dealing with Security**
- *Consuming a Service* in **Chapter 10 Building Microservice Systems**
- *Standardizing service boilerplate* in **Chapter 10 Building Microservice Systems**
- *Adding a View Layer* in this Chapter
- *Implementing Authentication* in this Chapter

Creating a Hapi Web App

Hapi is a fairly recent addition to the "enterprise" web framework offerings. The Hapi web framework has a reputation for stability, but tends to perform slower (for instance, see https://raygun.com/blog/node-performance/) while also requiring more boilerplate than alternatives. With a contrasting philosophy and approach to Express (and other "middleware" frameworks like Koa and Restify) Hapi may be better suited to certain scenarios and preferences. For instance, teams in large organizations that have a leaning towards Object Oriented Programming, particular where Java is the prevailing tradition, may find Hapi more fitting to the cultural proclivities.

In this recipe, we'll create a simple Hapi web application.

Getting Ready

Let's create a folder called `app`, initialize it as a package, and install `hapi` and `inert`:

```
$ mkdir app
$ cd app
$ npm install --save hapi inert
```

How to do it

Let's start by creating a few files:

```
$ touch index.js
$ mkdir routes public
$ touch routes/index.js
$ touch routes/dev-static.js
$ touch public/styles.css
```

We'll begin by populating the `index.js` file.

At the top of `index.js` let's require some dependencies:

```
const hapi = require('hapi')
const inert = require('inert')
const routes = {
  index: require('./routes/index'),
  devStatic: require('./routes/dev-static')
}
```

Now we'll instantiate a Hapi server, and set up `dev` and `port` constants:

```
const dev = process.env.NODE_ENV !== 'production'
const port = process.env.PORT || 3000

const server = new hapi.Server()
```

Next we'll supply Hapi server connection configuration:

```
server.connection({
  host: 'localhost',
  port: port
})
```

We're only going to use `inert` (a static file handling Hapi plugin) in development mode, so let's conditionally register the `inert` plugin, like so:

```
if (dev) server.register(inert, start)
else start()
```

We'll finish off `index.js` by supplying the `start` function we just referenced:

```
function start (err) {
  if (err) throw err

  routes.index(server)

  if (dev) routes.devStatic(server)

  server.start((err) => {
    if (err) throw err
    console.log(`Server listening on port ${port}`)
  })
}
```

This invokes our route handlers, and calls `server.start`.

Our `index.js` file is relying on two other files, `routes/index.js` and `routes/devStatic.js`.

Let's write the `routes/index.js` file:

```
module.exports = index

function index (server) {
  server.route({
    method: 'GET',
    path: '/',
    handler: function (request, reply) {
      const title = 'Hapi'
      reply(`
        <html>
          <head>
            <title> ${title} </title>
            <link rel="stylesheet" href="styles.css">
          </head>
          <body>
            <h1> ${title} </h1>
            <p> Welcome to ${title} </p>
          </body>
        </html>
      `)
    }
  })
}
```

And now the `routes/dev-static.js` file:

```
module.exports = devStatic

function devStatic (server) {
  server.route({
    method: 'GET',
    path: '/{param*}',
    handler: {
      directory: {
        path: 'public'
      }
    }
  })
}
```

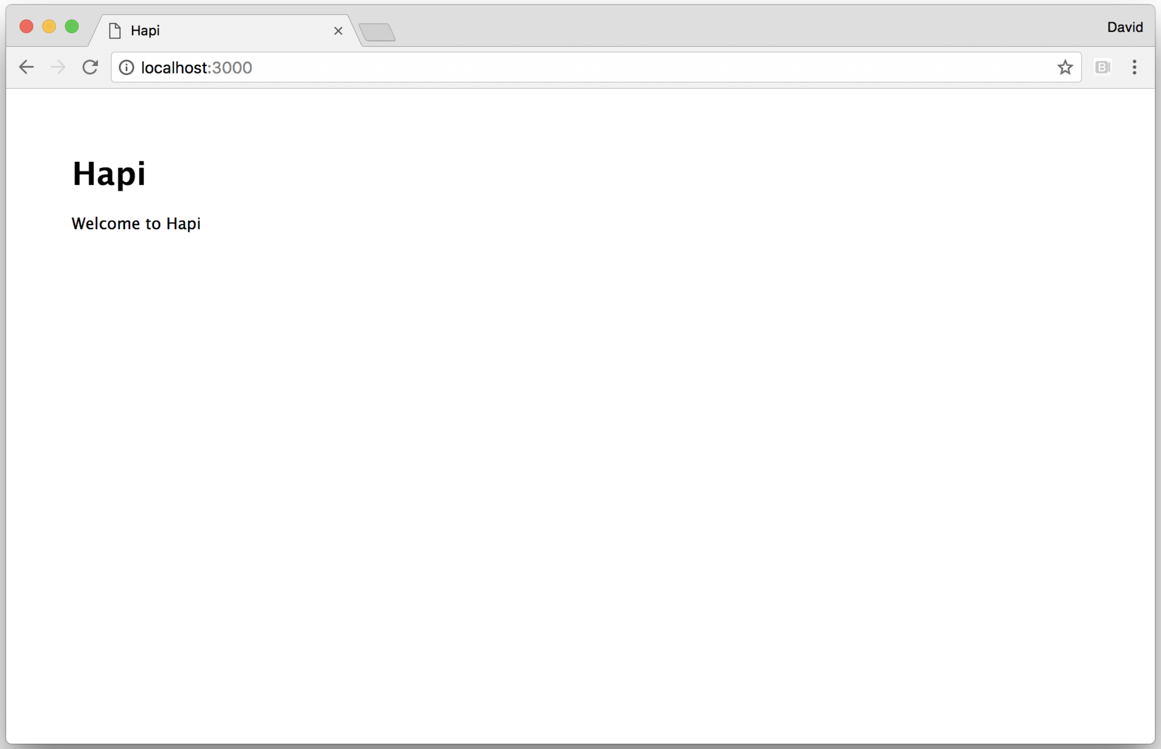
Finally we need to supply the `public/styles.css` file:

```
body {
  padding: 50px;
  font: 14px "Lucida Grande", Helvetica, Arial, sans-serif;
}
```

Now we can start our server:

```
$ node index.js
```

If we navigate to http://localhost:3000 in our browser, we should see something like the following:



Hapi

Welcome to Hapi

How it works

After we create a `hapi.Server` instance (which we named `server`) we call the `connection` method. This will register the settings we pass in a list of connections.

When we later call `server.start` Hapi creates an `http` (or `https` if a `tls` object is supplied with `key` and `cert` buffer values). Unlike Express or Koa, Hapi allows for multiple connections, which in turn will create multiple core `http` server instances (with Express or Koa we would simply instantiate multiple instances of Express/Koa and reuse any routes/middleware between them as required).

In our case we call `server.connection` once, as a result, upon calling `server.start`, a single `http` server is created which listens to port `3000` (unless otherwise set in the `PORT` environment variable, according to how we've defined the `port` constant).

We use the separate `inert` Hapi plugin to serve static files in development mode. The `server.register` function can take a single plugin, or an array of plugins. We currently only have one plugin (and only when `dev` is `true`), so we pass the `inert` plugin to `server.register` and supply the `start` function as the second argument. The second argument to `server.register` is a callback, which is triggered once plugins are loaded. If our server was in production mode (that is, if the `NODE_ENV` environment variable was set to production), then we simply call `start` directly as we have no other plugins to register.

We have two routes files, `routes/index.js` and `routes/dev-static.js`. These files simply export a function that takes the `server` object which we created in `index.js`.

In both `routes/index.js` and `routes/dev-static.js` we call `server.route` to register a new route with Hapi.

The `server.route` method takes an object which describes the route. We supply an object with `method`, `path` and `handler` properties in both cases.

> ### Route options
>
> In addition to the required three properties (`method`, `path`, `handler`), another possible key on the settings object passed to `server.route` is the `config` property. This allows for a vast amount of behavioral tweaks both for internal Hapi and for additional plugins. See https://hapijs.com/api#route-options for more information.

In `routes/index.js` we set the `method` to `GET`, the `path` to `/` (because it's our index route) and the `handler` to a function which accepts `request` and `reply` arguments.

The `request` and `reply` parameters while analogous to the parameters passed to the `http.createServer` request handler function (often called `req` and `res`) are quite distinct. Unlike Express which *decorates* `req` and `res`, Hapi creates separate abstractions (`request` and `reply`) which interface with `req` and `res` internally.

In the `handler` function, we call `reply` as a function, passing it our HTML content.

In `routes/dev-static.js` the `path` property is using route parametization with segment globbing to allow match any route. In our case the use of `param` in `/{param*}` is irrelevant. It could be named anything at all, this is just a necessity to get the required functionality. The asterisk following `param` will cause any number of route segments (parts of the route separated by `/`) to match. Instead of a function, the `handler` in our `routes/dev-static.js` file is an object with `directory` set to an object containing a `path` property which points to our `public` folder. This is as route configuration settings by the `inert` plugin.

Our `start` function checks for any error (rethrowing if there is one) and passes the `server` object to the the `routes.index` and `routes.devStatic` functions, then calls `server.start` which causes Hapi to create the `http` server and bind to the host and port supplied to `server.connection` earlier on. The `server.start` method also takes a callback function, which is called once all servers have been bound to their respective hosts and ports. The callback we supply checks and rethrows an error, and logs out confirmation message that the server is now up.

There's more

Let's explore some more of Hapi's functionality.

Creating a plugin

Let's copy the `app` folder from our main recipe to the `custom-plugin-app` and create a `plugins` folder with an `answer.js` file:

```
$ cp -fr app custom-plugin-app
$ cd custom-plugin-app
$ mkdir plugins
$ touch plugins/answer.js
```

We'll make the contents of `plugins/answer.js` look like so:

```
module.exports = answer

function answer (server, options, next) {
  server.ext('onPreResponse', (request, reply) => {
    request.response.header('X-Answer', 42)
    reply.continue()
  })
  next()
}

answer.attributes = {name: 'answer'}
```

The `next` callback is supplied to allow for any asynchronous activity. We call it to let Hapi know we've finished setting up the plugin. Under the hood Hapi would call the `server.register` callback once all the plugins had called their respective `next` callback functions.

Events and Extensions

> There are a variety of server events (which we can listen to with `server.on`) and "extensions". Extensions are very similar to server events, except we use `server.ext` to listen to them and must call `reply.continue()` when we're ready to proceed. See https://hapijs.com/api#request-lifecycle as a starting point to learn more.

We use the `onPreResponse` extension (which is very much like an event) to add our custom header. The `onPreResponse` extension is the *only* place we can register headers (the `onRequest` extension is too early and the `response` event is too late).

We'll add the answer plugin near the top of the `index.js` file like so:

```
const answer = require('./plugins/answer')
```

Then at the bottom of `index.js` we'll modify the boot up code to the following:

```
const plugins = dev ? [answer, inert] : [answer]
server.register(plugins, start)

function start (err) {
  if (err) throw err

  routes.index(server)

  if (dev) routes.devStatic(server)

  server.start((err) => {
    if (err) throw err
    console.log(`Server listening on port ${port}`)
  })
}
```

Label Selecting

Each Hapi connection can be labelled with one or more identifiers, which can in turn be used to conditionally register plugins and define routes or perform other connection specific tasks.

Let's copy the `app` folder from our main recipe to `label-app`:

```
$ node index.js
```

Now we'll alter our `index.js` to the following:

```
const hapi = require('hapi')
const inert = require('inert')
const routes = {
  index: require('./routes/index'),
  devStatic: require('./routes/dev-static')
}

const devPort = process.env.DEV_PORT || 3000
const prodPort = process.env.PORT || 8080

const server = new hapi.Server()

server.connection({
  host: 'localhost',
  port: devPort,
  labels: ['dev', 'staging']
})

server.connection({
  host: '0.0.0.0',
  port: prodPort,
  labels: ['prod']
})

server.register({
  register: inert,
  select: ['dev', 'staging']
}, start)

function start (err) {
  if (err) throw err

  routes.index(server)

  routes.devStatic(server)

  server.start((err) => {
    if (err) throw err
    console.log(`Dev/Staging server listening on port ${devPort}`)
    console.log(`Prod server listening on port ${prodPort}`)
  })
}
```

We removed the `dev` constant as we're using Hapi labels to handle conditional environment logic. We now have two port constants, `devPort` and `prodPort` and we use them to create two server connections. The first listens on the local loopback interface (`localhost`) as normal, on the `devPort` which defaults to port `3000` . The second listens on the public interface (`0.0.0.0`), on the `prodPort` default to port `8080` .

We add `label` property to each connection, on the first we supply an array of `['dev', 'staging']` and to the second a string containing `prod` . This means we can treat our development connection as a staging connection when it makes sense - for instance in our case we're using `inert` for static file hosting on both development and staging but in production we assume a separate layer in the deployment architecture is handling this.

We've removed the `if` statement checking for `dev` and have instead housed the `inert` plugin in an object as we pass it to `server.register` . Passing `inert` directly or passing as the `register` property of an object are equivalent. However passing it inside an object allows us to supply other configuration. In this case add a `select` property which is set to `['dev', 'staging']` . This means the `inert` plugin will only register on the development connection, but will not be present on the production connection.

In the `start` function we've also removed the `if(dev)` statement preceeding our call to `routes.devStatic` . We need to modify `routes/dev-static.js` so that the static route handler is only registered for the development connection.

Let's change `routes/dev-static.js` to the following:

```
module.exports = devStatic

function devStatic (server) {
  server.select(['dev', 'staging']).route({
    method: 'GET',
    path: '/{param*}',
    handler: {
      directory: {
        path: 'public'
      }
    }
  })
}
```

We've added in call to `server.select` . When we call `route` on the resulting object, the route is only applied to connections that match the supplied labels.

We can confirm that our changes are working by running our server:

```
$ node index.js
```

And using curl to check whether the development server delivers static assets (which it should) and the production server responds with 404:

```
$ curl http://localhost:3000/styles.css
```

This should respond with the contents of `public/styles.css`.

However the following should respond with `{"statusCode":404,"error":"Not Found"}`:

```
$ curl http://localhost:8080/styles.css
```

This approach does uses more ports than necessary in production, which may lead to reduced performance and does beg some security questions. However, we could side step these problems while still getting the benefits of labelling (in this specific case) by reintroducing the `dev` constant and only conditionally creating the connections based on whether `dev` is true or false.

For example:

```
const dev = process.env.NODE_ENV !== 'production'

if (dev) server.connection({
  host: 'localhost',
  port: devPort,
  labels: ['dev', 'staging']
})

if (!dev) server.connection({
  host: '0.0.0.0',
  port: prodPort,
  labels: 'prod'
})
```

However this would require a modification to any conditional routing, since there Hapi requires at least one connection before a route can be added. For instance in our case we would have to modify the top of the function exported from `routes/dev-static.js` like so:

```
function devStatic (server) {
  const devServer = server.select(['dev', 'staging'])
  if (!devServer.connections.length) return
  devServer.route({ /* ... etc ... */ })
}
```

See also

- *Hardening Hapi* in the *There's More* section of *Hardening Headers in Web Frameworks* in **Chapter 8 Dealing With Security**
- *Creating an HTTP Server* in **Chapter 5 Wielding Web Protocols**
- *Anticipating Malicious Input* in **Chapter 8 Dealing with Security**
- *Guarding Against Cross Site Scripting (XSS)* in **Chapter 8 Dealing with Security**
- *Adding a View Layer* in this Chapter
- *Implementing Authentication* in this Chapter

Creating a Koa Web App

Koa is an evolution of the middleware concept in line with updates to the JavaScript language. Originally in Koa v1, flow control was handled by re-purposing EcmaScript 2015 (ES6) Generator functions (using the `yield` keyword to freeze function execution) combined with promises. In Koa v2, a more normative route is taken using EcmaScript 2016 `async/await` syntax.

It's a minimalist web framework compared to Express (and far more minimalist compared to Hapi). Koa is more closely comparable to the Connect web framework (which was the precursor to Express). This means that functionality which tends to come as standard in other web frameworks (such as route handling) is installed separately as Koa middleware.

In this recipe, we're going to create a Koa (v2) web application.

> ### Node 8+ Only
>
> This recipe focuses on Koa 2, using up-to-date `async/await` syntax which is only supported from Node 8 onwards.

Getting Ready

Let's create a folder called `app`, initialize it as a package, and install `koa`, `koa-router` and `koa-static`:

```
$ mkdir app
$ cd app
$ npm install --save koa koa-router koa-static
```

How to do it

We'll start by creating a few files:

```
$ touch index.js
$ mkdir routes public
$ touch routes/index.js
$ touch public/styles.css
```

Now let's kick off the `index.js` file by loading necessary dependencies:

```
const Koa = require('koa')
const serve = require('koa-static')
const router = require('koa-router')()
const {join} = require('path')
const index = require('./routes/index')
```

Next we'll create a Koa app and assign `dev` and `port` configuration references:

```
const app = new Koa()
const dev = process.env.NODE_ENV !== 'production'
const port = process.env.PORT || 3000
```

Next we'll register relevant middleware and routes:

```
if (dev) {
  app.use(serve(join(__dirname, 'public')))
}

router.use('/', index.routes(), index)

app.use(router.routes())
```

Finally in `index.js` we'll bind Koa's internal server to our `port` by calling `app.listen`:

```
app.listen(port, () => {
  console.log(`Server listening on port ${port}`)
})
```

Our `index.js` file is relying on `routes/index.js` so let's write it.

Our code in `routes/index.js` should look as follows:

```
const router = require('koa-router')()

router.get('/', async function (ctx, next) {
  await next()
  const { title } = ctx.state
  ctx.body = `
    <html>
      <head>
        <title> ${title} </title>
        <link rel="stylesheet" href="styles.css">
      </head>
      <body>
        <h1> ${title} </h1>
        <p> Welcome to ${title} </p>
      </body>
    </html>
  `
}, async (ctx) => ctx.state = {title: 'Koa'})

module.exports = router
```

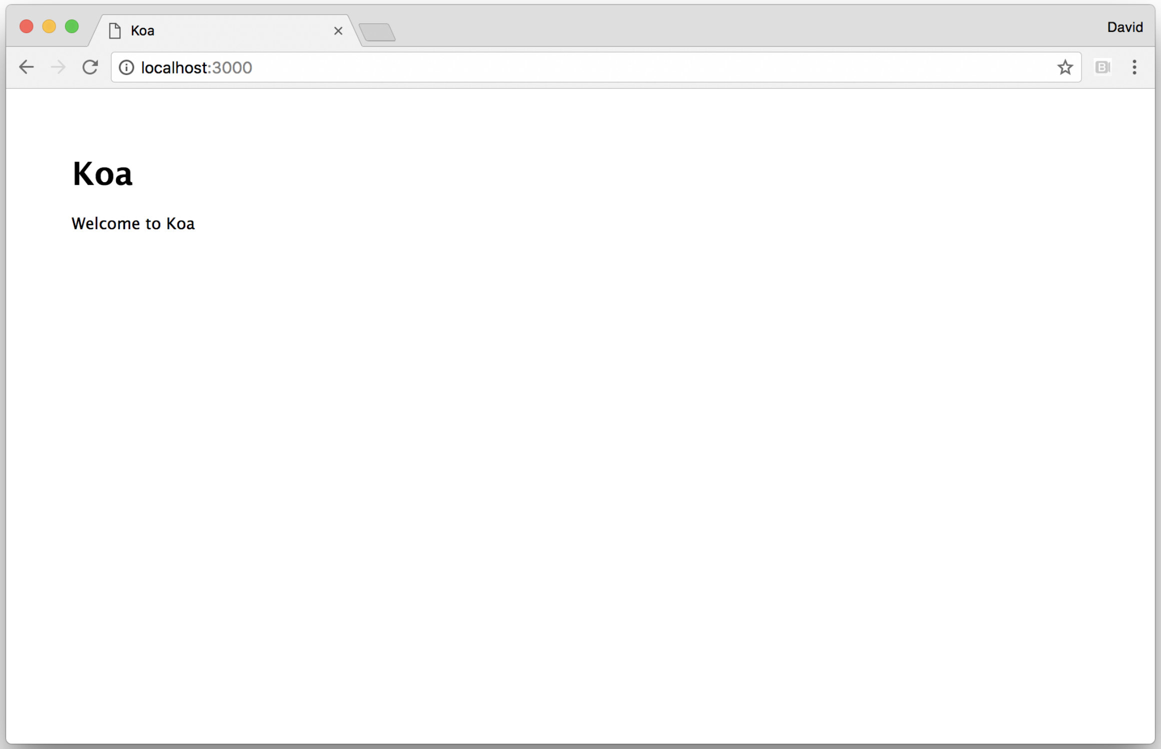
Finally the `public/styles.css` file:

```
body {
  padding: 50px;
  font: 14px "Lucida Grande", Helvetica, Arial, sans-serif;
}
```

let's start our server with:

```
$ node index.js
```

And access http://localhost:3000 in a browser, we should see something like the following image:



Koa

Welcome to Koa

How it works

Since Koa is a bare bones web framework, we installed `koa-static` and `koa-router` along with `koa` and use them in our `index.js` file.

> ### Essential Knowledge
>
> To understand how Koa works at a basic level, we need a fundamental understanding of JavaScript Promises (in particular ES 2015 Promises) and of `async/await` syntax. See https://medium.com/@bluepnume/eb148164a9c8 for an excellent article on how these abstractions interact.

The `koa-static` module returns a Koa middleware function which is passed into `app.use`. Koa middleware accepts a context object (often called `ctx`) and a `next` function. The `next` function always returns a promise.

The `koa-static` middleware attempts to locate files as per our defined path (the `public` folder), then creates a write stream from a file (if found) to the `ctx.request` object which is Node's core `http` request object (an instance of `http.IncomingMessage` often called `req`). If the file isn't found it passes on control to the next piece of middleware.

The `koa-router` middleware is superficially similar to the `Router` utility in

Express. However, we register other router instances with our main router instance (our `router` object in `index.js`) by calling `router.use`. This allows us to set mount points for a particular set of routes. Then we pass the main `router` instance into `app.use`.

In `routes/index.js` we load `koa-router` and call it as a function (the same as we do in `index.js`) to create another `router` instance. We can call methods on the `router` object that correspond to HTTP verbs (such as `get`, `post`, `delete`, `put` etcetera).

We register the `/` route with `router.get`, meaning we've set up a GET route that will respond to requests to the `/` path.

We've taken a contrived approach to handling this route, in order to demonstrate how control flow works in Koa.

We supply two functions to the `router.get` call, both of them prefixed with the `async` keyword. An `async` function always returns a promise, which Koa is expecting.

Our first function immediately calls the `next` function with the `await` keyword (`await next()`). This means the execution of the function pauses until the promise returned from `next` is resolved.

The `next` function will (indirectly) call whichever piece of middleware is next in the stack. In our case, it's the route specific middleware, that is, the third argument passed to `router.get`, which is also an `async` function.

This second function simply sets `ctx.state` to an object containing a `title` property. Since it's an `async` function it returns a promise, which our first function waits to be resolved because `await next()` in this case relates to the resolution of the next route middleware (the third function supplied to `router.get`).

The line following `await next()` then assigns the `title` constant based on the contents of `ctx.state`. In this case `title` will now equal "Koa". Then we set `ctx.body` to our HTML content with the `title` constant interpolated.

This asynchronous dance is completely unnecessary, we could have just set the `title` constant directly in the first function and not bothered with the second function. However, the point of supplying this example in this recipe was to showcase Koa's control flow behavior in action.

This declarative fine grained control over where a function should defer to subsequent middleware before the function continues to execute is what makes Koa special in comparison to Express and Hapi.

> ### A note about promises
>
> This book has taken a light touch approach to promises, since their usage on the server side is a matter of some contention. While the concept of promises is excellent, their specification in the language have unfortunate drawbacks the detailing of which is far too in depth and out of scope - but primarily concerns traceability and analysis which has an effect on certain production diagnostics, such as post mortems. However, Koa is a futuristic framework (which is on the brink of being modern), and promise adoption continues to increase so these issues will hopefully be resolved (or at least alternative approaches will arise) in future.

There's more

Let's explore more Koa functionality.

Creating Middleware

Let's copy the `app` folder from our main recipe to the `custom-middleware-app` and create a middleware folder with an `answer.js` file:

```
$ cp -fr app custom-middleware-app
$ cd custom-middleware-app
$ mkdir middleware
$ touch middleware/answer.js
```

Our `middleware/answer.js` file should look like the following:

```
module.exports = answer

function answer () {
  return async (ctx, next) => {
    ctx.set('X-Answer', 42)
    await next()
  })
}
```

In our main `index.js` file we can load our answer middleware like so:

```
const answer = require('./middleware/answer')
```

And then register the middleware with Koa as follows:

```
app.use(answer())
```

Our `answer` function returns an `async` function, which sets our custom header using `ctx.set` and then delegates execution to subsequent middleware by calling `next` with `await` (`await next()`).

Performing Asynchronous Lookups

Koa's use of promises via `async` functions does make a very clear declarative syntax when it comes to common scenarios involving asynchronous operations.

For instance, let's consider our `routes/index.js` file, imagine we had to lookup the `title` from a database.

With `async/await` it would look something like the following:

```
const router = require('koa-router')()

router.get('/', async function (ctx, next) {
  const title = await pretendDbLookup('title')
  ctx.body = `
    <html>
      <head>
        <title> ${title} </title>
        <link rel="stylesheet" href="styles.css">
      </head>
      <body>
        <h1> ${title} </h1>
        <p> Welcome to ${title} </p>
      </body>
    </html>
  `
})

function pretendDbLookup () {
  return Promise.resolve('Koa')
}
```

```
module.exports = router
```

We can check this by copying the `app` folder from the main recipe to `async-ops-app` and placing the above in `routes/index.js`.

As long as the asynchronous operation returns a promise, we can use `await` inside Koa middleware and route handlers to perform asynchronous operations in a syntactically aesthetic manner. On a side note `pretendDbLookup` could have been written as `async function pretendDbLookup () { return 'Koa' }` and the net result would be same (a promise which resolves to the string "Koa").

See also

- *Hardening Koa* in the *There's More* section of *Hardening Headers in Web Frameworks* in **Chapter 8 Dealing With Security**
- *Creating an HTTP Server* in **Chapter 5 Wielding Web Protocols**
- *Anticipating Malicious Input* in **Chapter 8 Dealing with Security**
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- *Adding a View Layer* in this Chapter
- *Implementing Authentication* in this Chapter

Adding a view layer

At a basic level, web frameworks are primarily responsible for delivering dynamically generated HTML to a web browser.

We tend to use a view layer of some kind, generally in the form of a template language, as a declarative way to integrate data with HTML to produce the desired combined output.

In this recipe we'll learn how to use views with Express, and in the *There's More* section we'll explore the same with the Hapi and Koa.

Getting Ready

For this recipe we're going to copy the express application from our **Creating an Express Web App** recipe (we'll cover view layers for Hapi and Koa in the *There's More* section).

Let's copy the folder called `express-views` and add the `ejs` module:

```
$ cp -fr creating-an-express-web-app/app express-views
$ cd express-views
$ npm install --save ejs
```

How to do it

Let's start by creating a `views` folder and placing a view file in there, which we'll call `index.ejs` :

```
$ mkdir views
$ touch views/index.ejs
```

Next we'll configure Express using `app.set` to configure the view engine and location of the views folder.

We'll place the following just underneath the `port` assignment in the main `index.js` file:

```
app.set('views', join(__dirname, 'views'))
app.set('view engine', 'ejs')
```

Now for our view, we'll fill the `views/index.js` file with the following content:

```
<html>
  <head>
    <title> <%= title %> </title>
    <link rel="stylesheet" href="styles.css">
  </head>
  <body>
    <h1> <%= title %> </h1>
    <p> Welcome to <%= title %> </p>
  </body>
</html>
```

> ## Escaping Inputs
>
> EJS syntax allows for interpolation with `<%= %>` or `<%- %>` . The former (with the equals sign) will escape inputs whereas the latter includes inputs verbatim. While the `title` template local is set by us (and is therefore trusted input

> which doesn't require escaping) it's generally good habit to use the `<%= %>` syntax by default, and then consciously unescape inputs at a later stage (e.g. when optimizing). For more on escaping inputs see the *Guarding Against Cross Site Scripting (XSS)* in **Chapter 8 Dealing with Security**.

Finally we'll modify the GET route in our `routes/index.js` file to use the template engine:

```
const {Router} = require('express')
const router = Router()

router.get('/', function(req, res) {
  const title = 'Express'
  res.render('index', {title: 'Express'})
})

module.exports = router
```

Now let's start our server:

```
$ node index.js
```

Then navigate to http://localhost:3000 we should see the same result as in previous recipes, however this time our page is being rendered from EJS templates.

How it works

The `app.set` method is used to alter settings which are used internally by Express (although can also be used a general store for application code too). We set the `views` namespace to the location of our `views` folder. This is actually unnecessary in our case, since Express defaults to this location anyway, but it's good to be explicit nonetheless.

The `view engine` setting sets the default extension for rendering. For instance in our `routes/index.js` file we call `res.render` with `index`. Express takes this to mean `views/index.ejs` because of the `views` setting and the `view engine` setting.

> ### Alternative View Engines
>
> We use EJS in this recipe because it's popular and easy to understand due to

> the use of embedded JavaScript syntax. For alternative template engines see https://github.com/expressjs/express/wiki#template-engines For incompatible view engines, there's the consolidate module, which maps a wide range of template engines.

We do not require the `ejs` module directly, Express will attempt to require the view engine based on the file extension. Since the file extension is exploded from `index` to `views/index.ejs`, the first time we load our view, Express parses out the extension (`ejs`) and requires it. Template engines that are compatible with Express export an `__express` function which will integrates the render engine with Express. Essentially the act of rendering `views/index.js` results in the `app.engine('ejs', require('ejs').__express))` being called on first render which maps the `ejs` extension to the function supplied by the `ejs` modules exported `__express` property. To use an alternative extension with the same view engine (say, `html`), we could call `app.engine('html', require('ejs').__express))` in the main `index.js` file.

> ### A note on CSS preprocessing
>
> While web frameworks do support CSS preprocessing on the fly (such as Sass, Less and Stylus) we would recommend avoiding this work in the web server layer. Instead, build assets (including CSS processing) as part of a build pipeline, then host them on a CDN. CSS preprocessing could be performed in the web server in development, but the time it takes to run this as separate process would be similar. Using a build pipeliine in development is also advisable.

There's more

Let's see how to render views with Hapi and Koa, plus a way to organize and render views in a framework independent way.

Adding a view layer to Koa

Let's copy the application we created in the **Creating a Koa Web App** recipe, and call it `koa-views`.

We'll install the `ejs` and `koa-views` module:

```
$ cp -fr creating-a-koa-web-app/app koa-views
$ cd koa-views
$ npm install --save koa-views ejs
```

We'll also copy the views folder from the main recipe to the `koa-views/views`:

```
$ cp -fr ../express-views/views views
```

Next we'll require `koa-views` module among the other dependencies at the top of `index.js`:

```
const {join} = require('path')
const Koa = require('koa')
const serve = require('koa-static')
const views = require('koa-views')
const router = require('koa-router')()
const index = require('./routes/index')
```

Next just beneath where we assign the `port` constant in `index.js` we'll add the following code:

```
app.use(views(join(__dirname, 'views'), {
  extension: 'ejs'
}))
```

> ## Alternative View Engines in Koa
>
> The `koa-views` middleware depends upon the `consolidate` module, which has a list of supported template engines at http://npm.im/consolidate#supported-template-engines

Now let's turn our attention to the `routes/index.js` file:

```
const router = require('koa-router')()

router.get('/', async function (ctx, next) {
  await next()
  await ctx.render('index')
}, async (ctx) => ctx.state = {title: 'Koa'})

module.exports = router
```

We can run our server `node index.js` and check http://localhost:3000 in a browser to verify that everything is working as before.

The `koa-views` middleware adds a `render` function to the `ctx` object, which we use to render a template. The `koa-views` middleware already knows that the extension is `ejs` and where the views folder is so it converts the string we pass (`index`) to `views/index.ejs` and attempts to load that view. Like Express, `koa-views` will require the `ejs` module by itself.

We could have passed our template locals as the second argument to `ctx.render`, much like we do in the main recipe with Express' `res.render` method.

However, `koa-views` will automatically set template locals based on `ctx.state`. In Express there is a equivalent behavior, any keys set on `res.locals` is loaded as template state as well.

However, with Koa, we can set the state in subsequent middleware (or route middleware), and then wait for `ctx.state` to be set (using `await next()` prior to rendering.

Again this slightly over complicated for teaching purposes, our GET route in `routes.js` could be written thusly:

```
router.get('/', async (ctx, next) => {
  await ctx.render('index', {title: 'Koa'})
})
```

The `ctx.render` method is called with `await`, without using `await` an error occurs (headers sent after response finished) because due to a race condition, the rendering process isn't able to complete before the request finishes. For instance, the following will cause a server error (and a 404 GET response code):

```
// WARNING THIS WON'T WORK~
router.get('/', async (ctx, next) => {
  ctx.render('index', {title: 'Koa'})
})
```

The return value of an `async` function is a promise, which only resolves (completes) when all `await` statements have resolved. If we don't call `ctx.render` with `await`, the promise returned from `ctx.render` resolves in *parallel* to the outer `async` function and the promise returned from the `async` function tends to resolve before the promise returned from `ctx.render`. When the promise from the `async` route middleware function resolves, subsequent middleware and Koa internals continue to execute until eventually the response is ended - but without using `await` on the `ctx.render` promise, the rendering process attempts to continue after the response has finished, resulting in the server error.

Adding a view layer to Hapi

Let's copy the `app` folder we created in the *Creating a Hapi Web App* recipe to the `hapi-views` folder, install the `vision` (a Hapi view manager) and `ejs` modules and copy the `views` folder from our main recipe into the `hapi-views` directory:

```
$ cp -fr creating-a-hapi-web-app/app hapi-views
$ cd hapi-views
$ npm install --save vision ejs
$ cp -fr ../express-views/views views
```

At the top of `index.js` we'll include the `vision` and `ejs` modules:

```
const hapi = require('hapi')
const inert = require('inert')
const vision = require('vision')
const ejs = require('ejs')
```

Near the bottom of `index.js` we'll update the plugins we want to register (based on the `dev` constant):

```
const plugins = dev ? [vision, inert] : [vision]
server.register(plugins, start)
```

Now we'll call the new `server.views` method, in our `start` function with relevant settings:

```
function start (err) {
  if (err) throw err

  server.views({
    engines: { ejs },
    relativeTo: __dirname,
    path: 'views'
  })

  routes.index(server)

  if (dev) routes.devStatic(server)

  server.start((err) => {
    if (err) throw err
    console.log(`Server listening on port ${port}`)
  })
}
```

Finally let's update the route handler in `routes/index.js`:

```
module.exports = index

function index (server) {
  server.route({
    method: 'GET',
    path: '/',
    handler: function (request, reply) {
      const title = 'Hapi'
      reply.view('index', {title})
    }
  })
}
```

The `vision` plugin decorates the server object by adding a `views` method, and the `reply` function with a `view` method.

When we call `server.views` in the `start` function, we set the `engines` property to an object with a key of `ejs` containing the `ejs` module (we used ES2015 shorthand object properties, `{ ejs }` is the same as `{ejs: ejs}`). The key on the `engines` object corresponds to the extension used for a given view, if there is only one property of the engines object then it becomes the default view extension. So when we call `reply.view` with `index` Hapi knows to assume we mean `views/index.ejs`.

> ## Alternative View Engines in Hapi
>
> The `vision` middleware used for template rendering has a standard interface for hooking in different template engines. See https://github.com/hapijs/vision#examples for several examples of template

> engines integrating with `vision`.

ES2015 Template Strings as Views

With the advent of ES2015 tagged template strings, and their implementation into Node's JavaScript engine (V8) multi-line strings with interpolation syntax became supported natively. If we wish to take a minimalist, framework independent approach to a web servers view layer implementation we could use functions that return template strings instead of template engines.

Let's copy the `app` folder from the *Creating an Express Web App* recipe and call it `express-template-strings`, create a `views` folder with an `index.js` file:

```
$ cp -fr creating-an-express-web-app/app express-template-strings
$ cd express-template-strings
$ mkdir views
$ touch index.js
```

This would generally be more performant, can be used with any web framwork without the need for compatibility facades and as a native part of JavaScript, doesn't require us to learn yet another DSL.

However, it's important not to forget a primary function that template engines typically provides: context aware escaping. In our case, `title` is a trusted template input, however if we were taking user input and displaying it in a template we would need to HTML escape (in this case) the input. Check out *Guarding Against Cross Site Scripting (XSS)* in **Chapter 8 Dealing with Security** for more information.

See also

- *Creating an HTTP Server* in **Chapter 5 Wielding Web Protocols**
- *Anticipating Malicious Input* in **Chapter 8 Dealing with Security**
- *Guarding Against Cross Site Scripting (XSS)* in **Chapter 8 Dealing with Security**
- *Implementing Authentication* in this Chapter

Adding Logging

A web server should provide some form of log data, particularly of incoming requests and their responses before it can be considered production worthy.

In this recipe we look at using `pino`, which is a high performance JSON logger with Express. In the *There's More* section we'll look at alternative loggers and integrating logging into Koa and Hapi.

Getting Ready

Let's copy the `express-views` folder from our previous recipe into a new folder we'll call `express-logging`, and install `pino` and `express-pino-logger`:

```
$ cp -fr adding-a-view-layer/express-views express-logging
$ cd express-logging
$ npm install --save pino express-pino-logger
```

How to do it

We'll require `pino` and `express-pino-logger` at the top of the `index.js` file:

```
const {join} = require('path')
const express = require('express')
const pino = require('pino')()
const logger = require('express-pino-logger')({
  instance: pino
})
const index = require('./routes/index')
```

Notice how we instantiate a Pino instance by immediately calling the function returned from `require('pino')` and then pass that as the `instance` property of the object passed to the function returned from `require('express-pino-logger')`.

This creates the `logger` middleware, let's register the middleware. Just underneath the second call to `app.set` we can add the following line:

```
app.use(logger)
```

At the bottom of `index.js` we'll modify the `app.listen` callback like so:

```
app.listen(port, () => {
  pino.info(`Server listening on port ${port}`)
})
```

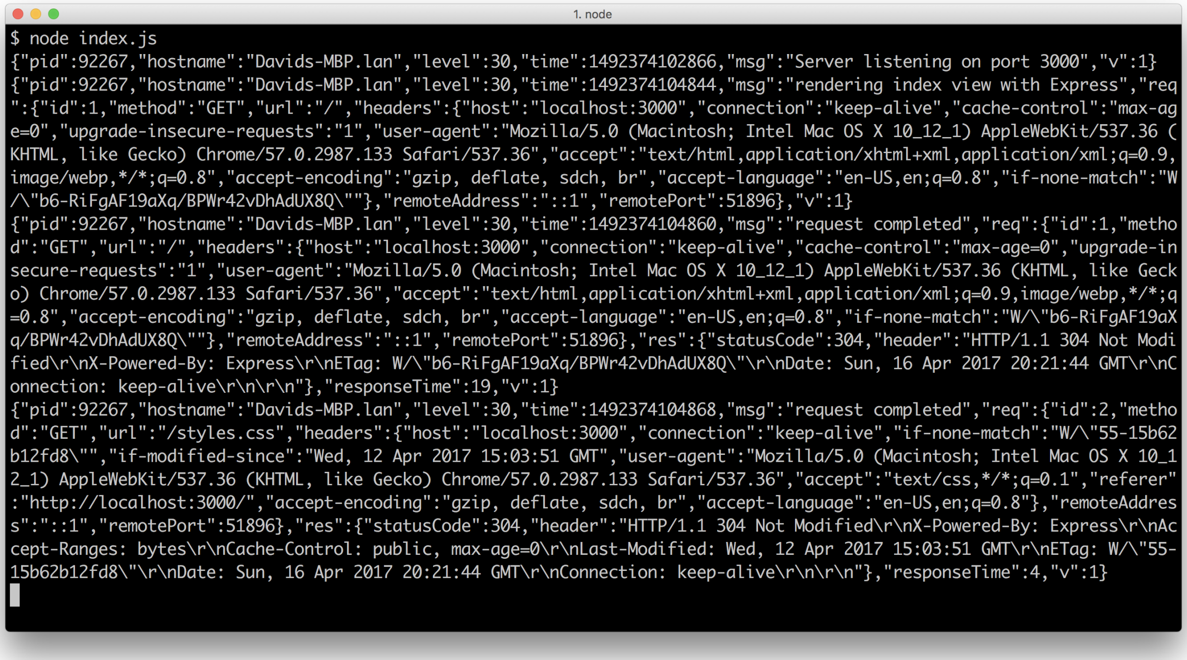
Let's also add a log message to the GET route in our `routes/index.js` file:

```
router.get('/', function (req, res) {
  const title = 'Express'
  req.log.info(`rendering index view with ${title}`)
  res.render('index', {title: 'Express'})
})
```

Now let's start our server:

```
$ node index.js
```

Then, if we make a request to the server by navigating to http://localhost:3000 in the browser, log messages similar to those shown in the following image should be generated.



```
$ node index.js
{"pid":92267,"hostname":"Davids-MBP.lan","level":30,"time":1492374102866,"msg":"Server listening on port 3000","v":1}
{"pid":92267,"hostname":"Davids-MBP.lan","level":30,"time":1492374104844,"msg":"rendering index view with Express","req
":{"id":1,"method":"GET","url":"/","headers":{"host":"localhost:3000","connection":"keep-alive","cache-control":"max-ag
e=0","upgrade-insecure-requests":"1","user-agent":"Mozilla/5.0 (Macintosh; Intel Mac OS X 10_12_1) AppleWebKit/537.36 (
KHTML, like Gecko) Chrome/57.0.2987.133 Safari/537.36","accept":"text/html,application/xhtml+xml,application/xml;q=0.9,
image/webp,*/*;q=0.8","accept-encoding":"gzip, deflate, sdch, br","accept-language":"en-US,en;q=0.8","if-none-match":"W
/\"b6-RiFgAF19aXq/BPWr42vDhAdUX8Q\""},"remoteAddress":"::1","remotePort":51896},"v":1}
{"pid":92267,"hostname":"Davids-MBP.lan","level":30,"time":1492374104860,"msg":"request completed","req":{"id":1,"metho
d":"GET","url":"/","headers":{"host":"localhost:3000","connection":"keep-alive","cache-control":"max-age=0","upgrade-in
secure-requests":"1","user-agent":"Mozilla/5.0 (Macintosh; Intel Mac OS X 10_12_1) AppleWebKit/537.36 (KHTML, like Geck
o) Chrome/57.0.2987.133 Safari/537.36","accept":"text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q
=0.8","accept-encoding":"gzip, deflate, sdch, br","accept-language":"en-US,en;q=0.8","if-none-match":"W/\"b6-RiFgAF19aX
q/BPWr42vDhAdUX8Q\""},"remoteAddress":"::1","remotePort":51896},"res":{"statusCode":304,"header":"HTTP/1.1 304 Not Modi
fied\r\nX-Powered-By: Express\r\nETag: W/\"b6-RiFgAF19aXq/BPWr42vDhAdUX8Q\"\r\nDate: Sun, 16 Apr 2017 20:21:44 GMT\r\nC
onnection: keep-alive\r\n\r\n"},"responseTime":19,"v":1}
{"pid":92267,"hostname":"Davids-MBP.lan","level":30,"time":1492374104868,"msg":"request completed","req":{"id":2,"metho
d":"GET","url":"/styles.css","headers":{"host":"localhost:3000","connection":"keep-alive","if-none-match":"W/\"55-15b62
b12fd8\"","if-modified-since":"Wed, 12 Apr 2017 15:03:51 GMT","user-agent":"Mozilla/5.0 (Macintosh; Intel Mac OS X 10_1
2_1) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/57.0.2987.133 Safari/537.36","accept":"text/css,*/*;q=0.1","referer"
:"http://localhost:3000/","accept-encoding":"gzip, deflate, sdch, br","accept-language":"en-US,en;q=0.8"},"remoteAddres
s":"::1","remotePort":51896},"res":{"statusCode":304,"header":"HTTP/1.1 304 Not Modified\r\nX-Powered-By: Express\r\nAc
cept-Ranges: bytes\r\nCache-Control: public, max-age=0\r\nLast-Modified: Wed, 12 Apr 2017 15:03:51 GMT\r\nETag: W/\"55-
15b62b12fd8\"\r\nDate: Sun, 16 Apr 2017 20:21:44 GMT\r\nConnection: keep-alive\r\n\r\n"},"responseTime":4,"v":1}
█
```

> ### Pino
>
> For more on `pino` and `express-pino-logger` see http://npm.im/pino and http://npm.im/express-pino-logger

How it works

We require `pino` and `express-pino-logger` which is a middleware wrapper around `pino`. We separate the creation of the logger (using `pino`) and the middleware instantiation, passing the logger instance into the middleware, so that the logger instance can be used independently.

The Pino logger has a Log4J interface - an Apache logger written for Java which has become a common, intuitive abstraction across other languages. Messages can be logged at different levels by calling methods on a logging instance (`trace`, `debug`, `info`, `warn`, `error`, `fatal`). The general log level is `info`.

So we changed our `console.log` in the `app.listen` callback to `pino.info`, which writes a JSON log message on server start, like:

```
{"pid":92598,"hostname":"Davids-MBP.lan","level":30,"time":149237515622
```

When we register `logger` in `app.js` the `express-pino-logger` middleware function adds a `log` object to every incoming request (as `req.log`). Each log object is unique to that request, and contains a req property with various data about the request, along with a unique generated id - which allows us to trace any log messages to a specific client request.

So our call to `req.log.info` outputs JSON similar to:

```
{"pid":92598,"hostname":"Davids-MBP.lan","level":30,"time":149237525991
```

Additionally the `express-pino-logger` middleware generates a log message for each completed request, adding a `res` key to the JSON describing the status code, headers and response time.

So we'll also see a log message like:

```
{"pid":92598,"hostname":"Davids-MBP.lan","level":30,"time":149237525993
```

Other JSON loggers and their respective middleware wrappers work in much the same way, however we focus on Pino in this recipe because it adds significantly less overhead to the server.

Log Processing

> Talk about transports, give e.g. elasticsearch etc

There's more

Let's take a look at some pino utilities, alternative loggers and adding logging to Hapi and Koa.

Pino Transports and Prettifying

It's advisable to keep as much log processing work outside of the main web server Node process as possible. To this end the Pino logging philosophy promotes piping log output to a separate process (which we call a logging transport).

This separate process may move the logs into a database, or message bus, or may apply data transforms or both.

For instance, if we wanted to marshal logs into an Elasticsearch database (which would allow us to analyse log messages with Kibana which is excellent data visualisation and anaalysis tool for Elasticsearch) in a production setting, we could use the `pino-elasticsearch` transport and pipe our server log output to it like so:

```
$ node index | pino-elasticsearch
```

See the `pino-elasticsearch` readme for more information (http://npm.im/pino-elasticsearch).

Another type of transport that's more for development purposes is a prettifier. The `pino` module supplies it's own prettifier, if we install `pino` globally:

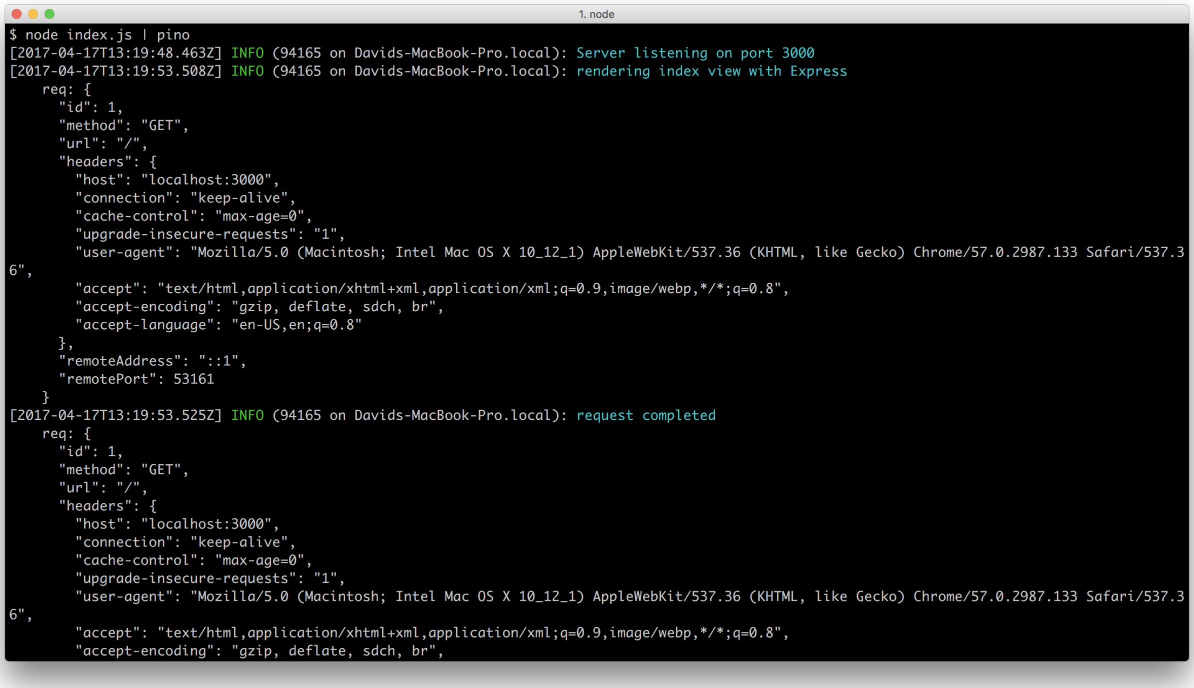
```
$ npm install -g pino
```

This will install a CLI executable called `pino` on our system.

Then if we run our server from the main recipe and pipe the servers output to `pino` executable:

```
$ node index.js | pino
```

After navigating to http://localhost:3000, we should see something like the following:



```
$ node index.js | pino
[2017-04-17T13:19:48.463Z] INFO (94165 on Davids-MacBook-Pro.local): Server listening on port 3000
[2017-04-17T13:19:53.508Z] INFO (94165 on Davids-MacBook-Pro.local): rendering index view with Express
    req: {
      "id": 1,
      "method": "GET",
      "url": "/",
      "headers": {
        "host": "localhost:3000",
        "connection": "keep-alive",
        "cache-control": "max-age=0",
        "upgrade-insecure-requests": "1",
        "user-agent": "Mozilla/5.0 (Macintosh; Intel Mac OS X 10_12_1) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/57.0.2987.133 Safari/537.3
6",
        "accept": "text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8",
        "accept-encoding": "gzip, deflate, sdch, br",
        "accept-language": "en-US,en;q=0.8"
      },
      "remoteAddress": "::1",
      "remotePort": 53161
    }
[2017-04-17T13:19:53.525Z] INFO (94165 on Davids-MacBook-Pro.local): request completed
    req: {
      "id": 1,
      "method": "GET",
      "url": "/",
      "headers": {
        "host": "localhost:3000",
        "connection": "keep-alive",
        "cache-control": "max-age=0",
        "upgrade-insecure-requests": "1",
        "user-agent": "Mozilla/5.0 (Macintosh; Intel Mac OS X 10_12_1) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/57.0.2987.133 Safari/537.3
6",
        "accept": "text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8",
        "accept-encoding": "gzip, deflate, sdch, br",
```

An alternative prettifer for pino which provides more concise information is the `pino-colada` module.

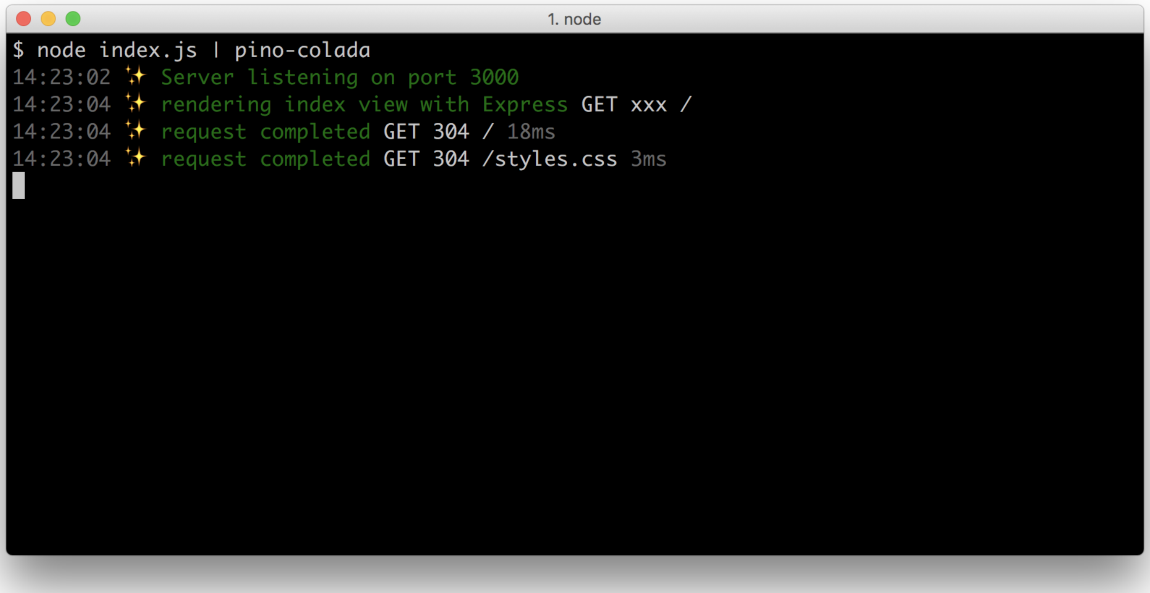
If we install `pino-colada` globally:

```
$ npm install -g pino-colada
```

And pipe our server output through the `pino-colada` executable now on our system:

```
$ node index.js | pino-colada
```

We should see something like the following, once we've hit http://localhost:3000:



```
$ node index.js | pino-colada
14:23:02 ✨ Server listening on port 3000
14:23:04 ✨ rendering index view with Express GET xxx /
14:23:04 ✨ request completed GET 304 / 18ms
14:23:04 ✨ request completed GET 304 /styles.css 3ms
```

Logging with Morgan

Another alternative logger is the Morgan logger, which can output logs in different formats. These can be defined using preset labels, a tokenized string or a function.

We'll use Morgan to make our Express server log messages in the common Apache log format,

Let's copy the `express-views` folder from our previous recipe into a new folder we'll call `express-morgan-logging`, and install `morgan`:

```
$ cp -fr adding-a-view-layer/express-views express-morgan-logging
$ cd express-morgan-logging
$ npm install --save morgan
```

Near the top of the `index.js` file, we can load morgan like so:

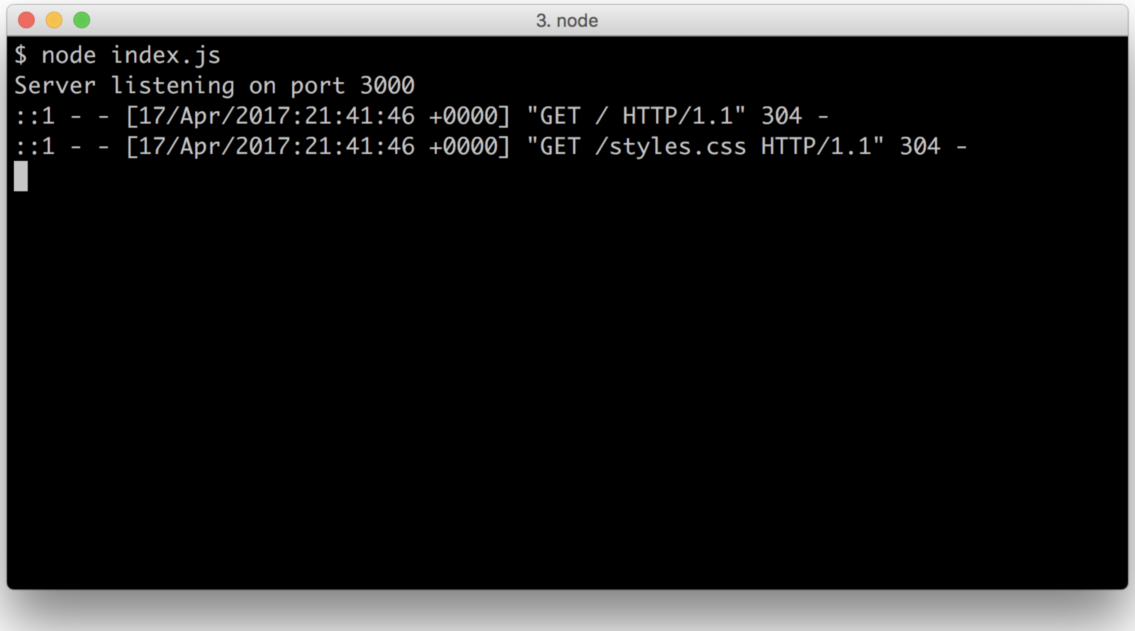
```
const morgan = require('morgan')
```

Then around the middleware, we can register it as the first middleware like so:

```
app.use(morgan('common'))
```

We pass `common` to configure Morgan to output messages in common Apache log format.

let's start ~~our~~ server with `node index.js` and make a request to http://localhost:3000 we should see something similar to the following:



```
$ node index.js
Server listening on port 3000
::1 - - [17/Apr/2017:21:41:46 +0000] "GET / HTTP/1.1" 304 -
::1 - - [17/Apr/2017:21:41:46 +0000] "GET /styles.css HTTP/1.1" 304 -
```

Morgan is a nice lightweight logger that can provide Apache style (and other common) log formats that may integrate well into pre-existing deployments. However it will only work for request/response logging, custom log messages are not supported.

Logging with Winston

A very popular alternative to `pino` is the `winston` logger.

In the main, the `winston` logger has the same Log4J interface as Pino, however it differs greatly from `pino` in philosophy.

The `winston` logger supplies a large amount of features and configuration options - such as log rotation, multiple destinations based on log levels, and in process logging transformations.

These come with the `winston` logger as standard, and are used in the same Node process as the server (which from a performance perspective is something of a trade off).

Let's copy the `express-views` folder from our previous recipe into a new folder we'll call `express-winston-logging`, and install `winston` and `express-winston`:

```
$ cp -fr adding-a-view-layer/express-views express-morgan-logging
$ cd express-morgan-logging
$ npm install --save morgan
```

Now we'll add the following to our dependencies at the top of the `index.js` file:

```
const winston = require('winston')
const expressWinston = require('express-winston')
```

Just above where we instantiate the Express app (`const app = express()`), we'll create a Winston logger instance, configured to output to `process.stdout` in JSON format:

```
const logger = new winston.Logger({
  transports: [
    new winston.transports.Console({
      json: true
    })
  ]
})
```

By default, the `winston.transports.Console` transport will output logs in the format `${level}: ${message}` . However we can set the `json` option to true to enable JSON logging.

In the middleware section of `index.js` we'll register the `express-winston` middleware , passing it the Winston logger instance (`logger`) like so:

```
app.use(expressWinston.logger({
  winstonInstance: logger
}))
```

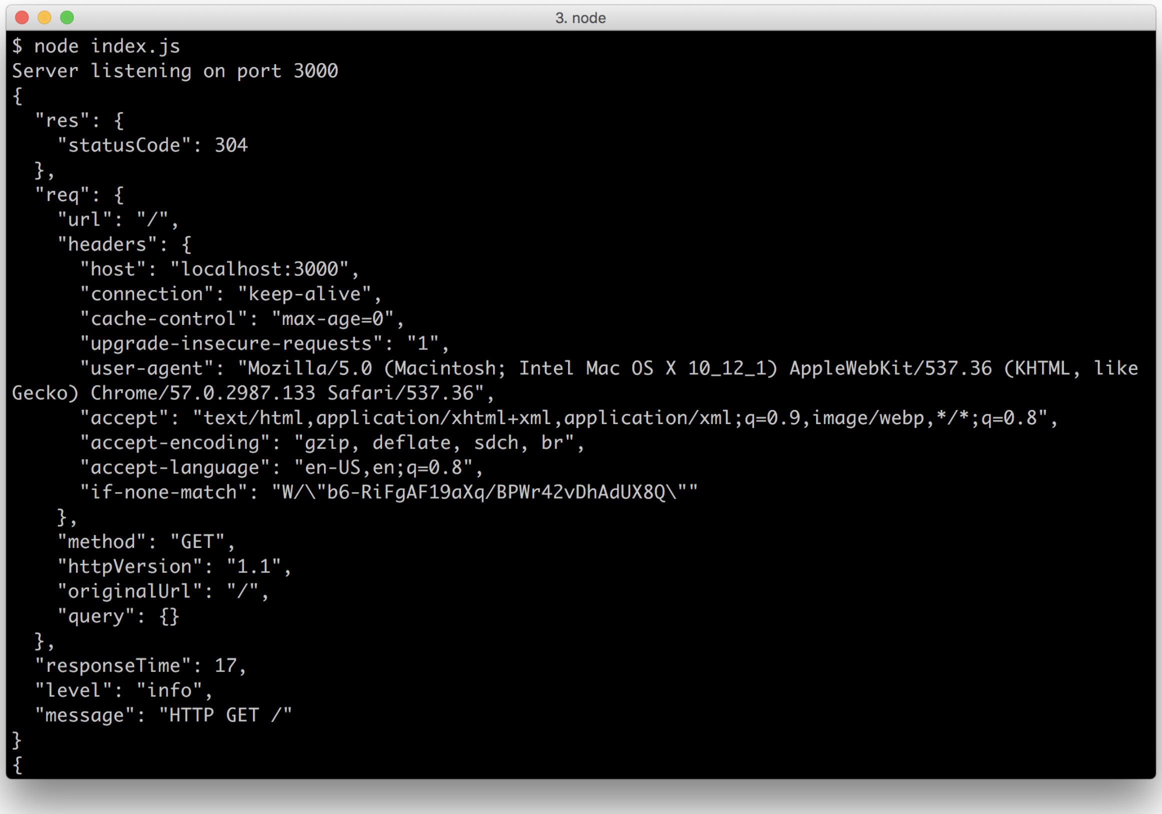
Finally at the bottom of `index.js` we'll use the `logger` instance to output the initial server log:

```
app.listen(port, () => {
  logger.info(`Server listening on port ${port}`)
})
```

We won't modify the `routes/index.js` file to log a request-linked message, as

Winston does not support this.

If we run our server (`node index.js`) and make a request to http://localhost:3000 we should see output similar to the following:



```
$ node index.js
Server listening on port 3000
{
  "res": {
    "statusCode": 304
  },
  "req": {
    "url": "/",
    "headers": {
      "host": "localhost:3000",
      "connection": "keep-alive",
      "cache-control": "max-age=0",
      "upgrade-insecure-requests": "1",
      "user-agent": "Mozilla/5.0 (Macintosh; Intel Mac OS X 10_12_1) AppleWebKit/537.36 (KHTML, like
Gecko) Chrome/57.0.2987.133 Safari/537.36",
      "accept": "text/html,application/xhtml+xml,application/xml;q=0.9,image/webp,*/*;q=0.8",
      "accept-encoding": "gzip, deflate, sdch, br",
      "accept-language": "en-US,en;q=0.8",
      "if-none-match": "W/\"b6-RiFgAF19aXq/BPWr42vDhAdUX8Q\""
    },
    "method": "GET",
    "httpVersion": "1.1",
    "originalUrl": "/",
    "query": {}
  },
  "responseTime": 17,
  "level": "info",
  "message": "HTTP GET /"
}
{
```

The `winston` logger and its `express-winston` counterpart have a vast API with many options, see the respective Readmes (http://npm.im/winston and http://npm.im/express-winston) for more information.

Adding Logging to Koa

Setting up logging with Koa is very similar to logging with Express. Let's copy the `koa-views` folder which we created in the *There's More* section of the *Adding a View Layer* recipe and name it `koa-logging` , we'll also install `pino` and `koa-pino-logger` :

```
$ cp -fr adding-a-view-layer/koa-views koa-logging
$ cd koa-logging
$ npm install --save pino koa-pino-logger
```

Near the top of our `index.js` we'll add the following:

```
const pino = require('pino')()
const logger = require('koa-pino-logger')({
  instance: pino
})
```

Then, still in `index.js` underneath where we configure view settings, we'll register the logging middleware like so:

```
app.use(logger)
```

At the bottom of `index.js` we'll update the `app.listen` callback to use `pino.info` instead of `console.log`:

```
app.listen(port, () => {
  pino.info(`Server listening on port ${port}`)
})
```

Finally in `routes/index.js` we'll add a log message to our GET route:

```
router.get('/', async function (ctx, next) {
  await next()
  ctx.log.info(`rendering index view with ${ctx.state.title}`)
  await ctx.render('index')
}, async (ctx) => ctx.state = {title: 'Koa'})
```

When we start our server with `node index.js` and navigate to http://localhost:3000 we'll see similar log output to the log messages in the main recipe.

Adding Logging to Hapi

For high performance logging in Hapi, there's the `hapi-pino` plugin.

Let's copy the `hapi-views` folder from the *There's More* section of the *Adding a View Layer* recipe, and call it `hapi-logging` and install the `pino` and `hapi-pino` modules.

```
$ cp -fr adding-a-view-layer/hapi-views hapi-logging
$ cd hapi-logging
$ npm install --save pino hapi-pino
```

Near the top of our `index.js` file we'll require and instantiate `pino`, and load the `hapi-pino` plugin:

```
const pino = require('pino')()
const hapiPino = require('hapi-pino')
```

Next we'll add the logger to our plugins (both development and production plugins):

```
const plugins = dev ? [{
  register: hapiPino,
  options: {instance: pino}
}, vision, inert] : [{
  register: hapiPino,
  options: {instance: pino}
}, vision]
```

Notice how we pass the `hapiPino` plugin inside an object with a `register` property and an `options` property containing and object with `instance` property referencing the `pino` logger instance. This instructs Hapi to supply the options provided to the `hapi-pino` plugin at instantiate time (Hapi instantiates plugins internally).

At the bottom of `index.js`, inside the `start` function, we'll modify the `server.start` callback to use `server.log` instead of `console.log`:

```
  server.start((err) => {
    if (err) throw err
    server.log(`Server listening on port ${port}`)
  })
```

Finally we'll update the `routes/index.js` file by adding an info log message in the request handler:

```
module.exports = index

function index (server) {
  server.route({
    method: 'GET',
    path: '/',
    handler: function (request, reply) {
      const title = 'Hapi'
      request.logger.info(`rendering index view with ${title}`)
      reply.view('index', {title})
    }
  })
}
```

The `hapi-pino` plugin modifies the `server.log` method to output info log messages with `pino` (it's also possible to get the entire logger instance by calling `server.logger()`).

Starting our server (`node index.js`) and hitting http://localhost:3000 should again yield similar JSON logs as output in the main recipe.

Capturing `debug` logs with with Pino

In **Chapter 1 Debugging Processes** we discuss the `debug` module which is used to conditionally output debug logs based on namespeces defined on the `DEBUG` variable. Both Express and Koa (and the dependencies they use) use the `debug` module heavily.

The `pino-debug` module can hook into the debug logs, and wrap them in JSON logs, all while logging at ten times the speed of `debug` module. This affords us the opportunity of high resolution production logging.

Let's check it out copying our `express-logging` folder from the main recipe, saving as `express-pino-debug-logging` and installing `pino-debug` :

```
$ cp -fr express-logging express-pino-debug-logging
$ cd express-pino-debug-logging
$ npm install --save pino-debug
```

Now we start our server using the `-r` (require) Node flag, with `pino-debug` . This will automatically load `pino-debug` as the process starts:

```
$ DEBUG=* node -r pino-debug index.js
```

If we hit the http://localhost:3000 route this will give us plenty of (low overhead) logging information.

See also

- *Enabling debug logs* in **Chapter 1 Debugging Processes**

- *Enabling core debug logs* in **Chapter 1 Debugging Processes**
- *Creating an Express Web App* in this chapter
- *Creating a Hapi Web App* in this chapter
- *Creating a Koa Web App* in this chapter

Implementing Authentication

A common scenario for web sites is an elevated privileges area that requires a user to identify themselves via authentication.

The typical way to achieve this is with sessions, so in this recipe we're going to implement an authentication layer with our Express server and in the *There's More* section we'll do the same with Koa and Hapi.

Getting Ready

Let's copy the `express-logging` folder from the previous section and name the new folder `express-authentication`, we'll also need to install `express-session` and `body-parser`:

```
$ cp -fr ../adding-logging/express-logging express-authentication
$ cd express-authentication
```

How to do it

We're going to need the `body-parser` module (so we can accept and parse POST requests for a login form), and the `express-session` module. Let's begin by installing those:

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

Along with modifying a few files, we're also going to create a `routes/auth.js` file and `views/login.ejs` file:

```
$ touch routes/auth.js views/login.ejs
```

Let's require the `express-session` and `body-parser` at the top of the `index.js` file:

```
const session = require('express-session')
const bodyParser = require('body-parser')
```

Underneath where we load the `index` route, we'll also load our `auth` route:

```
const index = require('./routes/index')
const auth = require('./routes/auth')
```

HTTP sessions rely on cookies, we want to use secure cookies in production, behind an SSL terminating load balancer but it's easier to have non-secure cookies server over HTTP in developemnt.

So underneath where we set our views we'll add the following configuration settting:

```
if (!dev) app.set('trust proxy', 1)
```

Next, underneath where we register the logger middleware, we'll register session and body parser middleware:

```
app.use(session({
  secret: 'I like pies',
  resave: false,
  saveUninitialized: false,
  cookie: {secure: !dev}
}))
app.use(bodyParser.urlencoded({extended: false}))
```

We'll also set another mount point, `/auth` for our `auth` routes, underneath the original `/` mount point,:

```
app.use('/', index)
app.use('/auth', auth)
```

We're going to supply a login link if the user does not have escalated privileges, and a logout link if they do, also acknowledging the user by name.

Let's modify `views/index.ejs` like so:

```
<html>
```

```
  <head>
    <title> <%= title %> </title>
    <link rel="stylesheet" href="styles.css">
  </head>
  <body>
    <h1> <%= title %> </h1>
    <p> Welcome to <%= title %> </p>
    <% if (user) { %>
    <p> Hi <%= user.name %>! </p>
    <p> <a href=/auth/logout> Logout </a> </p>
    <% } else { %>
    <p> <a href=/auth/login> Login </a> </p>
    <% } %>
  </body>
</html>
```

Now for the login screen, let's create a `views/login.ejs` file with the following content:

```
<html>
  <head>
    <title> Login </title>
    <link rel="stylesheet" href="../styles.css">
  </head>
  <body>
    <h1> Login </h1>
    <% if (fail) { %>
    <h2> Try Again </h2>
    <% } %>
    <form method=post action=login>
      User: <input name=un> <br>
      Pass: <input type=password name=pw> <br>
      <input type=submit value="login">
    </form>
  </body>
</html>
```

If login fails, our `view/login.ejs` template will include a "Try Again" message.

Now for our auth routes, let's populate `routes/auth.js` with the following code:

```
const { Router } = require('express')
const router = Router()

router.get('/login', function (req, res, next) {
  res.render('login', {fail: false})
})
```

```
router.post('/login', function (req, res, next) {
  if (req.session.user) {
    res.redirect('/')
    next()
    return
  }
  if (req.body.un === 'dave' && req.body.pw === 'ncb') {
    req.session.user = {name: req.body.un}
    res.redirect('/')
    next()
    return
  }

  res.render('login', {fail: true})

  next()
})

router.get('/logout', function (req, res, next) {
  req.session.user = null
  res.redirect('/')
})

module.exports = router
```

> ## Password Security
>
> It goes without saying, but we'll say it anyway: don't check plaintext passwords in real life. Always store a cryptographically secure hash of the password and check against the hash of user supplied password.

Finally we'll tweak the GET route in `routes/index.js` as follows:

```
router.get('/', function (req, res) {
  const title = 'Express'
  req.log.info(`rendering index view with ${title}`)
  const user = req.session.user
  res.render('index', {title, user})
})
```

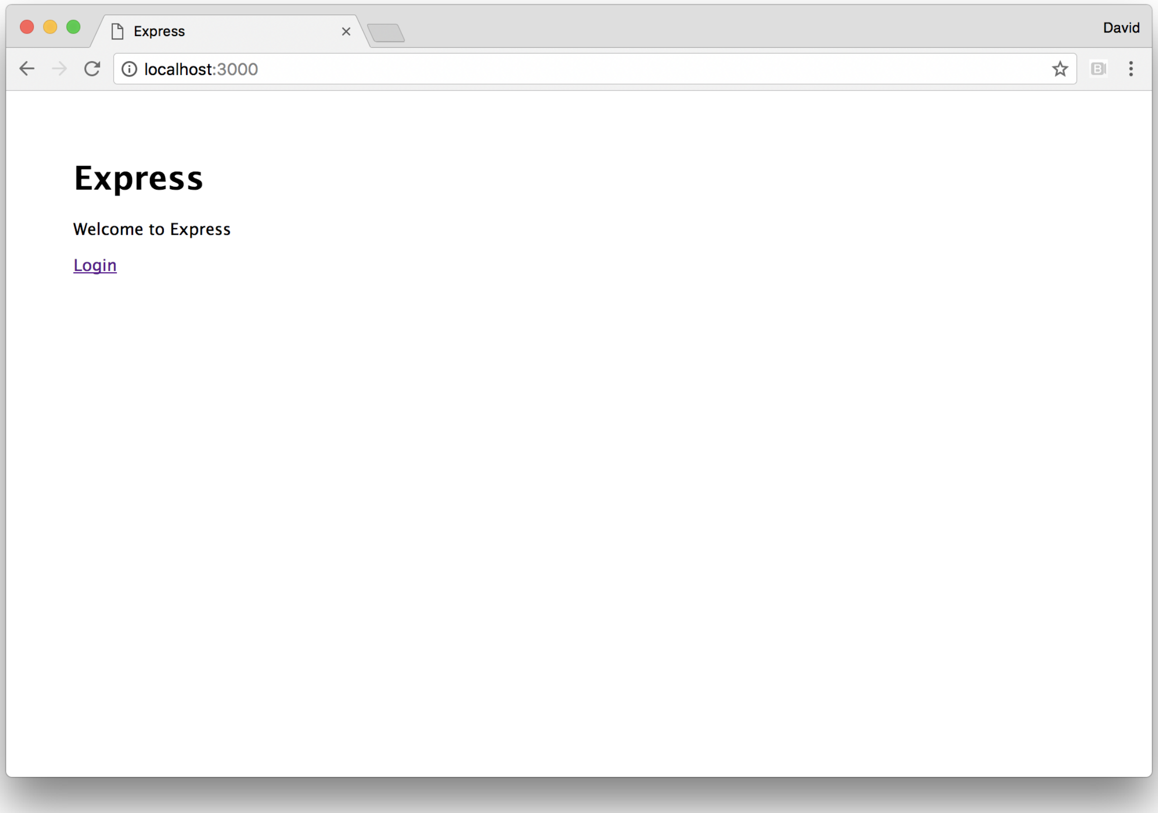
> ## Session storage and production worthiness
>
> The `express-session` module has a standard `MemoryStore` interface, that can be used to store sessions in a database. However, by default the session storage mechanism is in-process storage - the lack of a peer dependency

> makes for faster development. However, tokens are not expired, so a process would eventually crash. See the *There's More* section for alternative storage options.

Now let's start our server:

```
$ node index.js
```

When we navigate to http://localhost:3000 in a browser, we should see an initial screen like the following:

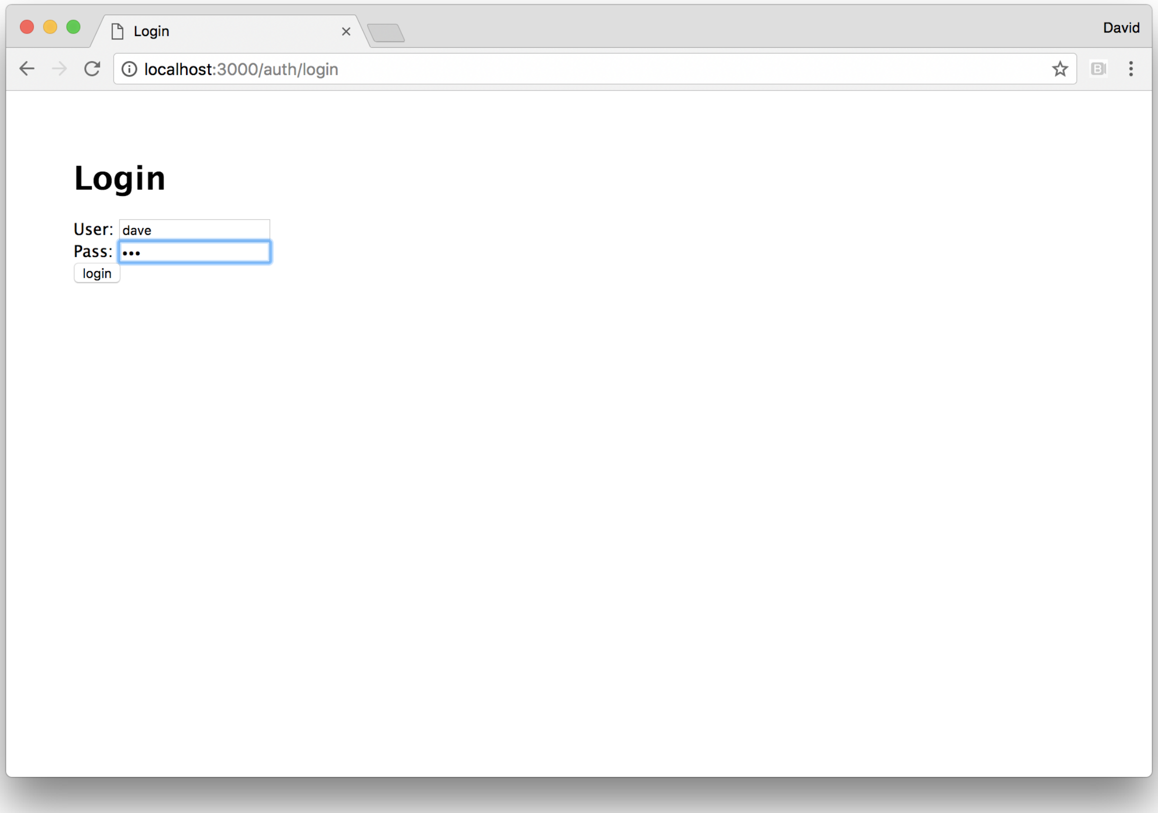


Express

Welcome to Express

Login

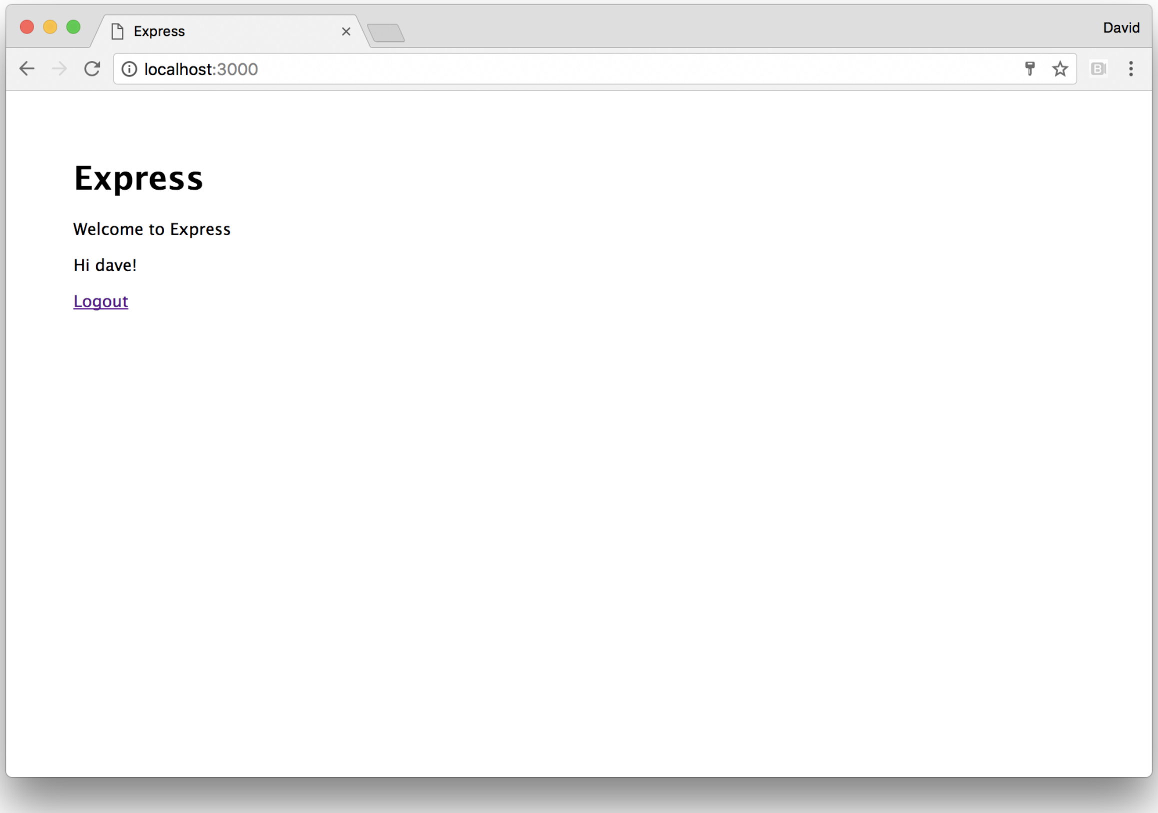
Upon clicking the login button we should see the following login view:



Login

User: dave
Pass: •••
login

Then after logging in, we're redirected back to the index page as an authenticated user, and should see something similar to the following:



Express

Welcome to Express

Hi dave!

Logout

If we click the logout link, we'll see the first screen again.

How it works

Perhaps the easiest way to discuss our authentication implementation is to analyze if from a user flow perspective.

The first route, the `/` (index) route conditionally displays a login or logout link, plus the users name if logged in. The `views/index.ejs` template contains the logic which checks for a truthiness of a `user` template local and if it doesn't exist presents a login link, pointing to `/auth/login`. The `user` local passed to the template in `routes/index.js` is the value on `req.session.user`.

We registered `express-session` middleware on our Express app in `index.js`, which means every `req` object has a `session` object. However, prior to logging in, the user does not have a session, it's simply an empty object where `user` is `undefined` (which equates to false in the the `views/index.js` `if` statement).

When the `/auth/login` link is clicked a GET request to `/auth/login` is made from the browser. In the main `index.js` file we mounted the `auth` routes at `/auth` with `app.use`. So a request to `/auth/login` matches the `/login` GET route in `routes/auth.js`. The route handler the `views/login.ejs` view with `fail` set to `false`.

When the HTML form is filled out and submitted, the browser creates a URL Encoded string of the inputs according to the input elements names. So in our case, given the user name of `dave` and password of `ncb` the browser creates a request body of `pw=dave&un=ncb`. The browser makes a POST request to the `/auth/login` route - because that's how the HTMl form was configured, the action attributed was set to `login` (which expands to `/auth/login` based on relative path) and the `method` attribute was set to `post`.

The `body-parser` module is covered in the *There's More* section (subheading *Route Parameters and POST requests*) of the first recipe of this chapter, *Creating an Express Web App*.

In short, a POST request has a message body. By default browser HTML forms send the message body in URL Encoded format (the same as we see with the "search" portion of GET urls, the parameters after the question mark). We use the `urlencoded` method of the `body-parser` module to create body parsing middleware converts an incoming POST request to the `/login` route to an object on `req.body`.

The POST `/auth/login` route handler in `routes/auth.js` handles the login request and will take one of three actions.

If there's is already a session, with an associated `user` object (that is, if `req.session.user` exists), it will redirect to the `/` (index) route.

Next we validate the request POST message (`req.body`). We do a simple conditional check on username and password, but this could be adapted to check a database of usernames and password hashes.

If the POST body is invalid, the `/auth/login` POST route will respond to the request by rendering the `views/loging.ejs` template again, but this time with `fail` set to `true`. Which will cause the template to render with a `Try Again` message.

If the POST body is valid we set `req.session.user`. At this point, a session identifer is created. Then we redirect to the `/` route. The redirect response will contain a `Set-Cookie` HTTP header, containing a key and value that holds the session key name (which defaults to `connect.sid`) and the session identifier.

> ## Session Key Name
>
> To avoid server fingerprinting, we should make a practice of configuring web servers to set a generic session key name. See the *Avoiding Fingerprinting* subheading of the *There's More* section in the *Hardening Headers in Web Frameworks* recipe in **Chapter 8 Dealing with Security** for details.

As the browser dutifily makes a new request for the `/` route (as per the HTTP redirection), it will pass the string which came through the `Set-Cookie` header back to the browser under the `Cookie` header.

The `express-session` middleware will intercept the request, and recognize the `connect.sid` portion of the `Cookie` header, extract the session identifier and match query the session storage for any state is associated with the identifer. State is then placed onto the `req.session` object. In our case the `user` object is added to `req.session`. The `routes/index.js` GET handler will pass the `req.session.user` object into the `res.render` method, and the `views/index.ejs` template will enter the first logic branch in the conditional statement checking for truthiness of the `user` template local.

This time when the `views/index.ejs` renders, it will include a welcome message to the logged in user ("Hi dave!") and a logout link pointing to `/auth/logout`.

When the `/auth/logout` link is clicked, the `/logout` GET route in `routes/auths.js` is passed the request and response objects. We set `req.session` to `null` which unsets the session (the session data is released from the session store). Then we redirect back to the index route (`/`).

The browser will continue to cache and send the obsolete session cookie until it expires, however the session identifer will have no matches in the store so our server will treat the browser as if it has no session (which it doesn't). Upon logging in again, the browser receives a new session cookie which replaces the old cookie.

The session cookie sent to the browser may or may not be marked with a "Secure" attribute. This attribute instructs the browser to never send the session cookie back to the server over HTTP - this helps to avoid person in the middle attacks designed to steal session cookies. However, the Secure attribute cannot be set in the first place if an incoming request is made over HTTP (and of course, even if it could, we wouldn't be able to receive the users session cookie back without HTTPS).

In production, we should absolutely use HTTPS and send secure session cookies, in development it's more convenient to use HTTP (which means we can't use secure cookies).

So we assume a production environment that applies SSL encryption to connections at a load balancer or reverse proxy layer, but our web server serves content to the load balancer (or reverse proxy) via HTTP. To make this work we set the Express `trust proxy` setting to `1`. Which means trust exactly one proxy IP to deliver unencrypted content *as if* it was encrypted when that proxy adds an `X-Forwarded-Proto` header with the value of `HTTPS` to the request. When this is the case, `express-session` will set the `Secure` attribute on the session cookie, even though it's technically served over HTTP to the proxy layer.

The `trust proxy` setting can also (preferably) be set to a whitelist array of accepted proxy IP addresses to trust (or for more complex setups, a predicate function which checks the IP for validitiy). We only do this in production, based on the value of the `dev` constant (which is set based on the `NODE_ENV` environment variable). We also use the `dev` constant to determine whether a session cookie should be secure or not. When we call the `session` function (which is exported from `express-session`) we pass an options object, with `secure` set to the opposite of `dev` (`!dev`).

There's more

Let's look at implementing authentication in Hapi and Koa.

Session Authentication in Hapi

Let's implement authentication in our Hapi server.

We'll copy the `hapi-logging` folder which we created in the *There*'s *More* section of the previous recipe (*Adding Logging*) name it `hapi-authentication`. We'll also copy the `views` folder from the main recipe, install the `yar` module, and create a `routes/auth.js` file:

```
$ cp -fr ../adding-logging/hapi-logging hapi-authentication
$ cd hapi-authentication
$ cp -fr ../express-authentication/views views
$ npm install --save yar
$ touch routes/auth.js
```

Let's require the `yar` module in the `index.js` module, and require the `routes/auth.js` file within our `routes` object:

```
const yar = require('yar')
const routes = {
  index: require('./routes/index'),
  auth: require('./routes/auth'),
  devStatic: require('./routes/dev-static')
}
```

Let's add `yar` to the `plugins` declaration:

```
const plugins = dev ? [{
  register: hapiPino,
  options: {instance: pino}
}, {
  register: yar,
  options: {
    cookieOptions: {
      password: 'I really really really like pies',
      isSecure: false
    }
  }
}, vision, inert] : [{
    register: hapiPino,
    options: {instance: pino}
  }, {
    register: yar,
    options: {
      cookieOptions: {
        password: 'something more secure than a bit about pies',
        isSecure: true
      }
    }
  }, vision]
```

The password has to be at least 32 bytes to be secure, hence the usage of longform passwords.

In development `isSecure` is set to `false` whereas in production `isSecure` is to set to `true`. As with our main recipe, we assume a production that serves content over HTTPS from a proxy layer (load balancer/reverse proxy). We don't need to set a `trust proxy` setting equivalent in Hapi, Hapi will implicitly trust proxies `X-Forwarded-Proto` headers and allow the `Secure` attributed to be set on the session cookie accordingly.

We'll add the `auth` route in the `start` function, between the `index` and `devStatic` routes:

```
/* inside start function: */
  routes.index(server)
  routes.auth(server)

  if (dev) routes.devStatic(server)
```

Now let's fill out the `auth/routes.js` file:

```
module.exports = auth

function auth (server) {

  server.route({
    method: ['GET', 'POST'],
    path: '/auth/login',
    handler: function (request, reply) {
      if (request.auth.isAuthenticated) {
        reply.redirect('/');
        return
      }
      if (request.method === 'get') {
        reply.view('login', {fail: false})
        return
      }

      if (request.method === 'post') {
        if (request.payload.un === 'dave' && request.payload.pw === 'nc
          request.yar.set('user', {name: request.payload.un})
          reply.redirect('/')
        } else {
          reply.view('login', {fail: true})
        }
      }
    }
  })

  server.route({
    method: 'GET',
    path: '/auth/logout',
    handler: function (request, reply) {
      request.yar.reset()
      reply.redirect('/')
    }
  })
}
```

Finally we'll alter our `routes/index.js` file like so:

```
module.exports = index

function index (server) {
  server.route({
    method: 'GET',
    path: '/',
    handler: function (request, reply) {
      const title = 'Hapi'
      const user = request.yar.get('user')
      request.logger.info(`rendering index view with ${title}`)
      reply.view('index', {title, user})
    }
  })
}
```

We can start our server with `node index.js` and execute the same user flow as in the main recipe to get the same results.

Our Hapi implementation is almost conceptually similar to the Express implementation in the main recipe. The API's differ (`request.yar.get('user')` instead of `request.session.user` , and so forth) but more potently there is a fundamental difference in approach to session storage.

The `yar` module, by default, will use a hybrid storage approach, keeping state first client-side and the server-side when client side state limits are met.

The `yar` plugin will store up to 1KB of session state in the cookie itself

- which allows for server-stateless sessions. A common use case of this approach is holding fine-grained permission flags.

The cookie is encrypted and decrypted server side (via the `iron` module) using the password set through the `yar` options object as the key. This means intermediaries (and clients) cannot decode the state in the cookie.

The amount of state stored in the session cookie be increased via the `yar` plugins `maxCookieSize` option, although we should avoid setting this above 4093 bytes since that's (historically - it may be 4096 bytes in recent iOS Safari versions) the maximum cookie size in mobile Safari (and is therefore the lowest common denomitor of browser cookie limit).

Equivalent behavior is available in Express with the `cookie-session` middleware which has an API similar to `express-session` .

Hapi's `yar` plugin, however, will also begin to use server side storage if `maxCookieSize` is exceeded. The storage mechanism is determined by Hapi's `server.cache` API, which can be configured with different storage mechanisms, typically via the `catbox` caching service. See http://npm.im/catbox, and https://github.com/hapijs/hapi/blob/master/API.md#servercacheprovisionoptions-callback for more information.

Session Authentication in Koa

Let's implement the same authentication as our main recipe, but this time using Koa!

Let's copy the `koa-logging` folder which we created in the *There's More* section of the previous recipe (*Adding Logging*) name it `koa-authentication` , copy the `views` folder from the main recipe, install the `koa-bodyparser` and `koa-generic-session` modules, and create a `routes/auth.js` file:

```
$ cp -fr ../adding-logging/koa-logging koa-authentication
$ cd koa-authentication
$ cp -fr ../express-authentication/views views
$ npm install --save koa-bodyparser koa-generic-session
$ touch routes/auth.js
```

Let's require the two additional modules we installed near the top of the `index.js` as well as loading our new `routes/auth.js` file:

```
const bodyParser = require('koa-bodyparser')
const session = require('koa-generic-session')
const index = require('./routes/index')
const auth = require('./routes/auth')
```

Koa has an internal concept of cookies - and also of signed cookies. Not only this, but it uses the `keygrip` module internally to supply a rotated credentials system.

So, to allow our session cookie to be signed, need to set the `app.keys` property to an array of possible keys (each key should be a minimum of 32 bytes), like so:

```
app.keys = ['koa has integrated secret management', 'add another key fo
```

Next we'll register the `koa-generic-session` and `koa-bodyparser` middleware:

```
app.use(session())
app.use(bodyParser())
```

Now we'll configure our main Koa `router` instance with a new `/auth` mount point that uses the routes defined on our `auth` router (which we'll create in `routes/auth.js` shortly):

```
router.use('/', index.routes())
router.use('/auth', auth.routes())

app.use(router.routes())
```

Our `routes/auth.js` file should look as follows:

```
const router = require('koa-router')()
```

```
router.get('/login', async (ctx) => {
  await ctx.render('login', {fail: false})
})

router.post('/login', async (ctx) => {
  const { session, request } = ctx
  const { body } = request
  if (session.user) {
    ctx.redirect('/')
    return
  }
  if (body.un === 'dave' && body.pw === 'ncb') {
    session.user = {name: body.un}
    ctx.redirect('/')
    return
  }

  await ctx.render('login', {fail: true})
})

router.get('/logout', async (ctx, next) => {
  ctx.session.user = null
  ctx.redirect('/')
})

module.exports = router
```

Finally we'll modify our `routes/index.js` like so:

```
const router = require('koa-router')()

router.get('/', async function (ctx) {
  const title = 'Koa'
  ctx.log.info(`rendering index view with ${title}`)
  const user = ctx.session.user
  await ctx.render('index', {title, user})
})

module.exports = router
```

We can now start our server (`node index.js`) and follow the same user authentication flow as in the main recipe.

There are two (official) Koa modules for session management, `koa-generic-session` and `koa-session`. We used `koa-generic-session` to duplicate the behavior of the main recipe. The `koa-generic-session` middleware uses the same store API as `express-session`, which means all of the compatible stores for `express-session` will work with `koa-generic-session`. The `koa-session` module can also use external stores, but has a slightly different API (promise returning functions) but by default will store state in the session cookie.

However unlike `yar` (see the previous *Session Authentication In Hapi* recipe) at the time of writing `koa-session` doesn't have a maxmium size limit for cookies, nor does it supply a hybrid approach to cookie and external storage - we either use cookie storage or external storage.

> ### CAUTION!
>
> This either/or approach to where cookies are stored (in browser or server side) can lead to accidentally becoming incompatible with some browsers and not others. For instance if all cookies on a particular domain become greater than 4096 bytes logins will fail on Chrome, Safari, and Firefox but not Internet Explorer. On the other hand, a vivid awareness of hard limit could help architectural design decisions in preventing state bloat, and allow for stateless (~~on the~~ server side) sessions.

See also

- *Receiving POST data* in **Chapter 5 Wielding Web Protocols**
- *Anticipating Malicious Input* in **Chapter 8 Dealing with Security**
- *Guarding Against Cross Site Scripting (XSS)* in **Chapter 8 Dealing with Security**
- *Adding a View Layer* in this Chapter
- *Implementing Authentication* in this Chapter