BUILD POWERFUL WEB APPLICATIONS QUICKLY!

Practical Keystone.js

Node.js, Express & MongoDB

Manikanta Panati

Practical Keystone.js

A Hands On Introduction To Keystone.js Using a Real-World Project

Manikanta Panati

This book is for sale at http://leanpub.com/keystonejs

This version was published on 2016-02-28

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https://twitter.com/search?q=#keystonejs

This book is dedicated to my Dad, Mom, Gundi, Gundma & My Love!

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Introduction

Keystone.js is an open source Node.js based CMS and web application framework created by Jed Watson in 2013. The framework makes it very easy to build database-driven websites, applications & APIs and is built upon Express, the defacto web server for Node.js and uses Mongo DB as its storage backend. Mongo DB is a very popular and powerful document store that is capable of storing data without it being structured in a schema.

Keystone.js philosophy

Keystone is designed to make complicated things simple, without limiting the power or flexibility of node.js or the frameworks it is built on.

What are web frameworks?

A web framework aims to assist a developer in delivering web applications quicker and easily. The term framework is relatively loosely defined and can include anything from a collection of components to a complete abstraction of workflow in an application. A framework typically provides a certain style and/or a certain structure that assists the developer and this structure is generally based on specific design patterns. Some of the well-known web frameworks include Ruby on Rails, Laravel, Django and Symfony. Ruby on Rails follows the popular MVC (Model-View-Controller) design pattern where as Django and Keystone.js follow the MVT (Model-View-Template) design pattern. Both the MVC and MVT design patterns allow for the logical separation of code and are very similar conceptually. Web frameworks encourage loose coupling and strict separation between pieces of application.

The Model-View-Template design pattern

Keystone.js is based on a design pattern called Model-View-Template. A good understanding of this concept is the basis for working with Keystone.js. Web application architecture generally comprises of three pieces that work together - data access logic, business logic, and presentation logic. A good framework will aim for the logical separation of these pieces in an application into distinct subsystems so as to allow for high degree of re-usability of components. Here’s roughly how the M, V, and T break down in Keystone.js:

M stands for “Model,” which represents the data access layer. Models typically contain definition of the data and methods to interact with data like how to access it, how to validate it, which behaviors it has, and the relationships between the data.

V stands for "View," which represents the business logic layer. Views contain the logic that access the model, performs any calculations and defers the results to the appropriate template(s). View is like a bridge between models and templates.

T stands for "Template," which represents the presentation layer. Templates handle presentation-related decisions: how something should be displayed on a Web page or other type of document.

If you're familiar with other MVC Web-development frameworks, such as Laravel, you may consider Keystone.js views to be the "controllers" and Keystone.js templates to be the "views". In Keystone.js, the "view" describes the data that gets presented to the user; it's not necessarily just how the data looks, but which data is presented. In contrast, Laravel and similar frameworks suggest that the controller's job includes deciding which data gets presented to the user, whereas the view is strictly how the data looks, not which data is presented.

Both MVC and MVT are very similar and interpretation of these concepts varies slightly from framework to framework and no one is more "correct" than the other. It is good to get a proper understanding of the underlying concepts.

Introducing the IncTicket Project

The best way to learn about a new technology is to be able to visualize the various capabilities of the technology in terms of using them in the implementation of a real world project. Throughout this book, I will introduce Keystone.js features and syntax in conjunction with developing IncTicket, a web based application that allows for the creation and management of incident tickets.

IncTicket will enable users to create tickets, assign statuses, set priorities, categories, and assign tikets to users. Other users can then interact with the tickets, updating their state and more.

Errata and Suggestions

"Have no fear of perfection - you'll never reach it", said Salvador Dali. When it comes to writing about the latest technology, I could'nt agree more!. I might have made mistakes in both code and grammar, and probably completely misconstrued a few pieces of this text. If you would like to report an error, ask a question or offer a suggestion, please reach me on twitter @jangreejelabi.

Chapter 1. Meet Keystone.js

This chapter will introduce Keystone.js along with its merits. We will cover how to install MongoDB and Node.js that are needed create the IncTicket application using Keystone.js and run it.

This chapter will cover the following points:

- Introduction to Keystone.js
- Installing MongoDB
- Installing Node.js
- Useful development and debugging tools

Why use Keystone.js

Before we begin installing and using Keystone.js, we will first look at why we use Keystone.js framework over other frameworks available online. Simply put, Keystone.js provides a standardized set of components that allow for fast and easy development of web applications that can be quickly developed, maintained and extended.

Keystone.js has a number of key features that makes it worth using including:

- **Modularity** - Keystone will configure express - the de facto web server for node.js - for you and connect to your MongoDB database using Mongoose, the leading ODM package.
- **Auto-generated Admin UI** - Whether you use it while you're building out your application, or in production as a database content management system, Keystone's Admin UI will save you time and make managing your data easy.
- **Session Management** - Keystone comes ready out of the box with session management and authentication features, including automatic encryption for password fields.
- **Email Sending** - Keystone makes it easy to set up, preview and send template-based emails for your application. It also integrates with Mandrill.
- **Form Processing** - Want to validate a form, upload an image, and update your database with a single line? Keystone can do that, based on the data models you've already defined.
- **Database Fields** - IDs, Strings, Booleans, Dates and Numbers are the building blocks of your database. Keystone builds on these with useful, real-world field types like name, email, password, address, image and relationship fields.

What is Keystone.js Best for?

Keystone.js is a generic content management framework, meaning that it can be used for developing a variety of web applications using Javascript. Because of its modular architecture and clean separation of various functionality, it is especially suitable for developing large-scale applications such as portals, forums, content management systems (CMS), e-commerce projects, RESTful Web services, and so on.

Keystone.js Versions

Keystone.js currently has two major versions available: 0.3.x and 0.4. At the time of writing this book, Version 0.3.x is the current generation of the framework and is in active development mode. Version 0.4 is work in progress, adopting the latest technologies and protocols, including Mongoose 4, elemental UI and core changes.

Installing MongoDB and Node.js

Let's start by looking at the process of installing MongoDB on a windows workstation. MongoDB is an open source, document-oriented database that is designed to be both scalable and easy to work with. MongoDB stores data in JSON-like documents with dynamic schema instead of storing data in tables and rows like a relational database, for example MySQL.

Let's install MongoDB database in a standalone mode. This is the quickest way to start a MongoDB server for the purpose of development.

How to install MongoDB

- Navigate to the downloads page on the MongoDB official website, http://www.mongodb.org/downloads.
- Click on the download link for the latest stable release Zip Archive under Windows 32-bit or 64-bit depending on your machine architecture.

  Find the architecture of your machine by typing in the following command into the command prompt:

```
wmic os get osarchitecture
```

The output will be similar to:

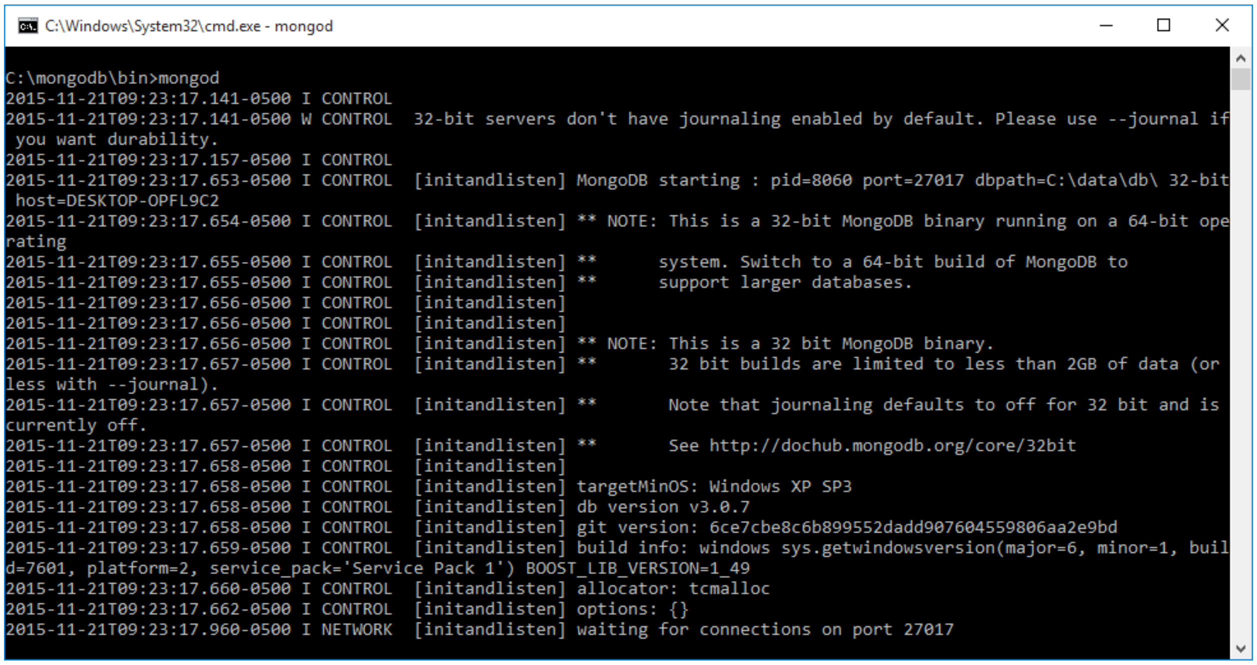
```
OSArchiecture
64-bit
```

- Once the download completes, move the ZIP archive to the C:\ drive and extract it.
- Rename the extracted folder (mongodb-win32-xxx-a.b.c where a.b.c is the version number) to mongodb.
- Create the default database path (c:\data\db). This is the location where the database files used by mongodb will reside.

```
c:\>mkdir data\db
```

- To start the mongodb database, Open a CMD prompt window, and enter the following commands:

```
c:\> cd mongodb\bin
c:\mongodb\bin>mongod
```



```
C:\mongodb\bin>mongod
2015-11-21T09:23:17.141-0500 I CONTROL
2015-11-21T09:23:17.141-0500 W CONTROL  32-bit servers don't have journaling enabled by default. Please use --journal if
 you want durability.
2015-11-21T09:23:17.157-0500 I CONTROL
2015-11-21T09:23:17.653-0500 I CONTROL  [initandlisten] MongoDB starting : pid=8060 port=27017 dbpath=C:\data\db\ 32-bit
 host=DESKTOP-OPFL9C2
2015-11-21T09:23:17.654-0500 I CONTROL  [initandlisten] ** NOTE: This is a 32-bit MongoDB binary running on a 64-bit ope
rating
2015-11-21T09:23:17.655-0500 I CONTROL  [initandlisten] **       system. Switch to a 64-bit build of MongoDB to
2015-11-21T09:23:17.655-0500 I CONTROL  [initandlisten] **       support larger databases.
2015-11-21T09:23:17.656-0500 I CONTROL  [initandlisten]
2015-11-21T09:23:17.656-0500 I CONTROL  [initandlisten]
2015-11-21T09:23:17.656-0500 I CONTROL  [initandlisten] ** NOTE: This is a 32 bit MongoDB binary.
2015-11-21T09:23:17.657-0500 I CONTROL  [initandlisten] **        32 bit builds are limited to less than 2GB of data (or
less with --journal).
2015-11-21T09:23:17.657-0500 I CONTROL  [initandlisten] **        Note that journaling defaults to off for 32 bit and is
currently off.
2015-11-21T09:23:17.657-0500 I CONTROL  [initandlisten] **        See http://dochub.mongodb.org/core/32bit
2015-11-21T09:23:17.658-0500 I CONTROL  [initandlisten]
2015-11-21T09:23:17.658-0500 I CONTROL  [initandlisten] targetMinOS: Windows XP SP3
2015-11-21T09:23:17.658-0500 I CONTROL  [initandlisten] db version v3.0.7
2015-11-21T09:23:17.658-0500 I CONTROL  [initandlisten] git version: 6ce7cbe8c6b899552dadd907604559806aa2e9bd
2015-11-21T09:23:17.659-0500 I CONTROL  [initandlisten] build info: windows sys.getwindowsversion(major=6, minor=1, buil
d=7601, platform=2, service_pack='Service Pack 1') BOOST_LIB_VERSION=1_49
2015-11-21T09:23:17.660-0500 I CONTROL  [initandlisten] allocator: tcmalloc
2015-11-21T09:23:17.662-0500 I CONTROL  [initandlisten] options: {}
2015-11-21T09:23:17.960-0500 I NETWORK  [initandlisten] waiting for connections on port 27017
```

Start MongoDB

If you find the console log indicating **[initandlisten] waiting for connections on port 27017**, then the MongoDB server has started up correctly and is ready to accept connections from client.

How to install Node.js

Next, we will look at the process of installing Node.js on a windows workstation. Node.js is an open-source, cross-platform runtime environment for developing web applications. Node.js applications are written in JavaScript and can be run within the Node.js runtime on OS X, Microsoft Windows, Linux and a variety of other operating systems.

- Navigate to the downloads page on the Node.js official website, https://nodejs.org/en/download/.
- Click on the download link for the latest stable release .MSI under Windows 32-bit or 64-bit depending on your machine architecture.

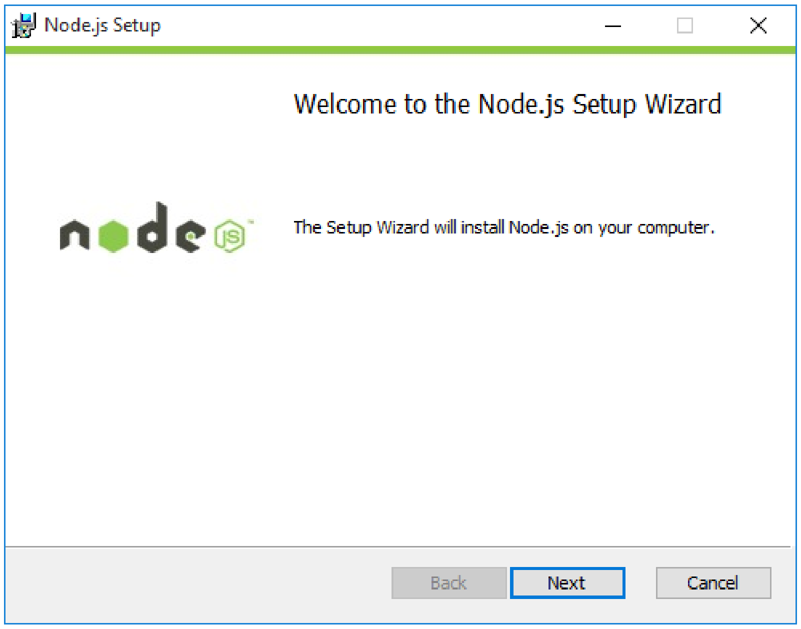
Find the architecture of your machine by typing in the following command into the command prompt:

```
wmic os get osarchitecture
```

The output will be similar to:

```
OSArchiecture
64-bit
```

- Once the download is complete, double-click on the .msi file, which will launch the Node installer.
- Proceed through each step of the installation wizard.

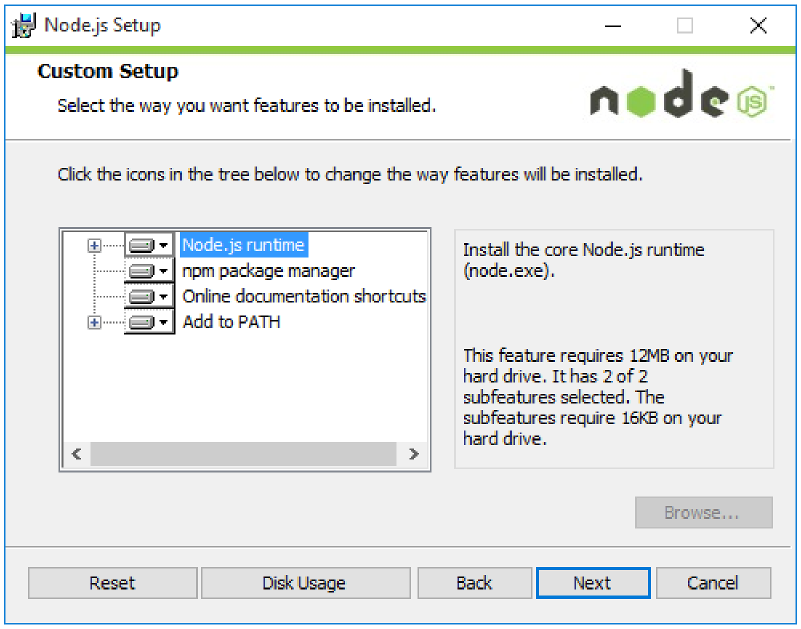

Node.js Setup

Welcome to the Node.js Setup Wizard

The Setup Wizard will install Node.js on your computer.

Node.js Installer

- At the custom setup screen during the installation, make sure that the wizard installs NPM (Node Package Manager) and configures the PATH environment variable along with installing the Node.js runtime. This should be enabled by default for all install.


Node.js Setup
Custom Setup
Select the way you want features to be installed.
Click the icons in the tree below to change the way features will be installed.
Node.js runtime
npm package manager
Online documentation shortcuts
Add to PATH
Install the core Node.js runtime (node.exe).
This feature requires 12MB on your hard drive. It has 2 of 2 subfeatures selected. The subfeatures require 16KB on your hard drive.
Browse...
Reset
Disk Usage
Back
Next
Cancel

Node.js Installer

Once these steps have been completed, both Node and npm should be installed on your system.

Testing whether Node.js is installed properly

After going through the Node.js installation wizard, let's run a quick test to ensure everything is working properly.

Run the following commands on a new command prompt window. You might need to open a new instance of command prompt for the PATH variable changes to take effect.

```
c:\> node --version
    v4.2.2

c:\> npm --version
    2.14.7
```

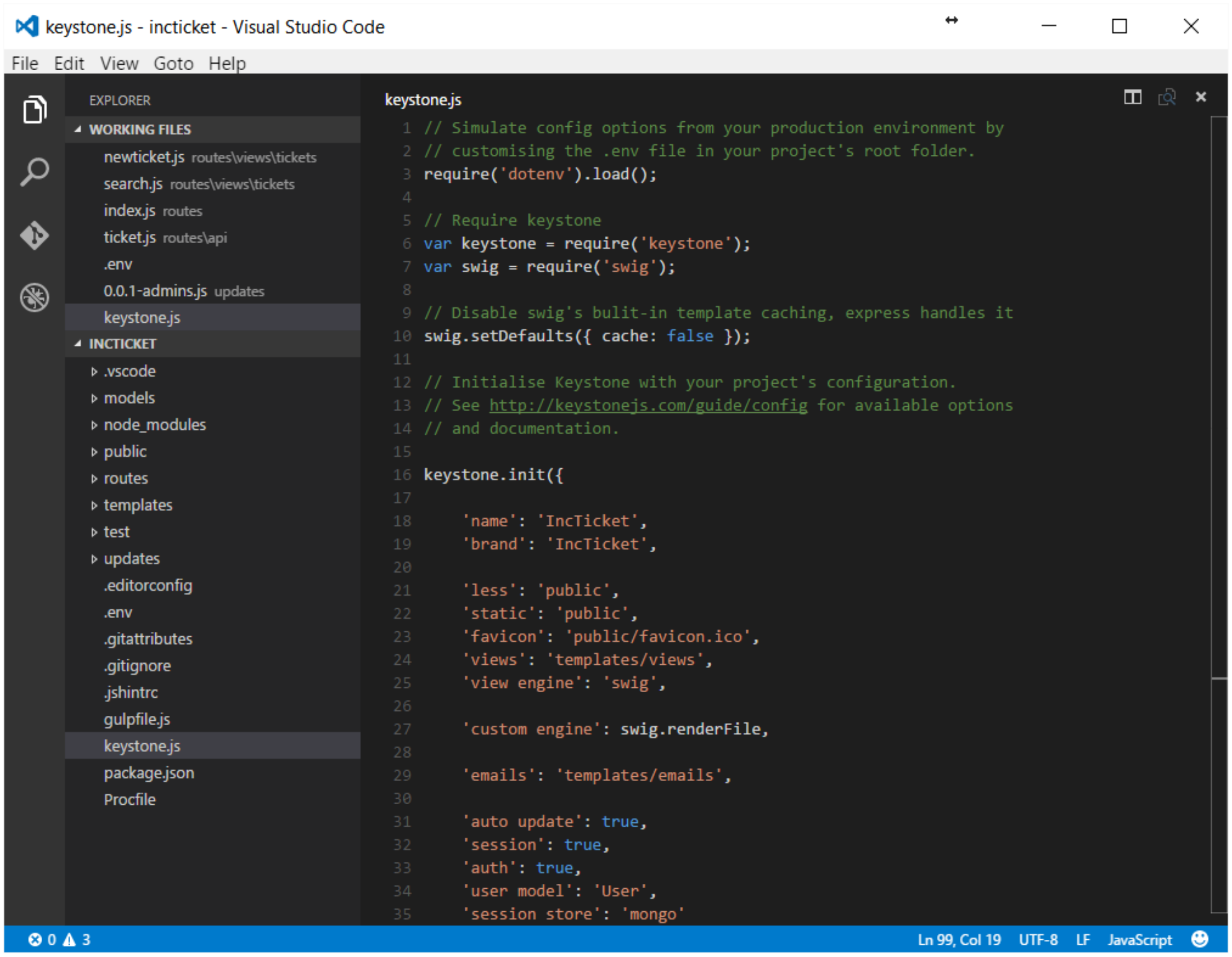
If the Node installation was successful, you will see the version number that was installed as an output on the screen as a response to running the above commands.

Useful Development and Debugging Tools.

I would like to introduce a couple of useful tools that make it really easy for us to develop Node.js and MongoDB based web applications. The first is Visual Studio Code, a code editor that offers excellent Node.js development and debugging support. It is free and available on multiple platforms - Linux, Mac OSX, and Windows. Visual Studio Code can be used for building and debugging modern web and cloud applications and includes great built-in support for C#, and Node.js development with TypeScript and JavaScript. It includes tooling for web technologies such as HTML, CSS, Less, Sass, and JSON. Code also integrates with package managers and repositories, and builds and other common tasks to make everyday workflows faster. Dowload Visual Studio Code from https://code.visualstudio.com/[1].

We can open up any folder on our filesystem using Visual Studio Code and get to editing files directly. Let us explore the GUI to get a better understanding of the various features.

[1]https://code.visualstudio.com/



```
// Simulate config options from your production environment by
// customising the .env file in your project's root folder.
require('dotenv').load();

// Require keystone
var keystone = require('keystone');
var swig = require('swig');

// Disable swig's bulit-in template caching, express handles it
swig.setDefaults({ cache: false });

// Initialise Keystone with your project's configuration.
// See http://keystonejs.com/guide/config for available options
// and documentation.

keystone.init({

    'name': 'IncTicket',
    'brand': 'IncTicket',

    'less': 'public',
    'static': 'public',
    'favicon': 'public/favicon.ico',
    'views': 'templates/views',
    'view engine': 'swig',

    'custom engine': swig.renderFile,

    'emails': 'templates/emails',

    'auto update': true,
    'session': true,
    'auth': true,
    'user model': 'User',
    'session store': 'mongo'
```

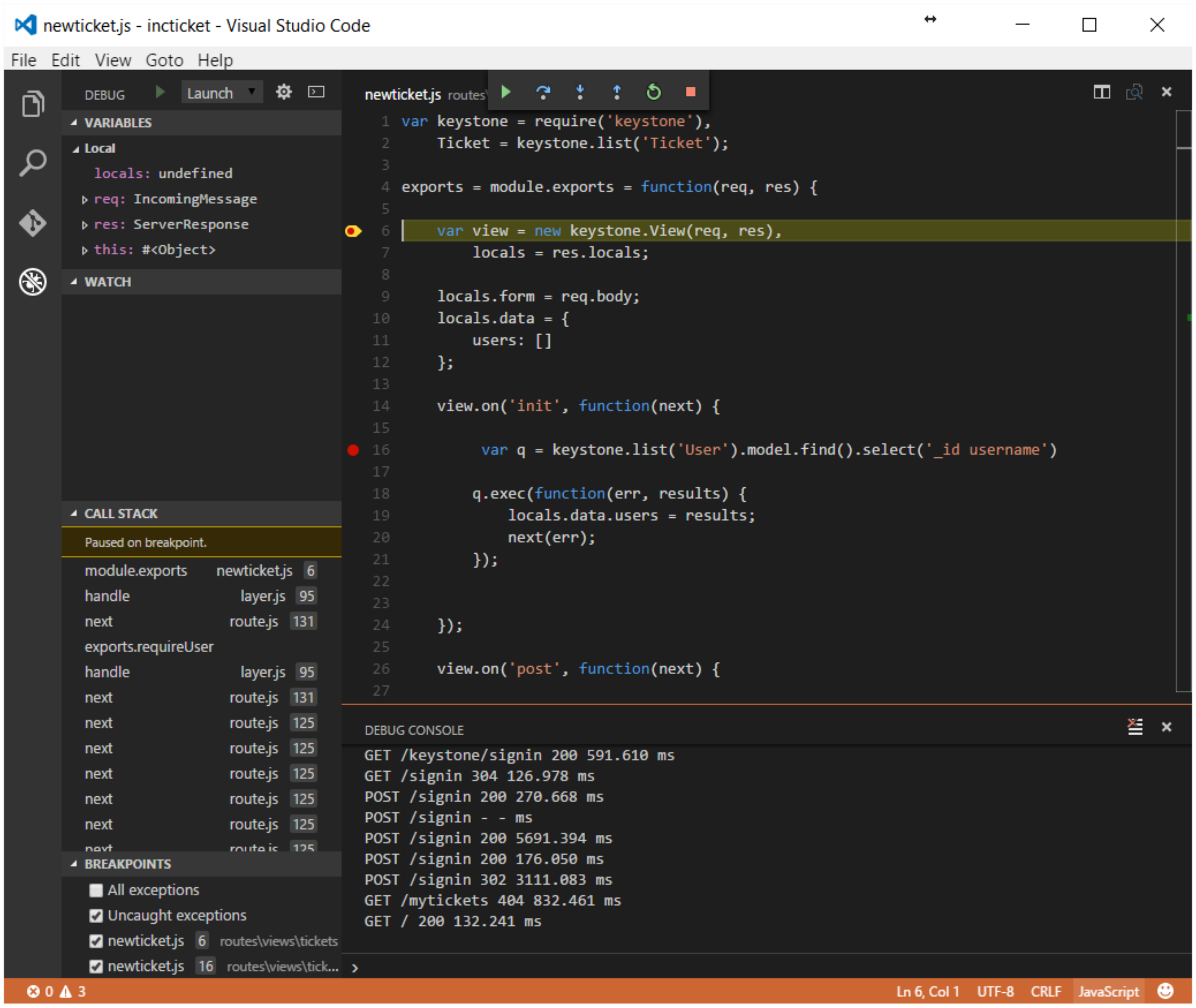
Visual Studio Code

The left pane has two sections; the first one has icons for the file explorer, file search, git integration and for debugging. The screenshot shows the explorer pane open. Visual Studio Code lists the files that are currently being worked upon in the working files section. Below the working files section is the list of files in the current directory that can be opened up for editing. The main area of the editor shows the file being edited and allows for multiple files to be opened at a time. The editor also has a split view allowing us to look at two files side by side.

Debugging in Visual Studio Code is very easy. To start off, we need to define a launch configuration that can tell the editor about the starting point to our app and other configuration data. Below is the configuration setting we can use to debug Keystone.js

```
{
	"version": "0.2.0",
	"configurations": [
		{
			"name": "Launch",
			"type": "node",
			"request": "launch",
			"program": "${workspaceRoot}/keystone.js",
			"stopOnEntry": false,
			"args": [],
			"cwd": "${workspaceRoot}",
			"runtimeExecutable": null,
			"runtimeArgs": [
				"--nolazy"
			],
			"env": {
				"NODE_ENV": "development"
			},
			"externalConsole": false,
			"sourceMaps": false,
			"outDir": null
		},
		{
			"name": "Attach",
			"type": "node",
			"request": "attach",
			"port": 5858,
			"sourceMaps": false,
			"outDir": null,
			"localRoot": "${workspaceRoot}",
			"remoteRoot": null
		}
	]
}
```

Set the configuration information by clicking on the debug icon on the left pane and then click the gear icon on the top bar. Once the configuration information is set, hit F5 to launch the application in debug mode.



```
Local
  locals: undefined
▷ req: IncomingMessage
▷ res: ServerResponse
▷ this: #<Object>
```

```
Paused on breakpoint.
module.exports      newticket.js 6
handle              layer.js 95
next                route.js 131
exports.requireUser
handle              layer.js 95
next                route.js 131
next                route.js 125
next                route.js 125
next                route.js 125
next                route.js 125
next                route.js 125
```

```
☐ All exceptions
☑ Uncaught exceptions
☑ newticket.js 6 routes\views\tickets
☑ newticket.js 16 routes\views\tick...
```

```javascript
var keystone = require('keystone'),
    Ticket = keystone.list('Ticket');

exports = module.exports = function(req, res) {

    var view = new keystone.View(req, res),
        locals = res.locals;

    locals.form = req.body;
    locals.data = {
        users: []
    };

    view.on('init', function(next) {

         var q = keystone.list('User').model.find().select('_id username')

        q.exec(function(err, results) {
            locals.data.users = results;
            next(err);
        });


    });

    view.on('post', function(next) {
```

```
GET /keystone/signin 200 591.610 ms
GET /signin 304 126.978 ms
POST /signin 200 270.668 ms
POST /signin - - ms
POST /signin 200 5691.394 ms
POST /signin 200 176.050 ms
POST /signin 302 3111.083 ms
GET /mytickets 404 832.461 ms
GET / 200 132.241 ms
```

Debugging with Visual Studio Code

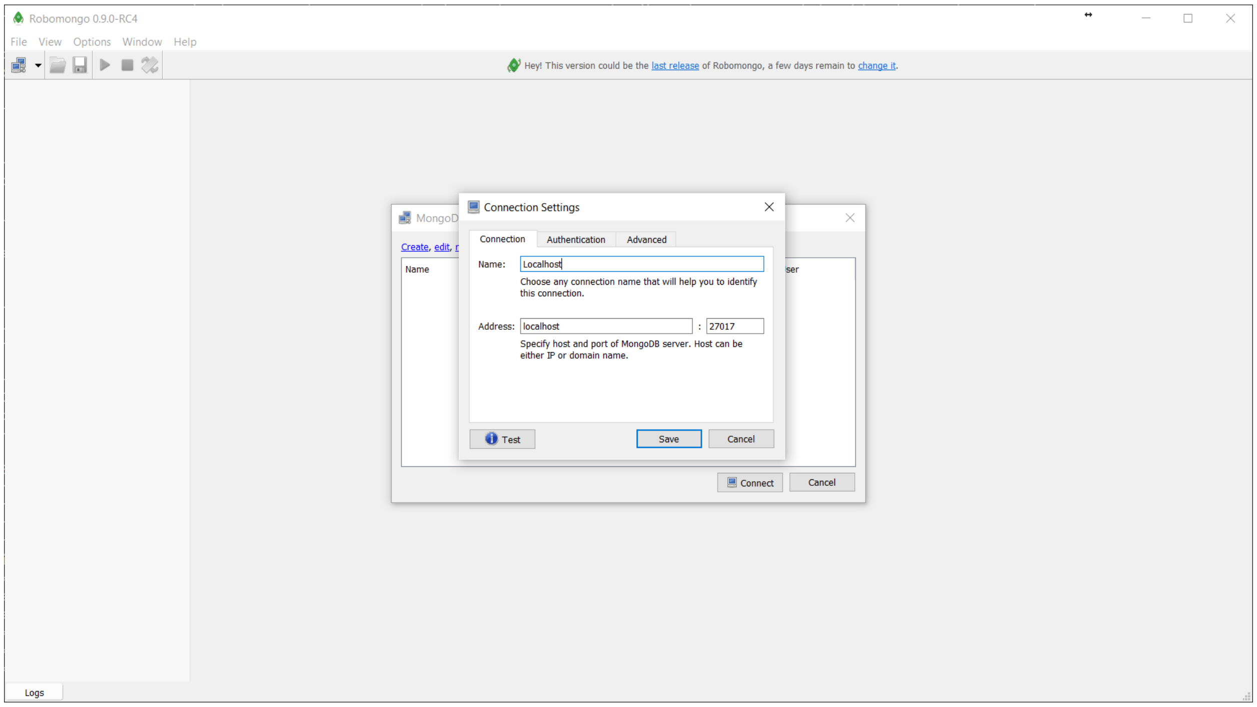
As shown above, we can set breakpoints in code, add variables to watch and inspect the call stack. At the bottom of the editor is the node console where we can see any console interactions like console.log in our application. The node console also allows us to inspect variables inline.

Get more information on in-depth features of Visual Studio Code at https://code.visualstudio.com/docs[2].

The next tool is Robomongo. Robomongo is a desktop application that allows us to manage MongoDB databases. Robomongo runs on Mac OS X, Windows, and Linux and is free!. It allows you to create new databases and view collections and to run queries. It has all the features that the native MongoDB shell provides such as multiple connections, multiple results, and autocompletion. Download and install Robomongo from http://robomongo.org[3].

If you have MongoDB running locally, we can create a new connection as shown below:

[2]https://code.visualstudio.com/docs
[3]http://robomongo.org



Hey! This version could be the last release of Robomongo, a few days remain to change it.

Name: Localhost

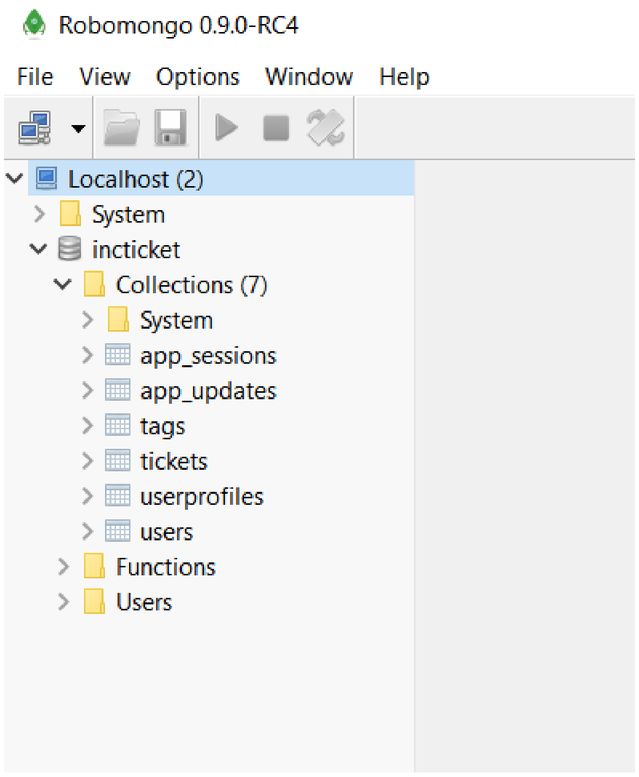
Choose any connection name that will help you to identify this connection.

Address: localhost : 27017

Specify host and port of MongoDB server. Host can be either IP or domain name.

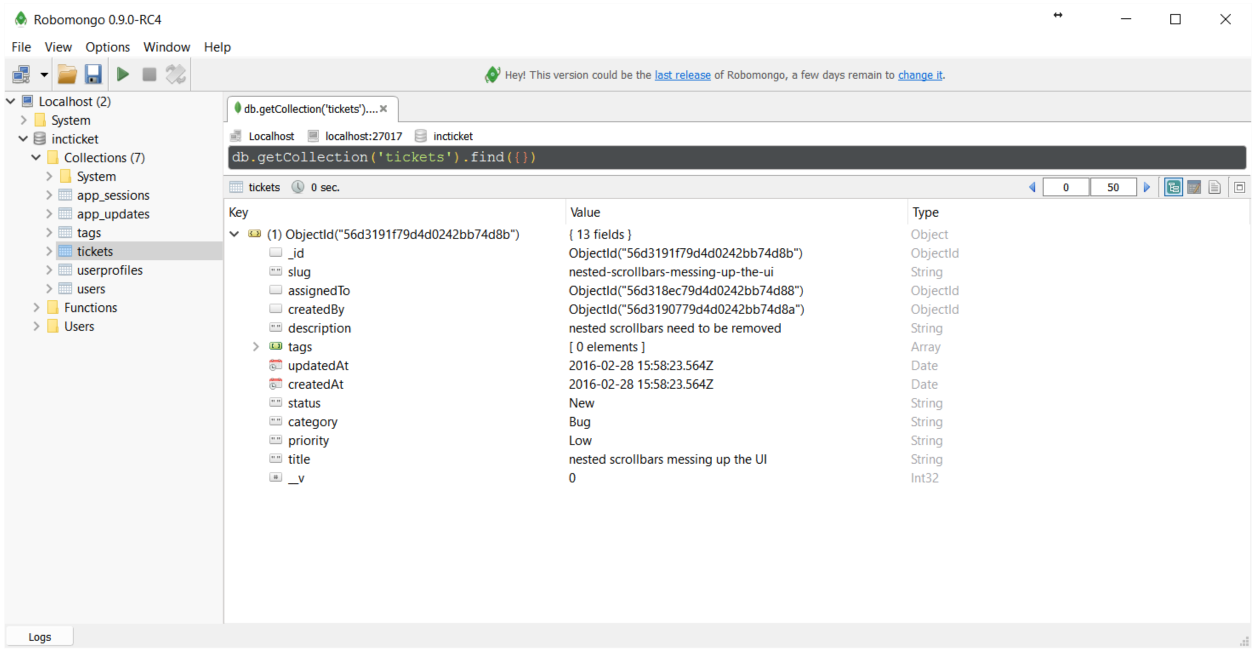
Connect to MongoDB using Robomongo

After connecting to the instance, we can browse all the collections using the sidebar.



Browse MongoDB collections

We can issue queries against our MongoDB and collections using the query bar and visually inspect the returned documents.



```
db.getCollection('tickets').find({})
```

Key	Value	Type
(1) ObjectId("56d3191f79d4d0242bb74d8b")	{ 13 fields }	Object
_id	ObjectId("56d3191f79d4d0242bb74d8b")	ObjectId
slug	nested-scrollbars-messing-up-the-ui	String
assignedTo	ObjectId("56d318ec79d4d0242bb74d88")	ObjectId
createdBy	ObjectId("56d3190779d4d0242bb74d8a")	ObjectId
description	nested scrollbars need to be removed	String
tags	[0 elements]	Array
updatedAt	2016-02-28 15:58:23.564Z	Date
createdAt	2016-02-28 15:58:23.564Z	Date
status	New	String
category	Bug	String
priority	Low	String
title	nested scrollbars messing up the UI	String
__v	0	Int32

Query MongoDB collections

Summary

We have reached the end of the second chapter and we've covered the necessary requirements to begin building the IncTicket application. Onwards!

Chapter 2. Building the IncTicket Application

This chapter will cover how to create the IncTicket application using Keystone.js. At the end of this chapter you should have a general idea of how the framework works, understand how the different pieces interact with each other, and give you an understanding on how to easily create Keystone.js projects with basic functionality. This chapter will get you up and running with a project without too many details to begin with.

This chapter will cover the following points:

- Installing Keystone.js and creating your first project
- Designing models and understanding Mongo collections
- Keystone.js Administration site for your models
- Working with Mongoose.js
- Building views, routes and templates
- Adding pagination to lists

Installing Keystone.js

This section will walk you through installing Keystone.js on a windows machine. The installation process does not differ much from OS to OS as most of the dependent components are cross platform compatible. Since Keystone.js is written in JavaScript, the installation is pretty simple.

Prerequisites

To setup Keystone.js, you are going to need a few prerequisites. These are:

- Node.js
- Yeoman
- NPM
- Mongo DB

We already saw how to install Node.js, NPM and MongoDB in the previous chapter.

Keystone.js uses Node.js as the platform and uses Mongo DB as the storage backend. **NPM** is the Node Package Manager which enables easy management of Node.js packages from online repositories. It simplifies dependency management so that developers no longer have to manually download and manage scripts. NPM comes preinstalled with a Node.js installation generally.

The easiest way of installing Keystone.js by using **Yeoman**, a helpful installer that will guide step by step through the process of installing Keystone.js. Yeoman is a set of tools for automating development workflow. It scaffolds out a new application along with writing build configuration, pulling in build tasks and NPM dependencies needed for the build. Keystone.js provides a very handy generator to generate a new project.

First, let's start by installing yo.

```
c:\> npm install -g yo
```

Next, to install the yo keystone app generator, use the following command

```
c:\> npm install -g generator-keystone
```

This installs the generator as a global package and can be used to generate new projects without needing to reinstall the Keystone.js generator.

Creating a new Keystone.js Application

With yo installed, its time to get down to business! We will start off creating the Locally application, since it will be used to understand much of the instructional material in this book. Setting up a new Keystone.js application is pretty trivial, thanks to the handy yo keystone application generator. Let's start off by creating a directory to save our project.

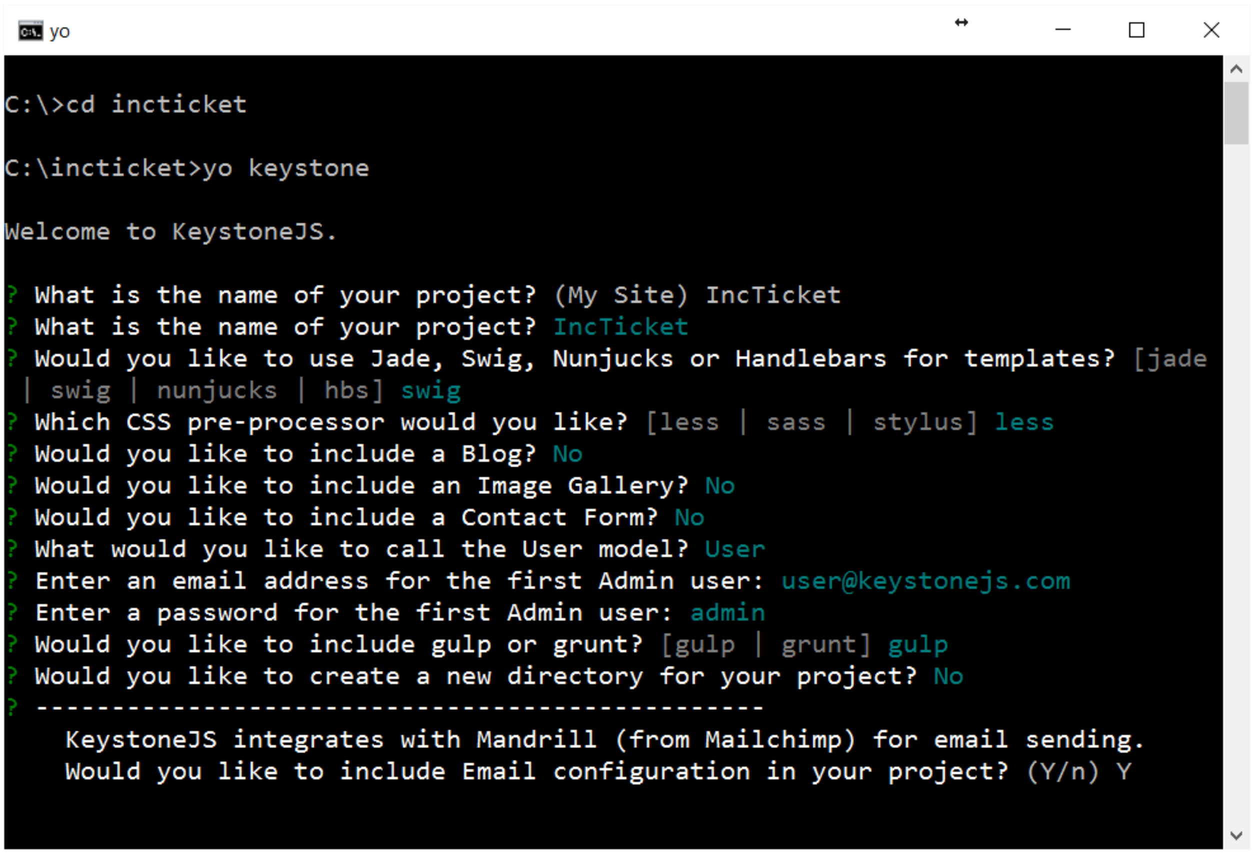
```
c:\> mkdir incticket
```

and change into that directory.

```
c:\> cd incticket
```

Now we can use the 'yo' command from Yeoman to generate the project. The generator will guide you through setting up the project with a few questions and then build the project by installing dependencies from npm. Most of the defaults will suffice for the creation of a project. All the settings can be later changed within the new application.

```
c:\incticket> yo keystone
```



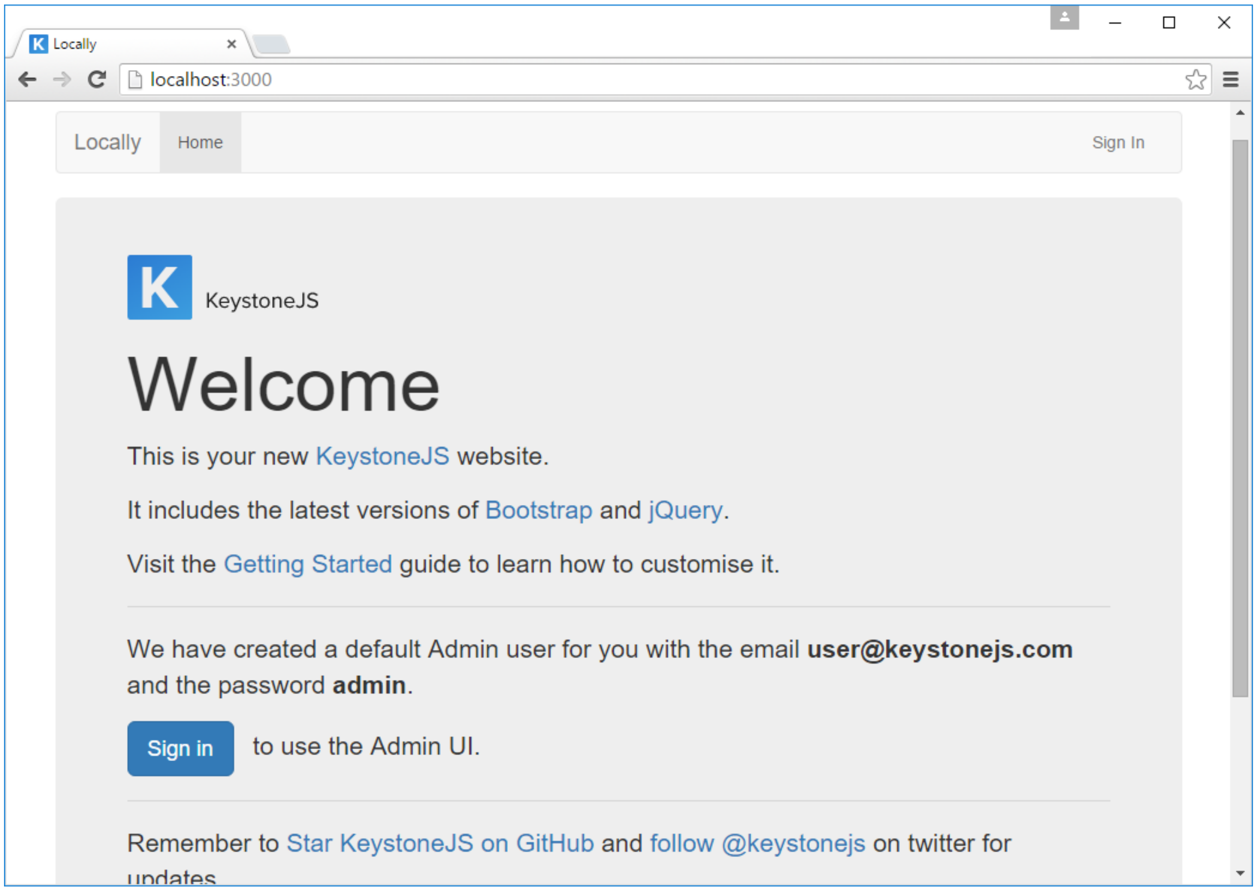
```
C:\>cd incticket

C:\incticket>yo keystone

Welcome to KeystoneJS.

? What is the name of your project? (My Site) IncTicket
? What is the name of your project? IncTicket
? Would you like to use Jade, Swig, Nunjucks or Handlebars for templates? [jade
 | swig | nunjucks | hbs] swig
? Which CSS pre-processor would you like? [less | sass | stylus] less
? Would you like to include a Blog? No
? Would you like to include an Image Gallery? No
? Would you like to include a Contact Form? No
? What would you like to call the User model? User
? Enter an email address for the first Admin user: user@keystonejs.com
? Enter a password for the first Admin user: admin
? Would you like to include gulp or grunt? [gulp | grunt] gulp
? Would you like to create a new directory for your project? No
? ------------------------------------------------
    KeystoneJS integrates with Mandrill (from Mailchimp) for email sending.
    Would you like to include Email configuration in your project? (Y/n) Y
```

Create project using yo

The new project will connect to Mongo DB on local host by default. So if you have Mongo DB up and running, we can serve up Keystone.js using the following command

```
c:\incticket> node keystone
```

The above command will serve up your project on port 3000. If you navigate to http://localhost:3000, you should see the Keystone.js landing page.



Welcome

This is your new KeystoneJS website.

It includes the latest versions of Bootstrap and jQuery.

Visit the Getting Started guide to learn how to customise it.

We have created a default Admin user for you with the email **user@keystonejs.com** and the password **admin**.

Sign in to use the Admin UI.

Remember to Star KeystoneJS on GitHub and follow @keystonejs on twitter for updates

Keystone.js Default Landing Page

Configuring Your Keystone.js Application

A typical web application goes through a number of deployments in its lifetime: a production push, a staging site, and multiple instances in dev environments maintained by each developer. Although each of those deployments might run the same code, each of these deploys will have environment-specific configurations. The most common example would be database connection settings, such as MongoDB connection url. Developers may share one instance of a development database, while the staging site and production sites each have their own MongoDB instances. Another example would be to use a different cache driver locally than you do on your production server.

A good solution to maintain separate application specific configuration is to use environment variables, and keep the config data out of the code. We get a couple of advantages by using environment variables for saving configuration data:

- The configuration data can be easily changed between environments and even isolated deploys. This leads to less complex deploys which saves time and money.

- There is a decreased chance of the production data leaking out into the wrong hands which reduces the chances that your database might accidentally be wiped.

Keystone.js uses an excellent node.js library, namely **dotenv**, to load the configuration data at runtime. In a fresh Keystone.js installation, the root directory of your application will contain a .env file. This file can be used to hold all our configuration data. All of the variables listed in this file will be loaded into the `process.env` global object when your application receives a request. It is recommended you do not commit this file to version control.

Each of the variables in the .env is declared as a key value pair separated by an equals sign. Keys are generally written in upper case. A fresh Keystone.js install .env file would be:

```
COOKIE_SECRET=oQQ*s0pz5(bF4gpmoNwM|BDB~db+qwQ`K>Ik~*R2D;;F(8u["l5<.=&Q9w+Ul$E=
MANDRILL_API_KEY=NY8RRKyv1Bure9bdP8-TOQ
```

To access the configuration variables in our application, we can use them as:

```
var madrillApiKey = process.env.MANDRILL_API_KEY;
```

App in Production

To put a Keystone.js app into production mode, set the NODE_ENV=production key in the .env file. Setting this enables certain features, including template caching, simpler error reporting and html minification.

By default, Keystone.js tries to connect to a local instance of MongoDB and uses no authentication. However, if you want to specify a MongoDB connection string, it is pretty easy to do so using the .env file.

```
MONGO_URI=mongodb://user:password@localhost:27017/databasename
```

Project Structure

Let us take a look at the new directory structure to better understand the different parts that make up a Keystone.js project. Below is the default directory structure of a Keystone.js project:

```
|--lib
|
|--models
|
|--public
|
|--routes
|   |--api
|   |
|   |--views
|   |
|   |--index.js
|   |
|   |--middleware.js
|   |
|--templates
|   |--includes
|   |
|   |--layouts
|   |
|   |--mixins
|   |
|   |--views
|   |
|--updates
|
|--package.json
|
|--keystone.js
|
```

Keystone.js Project Structure

- The **lib** directory holds any additional libraries that could be needed by our project.
- The **models** folder holds the data models that our project would need. Example model is a User model that deals with user login and user preferences.
- The **public** directory holds static content, related to the web application, such as images, CSS, fonts, Javascript. The LESS processor included within the framework will make sure that LESS files associated with the web application is compiled to CSS files during runtime.
- The **routes** directory contains index.js, middleware.js, and API & views directories.

  The **index.js** file initializes the application routes and associated views. Developers define various routes that respond to HTTP GET, POST & other HTTP verbs. Each route consists of an http protocol, a URL pattern and a view that can be invoked as a response or an inline function.

  Middleware.js contains custom code that can be invoked before and after a route has been invoked. This gives the user a powerful option to do custom operations and checks related to authorization, authentication, logging etc.

The **APIs** directory holds controllers that allow for REST interfaces to be exposed that allow clients written in different languages to uniformly interact with our web application. To understand the APIs better, take a look at the Restful API for Mobile and SPA applications chapter.

- The **views** directory contains our application views that respond to various routes. Each view may interact with multiple models to fetch data related to a request and render a template with the data.
- The **templates** directory include html templates that will be rendered per request to a route. The templates are generally composed during runtime by the inclusion of a master layout and various blocks of the page included via separate partial files. The data that the view queries with the help of models is combined with templates by a templating engine and converted to plain HTML for the browser to render. Keystone.js supports various templating engines, each having its own syntax. We will look at **Swig**, a node.js templating engine in a future chapter.
- The **layouts** directory will generally contain the master page that defines various blocks of the page where data can be injected before rendering. Each block has an identifying name. When partial templates are included with the master page, the identifying name is used by the templating engine to render the HTML appropriately. Pages can extend the master page to inherit the layout for a consistent appearance throughout the application.

Creating Your First Model/List

Let us begin by creating our first Keystone.js model, also known as List â€“ the Ticket model, which will be used in the application to manage a list of incident tickets for a product. The term model and list will be used interchangibly within the book. A model is a Javascript object that is an instance of the Keystone.List object, in which each attribute represents a field. Keystone.js will create a MongoDB collection for each model defined in the models folder. When you create a model, Keystone offers you a practical API to query the database easily using Mongoose.js.

To begin, create a file named Ticket.js in the models directory with following code:

```
var keystone = require('keystone');
var Types = keystone.Field.Types;;

var Ticket = new keystone.List('Ticket',{
        autokey: { from: 'title', path: 'slug', unique: true },
});

Ticket.add({
        title: { type: String, initial: true, default: '', required: true },
        description: { type: Types.Textarea },
        priority: { type: Types.Select, options: 'Low, Medium, High', default: '\
Low' },
        category: { type: Types.Select, options: 'Bug, Feature, Enhancement', de\
fault: 'Bug' },
        status: { type: Types.Select, options: 'New, In Progress, Open, On Hold,\
 Declined, Closed', default: 'New' },
        createdBy: { type: Types.Relationship, ref: 'User', index: true, many: f\
alse },
        assignedTo: { type: Types.Relationship, ref: 'User', index: true, many: \
false },
        createdAt: { type: Datetime, default: Date.now },
        updatedAt: { type: Datetime, default: Date.now }
    });

Ticket.defaultSort = '-createdAt';

Ticket.register();
```

We begin by requiring the Keystone library so we can use it. A keystone.js list allows us to define the attributes for the model that we intend to work with. The first parameter is a key that is used to identify collections uniquely in your MongoDB database. All documents related to the Ticket list will be saved in a collection within MongoDB named as tickets.

The call to register on our keystone.js list finalizes the model with any attributes and options we set.

Let's take a look at some of the fields we defined for our model:

- **title**: This is the field for the ticket title. The field can hold a string describing the purpose for the ticket. The default option can be used to specify any default value for the field if the user does not input a value. The required option is useful to validate that the field has a value before it is saved. A database index is also used to enforce this.
- **slug**: The slug is used for SEO friendly URLs. The field is defined as part of the List options using the autokey plugin. Autokey automatically generates a key for each model when it is saved, based on the value of another field. The value of the key is accessible via the 'slug' field on the object. In this case, we create a slug for each ticket from the title. The unique option indicates that we expect the key to be unique throughout the collection. If we create a ticket with the title set to 'My First Ticket' then the automatically generated slug would be similar to 'my-first-ticket'.
- **description**: This is the field to will be used to store the description of the ticket. The Textarea field type will display a text area within the admin UI.
- **priority**: This is a field to the priority of the ticket. We use a select field type, so the value for this field can be set to one of the given choices. The category & status fields are set up in a similar manner.
- **createdBy**: This field will hold a reference to the user that created a ticket. The field is like a foreign key that defines many to one relationships in a relational database. This field is

displayed as an auto-suggest text box in the admin UI that allows us to pick a single user. Setting the many option to false indicates that only a single user can be selected. Setting the index option to true will tell keystone.js that we are interested in a database index to be created for this field. The assignedTo field is a similar relationship field that is used to store a reference to the user that the ticket is currently assigned to. This is the user that will be incharge of resolving the issue mentioned in the ticket.

- **createdAt**: This datetime field indicates when the ticket was created by the user. Since we are using the default value of Date.now, the date will be saved automatically when creating a new ticket object.

As you can see, Keystone.js comes with different types of fields that you can use to define your models. You can find all field types at http://keystonejs.com/docs/database/#fieldtypes[4]

By setting the **defaultSort** property on the model, We are telling keystone.js to sort results by the createdAt field in descending order by default when we query the database. We specify descending order by using the negative prefix.

After saving our model, let us restart our application. Use the below command to restart the application via command line

```
node keystone.js
```

Restarting will cause keystone.js to create collections for our models. In our case, we should see the tickets collection in MongoDB.

Creating an administration site for your models

Now that we have defined the Ticket model, let us see how to create an administration site to manage tickets. Keystone.js comes with a built-in administration interface that is very useful for editing content. The Keystone.js admin site is built dynamically by reading them model metadata and providing a production-ready interface for editing content. You can use it out-of-the-box, configuring how you want your models to be displayed in it.

Creating an admin user

To begin with, we would need a user to manage the admin site. Keystone.js includes code for the creation of a admin user by default when the app is started for the first time. The user is created using the **updates framework** provided by Keystone.js. Updates provide an easy way to seed your database, transition data when your models change, or run transformation scripts against your database.

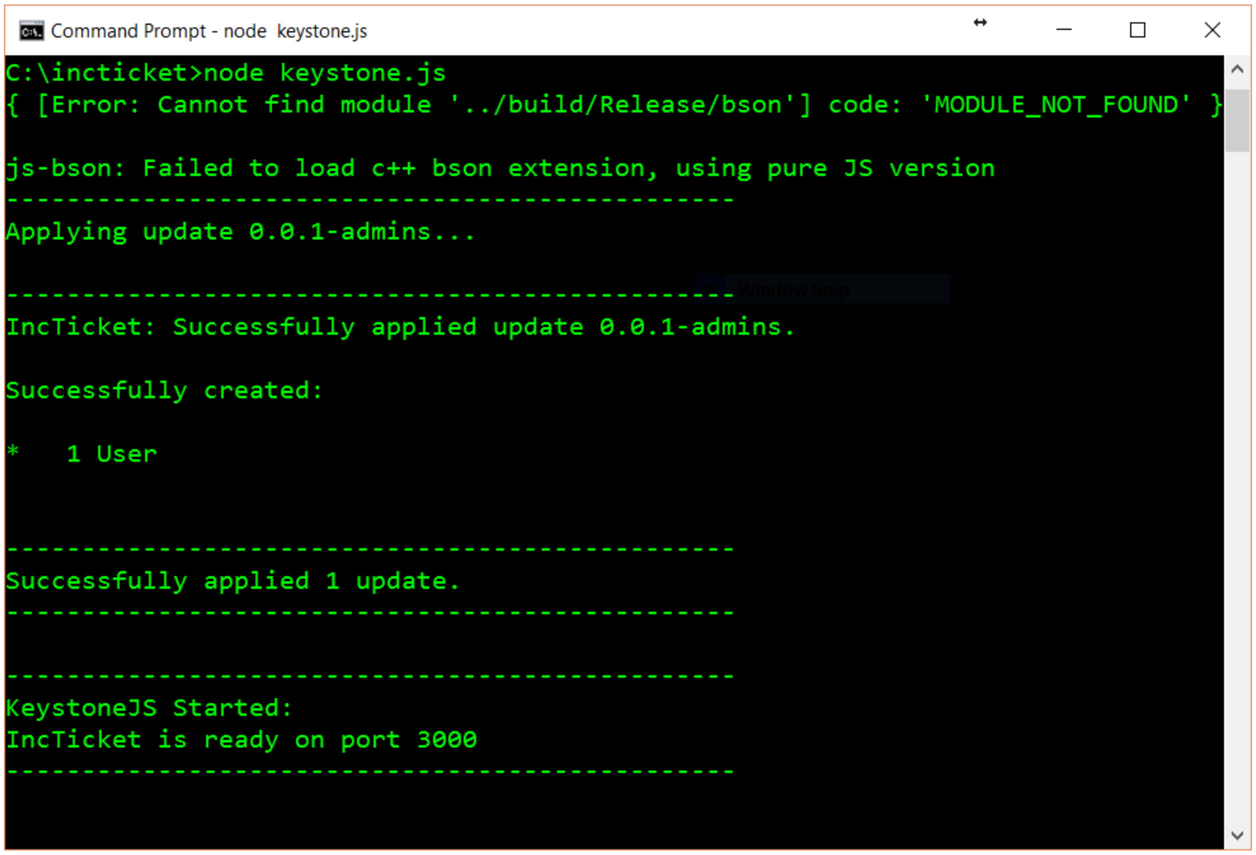
The default admin is created with the below code that is stored at `/updates/0.0.1-admins.js` with the following credentials:

[4]http://keystonejs.com/docs/database/#fieldtypes

- email - user@keystonejs.com
- password - admin

```
exports.create = {
        User: [
                { 'name.first': 'Admin', 'name.last': 'User', email: 'user@keystonejs.com',
                password: 'admin', isAdmin: true }
        ]
};
```

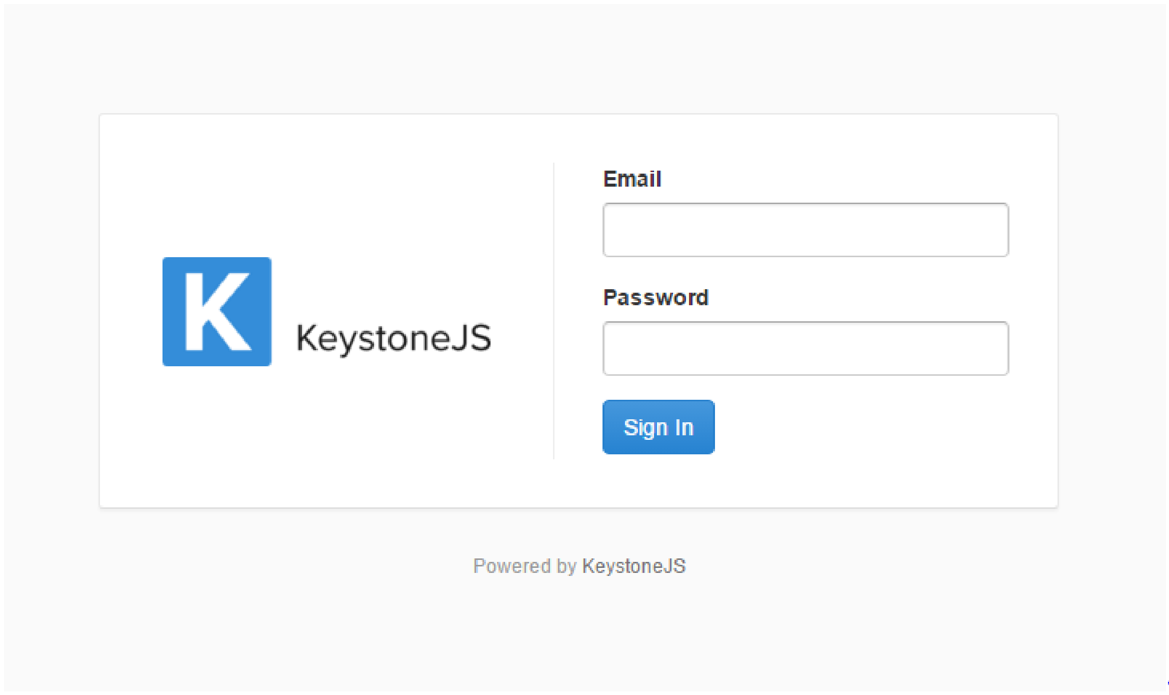
This script automatically creates a default Admin user when an empty database is used for the first time. Updates are run when the app is restarted using `node keystone.js` command. An update is not applied twice, hence editing the file after starting keystone.js atleast once will not result in changes to admin credentials. We will, however, be able to change the credentials through the admin site.


Command Prompt - node keystone.js

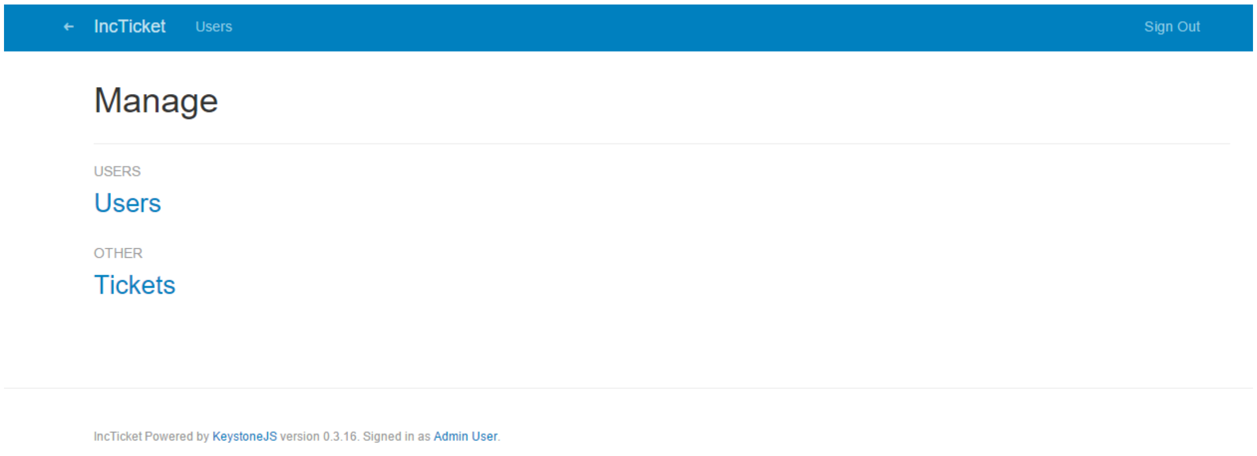
```
C:\incticket>node keystone.js
{ [Error: Cannot find module '../build/Release/bson'] code: 'MODULE_NOT_FOUND' }

js-bson: Failed to load c++ bson extension, using pure JS version
------------------------------------------------
Applying update 0.0.1-admins...


------------------------------------------------
IncTicket: Successfully applied update 0.0.1-admins.

Successfully created:

*   1 User



------------------------------------------------
Successfully applied 1 update.
------------------------------------------------


------------------------------------------------
KeystoneJS Started:
IncTicket is ready on port 3000
------------------------------------------------
```

The Keystone.js administration site

Start up our app using the `node keystone.js` command and open http://127.0.0.1:3000/keystone/signin in your browser. You should see the administration login page shown below.



Log in using the credentials of the user created in the previous step. You will see the admin site index page, as shown in the following screenshot:



IncTicket Powered by KeystoneJS version 0.3.16. Signed in as Admin User.

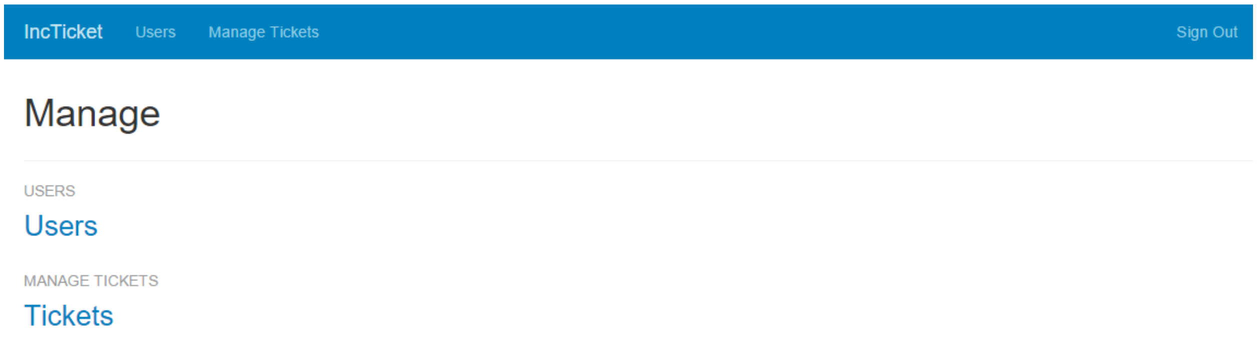
The user model seen on the page is automatically created for us by Keystone.js. If you click on **Users** you will see the admin user created for us. You can edit the admin user's email address and password to suit your needs and use the new credentials to login to the application next time.

Modifying the admin menu

The menu items in the administration site can be easily configured in the `/keystone.js` file. The menu items are stored an object in the configuration with 'nav' set to be the key. As evident in the screenshot above, Keystone.js classifies any new collections under the 'OTHER' header by default. Let's add the tickets menu item to the menu.

```
// Configure the navigation bar in Keystone's Admin UI

keystone.set('nav', {
        'users': 'users',
    'manageTickets': 'tickets'
});
```

The first parameter to the **nav** configuration item is label of the menu item. The second is the collection. After making the above changes, restart the application and the new menu should reflect as below:



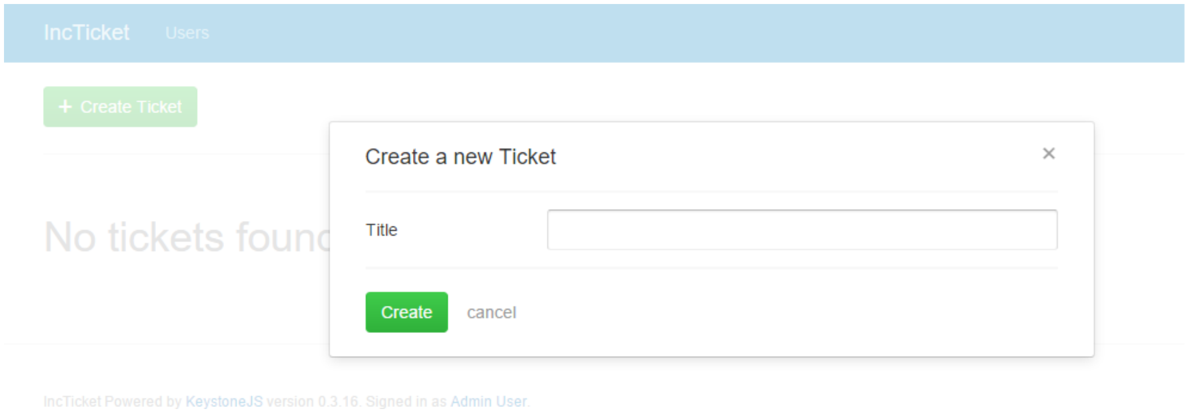
Adding models to the administration site

When all the fields and options have been set on our model, a call to `Ticket.register()` will register the list with Keystone and finalise its configuration.

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

var Ticket = new keystone.List(...);
...
Ticket.register();
```

When you register a model in Keystone.js, you get a user-friendly interface generated by inspecting the models that allows you to list, edit, create, and delete objects in an intuitive way.

Click on the Tickets link and then click on the 'Create Ticket' link to add a new ticket. You will see the create item form popup that Keystone.js has generated dynamically for the model, as shown in the following screenshot:



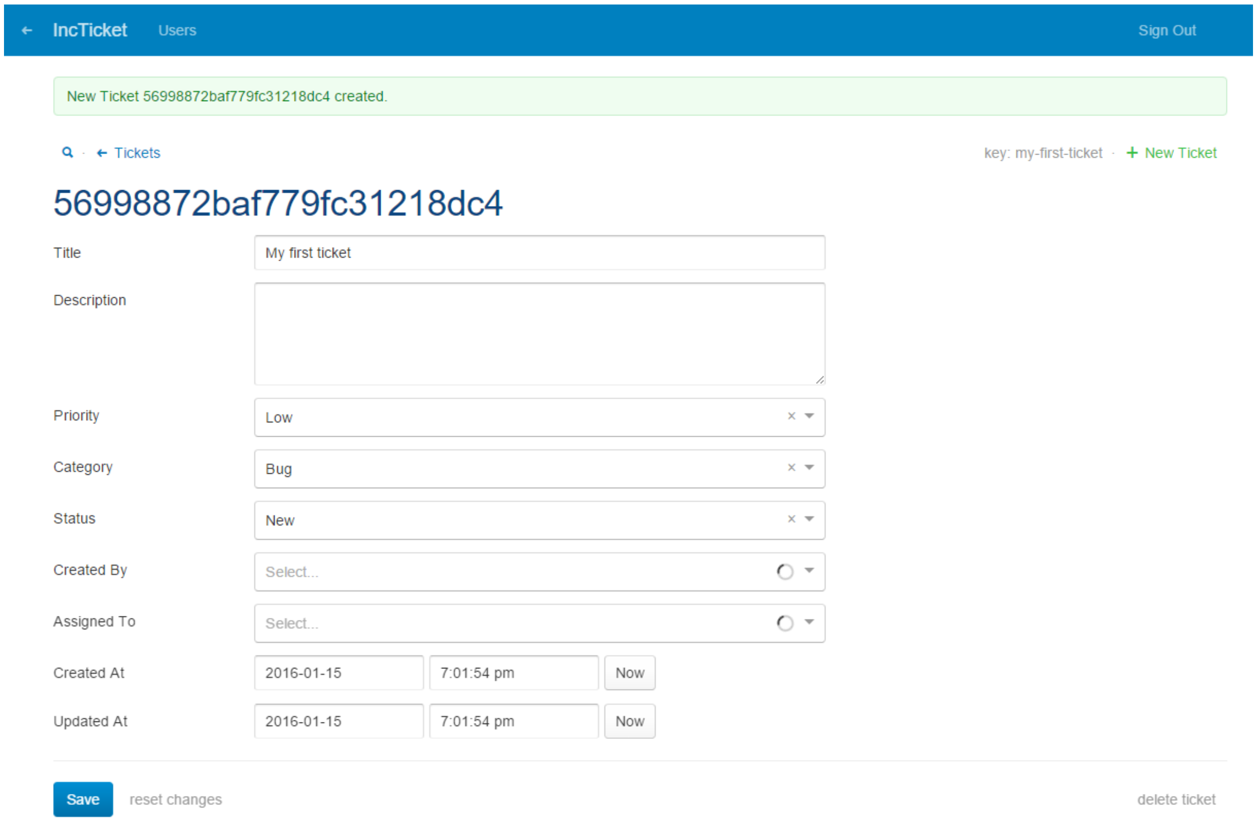
No tickets found

Create a new Ticket

Title

IncTicket Powered by KeystoneJS version 0.3.16. Signed in as Admin User.

The title field is shown with a text input field in this form as per our definition in the model. The title field was marked with **initial: true**. This causes the field to be shown in the create item form, in the Admin UI. Let us create a ticket with title 'My first ticket'. After creation, Keystone.js creates a document in the MongoDB tickets collection and returns the object id. The Object id is a 24 character unique identifier that can be used to identify a document across all collections.



New Ticket 56998872baf779fc31218dc4 created.

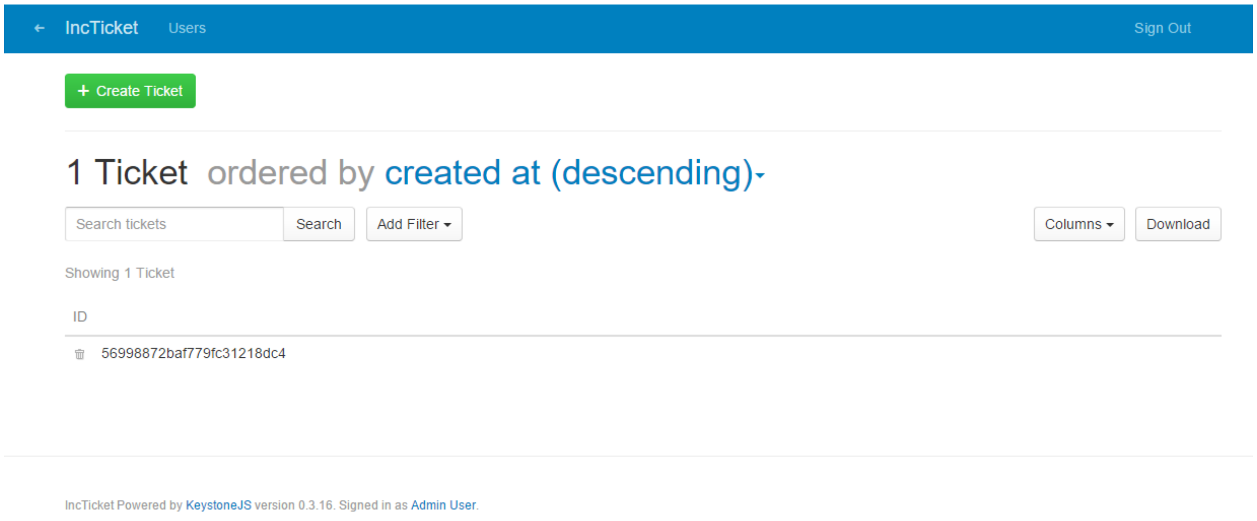
key: my-first-ticket

56998872baf779fc31218dc4

Title	My first ticket
Description	
Priority	Low
Category	Bug
Status	New
Created By	Select...
Assigned To	Select...
Created At	2016-01-15 7:01:54 pm
Updated At	2016-01-15 7:01:54 pm

Keystone.js uses different form widgets for each type of field. Even complex fields such as DateTime are displayed with an intuitive interface like a date and time picker form control.

Fill in the form and click on the Save button. You should be shown a successful message indicating your changes were saved. Click on the tickets link to be redirected to the tickets list page as shown in the following screenshot:



1 Ticket ordered by created at (descending)

Showing 1 Ticket

ID
56998872baf779fc31218dc4

IncTicket Powered by KeystoneJS version 0.3.16. Signed in as Admin User.

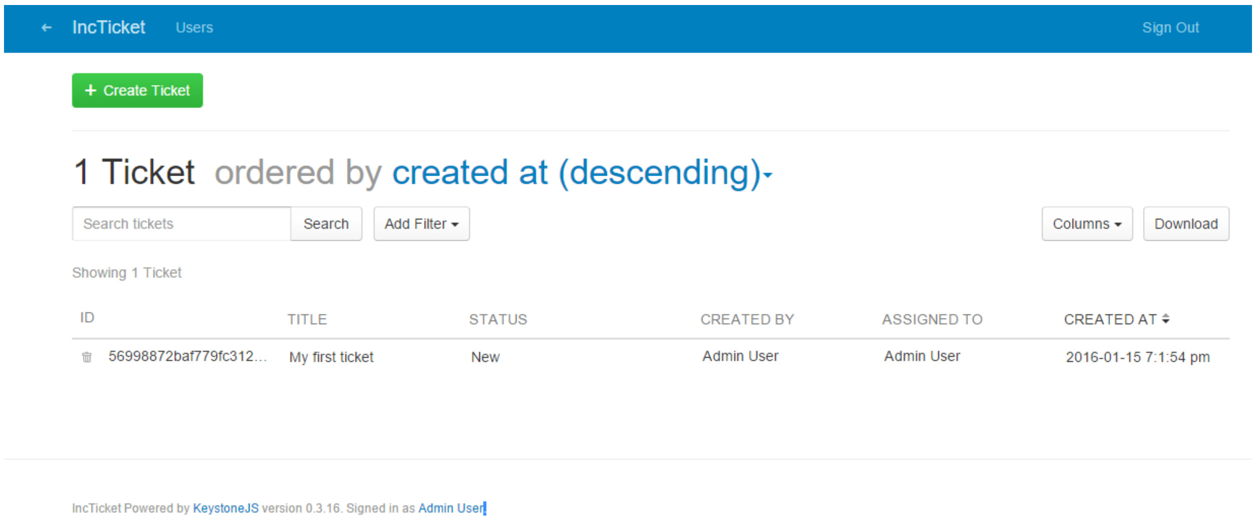
Customizing the way models are displayed

On the tickets list page, we see tickets are listed with the object id. This is not very helpful for managing tickets!. Let us now see how we can customize the admin site. Edit the Ticket.js file in the models folder and include the following lines:

```
...
Ticket.defaultColumns = 'title|20%, status|15%, createdBy, assignedTo, createdAt\
';
...
Ticket.register();
```

We can set a few different options on the model to provide more information about how to display the model in the admin site and how to interact with it. The **defaultColumns** option allows you to set the fields of your model that you want to display in the admin list page. By default only the object id is displayed. In the above piece of code we are specifying that the title, status, createdBy, assignedTo and createdAt as the default columns to display in the Admin UI, with title and status being given column widths.

Restart the app, go back to your browser and reload the ticket list page. Now it will look like this:



1 Ticket ordered by created at (descending)

Showing 1 Ticket

ID	TITLE	STATUS	CREATED BY	ASSIGNED TO	CREATED AT
56998872baf779fc312...	My first ticket	New	Admin User	Admin User	2016-01-15 7:1:54 pm

IncTicket Powered by KeystoneJS version 0.3.16. Signed in as Admin User

Keystone.js is clever enough to recognize that the createdBy and assignedTo are relationship fields to the User model and pulls the user's name for display purposes.

As you can also notice, the page heading indicates that the tickets are ordered by createdAt in a descending order. This is due to another option we already setup on our model - the **defaultSort** option

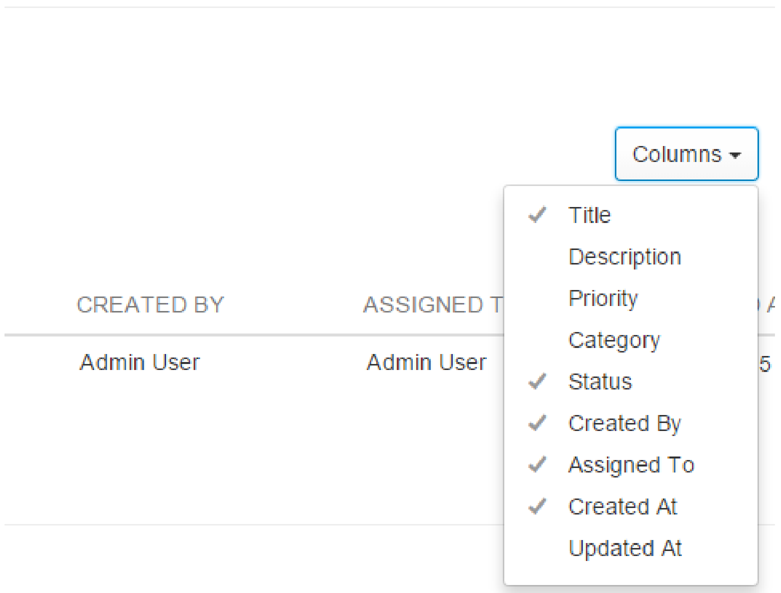
```
Ticket.defaultSort = '-createdAt';
```

The admin UI automatically lets us sort data in all the custom columns we added to our default-Columns option. Tickets can be sorted in ascending or descending order using the arrows next to the column headers. Data can be sorted across columns irrespective of whether they hold string, number, boolean or date values. How cool is that!.

Keystone.js provides very useful and intuitive ways of managing data through the powerful admin interface. This, I believe is the key differentiating factor compared other existing CMS frameworks; even across CMSes based on other programming languages.

Dynamically adding columns to Admin UI

One of the most useful feature for looking at data in the admin interface is the ability to dynamically add columns that we are interested in without having to modify the definition of the model in code. The columns dropdown on the top right lists all the fields defined on our model. Columns that have been listed in the defaultColumns option will appear with tick marks next to them. We can then pick any additional columns that we are interested in working with.



If a custom field was chosen, it will be added to the end of the displayed column headers. We can reset the list of displayed columns to the original state by using the 'Reset to default' option that will appear in the dropdown once one or more columns have been selected.

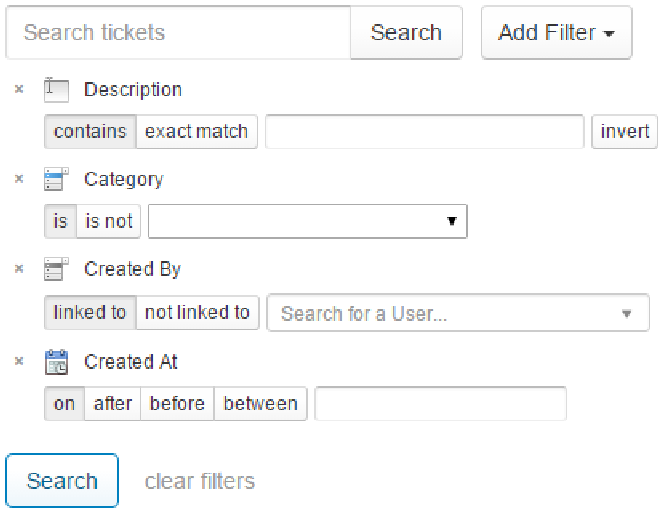
Finding data using the Admin UI

Perhaps the one feature that demonstrates the power of Keystone.js admin interface is the search functionality. The search box below the page header can be used for searching for data. By default the search will look for data in a field that has been specified in the **autokey.from** path. In the case of searching for tickets that would be the title field. We can also specify a comma-delimited list of fields to use for searching in Admin UI.

```
var Ticket = new keystone.List('Ticket',{
        autokey: { from: 'title', path: 'slug', unique: true },
        searchFields: 'description',
});
```

Above, we have specified that we are interested in the description field also being included in the search. When we search for a particular keyword, the search is performed using regular expressions to match any part of the saved data. If the search returns only a single search result object, then Keystone.js will automatically take us to the edit page for that result.

The add filter button allows us to select multiple conditions that we can use to filter the search results. As seen in the screenshot below, the search filters are intelligent enough to provide logical options for filtering based on the type of the field that has been specified in the model.



A string field such as description is presented with a text box with options for matching exactly or on a contains condition. The invert option will try to find results that negate the selected condition i.e. if exact match option was selected then it will try to find results that dont exactly match the keywords and if contains was selected then it will try to find results that dont contain the keyword.

A select field such as category is presented with options to match the select choices with a 'is' and 'is not' option. The dropdown for the select field is autopopulated with the predefined choices defined in the model.

A relationship field such as user is presented with options to find results that are either linked to or not linked to a related user. The UI also provides a very useful ajax based autocomplete text box to find the related user.

A datetime field such as createdAt is presented with multiple options to narrow down the search results. Keystone.js can find results that were created on, created after or before a specific datetime and between two date time ranges. These are critical pieces of functionality, that enhances the usability of an admin UI, that come out of the box with a Keystone.js application.

Creating Your First Route

The first thing that comes to mind, after we visited the url http://localhost:3000 to see if Keystone.js works, is how to create a page that is served as response. To create our own page, we need to define an entry point to our application in the form of a URL and tell Keystone.js to call a particular Javascript function when a visitor accesses this URL. This mapping of a URL to a Javacript function is called a route and forms the core of routing in Keystone.js.

Routes are typically stored within the `/routes/index.js` file.

Tickets Route

Let us define a couple of routes in Keystone.js that can be used to display a list of tickets and a ticket in detail. The most basic Keystone.js route is simply a combination a URI, a HTTP verb (get, post etc) and a Javascript function that accepts the request, response and an optional callback handler:

```
// Setup Route Bindings
exports = module.exports = function(app) {
...
    app.get('/tickets', function(req, res){
            res.send('We will show a list of tickets here');
    });
...
}
```

If we add the above code to our routes index file and navigate to http://localhost:3000/tickets, we should see the text - ‘We will show a list of tickets here’ displayed on the browser. The route we defined will respond to a HTTP get request. Keystone.js routes can accept the following HTTP verbs:

- get
- post
- put
- head
- delete
- options
- trace
- copy
- lock
- mkcol
- move
- purge
- propfind
- proppatch
- unlock
- report
- mkactivity
- checkout
- merge
- m-search
- notify

- subscribe
- unsubscribe
- patch
- search
- connect

The below piece of code demonstrates how we pass a parameter to a route. Add the below code to the routes index file and we navigate to http://localhost:3000/tickets/test-ticket.

```
// Setup Route Bindings
exports = module.exports = function(app) {
...
    app.get('/tickets/:ticketslug', function(req, res){
                    res.send('We will show a ticket that has a slug : ' + req.params.ticketslu\
g);
    });
...
}
```

We should see the text - 'We will show a ticket that has a slug : test-ticket' displayed on the browser. For this example, we have assumed that test-ticket is the slug for an existing ticket. The req.params collection can be used to get a reference to the value that is bound to :ticketslug url parameter.

URLs for models

In the above route, we saw that :ticketslug was used as a query parameter to refer to the slug for a Ticket object. The complete URL for a ticket model would the /tickets/:ticketslug. This URL is not part of the model yet and in every place we intend to use or link to a Ticket, we will need to manually build the URL by concatenating the slug. To address this issue, we can use virtual functions to build the canonical URL for Ticket objects. The convention we will follow is to add a url() virtual method to the model that returns the canonical URL of the object. Edit your Ticket.js model file and add the following before a call to the register() method:

```
Ticket.schema.virtual('url').get(function() {
                return '/tickets/'+this.slug;

});
```

The `Ticket.schema` is a reference to the underlying Mongoose schema which is used by Keystone.List to interact with MongoDB. A virtual function exists on the model but is not persisted to the database. Next, We will use the url() method in our templates rendered by our views.

Creating Your First View

In the previous section we were able to execute a piece of code in response to a HTTP request. Let us now see how we generate useful responses rather than just plain text. A view in Keystone.js terminology is a regular Javascript function attached to the keystone.View object that responds to a page request by generating a response. This response can be the rendered HTML content of a Web page, or a redirect, or a 404 error, or an XML document, or an image or anything.

Views are typically stored in `/routes/views` directory.

Create the following directories and files inside your application directory:

```
routes/
    views/
        index.js
        tickets/
            ticketlist.js
            singleticket.js
```

Since we have already defined the necessary routes, let us create a view that can respond to those routes. Then, finally, we will create HTML templates to render the data generated by the views. Each view will render a template passing variables to it and will return an HTTP response with the rendered output.

Creating Ticket list and detail views

Let's start by creating a view to display the list of Ticekts. Create a file named **ticketlist.js** in `/routes/views/tickets`. Edit the new file and make it look like this:

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

exports = module.exports = function(req, res) {

        var view = new keystone.View(req, res);
        var locals = res.locals;

        // locals.section is used to set the currently selected
        // item in the header navigation.
        locals.section = 'tickets';

    locals.data = {
                tickets: [],
        };

    // Load all tickets
        view.on('init', function(next) {

                var q = keystone.list('Ticket').model.find();

                q.exec(function(err, results) {
                        locals.data.tickets = results;
                        next(err);
                });
        });
        // Render the view
        view.render('tickets/ticketlist');

};
```

You just created your first Keystone.js view. The tickets view takes the request and response object as the parameters. Remember that these parameters are required by all views. In this view, we are retrieving all the tickets when the view is initialized. The `view.on('init'...)` method is called when the HTTP request comes through the route each time. We query our MongoDB inside this method and set the results to our locals.data.tickets array. These can then be used within the template when it is being rendered.

At the end of the code, we use the render() method provided by Keystone.js to render the list of tickets with the given template. This function takes the the template path. If we specify only the name of the template, Keystone.js will look for a template with that name under `/templates/views` folder. A view returns a HttpResponse object with the rendered text (normally HTML code). The render() function takes the response context into account, so any variable set within the **response.locals**s variable is accessible by the given template. Templates are rendered by Template Rendering Engines. Keystone.js supports multiple rendering libraries such as Swig, Jade, Ebs. We will look at Swig in depth in a future chapter.

Let's create a second view to display a single ticket. Create a file named **singleticket.js** in `/routes/views/tickets`. Edit the new file and make it look like this:

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

exports = module.exports = function(req, res) {

        var view = new keystone.View(req, res);
        var locals = res.locals;

        // locals.section is used to set the currently selected
        // item in the header navigation.
        locals.section = 'tickets';

    locals.data = {
                ticket: {},
        };

    // Load all tickets
        view.on('init', function(next) {

    var q = keystone.list('Ticket').model.findOne({slug: req.params.ticketslug});

                q.exec(function(err, result) {
                        if(result != null)
                        {
                                locals.data.ticket = result;
                        }
                        else
                        {
                                return res.status(404).send(keystone.wrapHTMLError('Sorry, no tick
(404)'));
                        }

                        next(err);
                });
        });


        // Render the view
        view.render('tickets/singleticket');

};
```

This is the ticket detail view. This view takes a ticket slug to retrieve a published ticket with the given slug. Notice that when we created the Ticket model, we added the unique constraint parameter to the slug field. This way we ensure that there will be only one ticket with a slug for a given title, and thus, we can retrieve single tickets by slug. In the detail view, we are using the res.status() to return a HTTP 404 (Not found) exception if no object is found. Finally, we use the render() method to render the retrieved ticket using a template.

Creating templates for your views

We have created routes and views for our application. Now it's time to add templates to display tickets in a user-friendly way.

Templates are typically stored in `/templates/views` directory.

Create the following directories and files inside your application directory:

```
templates/
    layouts/
        default.swig
    views/
        index.swig
        tickets/
            ticketlist.swig
            singleticket.swig
```

The `default.swig` file will include the main HTML structure of the website and divide the content into a main content area, header and a footer section. During installation, Keystone.js generates some bootstrap boiler plate code within default.swig for us. The ticketlist.swig and singleticket.swig files will inherit from the default.swig file and be rendered by the ticketlist and singleticket views respectively.

Keystone.js supports many templating languages and Swig is one we will look at. Swig is a powerful template language that allows you to specify how data is displayed on the browser. It is based on template tags, which look like `{% tag %}` , template variables, which look like `{{ variable }}` and template filters, which can be applied to variables and look like `{{ variable|filter }}`. You can see all swig template tags and filters at http://paularmstrong.github.io/swig/docs/[5].

Let's look at the default.swig file. All the static assets related to our project such as js, css files are stored in the /public directory. Let's add a incticket.css stylesheet to the /public/styles folder. This stylesheet will hold application specific styling.

Since Keystone.js uses **express.static** built-in middleware function in Express to serve static assets, we reference assets as if they resided in the root of the root of the application as shown below:

[5]http://paularmstrong.github.io/swig/docs/

```
<link href="/styles/incticket.css" rel="stylesheet">
```

In default.swig, you can see that there are a few `{% block %}` tags. These tell Keystone.js that we want to define a content block in that area. Templates that inherit from this template can fill the blocks with content. There is a predefined block called content that we can take advantage of.

Let's edit the tickets/ticketlist.html file and make it look like the following:

```
{% extends "../../layouts/default.swig" %}

{% block content %}

        <div class="container">
                <div class="panel panel-primary">
        <!-- Default panel contents -->
        <div class="panel-heading">Tickets</div>
        <div class="panel-body">
            <p>These are list of tickets in the system.</p>
        </div>

        <!-- Table -->
        <table class="table  table-striped">
            {% for ticket in data.tickets %}
               <tr>
               <td>
                <div class=' col-md-1'>
                    <span class="label label-info pull-right">{{ticket.status}}<\
/span>
                </div>

                 <a href='{{ticket.url}}'><b>{{ticket.title |capitalize}}</b><a>

                 <ul class="ticket-meta">
                       <li>&nbsp;</li>
                    <li>
                        <small>Status</small><a href="" rel="tag">{{ticket.statu\
s}}</a>
                    </li>
                    <li>
                        <small>Priority</small><a href="" rel="tag">{{ticket.pri\
ority}}</a>
                    </li>
                    <li>
```

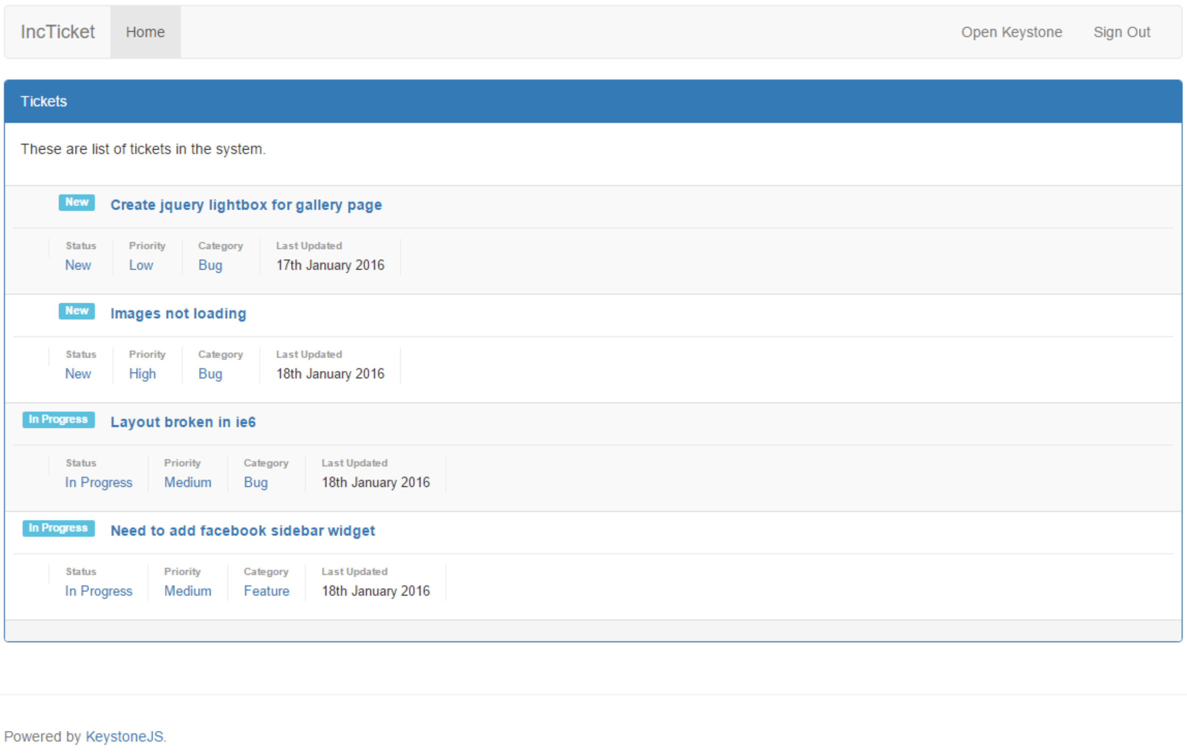
```
                        <small>Category</small><a href="" rel="tag">{{ticket.cat\
egory}}</a>
                    </li>
                    <li>
                                <small>Last Updated</small>
                                <abbr class="last-updated">{{ticket._.createdAt.format('Do MMM\
M YYYY')}}</abbr>
                        </li>
                              </ul>
               </td>
               </tr>
            {% endfor %}
        </table>
        <div class="panel-footer"></div>
        </div>

        </div>
{% endblock %}
```

With the `{% extends %}` template tag, we are telling Keystone.js to inherit from the layouts/default.swig template. Then we are filling the content blocks of the base template with content. We iterate through the tickets and display their title, date, status, priority and category, including a link in the title to the canonical URL of the ticket. In the title of the ticket, we are applying a template filter: capitalize - to upper-case the first letter of the input and lower-case the rest. You can concatenate as many template filters as you wish; each one will be applied to the output generated by the previous one.

Let us also update our route to point to the ticketlist view that we created.

```
// Setup Route Bindings
exports = module.exports = function(app) {
...
   app.get('/tickets', routes.views.tickets.ticketlist);
...
}
```

Open the command prompt and execute the command node keystone.js to restart the application server. Open http://127.0.0.1:3000/tickets/ in your browser and you will see everything running. Note that you need to have some tickets in order to see them here. You should see something like this:


IncTicket Home Open Keystone Sign Out

Tickets

These are list of tickets in the system.

New **Create jquery lightbox for gallery page**

Status	Priority	Category	Last Updated
New	Low	Bug	17th January 2016

New **Images not loading**

Status	Priority	Category	Last Updated
New	High	Bug	18th January 2016

In Progress **Layout broken in ie6**

Status	Priority	Category	Last Updated
In Progress	Medium	Bug	18th January 2016

In Progress **Need to add facebook sidebar widget**

Status	Priority	Category	Last Updated
In Progress	Medium	Feature	18th January 2016

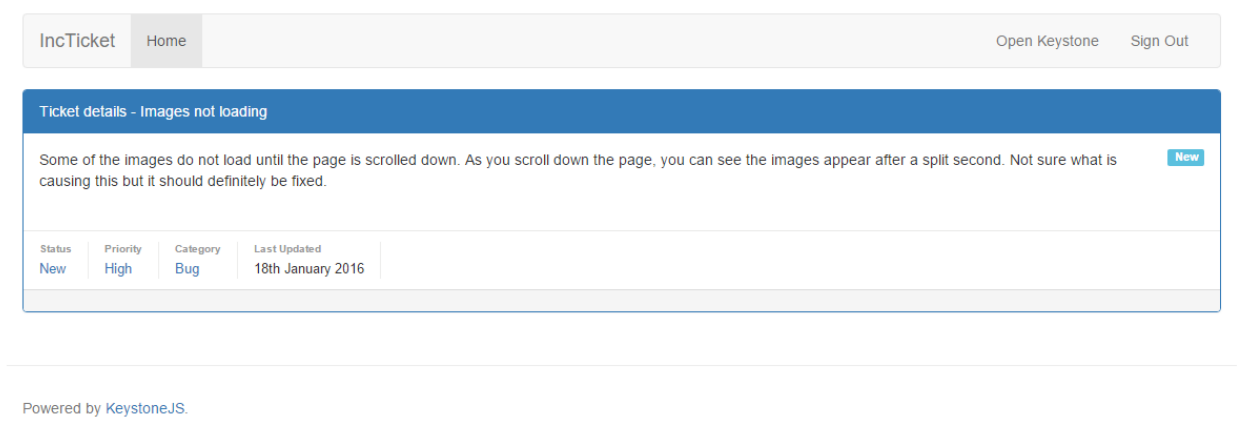
Powered by KeystoneJS.

List of Tickets

Then, let’s edit the tickets/singleticket.swig file and make it look like the following:

```
{% extends "../../layouts/default.swig" %}

{% block content %}

        <div class="container">
                <div class="panel panel-primary">
        <!-- Default panel contents -->
        <div class="panel-heading">Ticket details - {{data.ticket.title}}
        </div>
        <div class="panel-body">
            <span class="label label-info pull-right">{{data.ticket.status}}</sp\
an>
            <p>{{data.ticket.description}}</p>
        </div>
        <ul class="ticket-meta">
        <li>
            <small>Status</small><a href="" rel="tag">{{data.ticket.status}}</a>
        </li>
        <li>
            <small>Priority</small><a href="" rel="tag">{{data.ticket.priority}}\
</a>
        </li>
        <li>
            <small>Category</small><a href="" rel="tag">{{data.ticket.category}}\
</a>
        </li>
        <li>
            <small>Last Updated</small>
            <abbr class="last-updated">{{data.ticket._.createdAt.format('Do MMMM\
 YYYY')}}</abbr>
        </li>
        </ul>
        <div class="panel-footer"></div>
        </div>

        </div>
{% endblock %}
```

Now, you can go back to your browser and click on one of the ticket titles to see the detail view of a ticket. You should see the template rendered like this:



Ticket details - Images not loading

Some of the images do not load until the page is scrolled down. As you scroll down the page, you can see the images appear after a split second. Not sure what is causing this but it should definitely be fixed.

New

Status	Priority	Category	Last Updated
New	High	Bug	18th January 2016

Powered by KeystoneJS.

Ticket detail

Since we have created a SEO friendly URL for our tickets, the URL should look like http://127.0.0.1:3000/tickets/image
not-loading.

Adding pagination

As your application grows in terms of content, you will soon realize that you need to split the list of tickets across several pages. Keystone.js has a built-in pagination functionality that allows you to manage paginated data easily.

Edit the `routes/views/ticketlist.js` file as follows:

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

exports = module.exports = function(req, res) {

        var view = new keystone.View(req, res);
        var locals = res.locals;

        // locals.section is used to set the currently selected
        // item in the header navigation.
        locals.section = 'tickets';

    locals.data = {
                tickets: [],
        };

    // Load all tickets
        view.on('init', function(next) {

                var q = keystone.list('Ticket').paginate({
                    page: req.query.page || 1,
                    perPage: 5,
                    maxPages: 5
                });

                q.exec(function(err, results) {
                        locals.data.tickets = results;
                        next(err);
                });

        });


        // Render the view
        view.render('tickets/ticketlist');

};
```

This is how pagination works:

- We call the List.paginate() which returns a query object. It accepts the following options
  - **page** - page to start at
  - **perPage** - number of results to return per page
  - **maxPages** - optional, causes the page calculation to omit pages from the beginning/middle/end
- We get the page GET parameter that indicates the current page number.
- If the page parameter is not an integer, we retrieve the first page of results.
- We pass the retrieved objects to the template.

When you call exec on a paginated query, it will return a lot of metadata along with the results:

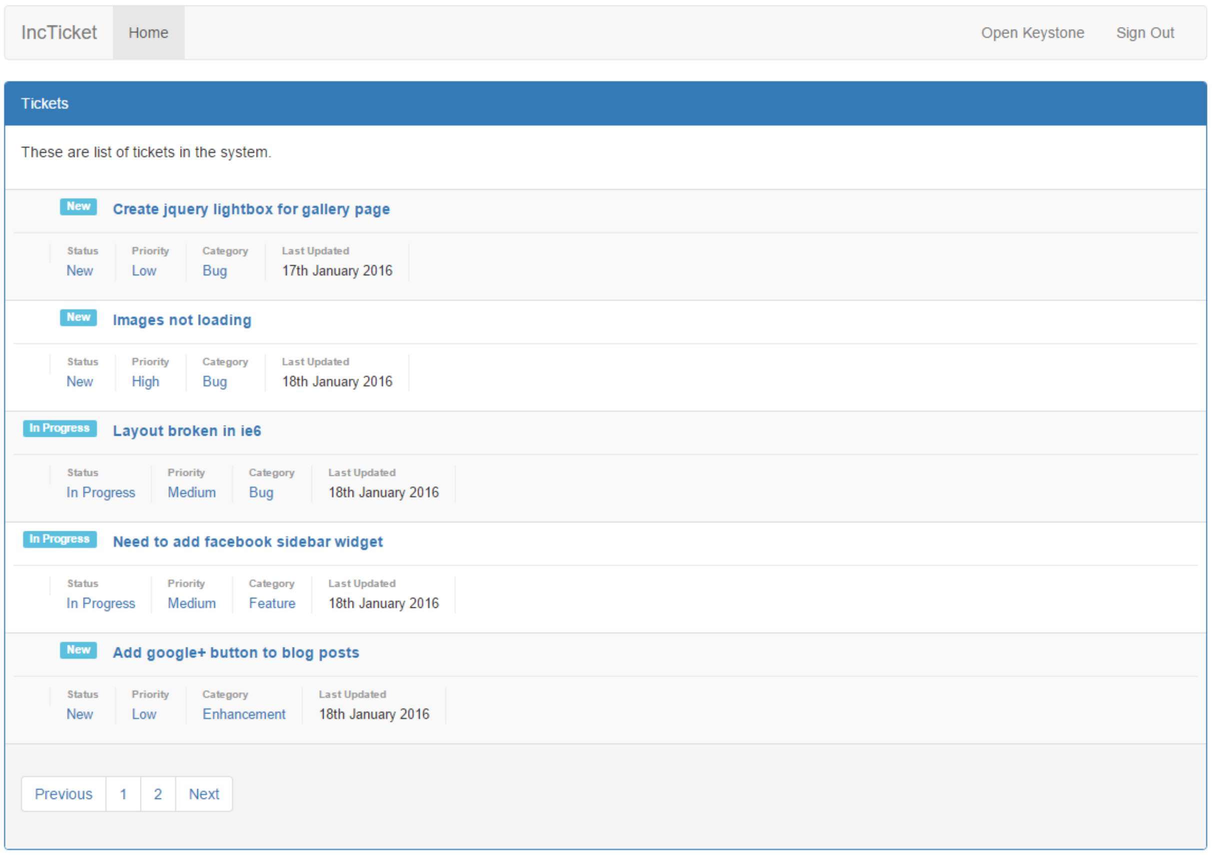
- **total**: all matching results (not just on this page)
- **results**: array of results for this page
- **currentPage**: the index of the current page
- **totalPages**: the total number of pages
- **pages**: array of pages to display
- **previous**: index of the previous page, false if at the first page
- **next**: index of the next page, false if at the last page
- **first**: the index of the first result included
- **last**: index of the last result included

Let us update our ticketlist.swig template to include the pagination links displayed below. We would also need to iterate over `data.tickets.results` instead of just `data.tickets` as we did earlier.

```
{% for ticket in data.tickets.results %}
....
{% endfor %}
```

```
<ul class="pagination">
        {% if data.tickets.totalPages > 1 %}

        {% if data.tickets.previous %}
        <li><a class="page-num" href="?page={{ data.tickets.previous }}">Previous</a></\
li>
        {% else %}
        <li><a class="page-num" href="?page=1">Previous</a></li>
        {% endif %}

        {% for i,p in data.tickets.pages %}
        <li><a class="page-num {% if data.tickets.currentPage == p %} active {% endif %\
}" href="?page={% if p == '...' %} {% if i+1 == data.tickets.totalPages %} 1 {% \
else %} {{ p }} {% endif %}{% else %}{{ p }}{% endif %}">{{ p }}</a></li>
        {% endfor %}

        {% if data.tickets.next %}
        <li><a class="page-num" href="?page={{ data.tickets.next }}">Next</a></li>
        {% else %}
        <li><a class="page-num" href="?page={{data.tickets.totalPages}}">Next</a></li>
        {% endif %}

        {% endif %}
</ul>
```

Now, open http://127.0.0.1:3000/tickets/ in your browser. You should see the pagination at the bottom of the ticket list and you should be able to navigate through pages:



These are list of tickets in the system.

New **Create jquery lightbox for gallery page**

Status	Priority	Category	Last Updated
New	Low	Bug	17th January 2016

New **Images not loading**

Status	Priority	Category	Last Updated
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Status	Priority	Category	Last Updated
In Progress	Medium	Bug	18th January 2016

In Progress **Need to add facebook sidebar widget**

Status	Priority	Category	Last Updated
In Progress	Medium	Feature	18th January 2016

New **Add google+ button to blog posts**

Status	Priority	Category	Last Updated
New	Low	Enhancement	18th January 2016

List tickets with pagination

Summary

In this chapter, you have learned the basics of the Keystone.js web framework by creating functionality for basic ticket listing. You have designed the data models, views, templates, and URLs for your application, including object pagination.

Chapter 3. Introducing Keystone.js Models

Introducing the Mongoose ODM

MongoDB is very good at storing data in JSON format and Mongoose, a Node.js Object Document Mapper makes it easy to work with the data stored in your Mongo DB database. An ODM, or object document mapper, simply put, translates between your objects in code and the document representation of the data. It creates an abstraction layer between the application code and the database and allows for easier programming. MongoDB is schema less, meaning each object stored in a collection does not need to have properties similar to other objects. This provides great flexibility for the developers to store heterogeneous pieces of data.

In a relational database, a table schema provides a rigid structure to the data and the developer has to make sure to insert data that follows the schema, else saving data will fail. If data requirements change or new properties are introduced, we would need to alter the underlying table to allow the change and/or provide a default value to the new property. When using MongoDB, if the data requirements change or a new property is added, we can directly save a document with the necessary information and simply retrieve it back. This means we technically don't need to adhere to any schema while working with Mongo DB.

While being schema less has advantages, it can quickly become difficult to keep track of the contents of our Mongo collections. We can use Mongoose to provide consistent readable schemas for our collection. It also gives us a clean interface for communication with our MongoDB database. Mongoose maps data in our Mongo collection into full-blown Javascript objects that have data and methods for validation and other business logic.

Mongoose ODM is fully supported by the MongoDB team and offer a vast array of convenient features useful for querying, inserting, updating, and deleting documents, managing relationships between documents.

Mongoose Schemas and Keystone Lists

Mongoose schemas are blueprints of documents that we intend to store in our MongoDB. The schema defines any fields, their data types and any constraints we want to add on them before storing into a collection. The data types that Mongoose supports are –

- String

- Number
- Date
- Buffer
- Boolean
- Mixed
- ObjectId
- Array

The Mixed field can be used to store data of any arbitrary JSON representation. The ObjectId field can be used to store the ObjectId, a unique identifier for a document. This is useful while defining relationships. The array data type can be used to hold a collection of nested schemas.

While a schema defines the attributes of the document, a Model is a concrete instance of the schema that can be used to invoke schema methods and access data. Mongoose models provide features such as saving, finding, creating, and deleting documents.

Keystone.js builds on top of Mongoose schemas to create "Lists". Lists basically wrap and extend a Mongoose schema. Keystone.js automatically creates and registers a Mongoose schema and Mongoose model when a list is created.

Keystone.js includes Mongoose as a package dependency. So we do not need to install Mongoose separately using the node package manager (npm). To access Mongoose from within our Keystone.js application, we can use the following –

```
var keystone = require('keystone');
var mongoose = keystone.mongoose
var Schema   = mongoose.Schema;
```

Adding fields to your model

In the previous chapter, we learnt how to define the Ticket Model/List. Let us add a new Model that defines a Product to which a particular ticket is related to and add fields to our Product model so we can save data related to those fields and use them in our application. We will need to first visualize the type of data we want to save and the associated data types that will work. A Product model at the least contain a name, a team name that the product belongs to, a published status that will indicate if the particular product is in published, draft stage and a create date to indicate when the product document was created within the application.

To add fields to our Product model, we should use the `Product.add(fields)` method, where fields is an object of keys and corresponding values. The keys identify the field name or is also referred to as field path. The values indicate the type of field and its associated options. A field is a defined as a JavaScript object that has a type attribute. The type attributes must be a basic data type that

Mongoose natively supports such as string, number or it should be a Keystone.js Field Type. Each field can have additional options that alter its behavior such as filtering and indexing.

Keystone.js fields allows you to easily add rich, functional fields to your application's models. Adding a Keystone.js field to our model gives us a lot of added functionality such as -

- Rich controls in Keystone's Admin UI
- Complex data types; e.g. the location field stores address and lng/lat point
- Formatting and validation methods
- Metadata about how fields relate to each other; e.g. which fields depend on certain values in other fields

Here is a list of basic data types that are mapped to their corresponding Keystone.js field types:

Data type	Field type
String	Text
Number	Number
Date	DateTime
Boolean	Boolean

Let us add our fields to the Product model.

```
  var keystone = require('keystone');
  var Types = keystone.Field.Types;

  var Product = new keystone.List('Product');
  Product.add({
    name: { type: String, required: true },
    team: { type: String },
    publishedStatus: { type: Types.Select, options: 'draft, published', defa\
ult: 'draft' },
    createdAt: { type: Date, default: Date.now }

  });
  Product.register();
```

As seen above, we have defined four properties/fields within the Product model with their types and additional options. The name, team and createdAt fields are of the basic Javascript data types, namely String and Date respectively. The publishedStatus is a select field that uses Keystone.js's built-in Field Types. By setting the required option, Keystone.js will ensure that a new product document is not created without those fields being entered by the user. The default option enables us to specify fallback values for a field if a user does not enter one. The select field will render a HTML select drop down with two options - draft and published. The default option on the publishedStatus is set to be draft.

Defining Virtual Properties

Virtual properties are accessors and mutators that allow us to format our fields when retrieving them from a model or setting their value. To define a virtual property, we add it to the underlying Mongoose schema. Let us add a virtual property that returns the full title of a product which is a combination of product name and product team name.

```
//our virtual property to display full title
Product.schema.virtual('fulltitle').get(function() {
    return this.title + ' ' + this.team;
});

Product.register();
```

To access the Mongoose schema from our Keystone.js List, we need to reach into the schema property of the List. This property is a pass through for the options that we want to the Mongoose schema to possess. The virtual method on the schema takes a parameter as the name of the property. We can use this property directly on our model within our application as if we had added it to our list. The advantage of virtual properties is that they are not persisted to the document saved within MongoDB.

When we fetch a document from our Mongo DB, we can use the virtual property as

```
    console.log(productObj.fulltitle);
```

Finding Data

Keystone.js provides you with numerous ways to fetch data from your database, each with their own appropriate use case. You can simply fetch all records in one go; a single record based on a field; data based on conditions; or a paginated list of either all or filtered data. There are two major syntaxes for querying data:

- Using the QueryBuilder interface
- Query with a Single Operation

Using the QueryBuilder

We can use the powerful QueryBuilder interface provided by Mongoose to build up the query in a fluent manner before execution. The QueryBuilder allows us to disperse code over multiple lines to compose our query before executing it at a certain point. Look at the example in the following snippet:

```
ticketQuery = keystone.list('Ticket').model.find();
ticketQuery.where('priority').in(['Low', 'Medium']);
ticketQuery.sort('-createdAt');
ticketQuery.select('title priority category');
ticketQuery.exec(function (err, tickets){
  if (!err){
    console.log(tickets); // output array of tickets
  }
});
```

The QueryBuilder builder syntax is pretty simple to understand. In the above query, we are trying to retrieve all tickets where the priority is either low or medium. We want the tickets to be ordered by created date in a descending order (that is, most recent first) and only return the title, priority and category fields. The query is actually executed when the exec function is called.

We can also chain the commands using dot syntax. The earlier code could be rewritten using the dot syntax method as in the following:

```
keystone.list('Ticket').model.find();
    .where('priority').in(['Low', 'Medium'])
    .sort('-createdAt');
    .select('title priority category');
    .exec(function (err, tickets){
          if (!err){
            console.log(tickets);
          }
    });
```

Query with a Single Operation

The QueryBuilder makes it easy to compose complex queries and helps improve the code readability and maintainability. Sometimes however, we might just need a simple query to satisy our needs and it might be equally well readable in well formatted code.

To use a single-query operation, we pass the necessary query conditions and constraints to the find() method. Below is a rewrite of the query we previously saw, but in a single operation. `keystone.list('Ticket').model.find({ priority: { $in: ['Low', 'Medium'] }, }, ['title', 'priority', 'category'], function(err, tickets){ if (!err){ console.log(tickets); } }).sort('-createdAt');`

We can also use a couple of helper methods that simplify querying: * **Model.find(query)** to return an array of documents matching the query * **Model.findOne(query)** to return the first document found that matches the query * **Model.findById(ObjectID)** to return a single document that matches the given ObjectID

Retrieving All Tickets

To fetch all tickets, we can use the find method:

```
var q = keystone.list('Ticket').model.find();

q.exec(function(err, results) {
        var tickets = results;
        next(err);
});
```

Retrieving A Ticket By Slug

To fetch a ticket that matches the slug, we can use the find method shown below. The slug can be read from req.params collection.

```
var q = keystone.list('Ticket').model.findOne({'slug':req.params.slug});

q.exec(function(err, result) {
        var ticket = result;
        next(err);
});
```

Selecting Specific Fields

For optimal performance, it is always advised to construct queries that retrieve only the necessary data required to render a view. For example, if you're displaying a list of tickets that only displays the ticket title, priority and category, there is no reason to retrieve the id, createdAt, status, assignedTo and other columns. You can restrict which columns are selected using the select method, as demonstrated below:

```
var q = keystone.list('Ticket').model
    .findOne({'slug':req.params.slug})
    .select('title priority category');

q.exec(function(err, result) {
        var ticket = result;
        next(err);
});
```

Counting Documents

To count the number of documents associated with a given query, use the `count` method

```
var q = keystone.list('Ticket').model
    .count({'category':'Bug'});

q.exec(function(err, count) {
        console.log('There are %d tickets categorized as Bug', count);
        next(err);
});
```

Ordering Documents

You can order records using the `sort` method in conjunction with the find method. The following example will retrieve all tickets records, ordered by title

```
var q = keystone.list('Ticket').model.find()
                .sort('title');

q.exec(function(err, results) {
        var tickets = results;
        next(err);
});
```

By default, the results are sorted in ascending order. You can change this default behavior by prefixing a minus sign to the field that is being used to sort. We can also use the asc, desc, ascending, descending keywords if we pass the condition as an object.

```
var q = keystone.list('Ticket').model.find()
                .sort('-title');

q.exec(function(err, results) {
        var tickets = results;
        next(err);
});
```

A short form notation is to use 1 and -1 to represent ascending and descending respectively. We can also sort on multiple fields as shown below. We will sort by category ascending and priority descending.

```
var q = keystone.list('Ticket').model.find()
                .sort([['category', 1], ['priority', -1]]);

q.exec(function(err, results) {
        var tickets = results;
        next(err);
});
```

Conditional Filtering

We can use the `where` method to conditionally find documents with attributes that we are interested in. As an example, let us try to retrieve documents which are categorized as Bug and also with Low priority.

```
var q = keystone.list('Ticket').model.find()
                .where('category').equals('Bug")
                .where('priority').equals('Low);

q.exec(function(err, results) {
        var tickets = results;
        next(err);
});
```

As you see in the above code, multiple where clauses can be chained together which makes it easy to read and maintain the code. The field that we are interested in comparing is passed to the where method, the comparison operator is chained with the comparison value. The where condition can be filtered using comparison helpers such as equals, gt (greater than), lt (less than), in; which makes querying very easy. We saw an example of querying using the 'in' condition in our dot syntax sample above.

Limiting Returned Documents

Most often we will want to just retrieve a small subset of documents, for instance the ten most recently added tickets. You can do so using the `limit` method:

```
var q = keystone.list('Ticket').model.find()
                .sort('-createdAt')
                .limit('10');

q.exec(function(err, results) {
        var tickets = results;
        next(err);
});
```

If you wanted to retrieve a subset of documents beginning at a certain offset, you can combine limit method with the skip method. The following example will retrieve ten recent ticket beginning with the sixth record:

```
var q = keystone.list('Ticket').model.find()
                .sort('-createdAt')
                .skip(5)
                .limit('10');

q.exec(function(err, results) {
        var tickets = results;
        next(err);
});
```

Check for Existence of Field

We can use the `exists` method to determine whether a particular document contains a field, without actually loading it. For example, to determine a list of tickets that are unassigned i.e. the assignedTo field does not exist on the Ticket MongoDB document, use the following statements:

```
var q = keystone.list('Ticket').model.find()
                .where('assignedTo')
                .exists(false);


q.exec(function(err, results) {
        var tickets = results; //list of unassigned tickets
        next(err);
});
```

Inserting a New Record

To create and save a new document use the `save` method. You'll first create a new instance of the desired model, update its attributes, and then execute the save method:

```
var keystone = require('keystone')
        Ticket = keystone.list('Ticket');


    var newTicket = new Ticket.model();

        newTicket.title = 'Update sidebar widget to include Facebook';
        newTicket.category = 'Feature';
        newTicket.status = 'In Progress';
        newTicket.priority = 'Medium';
        newTicket.description = 'Should be able to add Facebook sidebar widget to inter\
ior pages';

        newTicket.save(function(err) {
                if (err) {
                        console.error("Error adding new ticket to the database:");
                        console.error(err);
                } else {
                        console.log("Added ticket " + newTicket.title + " to the database.");
                }
                done(err);
        });
```

Note: Because we set the autokey option on our Ticket list, it will have generated a unique slug based on the title before it was saved to the database.

In real world scenario, you will get the necessary data for the attributes from a HTML form post in your view. If you have a Javascript object with all the attributes set, then you can pass that to the model and invoke the save method to save it to the database.

```
var keystone = require('keystone')
        Ticket = keystone.list('Ticket');

var ticketObj = {
    'title': 'Update sidebar widget to include Facebook',
    'category': 'Feature',
    'status': 'In Progress',
    'priority': 'Medium',
    'description': 'Should be able to add Facebook sidebar widget to interior pa\
ges'
};

var newTicket = new Ticket.model(ticketObj);
```

```

        newTicket.save(function(err) {
                if (err) {
                        console.error("Error adding new ticket to the database:");
                        console.error(err);
                } else {
                        console.log("Added ticket " + newTicket.title + " to the database.");
                }
                done(err);
        });
```

Updating Existing Records

Users will commonly want to update existing tickets, perhaps changing the assigned user or the status of the ticket. To do so, you'll use Keystone.js's UpdateHandler functionality. This typically involved retrieving the desired document using its identifier, and set the changed fields on the document and request Keystone.js to process the updates.

Let us assume we receive the id of the ticket via a form post along with the changes. The below code first retrieves a ticket that matches the provided id. If the ticket is found, any matching fields and their values (from the form post) are set to the data object. The getUpdateHandler method on the matching ticket can process the updates to the document via a call to the process method. The data object is provided as an input to this method. "‘ Ticket.model.findById(req.body.id).exec(function(err, item) {

```
        if (err) return res.apiError('database error', err);
        if (!item) return res.apiError('not found');

        var data = req.body;

        item.getUpdateHandler(req).process(data, function(err) {

                if (err) return console.error('create error', err);

                console.log("Successfully updated the ticket");

        });

});
```

```
## Deleting Documents

To delete a document, first locate the document, then use the ```remove``` metho\
d. Below, we will find a Ticket that has the slug need-to-add-facebook-sidebar-w\
idget and delete it.
```

var keystone = require('keystone'), Ticket = keystone.list('Ticket');

var ticketSlug = 'need-to-add-facebook-sidebar-widget';

Ticket.model.find({'slug': ticketSlug}) .remove(function(err) { // ticket has been deleted }); "'

Summary

In this chapter, we learnt how to create and work with models to save, retrieve and manipulate data. These are the most basic operations in all web applications and Keystone.js makes it a breeze to implement!

Chapter 4. Model Relations

In a fairly simplistic view, we have seen how to create individual models, add properties to them, interact with models and learnt about Mongo collections in the previous chapters. This was a great beginning point. However, in real world applications there will always be a need for models to be interconnected with each other.

Interconnections, also known as relationships between models, make it possible for us to determine which incident tickets are associated with a product, associate a specific user with a list of tickets and identify all tickets that belong to a particular queue.

Keystone.js works in conjunction with Mongoose and MongoDB to provide very useful features for building and traversing relations between models with ease. Keystone.js utilizes MongoDB's ability to store the ObjectIDs of related documents in a field (or many related ObjectIDs in an Array) to provide powerful relationship capabilities.

Defining Relations

To understand relations, let's start by looking at a simple use case. For instance, an incident ticket can be assigned to a single user, to be resolved but a single user can handle multiple ticket resolutions. So how is this relationship formally defined in a Keystone.js application? Furthermore, how to traverse a relation, for instance to show all tickets that have been assigned to a single user. Keystone.js's wrapper aroung Mongoose.js makes such relationships; a breeze to work with.

Keystone.js supports that following type of relationships:

- The **One-to-Many Relation**: One-to-Many relations are used when one model document can be associated with multiple documents of another single model. For instance, a user can have many tickets and one ticket can belong only to one user.
- The **Many-to-Many Relation**: Many-to-Many relations are used when one document of a model can be related to multiple documents from another model, and vice versa. For instance, an incident ticket can be tagged with many tags and each tag could be associated with many incident tickets.
- The **One-to-One Relation**: Although modeling One-to-One relations in NoSQL is thought of as being counterintuitive, we can still achieve it within Keystone.js. A one-to-one relation is used when one model document can belong to only one other model document. For example, a user can have only one user profile and one user profile can belong to only a single user. A user profile generally contains related information about a user such as a list of his social network accounts and his bio. The user profile will be a separate model which differs from the user's

authentication model. Because one user can be associated with one user profile and one user profile can be related to only a single user, this is a good case for a one-to-one relationship. We can implement a One-to-One relation in Keystone.js with an inherent One-to-Many relation with a constraint that limits the document from being saved if the One-to-One characteristic is violated.

Modeling One-to-Many Relations

For the purpose of illustrating how One-to-Many relationships can be easy implemented using Keystone.js, let us look at the relationship between a user and ticket. One user can have many tickets, however one ticket will belong to only a single user.

If you recall from the earlier chapter, we have defined the relationship between a ticket and user on the Ticket Model. The field is of type Types.Relationship and the ref option is set to the User model, which indicates the Model it is related to. Setting many to false indicates that we can only select one user for this field.

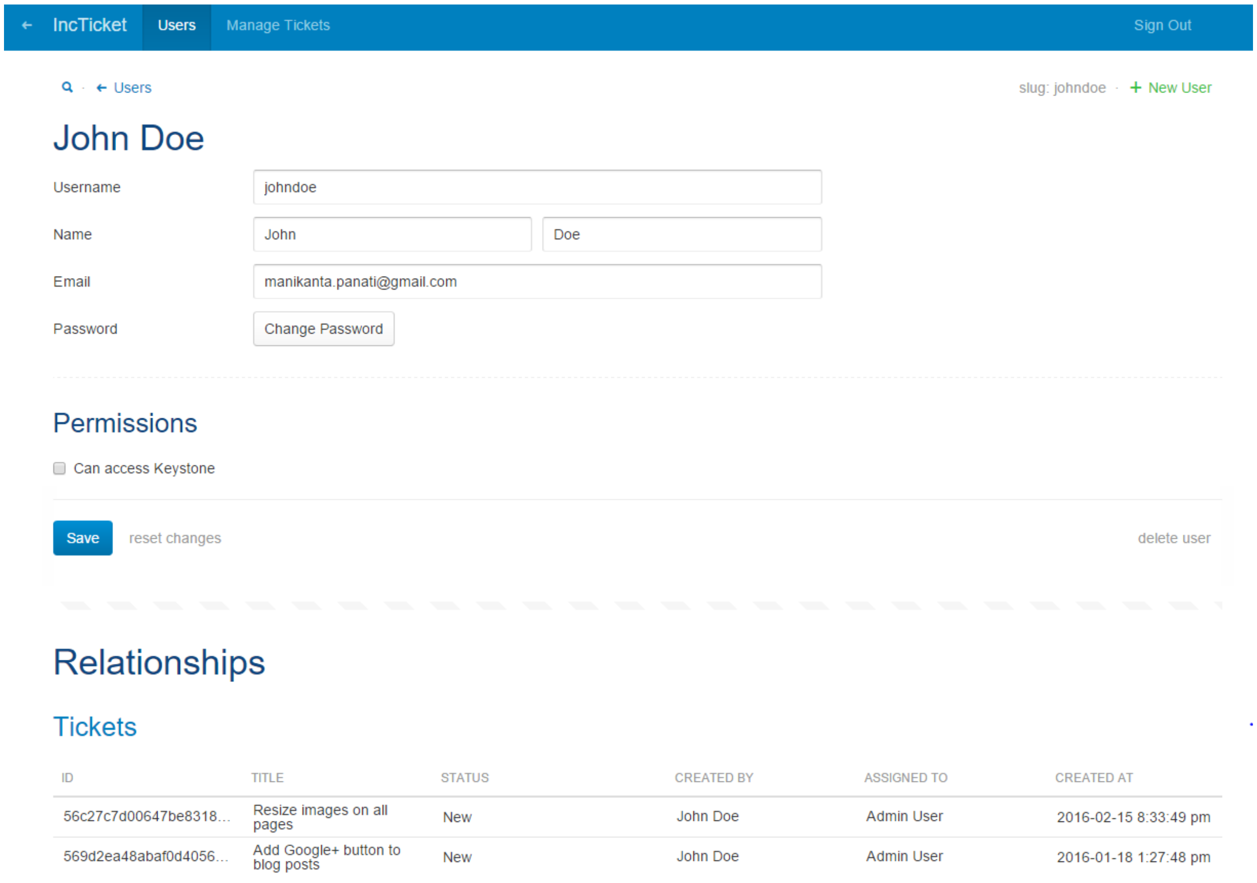
```
createdBy: { type: Types.Relationship, ref: 'User', index: true, many: false }
```

To represent the relationship from both sides, we can define the relationship on the user model as well. We can do this by calling the relationship method on the user model. Add the below line to the user model.

```
User.relationship({ path: 'tickets', ref: 'Ticket', refPath: 'createdBy' });
```

- **path**: This option defines the path of the relationship reference on the Model
- **ref**: This option is the key of the referred Model (the one that has the relationship field)
- **refPath**: This option specifies the field of the relationship being referred to in the referred Model

Restart the application and navigate to any user on the admin site and you should notice a relationship section on the page that links to all the tickets that were created by that user.



John Doe

Username	johndoe
Name	John Doe
Email	manikanta.panati@gmail.com
Password	Change Password

Permissions

☐ Can access Keystone

Relationships

Tickets

ID	TITLE	STATUS	CREATED BY	ASSIGNED TO	CREATED AT
56c27c7d00647be8318...	Resize images on all pages	New	John Doe	Admin User	2016-02-15 8:33:49 pm
569d2ea48abaf0d4056...	Add Google+ button to blog posts	New	John Doe	Admin User	2016-01-18 1:27:48 pm

Retrieving a One-to-Many relation

We can easily find one-to-many related items. Simply specify the ID of the item you wish to filter on like any other value. To find tickets that are created by a specific user, use the following code:

```
keystone.list('Ticket').model.find().where('createdBy', user.id).exec(function(e\
rr, tickets) {
    // ...
});
```

Keystone.js makes it very simple to be able to retrieve a related document automatically. To be able to get the user related to a ticket, we can use the populate method. Keystone.js takes advantage of the underlying Mongoose populate functionality to provide this. The relevant code to load user information along with a ticket would be:

```
keystone.list('Ticket').model.findOne().populate('createdBy assignedTo').exec(fu\
nction(err, ticket) {

    console.log('The ticket is created by ' + ticket.createdBy.username);
    console.log('The ticket is assigned to ' + ticket.assignedTo.username);

});
```

To automatically populate all the tickets created by a user, we can use the populateRelated method. However this method can be inefficient if there are a lot of tickets per user.

```
keystone.list('User').model.findOne().exec(function(err, user) {
  user.populateRelated('tickets', function(err) {
    // tickets are populated. access using user.tickets
  });
});
```

The user's tickets will be added as a field on the user object.

Modeling Many-to-Many Relations

For the purpose of illustrating Many-to-Many relations, let us introduce tagging to our tickets. Each ticket can be be tagged with multiple tags and a single tag can be associated with many tickets. Hence there is a many to many relationship between tickets and tags.

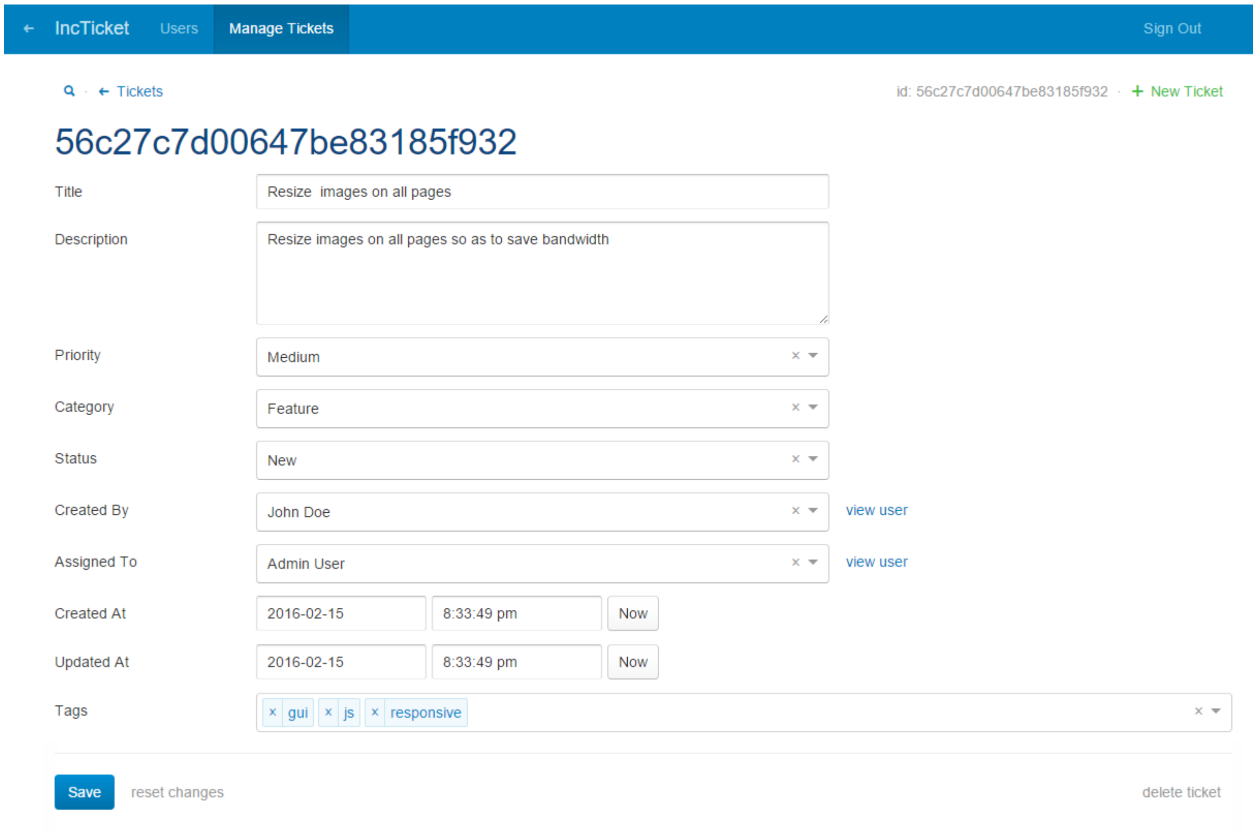
Add a field named tags to the ticket model as below: `tags: { type: Types.Relationship, ref: 'Tag', many: true },` We have specified that the field type is Types.relationship and that the field is a reference pointing to the Tag model. By setting the many option to true, we specify that multiple tags can be selected.

Next, create a file named Tag.js in /models with the following code in it:

```
var keystone = require('keystone');
var Types = keystone.Field.Types;


var Tag = new keystone.List('Tag', {
        autokey: { from: 'name', path: 'slug', unique: true }
});

Tag.add({
        name: { type: String, required: true }
});

Tag.relationship({ ref: 'Ticket', refPath: 'tickettags', path: 'tags' });
Tag.register();
```

We have defined a tag to contain just the name and a unique slug. This will prevent duplicate tags from being created. We have called the relationship method on the Tag list and specified that the model that it is related to is Ticket via the tags field.

Create some tags in the admin site and you should be able to pick multiple ones on the ticket edit page as shown below:



56c27c7d00647be83185f932

Title	Resize images on all pages
Description	Resize images on all pages so as to save bandwidth
Priority	Medium
Category	Feature
Status	New
Created By	John Doe
Assigned To	Admin User
Created At	2016-02-15 8:33:49 pm
Updated At	2016-02-15 8:33:49 pm
Tags	gui, js, responsive

If you inspect the document stored in MongoDB, you will find that the tags are stored as an array of Mongo object ids.

```
 "tags": [
            {
                "$oid": "56d228f9b5726a582219b5c7"
            },
            {
                "$oid": "56d22903b5726a582219b5c8"
            },
            {
                "$oid": "56d22914b5726a582219b5c9"
            }
    ]
```

Retrieving a Many-to-Many relation

To fetch all the tags associated with a ticket, we can use the populate method.

```
keystone.list('Ticket').model.findOne().populate('tags').exec(function(err, tick\
et) {
  //tags populated as ticket.tags
});
```

To fetch all the tickets that as associated with a particular tag, we can use the in operator since the tags field is an array.

```
keystone.list('Ticket').model.find().where('tags').in([tag.id]).exec(function(er\
r, tickets) {
    // all the tickets that were tagged with tag identified by tag.id
});
```

Filtering Relations

Keystone.js also allows us to filter a relationship field using the filters option. The filters option is an object of key/value pairs, in which the keys correspond to the fields of the related model to be filtered, and the values will either be literals or field names in the current model, the value of which will be used to filter the relationship.

In the example below, the createdBy field will only allow selection of a User whose isAdmin field is set to true.

```
Ticket.add({
   ...
    createdBy: { type: Types.Relationship, ref: 'User', index: true, filters: { \
isAdmin: true }  },
   ...
});
```

We can also filter by the value of another field on the model. Do this by setting the value of the filter to the name of the field, prefixed by a colon (:). Let's assume, you wanted to assign a sample ticket based on the category that was selected. The below code will filter tickets and provide only the ones where the category is the same as the one that is selected for the ticket being created.

```
Ticket.add({
   ...
    category: { type: Types.Select, options: 'Bug, Feature, Enhancement', defaul\
t: 'Bug' },
    similarTicket: { type: Types.Relationship, ref: 'Ticket', filters: { categor\
y: ':category' } },
   ...
});
```

You can also filter by the current model's _id field similar to the above example.

Note: You can only set filters on one-many relationships (i.e. when the many option is NOT set to true).

Summary

In this chapter, we read about how Keystone.js provides an easy way to define relationships and query related data. Building complex database drived applications should now be easy! Onward!.

Chapter 5. Integrating Web Forms

Most modern day web application developers spend a considerable amount of time in implementing forms that the user can use to interact with the application models. For instance, in our IncTicket application, users will use forms to create tickets and update them. Developing the HTML for a form might be simple enough, but integrating it with the application back-end might be a little tricky. In this chapter, we will look at how we can integrate forms within a Keystone.js application.

Creating a New Ticket Form

Let us create a form where an authenticated user in our application can create a new ticket. Create a new template named newticket.swig to hold our web form, and place it in the /templates/views/tickets folder.

```
{% extends "../../layouts/default.swig" %}

{% block content %}

<div class="container">
        <div class="panel panel-primary">
    <!-- Default panel contents -->
    <div class="panel-heading">Create a New Ticket</div>
    <div class="panel-body">
         <form class="form-horizontal custom-form" action="/createticket" method\
="post">
                <div class="form-group">
                    <div class="col-sm-2 label-column">
                        <label for="name-input-field" class="control-label">Titl\
e </label>
                    </div>
                    <div class="col-sm-6 input-column {% if validationErrors.tit\
le %}has-error{% endif %}">
                        <input type="text" name="title" placeholder="Title of th\
e ticket" class="form-control" value="{{form.title}}" />
                    </div>
                </div>
                <div class="form-group">
                    <div class="col-sm-2 label-column">
```

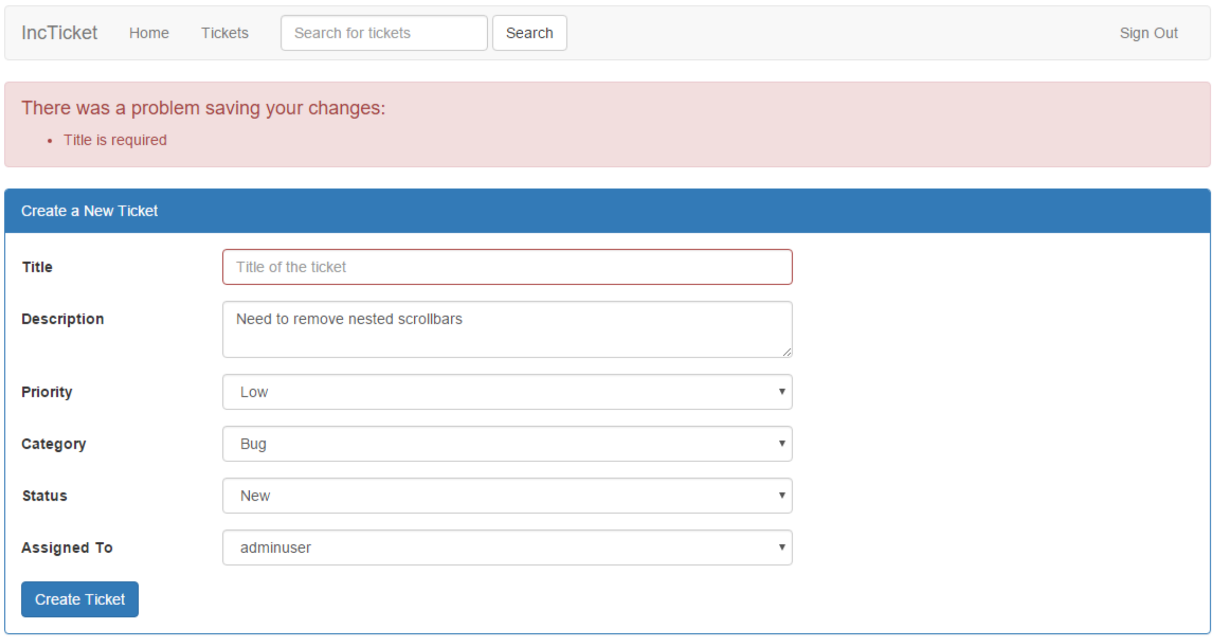
```
                        <label for="email-input-field" class="control-label">Des\
cription </label>
                    </div>
                    <div class="col-sm-6 input-column" {% if validationErrors.de\
scription %}has-error{% endif %}>
                        <textarea name="description" placeholder="Describe the i\
ssue" class="form-control">{{form.description}}</textarea>
                    </div>
                </div>
                <div class="form-group">
                    <div class="col-sm-2 label-column">
                        <label for="pawssword-input-field" class="control-label"\
>Priority </label>
                    </div>
                    <div class="col-sm-6 input-column">
                        <select class="form-control" name="priority">
                                <option value="Low" {% if form.priority == 'Low'\
 %} selected{% endif %}>Low</option>
                                <option value="Medium" {% if form.priority == 'M\
edium' %} selected{% endif %}>Medium</option>
                                <option value="High" {% if form.priority == 'Hig\
h' %} selected{% endif %}>High</option>
                        </select>
                    </div>
                </div>
                <div class="form-group">
                    <div class="col-sm-2 label-column">
                        <label for="repeat-pawssword-input-field" class="control\
-label">Category </label>
                    </div>
                    <div class="col-sm-6 input-column">
                        <select class="form-control" name="category">
                                <option value="Bug"  {% if form.category == 'Bug\
' %} selected{% endif %}>Bug</option>
                                <option value="Feature" {% if form.category == '\
Feature' %} selected{% endif %}>Feature</option>
                                <option value="Enhancement" {% if form.category \
== 'Enhancement' %} selected{% endif %}>Enhancement</option>
                        </select>
                    </div>
                </div>
                <div class="form-group">
```

```
                    <div class="col-sm-2 label-column">
                        <label for="repeat-pawssword-input-field" class="control\
-label">Status </label>
                    </div>
                    <div class="col-sm-6 input-column">
                        <select class="form-control" name="status">
                                <option value="New" selected>New</option>
                                <option value="In Progress">In Progress</option>
                                <option value="Open">Open</option>
                                <option value="On Hold">On Hold</option>
                                <option value="Declined">Declined</option>
                                <option value="Closed">Closed</option>
                        </select>
                    </div>
                </div>
                <div class="form-group">
                    <div class="col-sm-2 label-column">
                        <label for="repeat-pawssword-input-field" class="control\
-label">Assigned To </label>
                    </div>
                    <div class="col-sm-6 input-column">
                        <select class="form-control" name="assignedTo">
                        {% for assignUser in data.users %}
                            <option value="{{assignUser.id}}">{{assignUser.usern\
ame}}</option>
                        {% endfor %}
                        </select>
                    </div>
                </div>
                <input type="submit" class="btn btn-primary submit-button" value\
="Create Ticket"/>
        </form>
    </div>
    </div>
</div>
{% endblock %}
```

The form is pretty straightforward. We have HTML form fields for each of the model fields on the Ticket model. Our view will perform all the input validations and will populate the validationErrors in the reponse, if any. We can use the below snippet to highlight any fields that failed validation by applying the bootstrap ‘has-errors’ css class.

```
{% if validationErrors.title %}has-error{% endif %}"
```

The view will also return flash messages if there are validation errors. The below screenshot is an example of input validation.



There was a problem saving your changes:

- Title is required

Create a New Ticket

Title: Title of the ticket

Description: Need to remove nested scrollbars

Priority: Low

Category: Bug

Status: New

Assigned To: adminuser

Add a route to the routes index file,

```
app.all('/createticket', middleware.requireUser, routes.views.tickets.newticket);
```

As you see, we are taking advantage of the requireUser middleware to make sure that our user is first logged into the application before being able to create a ticket.

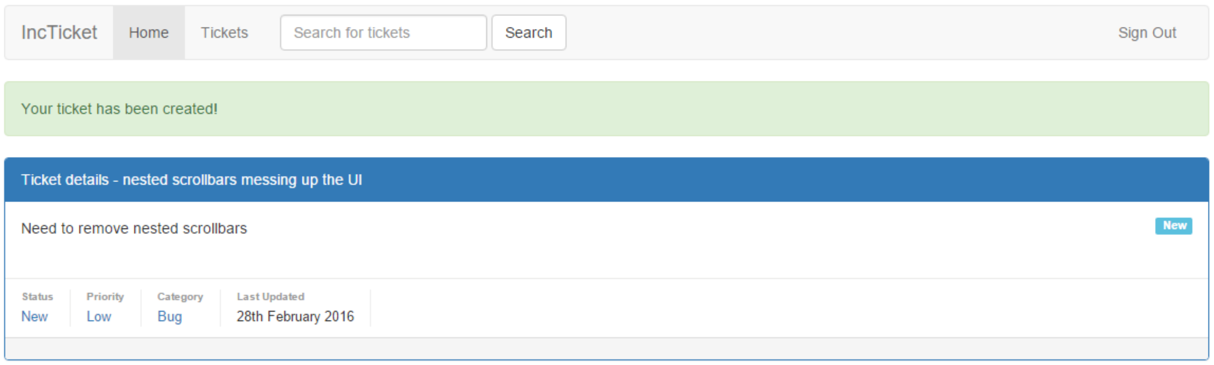
Next, create a file for our view named newticket.js, under /routes/views/tickets

```
var keystone = require('keystone'),
    Ticket = keystone.list('Ticket');

exports = module.exports = function(req, res) {

        var view = new keystone.View(req, res),
                locals = res.locals;

    locals.form = req.body;
        locals.data = {
                users: []
        };

        view.on('init', function(next) {

                 var q = keystone.list('User').model.find().select('_id username')

                q.exec(function(err, results) {
                        locals.data.users = results;
                        next(err);
                });


         });

    view.on('post', function(next) {

        var newTicket = new Ticket.model(),
                data = req.body;

        data.createdBy = res.locals.user.id;

        newTicket.getUpdateHandler(req).process(data, {
                        flashErrors: true,
                }, function(err) {
            if (err) {
                    locals.validationErrors = err.errors;
                } else {
                    req.flash('success', 'Your ticket has been created!');
                    return res.redirect('/tickets/' + newTicket.slug);
                }
                next();

            });

        });

        // Render the view
        view.render('tickets/newticket');

};
```

On the view initialization, we attempt to retrieve a list of users. This is returned to the template during render to be used to show a dropdown list to select the user to whom the ticket can be assigned. As shown in the snippet below, we use a for loop to render the select control with the id of the user being the key and the username being the value.

```
<div class="form-group">
    <div class="col-sm-2 label-column">
        <label for="repeat-pawssword-input-field" class="control-label">Assigned\
 To </label>
    </div>
    <div class="col-sm-6 input-column">
        <select class="form-control" name="assignedTo">
        {% for assignUser in data.users %}
            <option value="{{assignUser.id}}">{{assignUser.username}}</option>
        {% endfor %}
        </select>
    </div>
</div>
```

On form post, we create an instance of the Ticket model and gather the form post into the data variable. We set the createdBy property to the currently logged in user. The form data is processed by the Ticket's update handler. If there are errors, we set the errors to the validationErrors variable otherwise we redirect the user to the ticket details page as shown below.



Your ticket has been created!

Ticket details - nested scrollbars messing up the UI

Need to remove nested scrollbars

New

Status	Priority	Category	Last Updated
New	Low	Bug	28th February 2016

We can use a similar form and view to be able to edit an existing ticket and update it using the update handler.

Summary

In this chapter, we were able to create some useful functionality for creating tickets. Keystone.js's form validation makes it very convinient to implement complex forms in any application.

Chapter 6. Filtering Requests with Middleware

Introducing Middleware

Middleware is a piece of code that hooks into Keystone.js's request/response processing cycle. Middleware is available globally throughout the application for altering input or output and is generally considered code that is not specific to any domain. Examples of middleware include authentication and authorization, caching, performance monitoring and content compression. While all of these features are critical, none are specific to any one kind of project and therefore it is a good idea to separate these out from the project's code in order to take advantage of them. In this chapter I'll introduce you to the middleware included in Keystone.js, and even show you how to write your own custom middleware solution.

Middleware conists of Javascript methods that are each responsible for doing a specific function. For example, Keystone.js includes a flashMessages middleware function that retrieves flash messages from session before the view template is rendered. Middleware provide a convenient mechanism for filtering HTTP requests entering your application. We could define a middleware that makes sure that the user of your application is authenticated. If the user is not authenticated, the middleware will redirect the user to the login screen. However, if the user is authenticated, the middleware will allow the request to proceed further into the application. A logging middleware could be used to log all incoming requests to your application.

Keystone.js's middleware resides in `/routes/middleware.js`

Introducing Keystone.js's Default Middleware

Open your project's /routes/middleware.js file and you'll find three ready-made middleware solutions, including:

- **initLocals**: This middleware initializes standard view locals to include navlinks and the current user. View local is object that contains response local variables scoped to the request, and therefore available to the view(s) rendered during that request / response cycle. This property is useful for exposing request-level information such as the request path name, authenticated user, user settings and data.
- **flashMessages**: This middleware fetches and clears the flash messages before a view is rendered. Flash messages are an essential way of returning alerts/errors to users as they navigate from one page to another withn your application.

- **requireUser**: This middleware is used to confirm a user is signed into the application. If not, the user is redirected to the login page. Further in the chapter, we will see how to write our own middleware that also checks if the user is an admin.

If you look further into the core libraries for Keystone.js, there are additional middleware implemented such as:

- **cors**: Cross-Origin Resource Sharing is a mechanism for allowing clients to interact with APIs that are hosted on a different domain. CORS works by requiring the server to include a specific set of headers that allow a browser to determine if and when cross-domain requests should be allowed. The cors middleware makes it easy to add those headers.
- **initAPI**: This middleware adds apiResponse and apiError properties to the response. These are useful when building APIs using Keystone.js. We will read more about this in the Restful API for Mobile and SPA applications chapter.

Defining Middleware in Keystone.js

Creating a new middleware function is very easy in Keystone.js. You would need to export a function within the middleware.js file and define the implementation of that function. The middleware file is already included into Keystone.js's routing mechanism there by simplifying the creation and use of a middleware function. Let us define a middleware that verifies if the user is an administrator. This middleware can be used to protect parts of the application like the admin backend, that need a user to be logged in and be designated as an administrator.

```
exports.isAdmin = function(req, res, next) {

        if (!req.user) {
                req.flash('error', 'Please sign in to access this page.');
                res.redirect('/signin');
        } else if(!req.user.isAdmin)
        {
            req.flash('error', 'User does not belong to admin group');
            res.redirect('/');
        }
        else
        {
                next();
        }

}
```

Keystone.js expects middleware functions to accept the following arguments:

- req - an express request object
- res - an express response object
- next - the method to call when the middleware has finished running (including any internal callbacks) to pass control to the next stage within the application

The isAdmin middleware function returns a HTTP redirect to the client if the user is not authenticated or if the user is not an administrator. If the user satisfies both these criteria, the request will be passed further into the application. To pass the request to the subsequent step in the application flow, simply call the next() callback.

Assigning Middleware To Routes

To assign middleware to specific routes, you should update the /routes/index.js file to include the HTTP verbs that the middleware should deal with along with the route signature.

```
exports = module.exports = function(app) {

        app.all('/admin*', middleware.isAdmin);
        app.get('/admin/viewcontent', routes.views.viewcontent);
        app.post('/admin/editcontent', routes.views.editcontent);

}
```

To protect the admin page using your new middleware, update the application routes to use the isAdmin method. When the app recieves any kind of http request (GET,POST etc) with any route signature that matches /admin followed by optional url segments, the middleware kicks in and passes the request through the isAdmin method. Once the isAdmin middleware returns a valid call, the application will continue to serve the corresponding view and template.

It is very easy to protect all routes that fall under a certain parent route segment. This is achieved using the asterik following the parent route segment. The asterik is part of the regular expression based routing engine which indicates that the isAdmin method will be called prior to the request flowing to viewcontent or editcontent or even just the /admin method. The ordering of routes are important to have the necessary effect of middleware.

Use an array to assign multiple middleware to a route. Suppose you had another middleware method named logRequests that logs incoming requests, we can use multiple middleware for a single route as shown below:

```
app.get('/admin/*', [middleware.requireUser, middleware.logRequests]);
```

Summary

Think of middleware as a series of “layers” that requests to your application must pass through before they are completed. Each layer can examine the request and even reject it entirely.

Chapter 7. Authenticating and Managing Your Users

User authentication is critical to any modern web application. Various forms of user authentication mechanisms are available today. Traditionally users log in to an application using a username and password. With the rise of social networking, single sign-on using an OAuth provider such as Facebook or Twitter has become a popular authentication method. In this chapter you will learn to implement username & password based authentication for your application.

Out of the box, Keystone.js provides the capability for users to be created at the admin backend only. An admin can login to the adminstration panel and add a new user and set the user's password. There is no pre-built functionality for a user to create an account via the front end. Let us learn how Keystone.js makes it very simple to allow users to create an account, login and view tickets that were created by them. To start, let us look at the configuration options & routes we would need and also changes to the frontend.

Configuring Authentication Options

To use Keystone.js authentication system, we need to make sure it's set up correctly. The keystone.js Javascript file contains all the authentication settings. In most cases the default settings are good to be used, however let us review the settings so you have a clear understanding of what is available.

- **session**: Set this option to true if you want your application to support session management. Loading sessions incurs a small overhead, so if your application doesn't need sessions you can turn this off.
- **auth**: This option indicates whether to enable built-in auth for Keystone's Admin UI, or a custom function to use to authenticate users. If this is set to false (or not defined), Keystone's Admin UI will be open to the public, hence it is good to set it to **true**.
- **user model**: This setting tells Keystone.js what model will be used to maintain the user information (e-mail address, password). By default it's set to User referring to the models/user.js file.
- **cookie secret**: Use this option to specify the encryption key to use for your cookies. This is usually set to a long, random string.
- **session store**: By default, Keystone.js will use the in-memory session store provided by Express, which should only be used in development because it does not scale past a single process, and leaks memory over time. Use this option to specify an alternate session store such as MongoDB or Redis for persistent sessions. To use our MongoDB, set this option to

mongo. Keystone.js will not bundle any session store packages during installation. It is upto us to bring in any dependencies we need. To use MongoDB, install connect-mongo using NPM.

```
npm install connect-mongo --save
```

After enabling the session based authentication options, we should see an **app_sessions** collection in our MongoDB with documents like below to store session data.

```
{
    "_id": "892GDPMz3DdiK8Jb7vWJoOw1JDSrVILt",
    "session": "{\"cookie\":{\"originalMaxAge\":null,\"expires\":null,\"httpOnly\
\":true,\"path\":\"/\"},\"flash\":{}}",
    "expires": {
        "$date": "2016-03-07T22:35:10.698Z"
    }
}
```

Authentication routes

We need to define routes and views related to user authentication so the user can click either a register link to create an account or a login link to be able to access their tickets. Start by making some amends to the master layout at `/templates/layouts/default.swig` to display the login link to guests and the logout link to users who are logged in. To check whether a visitor is logged in, we use the user object from our middleware. We will remove the existing signin link that points to the admin backend.

If you recall from chapter 6, Keystone.js's default middleware exposes a method named initLocals. This middleware function sets the current user object in the response that is returned to the template.

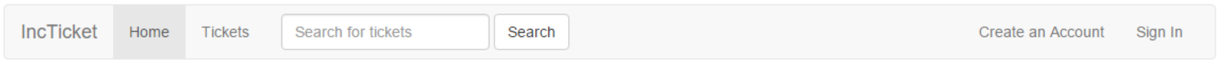
```
locals.user = req.user;
```

Update the navbar to include the below code:

```
{% if user %}
        <li><a href="/signout">Sign Out</a></li>
{% else %}
        <li><a href="/join">Create an Account</a></li>
        <li><a href="/signin">Sign In</a></li>
{% endif %}
```

In the above piece of code, we first check to see if the user object exists in the data that is returned to the template from a view. This object will be undefined for a guest or a user that has not logged in to the site. If the user has logged in, we render a sign out link. However, if the user has not logged in then we render both the links for creating an account and a signin link.

After the including the markup for login and signin links, the navbar should look like below:



Signin Links

The routes to display the login form, registration form could not be easier. Create a folder named auth within the /routes folder to organize all your authentication related views. We will also look at implementing password reset in case users forget their password.

```
app.all('/join', routes.views.auth.join);
app.all('/signin', routes.views.auth.signin);
app.get('/signout', routes.views.auth.signout);
app.all('/forgotpassword', routes.views.auth.forgotpassword);
app.all('/resetpassword/:key', routes.views.auth.resetpassword);
```

As you see, we have used the **app.all** method to specify the routes for join and signin. This makes it very convenient to display the registration form when the visitor does a GET on that route & then POST all the form parameters to the same route and handle the form post within the same view. This helps keep related code in a single view rather than having to define separate views for GET and POST, making it very easy for us to maintain our codebase.

The user model

To begin, you need to define the model that is going to be used to represent the users of your application. Keystone.js already provides you with sensible defaults in a user model located at `/models/User.js`, where you can change the model or collection that is used to store your user accounts.

Let us to add a username property to the user model so users can set an unique username. Add the autokey list option to the user model so that a slug is generated from the username. Also, add the resetPasswordKey property and set the **hidden** option to true. This property will be used to allow the user to reset the password of their profile. The hidden option hides this field from being displayed on the admin UI.

```
var keystone = require('keystone'),
        Types = keystone.Field.Types;

var User = new keystone.List('User', {
        autokey: { path: 'slug', from: 'username', unique: true }
});

User.add({
    username: { type: String, required: true, unique: true, index: true, default\
:'' },
        name: { type: Types.Name, required: true, index: true },
        email: { type: Types.Email, initial: true, required: true, index: true },
        password: { type: Types.Password, initial: true, required: true },
        resetPasswordKey: { type: String, hidden: true }
}, 'Permissions', {
        isAdmin: { type: Boolean, label: 'Can access Keystone', index: true }
});

// Provide access to Keystone
User.schema.virtual('canAccessKeystone').get(function() {
        return this.isAdmin;
});

 User.schema.virtual('url').get(function() {
    return '/users'+this.slug;
 });

User.defaultColumns = 'name, email, isAdmin';
User.register();
```

Also, We should add a virtual property named url to the user model, that can be used to show the user profile. The url will be formed using the slug from the user’s username prefixed with **/users** url segment.

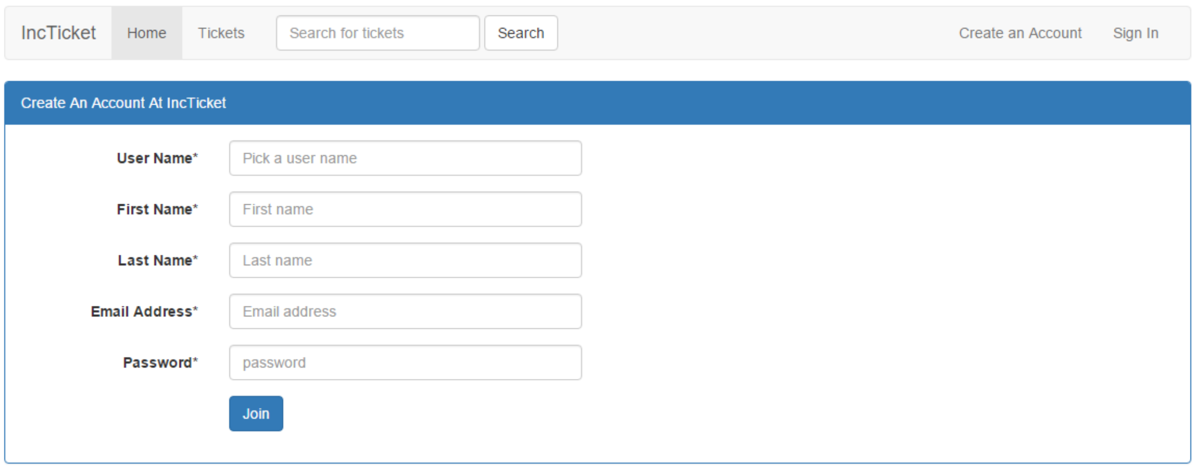
Note: The user model must have a canAccessKeystone property that says whether a user can access Keystone’s Admin UI or not.

Registering Users

Let us take a look at the template that can be used to allow a user to register at your site. The template will contain a form that will accept a user’s username, first & last name, email address and password. Create a template named join.swig and place it within /templates/views/auth directory.

```
{% extends "../../layouts/default.swig" %}

{% block content %}
<div class="container">
    <div class="panel panel-primary">
    <div class="panel-heading">Create An Account At IncTicket</div>
    <div class="panel-body">
     <div class="col-md-6">
    <form action="/join" method="post" class="form-horizontal">
      <fieldset>
      <div class="form-group required">
          <label class="col-md-4 control-label">User Name*</label>
          <div class="col-md-8">
            <input class="form-control" id="username" placeholder="Pick a user n\
ame" name="username" type="text" value="{{form.username}}">
          </div>
        </div>
                <div class="form-group required">
          <label class="col-md-4 control-label">First Name*</label>
          <div class="col-md-8">
            <input class="form-control" id="firstname" placeholder="First name" \
name="firstname" type="text" value="{{form.firstname}}">
          </div>
        </div>
                <div class="form-group required">
          <label class="col-md-4 control-label">Last Name*</label>
          <div class="col-md-8">
            <input class="form-control" id="lastname" placeholder="Last name" na\
me="lastname" type="text" value="{{form.lastname}}">
          </div>
        </div>
                <div class="form-group required">
          <label class="col-md-4 control-label">Email Address*</label>
          <div class="col-md-8">
            <input class="form-control" id="email" placeholder="Email address" n\
ame="email" type="email" value="{{form.email}}">
          </div>
        </div>
                <div class="form-group required">
          <label class="col-md-4 control-label">Password*</label>
          <div class="col-md-8">
            <input class="form-control" id="password" name="password" placeholde\
r="password" type="password">
          </div>
        </div>
                <div class="form-group">
          <label class="col-md-4 control-label"></label>
          <div class="col-md-8">

            <div style="clear:both"></div>
                <button class="btn btn-primary" type="submit">Join</button>
                    </div>
        </div>
      </fieldset>
    </form>
    </div>
 </div>
  </div>
   </div>
 {% endblock %}
```

The rendered markup will look like below:



Create An Account At IncTicket

User Name*	Pick a user name
First Name*	First name
Last Name*	Last name
Email Address*	Email address
Password*	password

Signup Screen

In the form, we have defined input fields for capturing the necessary data from the user. The form will POST to the /join url. If there are errors during user authentication such as invalid email or password, we display those errors using the FlashMessages.renderMessages method that is offered by Keystone.js.

Note: The FlashMessages.renderMessages code is in our Default.swig layout file. This will help show messages on every page that extends the layout file.

Create the view named join.js under /routes/views/auth directory with the following code:

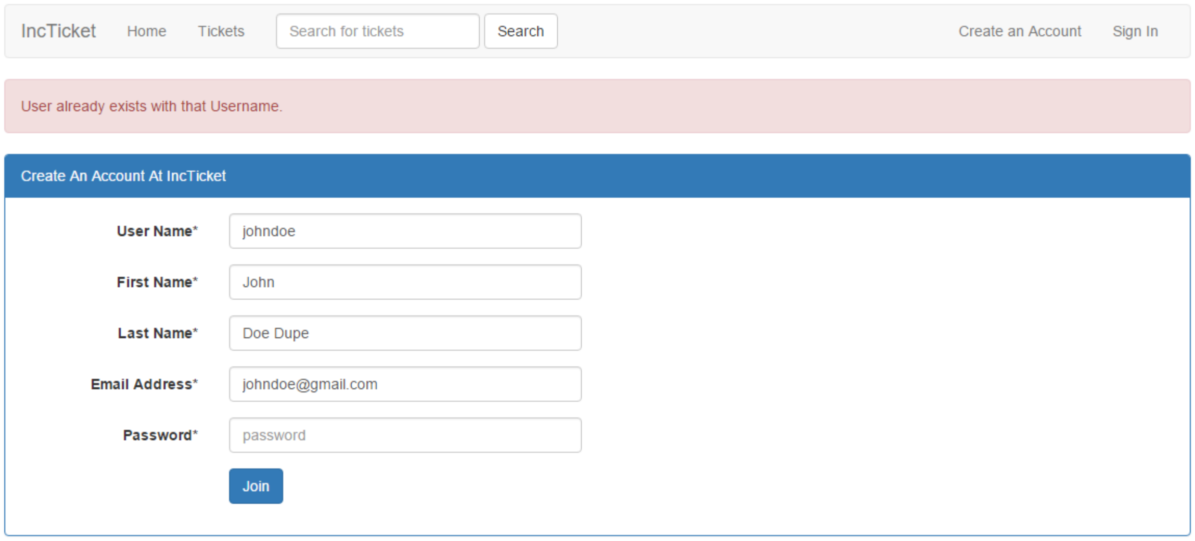
```
var keystone = require('keystone'),
        async = require('async');

exports = module.exports = function(req, res) {

        if (req.user) {
                return res.redirect('/tickets');
        }

        var view = new keystone.View(req, res),
                locals = res.locals;

        locals.section = 'createaccount';
        locals.form = req.body;

        view.on('post', function(next) {

                async.series([

                        function(cb) {

                                if (!req.body.username || !req.body.firstname || !req.body.lastnar
body.email || !req.body.password) {
                                        req.flash('error', 'Please enter a username, your name, er
');

                                        return cb(true);
                                }

                                return cb();

                        },

            function(cb) {

                                keystone.list('User').model.findOne({ username: req.body.username
n(err, user) {

                                        if (err || user) {
                                                req.flash('error', 'User already exists with that
                                                return cb(true);
                                        }
```

```

                                       return cb();

                               });

                       },

                       function(cb) {

                               keystone.list('User').model.findOne({ email: req.body.email }, fu
user) {

                                       if (err || user) {
                                               req.flash('error', 'User already exists with that
                                               return cb(true);
                                       }

                                       return cb();

                               });

                       },

                       function(cb) {

                               var userData = {
                   username: req.body.username,
                                       name: {
                                               first: req.body.firstname,
                                               last: req.body.lastname,
                                       },
                                       email: req.body.email,
                                       password: req.body.password
                               };

                               var User = keystone.list('User').model,
                                       newUser = new User(userData);

                               newUser.save(function(err) {
                                       return cb(err);
                               });

```

```
                        }

                ], function(err){

                        if (err) return next();

                        var onSuccess = function() {
                                        res.redirect('/tickets');
                        }

                        var onFail = function(e) {
                                req.flash('error', 'There was a problem signing you up, please try
                                return next();
                        }

                        keystone.session.signin({ email: req.body.email, password: req.body.passwo
}, req, res, onSuccess, onFail);

                });

        });

        view.render('auth/join');

}
```

In the code above, we begin by checking if the user has already signed in. If yes, we redirect the user to the /tickets route. We assign the request body to a local variable named form (`req.body`). This is useful for us to repopulate the form if there is an error such as a duplicate username or a duplicate email.

To test this, submit the form with an existing username. In the below screenshot, we submit the form twice with the username johndoe. The application indicates that a duplicate username has been detected, however notice that the other form fields such as first name, last name and email address have been populated with the values that were submitted. This provides for a good user experience on the sign up page.



User already exists with that Username.

Create An Account At IncTicket

User Name*	johndoe
First Name*	John
Last Name*	Doe Dupe
Email Address*	johndoe@gmail.com
Password*	password

To set the values back to the form, we populate the locals.form object with the request body in the view. During the rendering of the template, we set the form input value from the locals object. At the first render, the value will be empty. However when a post back to the server is performed, then the value will contain the user input.

```
 <input class="form-control" id="firstname" placeholder="First name" name="first\
name" type="text" value="{{form.firstname}}">
```

If you notice, we use the `async.series()` method to perform a series of checks during signup. First, we check if all the necessary form variables have been filled. Next, check if the user has input a duplicate username followed by a check for a duplicate email address. If all these conditions pass, we create a new user object from the user model and save it, followed by a call to the `keystone.session.signin` method to signin the user.

The async.series method takes an array of functions and executes each one in order, not starting on one until the previous has finished. The async object automatically passes each function a callback argument. Once we manually call the callback, async knows that it's safe to move on to the next function.

User Login

To allow users to login to our application we will first need a template with a form to enter our login credentials. Create a template named signin.swig and place it within /templates/views/auth directory.

```
{% extends "../../layouts/default.swig" %}

{% block content %}

<div class="container">
    <div class="panel panel-primary">
    <!-- Default panel contents -->
    <div class="panel-heading">Login to IncTicket</div>
    <div class="panel-body">
    <div class="col-md-4">
    <form role="form" action="/signin" method="post">
    <div class="form-group">
        <label for="sender-email" class="control-label">Email address:</label>
        <div class="input-icon">
        <input class="form-control email" id="signin-email" placeholder="you@mai\
l.com" name="email" type="email" value="">
        </div>
    </div>
    <div class="form-group">
        <label for="user-pass" class="control-label">Password:</label>
        <div class="input-icon">
        <input type="password" class="form-control" placeholder="Password" name=\
"password" id="password">
        </div>
    </div>
    <div class="form-group">
        <input type="submit" class="btn btn-primary " value="Login">
    </div>
    </form>
    </div>
    </div>
    </div>
</div>

{% endblock %}
```

The markup above for our login form is pretty straightforward. We have defined input fields for the user's email address and the password. The form will POST to the /signin url. If there are errors during user authentication such as invalid email or password, we display those errors using the FlashMessages.renderMessages method that is offered by Keystone.js. Flash messages are meant to be used only once. They are stored in the session and exist only between one request and response cycle. They are purged from the session automatically as soon as you retrieve them. Flash messages allow you to display once-off status messages to users, e.g. form validation errors, success messages, etc. We have included the following piece of code in our layout file - /templates/layouts/Default.swig to render the flash messages.

```
{{ FlashMessages.renderMessages(messages) }}
```

Create the view named signin.js under /routes/views/auth directory with the following code:

```
var keystone = require('keystone'),
        async = require('async');

exports = module.exports = function(req, res) {

        if (req.user) {
                return res.redirect('/mytickets');
        }

        var view = new keystone.View(req, res),
                locals = res.locals;

        locals.section = 'signin';
         view.on('post', function(next) {

                if (!req.body.email || !req.body.password) {
                        req.flash('error', 'Please enter your email and password.');
                        return next();
                }

                var onSuccess = function() {
                        res.redirect('/mytickets');
                }

                var onFail = function() {
                        req.flash('error', 'Input credentials were incorrect, please try again.')
                        return next();
                }

                keystone.session.signin({ email: req.body.email, password: req.body.password }\
, req, res, onSuccess, onFail);

        });

        view.render('auth/signin');

}
```

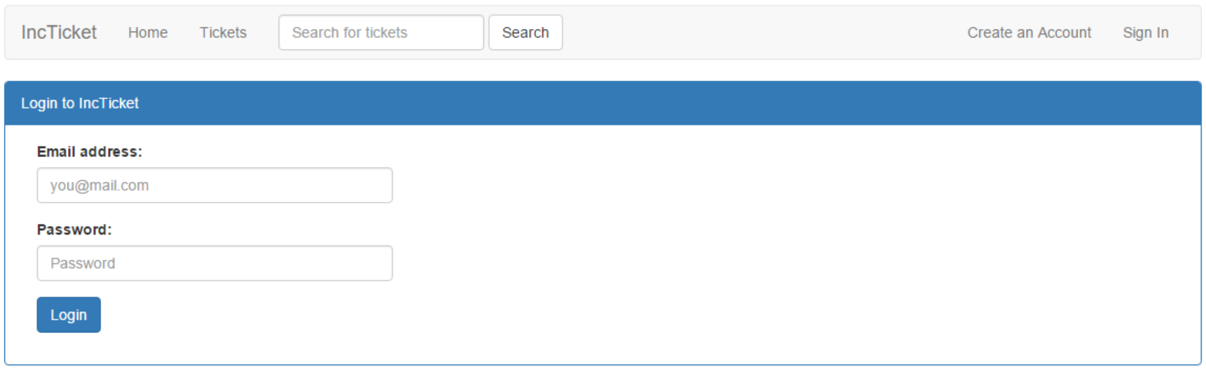
In the code for the view, we begin by checking if the user has already logged in. If they have logged in, we redirect the user to the /mytickets route to display a list of tickets created by the user. If the user has not logged in and has submitted the login form, we will process the login request using the **view.on** method. This handy method allows us to execute code depending on information in request object or on the type of HTTP VERB that was used. Since we POST the form to the view, we can process the login request using `view.on('post, function..)`. To validate the form contents, we check if the user has provided an email address and a password. If either one is empty, we set a flash error indicating the missing data and return the callback.

When the form data has been provided, we specify a couple of functions that indicate what has to be done when the user has successfully authenticated and when the authentication fails. These functions (onSuccess, onFail) are passed to the **keystone.session.signin** method. This handy method will first check to see if the email that was provided conforms to an email address regex pattern, then it will query our MongoDB database to see if a user exists with the specified email address and compares the password. If the user has provided valid credentials, then the function will regenerate a new session, sets the below objects in the request. To complete the login, the onSuccess method is called next.

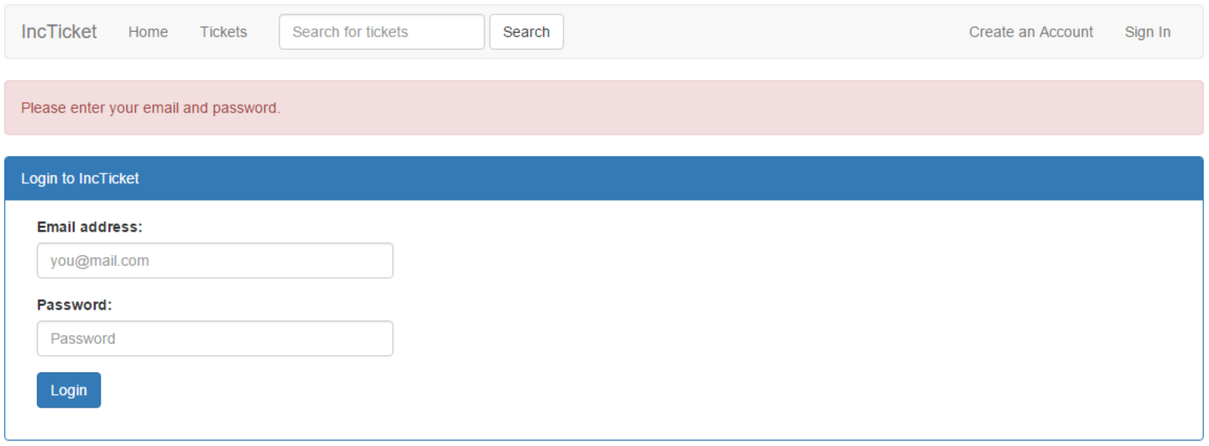
```
req.user = user;
req.session.userId = user.id;
```

Note: If the 'cookie signin' config object has been set, then Keystone.js will set a cookie on successful login.

Navigate to http://localhost:3000/signin and you should see the template rendered as below.



To test the validation and flash message rendering, click the login button without filling any credentials. We should see the validation error rendered as below:



Please enter your email and password.

Login to IncTicket

Email address:

you@mail.com

Password:

Password

Upon entering of valid email address and password, we should see the browser being redirecteed to /mytickets route.

Logging Out A User

To signout a user from your application, you just need to call the keystone.session.signout method. The signout operation will clear the user's cookies, set the request user object to null and regenerate a new session. Upon completion of signout, the user will be redirected to the root route of the application.

Create a view named signout.js under /routes/views/auth directory with the following code:

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

exports = module.exports = function(req, res) {

        keystone.session.signout(req, res, function() {
                res.redirect('/');
        });
};
```

Password Recovery

It is very easy to implement password recovery functionality. When a user wants to reset the password for their profile, we will generate a random key that will be set on the resetPasswordKey field on the user object and send an email to the user with a link to reset the password. After the user clicks on the link and returns to our application, we will validate that the key is actually valid for a user and then accept the new password.

Create a view named forgotpassword.js under /routes/views/auth directory with the following code:

```
var keystone = require('keystone'),
        User = keystone.list('User');

exports = module.exports = function(req, res) {

        var view = new keystone.View(req, res);

        view.on('post', function(next) {

                if (!req.body.email) {
                        req.flash('error', "Please enter an email address.");
                        return next();
                }

                User.model.findOne().where('email', req.body.email).exec(function(err, user) {
                        if (err) return next(err);
                        if (!user) {
                                req.flash('error', "Sorry, That email address is not registered i
cation.");
                                return next();
                        }

            user.resetPasswordKey = keystone.utils.randomString([16,24]);
            user.save(function(err) {
                if (err) return next(err);
                new keystone.Email({'templateName': 'forgotpassword', 'templateE\
xt': 'swig'}).send({
                    user: user,
                    link: '/resetpassword/' + user.resetPasswordKey,
                    subject: 'Reset your Password',
                    to: user.email,
                    from: {
                        name: 'IncTicket',
                        email: 'info@incticket.com'
                    }
                }, function(err) {
                    if (err) {
                        console.error(err);
                        req.flash('error', 'Error sending reset password email!'\
);
                        next();
                    } else {
                        req.flash('success', 'We have emailed you a link to rese\
t your password');
                        res.redirect('/signin');
                    }
                });
            });
                });

        });

        view.render('auth/forgotpassword');
}
```

In the code above, we first check if the user provided an email address to reset the password for. If the email belongs to a valid account then we generate a random string between 16 to 24 characters and save it on the user object. Next, we attempt to send an email to the user with the link to reset the password. Keystone.js makes it really easy to send emails. The **keystone.Email** method takes a templatePath parameter string which must be a folder in the emails path, and must contain either 'templateName/email.templateExt' or 'templateName.templateExt'. The **send** method takes an object that will be combined with the template and rendered before sending the email via Mandrill.

To configure the emails path, set the following option in keystone.js Javascript file:

```
'emails': 'templates/emails',
```

To configure the Mandrill API key, set the following key in your .env file:

```
MANDRILL_API_KEY= xxxx
```

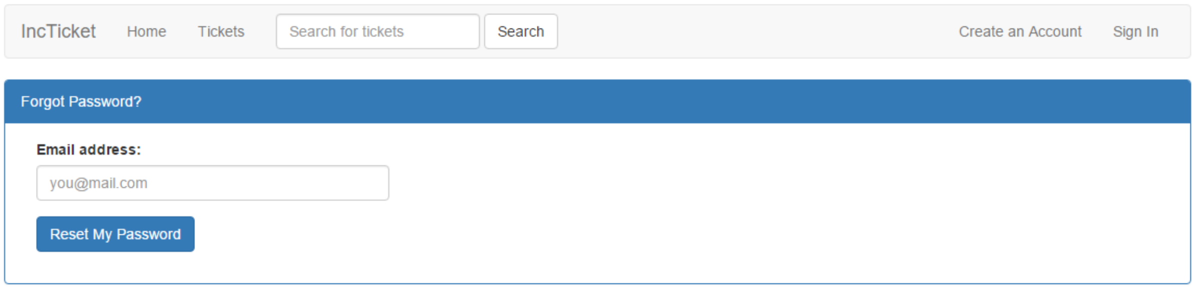
To create the email template, create a template named email.swig in /templates/emails/forgotpassword directory with the following markup:

```
Hello {{user.name.first}},
        <p>You recently requested a link to reset your IncTicket password.</p>
        <p>Please set a new password by following the link below:
        <a href='{{host}}{{link}}'>Click Here</a>
        </p>
```

Create a template named forgotpassword.swig under /templates/views/auth directory with the following markup:

```
{% extends "../../layouts/default.swig" %}

{% block content %}

<div class="container">
    <div class="panel panel-primary">
    <!-- Default panel contents -->
    <div class="panel-heading">Forgot Password?</div>
    <div class="panel-body">

    <div class="col-md-4">
    <form role="form" action="/forgotpassword" method="post">
    <div class="form-group">
        <label for="email" class="control-label">Email address:</label>
        <div class="input-icon">
        <input class="form-control email" id="email" placeholder="you@mail.com" \
name="email" type="email" value="">
        </div>
    </div>

    <div class="form-group">
        <input type="submit" class="btn btn-primary " value="Reset My Password">\

    </div>
    </form>
    </div>
    </div>
    </div>
</div>
 {% endblock %}
```

Let's update our signin page with a link to the forgot password route. Navigate to http://localhost:3000/forgotpasswor
and you should see the form rendered as below:



Let us fill out the form with a valid email id and inspect our MongoDB users collection. We should see the resetPasswordKey generated and stored on that user document.

```
{
    "_id": {
        "$oid": "56cb93af9b6f78b82c19c8c6"
    },
    "slug": "mpanati",
    "email": "manikanta.panati@gmail.com",
    "password": "$2a$10$Araw8IGfRpKa9xaEF/I540aCNvgE28MFEGOwqIbefMAtGs3px4I7K",
    "name": {
        "first": "Mani",
        "last": "Panati"
    },
    "username": "mpanati",
    "__v": 0,
    "resetPasswordKey": "30kNJIydGImAb2vHZGrFd8n"
}
```

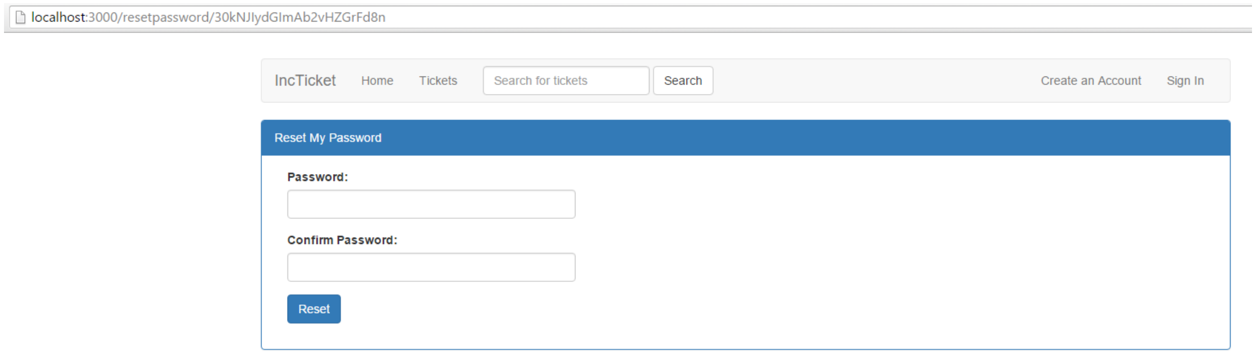
Create a template named resetpassword.swig under /templates/views/auth directory with the following markup:

```
{% extends "../../layouts/default.swig" %}

{% block content %}

<div class="container">
    <div class="panel panel-primary">
    <!-- Default panel contents -->
    <div class="panel-heading">Reset My Password</div>
    <div class="panel-body">

    <div class="col-md-4">
    <form role="form" action="/resetpassword" method="post">
    <input type='hidden' name='resetkey' value='{{key}}'/>
    <div class="form-group">
        <label for="password" class="control-label">Password:</label>
        <div class="input-icon">
        <input class="form-control email" id="password" name="password" type="pa\
ssword" value="">
        </div>
    </div>
    <div class="form-group">
        <label for="password_confirm" class="control-label">Confirm Password:</l\
abel>
        <div class="input-icon">
        <input class="form-control" id="password_confirm" name="password_confirm\
" type="password" value="">
        </div>
    </div>

    <div class="form-group">
        <input type="submit" class="btn btn-primary " value="Reset">
    </div>
    </form>
    </div>
    </div>
    </div>
</div>
 {% endblock %}
 {% endblock %}
```

Create a view named resetpassword.js under /routes/views/auth directory with the following code:

```
var keystone = require('keystone'),
        User = keystone.list('User');

exports = module.exports = function(req, res) {

        var view = new keystone.View(req, res),
                locals = res.locals;

        view.on('init', function(next) {

                User.model.findOne().where('resetPasswordKey', req.params.key).exec(function(e\
rr, userFound) {
                        if (err) return next(err);
                        if (!userFound) {
                                req.flash('error', "Sorry, that reset password key isn't valid.")
                                return res.redirect('/forgotpassword');
                        }
                        locals.key =  req.params.key;
                        next();
                });

        });

        view.on('post', function(next) {

                if (!req.body.password || !req.body.password_confirm) {
                        req.flash('error', "Please enter, and confirm your new password.");
                        return res.redirect('/resetpassword/'+req.params.key);
                }

                if (req.body.password != req.body.password_confirm) {
                        req.flash('error', 'Please make sure both passwords match.');
                        return res.redirect('/resetpassword/'+req.params.key);
                }

        User.model.findOne().where('resetPasswordKey', req.body.resetkey).exec(f\
unction(err, userFound) {
                        if (err) return next(err);
                        userFound.password = req.body.password;
           userFound.resetPasswordKey = '';
            userFound.save(function(err) {
                if (err) return next(err);
                req.flash('success', 'Your password has been reset, please sign \
in.');
                res.redirect('/signin');
            });
                });

        });

        view.render('auth/resetpassword');
};
```

Navigate to http://localhost:3000/resetpassword/30kNJIydGImAb2vHZGrFd8n and we should see the form to reset our password.

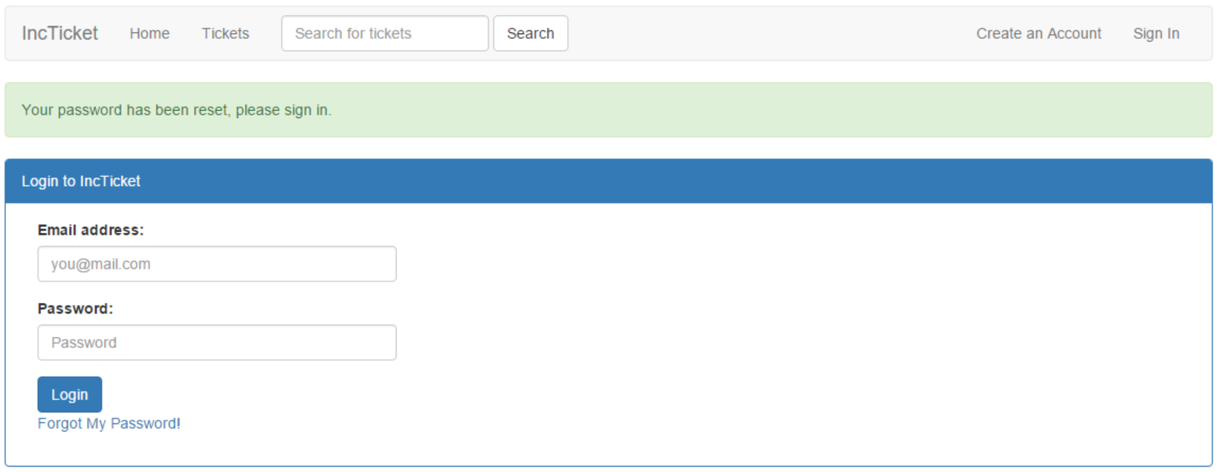

localhost:3000/resetpassword/30kNJlydGlmAb2vHZGrFd8n

Reset My Password

Password:

Confirm Password:

Populate the password field with a new password and a matching password in the confirm password field and click reset. The password for the user should be updated and the application should redirect to the signin page with a success flash message as shown below:



Your password has been reset, please sign in.

Login to IncTicket

Email address: you@mail.com

Password: Password

Retrieving the Authenticated User

To obtain a reference to the users document associated with the authenticated user, use `{{user}}`. For instance, to retrieve the user's name you'll access user like so:

```
Hello {{ user.name.first }} {{ user.name.last }}!
```

We would, however, need to check if the user actually authenticated before access the user's details. The user object is populated only if the user has authenticated else it would be undefined (for guests).

```
{% if user %}
    Hello {{ user.name.first }} {{ user.name.last }}!
{% endif %}
```

Restricting Access to Authenticated Users

To restrict access to a route to be accessible only by authenticated users, we can rely on Keystone.js's middleware. The middleware exposes a `requireUser` method that prevents people from accessing protected pages when they're not signed in. We can apply the middleware to the route as below:

```
app.all('/mytickets*', middleware.requireUser);
```

In the above example, we have specified that any sub-routes under /mytickets such as /mytickets, /mytickets/new, /mytickets/edit/1 with any HTTP verb, would all need the user to be first logged in.

Securing your application

A good framework should must possess the capability to provide security for the application being developed and Keystone.js is no exception. Keystone.js has capability built into it to prevent malicious attacks such as CSRF, IP range-based access control and iframe protection headers. Let us look how we can take advantage of these features.

Cross-site request forgery

Cross-site request forgery, commonly known as CSRF is a type of attack where a malicious website will send a request to another web application where the user is already authenticated. This enables the attacker to manipulate functionality in the target web application via the victim's authenticated browser. It is the responsibility of the affected web application to prevent such attacks and neither the victim's browser nor the site hosting the CSRF can do anything to prevent it.

The most common method to prevent Cross-Site Request Forgery (CSRF) attacks is to append CSRF tokens to each request and associate them with the user's session (ex via cookies). Such tokens can be unique per session or per request. By including the token with each request, the developer can ensure that the request is valid and not coming from a source other than the user.

Keystone.js's middleware makes the above mentioned very simple to implement. In fact, it takes just three lines to implement CSRF protection automatically. Let us look at how to add CSRF protection to the reset password form we present to the user as an example.

The first step is to automatically generate a CSRF token and set it in the cookie. Use the Keystone.js security middleware to do it on the GET route as below:

```
app.get('/resetpassword/:key', keystone.security.csrf.middleware.init, routes.vi\
ews.auth.resetpassword);
```

The next step is to set a hidden variable in the reset password form so that it can be posted back to the server along with the cookie behind the scenes. Add the following line to the template form:

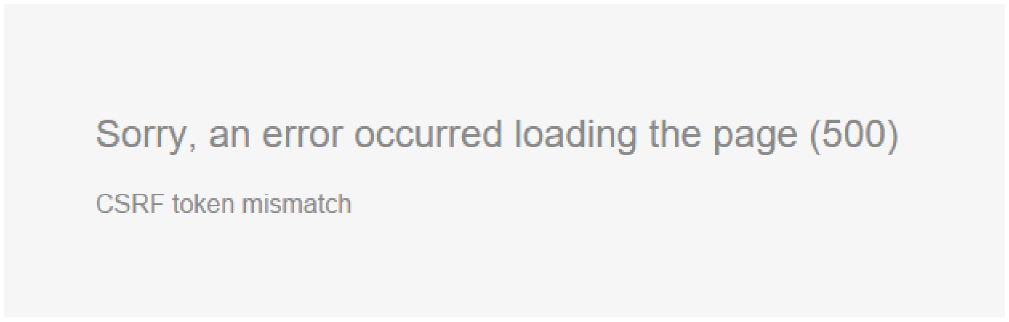
```
<input type='hidden' name='_csrf' value='{{csrf_token_value}}'/>
```

When `keystone.security.csrf.middleware.init` is called, it automatically adds a property named **csrf_token_value** to the response. Keystone.js expects the CSRF token to be named **_csrf** when it is posted back to the server for validation.

The next step is to request Keystone.js to validate the token before we start to process the form contents to reset the password. We can accomplish this with the validate security middleware method as shown below.

```
app.post('/resetpassword', keystone.security.csrf.middleware.validate, routes.vi\
ews.auth.resetpassword);
```

Adding the validate middleware method automatically checks for the validity of the incoming token. If the validation fails, Keystone.js returns a response with a HTTP 500 status.



Sorry, an error occurred loading the page (500)

CSRF token mismatch

The CSRF token generation and validation can also be done manually, if we choose to.

To generate the token, use the below methods and use in the template rendering:

```
var csrfTokenKey = keystone.security.csrf.TOKEN_KEY;
var csrfTokenValue = keystone.security.csrf.getToken(req, res);
```

To validate the token, use the validate methods:

```
if (keystone.security.csrf.validate(req)) {
    // CSRF is valid
    ...
  } else {
    // CSRF is not valid
    ...
  }
```

Cross-site scripting

Cross-site scripting, commonly known as XSS, is a form of attack where the intention is to execute a piece of Javascript on the user's browser when they are authenticated, in the hope of stealing cookies or session tokens. The most common way of performing such attacks is via unsanitized form inputs where the application accepts user input but does not sanitize it either before saving to the database or before rendering on the browser.

Avoiding such attacks is pretty easy. Swig, our rendering engine, will escape all output by default. There is no need to do any else!. In case we want to render something that should not be escaped, then use the **autoescape** tag and set it to false.

```
{% autoescape false %}{{ somejs }}{% endautoescape %}
```

As a good practise, It is very important for us to sanitize the input from users. OWASP has a list of rules that we can follow to mitigate XSS. More information is available at [https://www.owasp.org/index.php/XSS*(C*
Site_Scripting)_Prevention_Cheat_Sheet](https://www.owasp.org/index.php/XSS(Cross_Site_Scripting)_-
Prevention_Cheat_Sheet)

Cookies

Sessions are persisted using an encrypted cookie storing the user's ID using the `cookie secret` option for encryption. All cookies are automatically signed and encrypted which means that if they are tampered with, Keystone.js will automatically discard them and makes it very difficult to be read on the client side using JavaScript.

Summary

In this chapter, we have learned how to use Keystone.js's built in capabilty to add authentication features to our application quickly and also how to avoid common security problems.

Chapter 8. Searching site data

A good navigation menu makes a site very usable. Add a fast search to it and it makes the site much better. People use search engines like Google to find relevant information and expect to be able to find relevant information quickly and easily similarly, on our site as well. A good search experience can make users return to the website for future queries as well. Writing a good search system from scratch is a tough task but node, express and keystone.js make it relatively easy.

In this chapter we will look at a quick way to present search results from our keystone.js application using Mongo DB's inbuilt full-text search capability.

MongoDB fulltext search

A good search system is indispensible to locating relevant online information on a website. To be able to provide precise search results in response to a query, the search system should not only cut down extra results but also use ranking and precision to organize the search results. A good search system will provide the most relevant results at the top. Beginning from version 2.4, MongoDB offered full-text search using Text indexes. MongoDB full-text search allows us to define a text index on any field in the document whose value is either a string or an array of string elements. When we create a text index on a field, MongoDB tokenizes, eliminates stop words, and stems the indexed field's content and adds it to the index. An important consideration is that a collection can contain only one text index. Hence it is very important for us to determine what we want fields to allow to be searched.

To create a text index, use the `db.collection.createIndex()` command against the MongoDB database.

Indexing a Single Field

To kick off things, let's create a text index on the title field of our ticket documents. Run the following query on the mongo shell:

```
db.tickets.createIndex({"title":"text"})
```

To inspect the full-text index, let us retrieve a list of indexes on the tickets collection using db.tickets.getIndexes() method. We should see a response similar to below.

```
{
        "v" : 1,
        "key" : {
                "_fts" : "text",
                "_ftsx" : 1
        },
        "name" : "title_text",
        "ns" : "practicalkeystone.tickets",
        "weights" : {
                "title" : 1
        },
        "default_language" : "english",
        "language_override" : "language",
        "textIndexVersion" : 2
}
```

As you see, the name of the index is automatically set to title_text that indicates the indexed field and the text type of index. By default, the field is given a weight of 1. To test this newly created text index on the title field, we will search documents using the **$text** operator. Since we are interested in displaying the results according to decreasing level of relevance, lets get some statistics about how relevant the resultant documents are using the `{ $meta: "textScore" }` expression. A higher textScore indicates a more relevant match. Use the sort command on textScore to order the documents. For the test, let us search for all the tickets that have the keyword 'image' in their subject field.

```
db.tickets.find({$text: {$search: "image"}}, {score: {$meta: "textScore"}}).sort\
({score:{$meta:"textScore"}})
```

The above query returns the following documents:

```
{
  "_id": ObjectId("569cf4b858af0e88163ac180"),
  "slug": "images-not-loading",
  "title": "Images not loading",
  "updatedAt": ISODate("2016-01-18T14:20:40Z"),
  "createdAt": ISODate("2016-01-18T14:20:40Z"),
  "status": "New",
  "category": "Bug",
  "priority": "High",
  "__v": 0,
  "assignedTo": ObjectId("5692e414daa25ac42d792aed"),
  "createdBy": ObjectId("5692e414daa25ac42d792aed"),
  "description": "Some of the images do not load until the page is scrolled down\
. As you scroll down the page, you can see the images appear after a split secon\
d. Not sure what is causing this but it should definitely be fixed.\r\n",
  "score": 0.75
}{
  "_id": ObjectId("56c27c7d00647be83185f932"),
  "slug": "resize-images-on-all-pages",
  "assignedTo": ObjectId("5698e871a3497098256941b4"),
  "createdBy": ObjectId("5692e414daa25ac42d792aed"),
  "description": "Resize images on all pages so as to save bandwidth",
  "updatedAt": ISODate("2016-02-16T01:33:49.867Z"),
  "createdAt": ISODate("2016-02-16T01:33:49.867Z"),
  "status": "New",
  "category": "Feature",
  "priority": "Medium",
  "title": "Resize  images on all pages",
  "__v": 0,
  "score": 0.6666666666666666
}{
  "_id": ObjectId("56c27c6100647be83185f931"),
  "slug": "lazy-load-images-on-all-pages",
  "assignedTo": ObjectId("5698e871a3497098256941b4"),
  "createdBy": ObjectId("5692e414daa25ac42d792aed"),
  "description": "Lazy load images on all pages so they load faster",
  "updatedAt": ISODate("2016-02-16T01:33:21.110Z"),
  "createdAt": ISODate("2016-02-16T01:33:21.110Z"),
  "status": "New",
  "category": "Feature",
  "priority": "Medium",
  "title": "Lazy load images on all pages",
  "__v": 0,
  "score": 0.625
}
```

As you can see, the first document has a score of 0.75 (since the keyword image appears first in its title) as opposed to the second document with a score of 0.66. The query has also sorted the returned documents in descending order of their score.

Indexing Multiple Fields/Wild Card Indexing

In the previous example, we created an index from the title field for our tickets. Most often, we might need to search on multiple fields on our documents. MongoDB allows indexing of multiple fields known as compound indexing or indexing of all fields in a document known as wild card indexing. We will look at an example of both.

Let us create a compound full-text index on the title and description fields of our tickets. Since MongoDB allows only for one full-text index per collection, we would need to drop the one that was created during the previous example.

Drop the index using the below command:

```
db.tickets.dropIndex("title_text");
```

Next, use the below command to create the compound index:

```
db.tickets.createIndex({"title":"text","description":"text"})
```

If we retrieve the list of indexes on the tickets collection, we should see the new compound index:

```
{
    "v" : 1,
    "key" : {
            "_fts" : "text",
            "_ftsx" : 1
    },
    "name" : "title_text_description_text",
    "ns" : "practicalkeystone.tickets",
    "weights" : {
            "description" : 1,
            "title" : 1
    },
    "default_language" : "english",
    "language_override" : "language",
    "textIndexVersion" : 2
}
```

The way to query a compound index remains the same as a single field index except that MongoDB will search on two fields to compute its relevance score. As you see, the weights for both the title and description are set to 1 by default. We can specify relative weights for the indexed fields by using the **weights** option while creating the index. For each indexed field in the document, MongoDB multiplies the number of matches by the weight and sums the results. Using this sum, MongoDB then calculates the score for the document.

```
db.tickets.createIndex({"title":"text","description":"text"},{"weights": { title\
: 3, description:1 }});
```

To index an entire document using the wild card indexing, use the below command after dropping any existing text indexes:

```
db.tickets.createIndex({"$**":"text"})
```

The above command will automatically index all text fields in the documents. It is important to keep in mind that wild card indexes can be slow sometimes if the data is very large. For this reason, it is important to plan full-text indexes for proper search experience.

Note: MongoDB's full-text search is not a complete replacement for search applications such as Elastic search, SOLR, etc. However, it can be effectively used for the majority of applications that are built. If you need fine grain control, efficient binary file indexing then I suggest investigating full-blown search solutions.

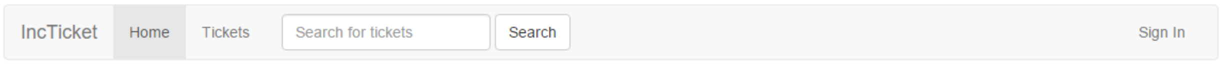
Adding search to Keystone.js

We will implement a search bar on our site, which will query our MongoDB full-text index for relevant results. Each result will contain a title of the ticket that is linked to the indexed ticket, followed by a summary. The results are ranked with the most relevant at the top.

Start by adding the below markup, for the search bar, to the navbar in `/templates/layouts/default.swig`:

```
 <form class="navbar-form navbar-left" role="search" action="/search" method="GE\
T">
    <div class="form-group">
        <input type="text" class="form-control" id="keywords" name="keywords" pl\
aceholder="Search for tickets">
    </div>
    <button type="submit" class="btn btn-default">Search</button>
</form>
```

The header should show a search bar as shown below:



Search Bar

The search keywords will be sent to the `/search` route using a HTTP GET. Let us add this route to our `/routes/index.js` file. Using a GET is convenient in our case if we want to allow users to deep link to search results i.e. share the URL for search results with other users.

```
app.get('/search', routes.views.tickets.search);
```

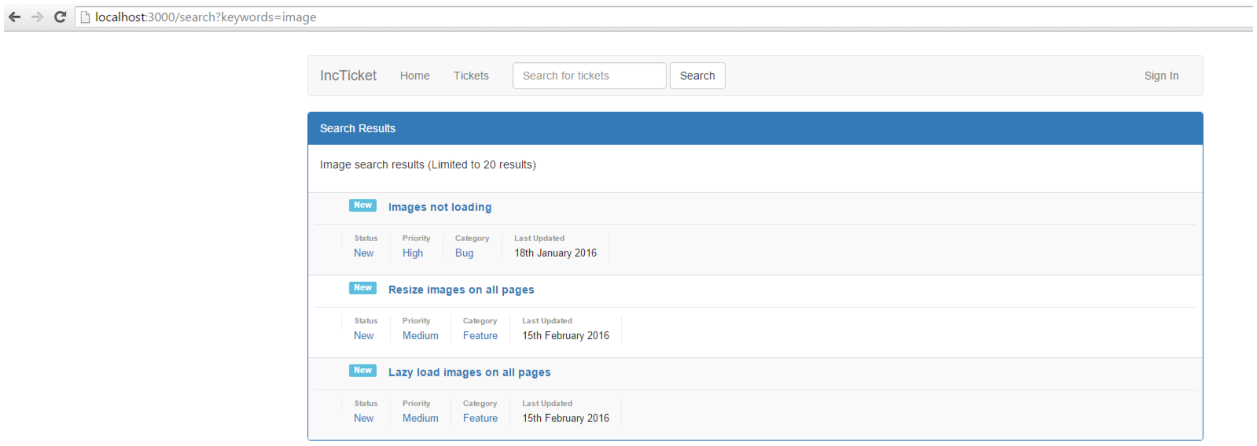
Next create the search view at `/routes/views/tickets/search.js` and add the below code:

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

exports = module.exports = function(req, res) {

	var view = new keystone.View(req, res),
		locals = res.locals;

	// Set locals
	locals.filters = {
		keywords: req.query.keywords
	};
	locals.data = {
		tickets: [],
		keywords: "",
	};

	// Load the current product
	view.on('init', function(next) {
		console.log('search keywords=' + locals.filters.keywords);
		locals.data.keywords = locals.filters.keywords;

		//search the full-text index
		keystone.list('Ticket').model.find(
			{ $text : { $search : locals.filters.keywords } },
			{ score : { $meta: "textScore" } }
		).sort({ score : { $meta : 'textScore' } }).
			limit(20).
			exec(function(error, results) {
				if(error) console.log(error);

				 locals.data.tickets = results
				next();
		});
	 });

	// Render the view
	view.render('tickets/search');

};
```

In the code above, we retrieve the search keywords from the request object and use the full-text index to search for tickets that match the keywords. To display the list of search results, create a template named **search.swig** in `/templates/views/tickets` and add the following code.

```
{% extends "../../layouts/default.swig" %}

{% block content %}

        <div class="container">
                <div class="panel panel-primary">
        <!-- Default panel contents -->
        <div class="panel-heading">Search Results</div>
        <div class="panel-body">
            <p>{{data.keywords | title}} search results (Limited to 20 results)<\
/p>
        </div>

        <!-- Table -->
        <table class="table  table-striped">
            {% for ticket in data.tickets %}
               {% include 'ticket.swig' %}
            {% endfor %}
        </table>

        </div>

        </div>
{% endblock %}
```

Restart the application using node keystone.js command and issue a search for the keyword ‘image’. We should see search results similar to below:


localhost:3000/search?keywords=image

Search Results

Image search results (Limited to 20 results)

New Images not loading

Status	Priority	Category	Last Updated
New	High	Bug	18th January 2016

New Resize images on all pages

Status	Priority	Category	Last Updated
New	Medium	Feature	15th February 2016

New Lazy load images on all pages

Status	Priority	Category	Last Updated
New	Medium	Feature	15th February 2016

List of Search Results

Summary

This chapter has introduced the full-text search engine capability that MongoDB provides and how Keystone.js easily enables a developer to add a search facility to a website. We have looked in detail at how to index data in our MongoDB tickets collection, provide weights to the fields that are important and how to query & display the results. There are additional, powerful features such as text search for various languages that we can take advantage of.

Chapter 9. Restful API for Mobile and SPA applications

Introducing Restful APIs

REST stands for REpresentational State Transfer and is a pattern for developing APIs where we expose our business entities to be accessed and manipulated using HTTP requests. Each request can be one of these most often used protocols - GET, POST, PUT, PATCH, and DELETE. Each of these methods correspond to a particular, well defined behavior that can be leveraged while building the API. Each entity is exposed under a logical grouping which allows for easier maintenance of the API, providing simplicity along with portability.

RESTful APIs are platform-independent and the fact that they are based on simple, well-established standards allows developers to achieve high performance, large scale, and secure communication when using REST APIs. The server is understood to be stateless in the RESTful paradigm which means there is no notion of multiple requests acting within a single context on the server, this helps to scale out the services better. Content negotiation is also a part of the RESTful paradigm wherein the client can specify what format of data they are expecting back.

The RESTful paradigm should be treated as a useful set of rules to expose our application via end points. There may be many ways of implementing RESTful APIs and each developer tends to follow their own conventions as to what RESTful means to them. The simple bottomline should be that the APIs must be designed in such a manner that it serves the purpose of the application in a manner that you see fit and not get bogged down in following what a manual might specify.

What Are We Building?

Let's begin by outlining how our API is actually going to look like. To be able to work with the tickets that are stored in our MongoDB database, we are going to support a GET to an API called tickets that will return a list of tickets. We would like to include a parameter named page for paging the results. In addition, the API will allow users to get data about a specific ticket by ID. The API will also support getting a list of tickets for the current user logged in. The API should also allow users to Post a new ticket and allow them to delete an individual ticket. With these features in mind, let's see how we can expose a RESTful API for our Ticket Model. We will develop the following routes to allow for data retrieval and manipulation in a REST based fashion:

- **GET /api/tickets**: This gets the list of tickets

- **GET /api/tickets/{id}**: This gets the ticket with ID {id}
- **POST /api/tickets**: This creates a new ticket
- **PUT /api/tickets/{id}**: This updates the ticket with ID {id}
- **DELETE /api/tickets/{id}**: This deletes the ticket with ID {id}

With an understanding of what APIs we intend to build, let us begin implementing them in our application. To start off, add the following routes that define the endpoints. The URL for a RESTful API is known as an endpoint.

```
// API
app.get('/api/tickets', keystone.middleware.api, routes.api.ticket.getTickets);
app.get('/api/tickets/:id', keystone.middleware.api, routes.api.ticket.getTicket\
ById);
app.post('/api/tickets', keystone.middleware.api, routes.api.ticket.createTicket\
);
app.put('/api/tickets/:id', keystone.middleware.api, routes.api.ticket.updateTic\
ketById);
app.delete('/api/tickets/:id', keystone.middleware.api, routes.api.ticket.delete\
TicketById);
```

The **keystone.middleware.api** parameter in the route adds the following shortcut methods for JSON API responses.

- res.apiResponse(data)
- res.apiError(key, err, msg, code)
- res.apiNotFound(err, msg)
- res.apiNotAllowed(err, msg)

The **apiReponse** method returns the response data in the JSON format. It can also automatically return data in JSONP if there is a callback specified in the request parameters.

The **apiError** method is a handy utility to return error messages to the client from our APIs. It returns an object with two keys - error and detail, which contain the exception that occured. By default, it returns a HTTP status of 500 if the code parameter is not passed.

The **apiNotFound** method provides a quick way to raise a 404 (not found) exception from our APIs.

The **apiNotAllowed** method provides a quick way to raise a 403 (not allowed) HTTP response from our APIs.

Next, update the keystone.js file with the below code to indicate to the application that we need to import views that are under the routes/api directory. By default, the code will only look for views under /routes/views directory.

```
// Import Route Controllers
var routes = {
        views: importRoutes('./views'),
    api: importRoutes('./api')
};
```

After defining the end points for the APIs, create the ticket.js view under **routes/api** directory to handle the responses.

ticket.js

```
var keystone = require('keystone'),
    Ticket = keystone.list('Ticket');

/**
 * List Tickets
 */
exports.getTickets = function(req, res) {
        Ticket.model.find(function(err, items) {

                if (err) return res.apiError('database error', err);

                res.apiResponse({
                        tickets: items
                });

        });
}

/**
 * Get Ticket by ID
 */
exports.getTicketById = function(req, res) {
        Ticket.model.findById(req.params.id).exec(function(err, item) {

                if (err) return res.apiError('database error', err);
                if (!item) return res.apiError('not found');

                res.apiResponse({
                        ticket: item
                });

        });
```

```
}


/**
 * Create a Ticket
 */
exports.createTicket = function(req, res) {

        var item = new Ticket.model(),
                data = req.body;

        item.getUpdateHandler(req).process(data, function(err) {

                if (err) return res.apiError('error', err);

                res.apiResponse({
                        ticket: item
                });

        });
}

/**
 * Update Ticket by ID
 */
exports.updateTicketById = function(req, res) {
        Ticket.model.findById(req.params.id).exec(function(err, item) {

                if (err) return res.apiError('database error', err);
                if (!item) return res.apiError('not found');

                var data = req.body;

                item.getUpdateHandler(req).process(data, function(err) {

                        if (err) return res.apiError('create error', err);

                        res.apiResponse({
                                ticket: item
                        });

                });

        });
}

/**
 * Delete Ticket by ID
 */
exports.deleteTicketById = function(req, res) {
        Ticket.model.findById(req.params.id).exec(function (err, item) {

                if (err) return res.apiError('database error', err);
                if (!item) return res.apiError('not found');

                item.remove(function (err) {
                        if (err) return res.apiError('database error', err);

                        return res.apiResponse({
                                success: true
                        });
                });

        });
}
```

Tools for working with Restful APIs

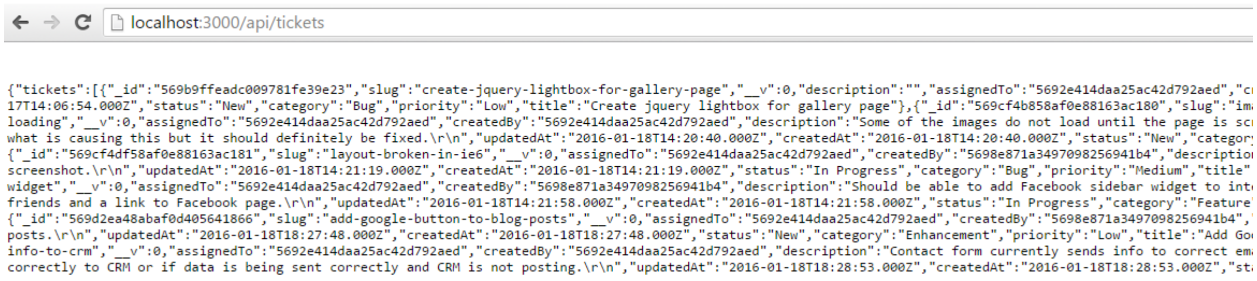
Now that we have implemented our APIs, how do we actually test whether they work?. There are a couple of useful tools that make it really simple to issue RESTful requests (GET, POST, PUT etc) to our application API end points and look at the response. The first, simple but often very useful tool is the JSON Formatter Chrome extension. By default, Chrome renders any JSON as plain text, making it hard to understand the structure of the response. The extension helps by converting any JSON responses in the browser into a well formatted tree display with syntax highlighting and code folding. This can be useful for making a few test calls to APIs from within the browser for experimentation. The second tool is an application named POSTMAN REST client. POSTMAN makes it really easy to craft various kinds of requests to API endpoints. This application can be run as a Google Chrome extension within the browser or as a standalone application.

JSON Formatter Chrome Extension

To install the JSON Formatter Chrome extension, navigate to https://chrome.google.com/webstore/detail/json-formatter/bcjindcccaagfpapjjmafapmmgkkhgoa?[6] from chrome and add the extension to the browser.

[6]https://chrome.google.com/webstore/detail/json-formatter/bcjindcccaagfpapjjmafapmmgkkhgoa?

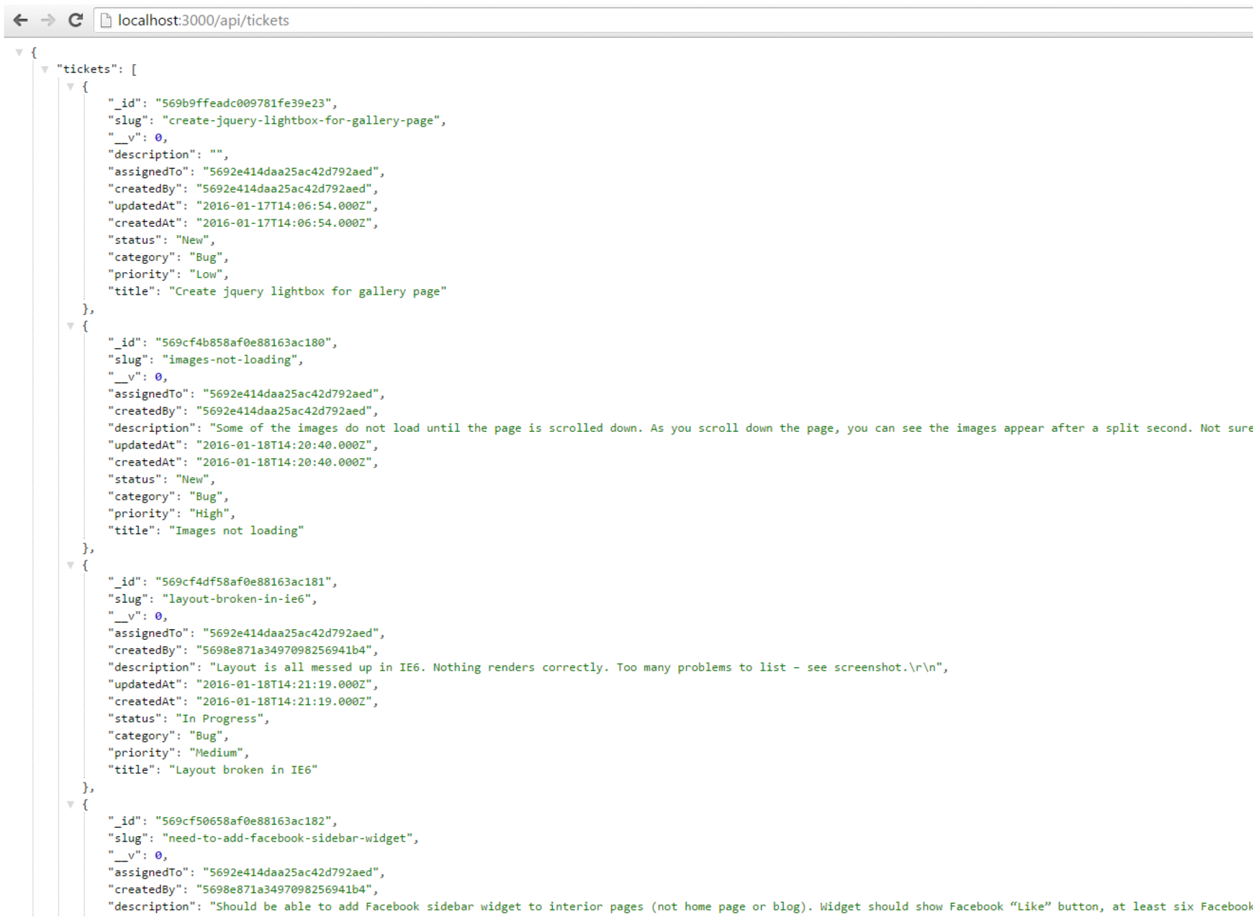
Here is the response from pointing to our tickets endpoint that returns JSON before JSON Formatter is installed:



localhost:3000/api/tickets

```
{"tickets":[{"_id":"569b9ffeadc009781fe39e23","slug":"create-jquery-lightbox-for-gallery-page","__v":0,"description":"","assignedTo":"5692e414daa25ac42d792aed","c
17T14:06:54.000Z","status":"New","category":"Bug","priority":"Low","title":"Create jquery lightbox for gallery page"},{"_id":"569cf4b858af0e88163ac180","slug":"im
loading","__v":0,"assignedTo":"5692e414daa25ac42d792aed","createdBy":"5692e414daa25ac42d792aed","description":"Some of the images do not load until the page is sc
what is causing this but it should definitely be fixed.\r\n","updatedAt":"2016-01-18T14:20:40.000Z","createdAt":"2016-01-18T14:20:40.000Z","status":"New","categor
{"_id":"569cf4df58af0e88163ac181","slug":"layout-broken-in-ie6","__v":0,"assignedTo":"5692e414daa25ac42d792aed","createdBy":"5698e871a3497098256941b4","descriptio
screenshot.\r\n","updatedAt":"2016-01-18T14:21:19.000Z","createdAt":"2016-01-18T14:21:19.000Z","status":"In Progress","category":"Bug","priority":"Medium","title"
widget","__v":0,"assignedTo":"5692e414daa25ac42d792aed","createdBy":"5698e871a3497098256941b4","description":"Should be able to add Facebook sidebar widget to int
friends and a link to Facebook page.\r\n","updatedAt":"2016-01-18T14:21:58.000Z","createdAt":"2016-01-18T14:21:58.000Z","status":"In Progress","category":"Feature
{"_id":"569d2ea48abaf0d405641866","slug":"add-google-button-to-blog-posts","__v":0,"assignedTo":"5692e414daa25ac42d792aed","createdBy":"5698e871a3497098256941b4",
posts.\r\n","updatedAt":"2016-01-18T18:27:48.000Z","createdAt":"2016-01-18T18:27:48.000Z","status":"New","category":"Enhancement","priority":"Low","title":"Add Go
info-to-crm","__v":0,"assignedTo":"5692e414daa25ac42d792aed","createdBy":"5692e414daa25ac42d792aed","description":"Contact form currently sends info to correct em
correctly to CRM or if data is being sent correctly and CRM is not posting.\r\n","updatedAt":"2016-01-18T18:28:53.000Z","createdAt":"2016-01-18T18:28:53.000Z","st
```

And here is that same URL after JSON Formatter has been installed:

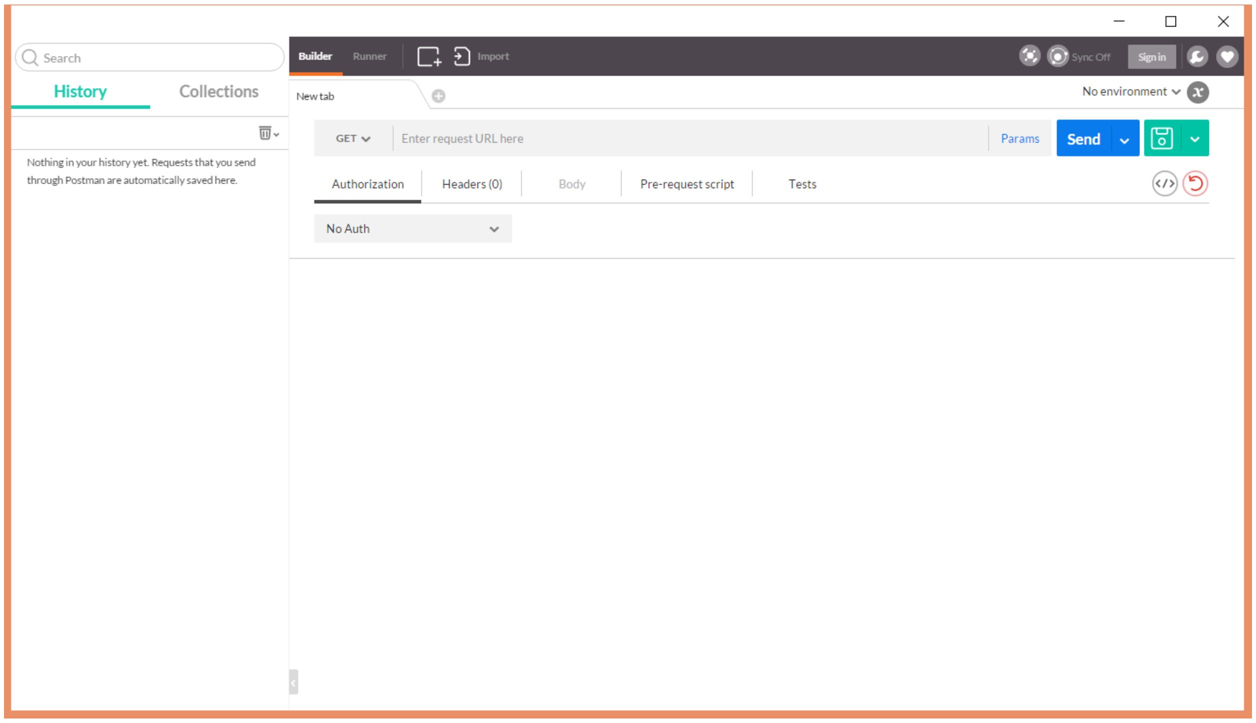


localhost:3000/api/tickets

```
{
  "tickets": [
    {
      "_id": "569b9ffeadc009781fe39e23",
      "slug": "create-jquery-lightbox-for-gallery-page",
      "__v": 0,
      "description": "",
      "assignedTo": "5692e414daa25ac42d792aed",
      "createdBy": "5692e414daa25ac42d792aed",
      "updatedAt": "2016-01-17T14:06:54.000Z",
      "createdAt": "2016-01-17T14:06:54.000Z",
      "status": "New",
      "category": "Bug",
      "priority": "Low",
      "title": "Create jquery lightbox for gallery page"
    },
    {
      "_id": "569cf4b858af0e88163ac180",
      "slug": "images-not-loading",
      "__v": 0,
      "assignedTo": "5692e414daa25ac42d792aed",
      "createdBy": "5692e414daa25ac42d792aed",
      "description": "Some of the images do not load until the page is scrolled down. As you scroll down the page, you can see the images appear after a split second. Not sure
      "updatedAt": "2016-01-18T14:20:40.000Z",
      "createdAt": "2016-01-18T14:20:40.000Z",
      "status": "New",
      "category": "Bug",
      "priority": "High",
      "title": "Images not loading"
    },
    {
      "_id": "569cf4df58af0e88163ac181",
      "slug": "layout-broken-in-ie6",
      "__v": 0,
      "assignedTo": "5692e414daa25ac42d792aed",
      "createdBy": "5698e871a3497098256941b4",
      "description": "Layout is all messed up in IE6. Nothing renders correctly. Too many problems to list - see screenshot.\r\n",
      "updatedAt": "2016-01-18T14:21:19.000Z",
      "createdAt": "2016-01-18T14:21:19.000Z",
      "status": "In Progress",
      "category": "Bug",
      "priority": "Medium",
      "title": "Layout broken in IE6"
    },
    {
      "_id": "569cf50658af0e88163ac182",
      "slug": "need-to-add-facebook-sidebar-widget",
      "__v": 0,
      "assignedTo": "5692e414daa25ac42d792aed",
      "createdBy": "5698e871a3497098256941b4",
      "description": "Should be able to add Facebook sidebar widget to interior pages (not home page or blog). Widget should show Facebook “Like” button, at least six Facebook
```

POSTMAN REST Client

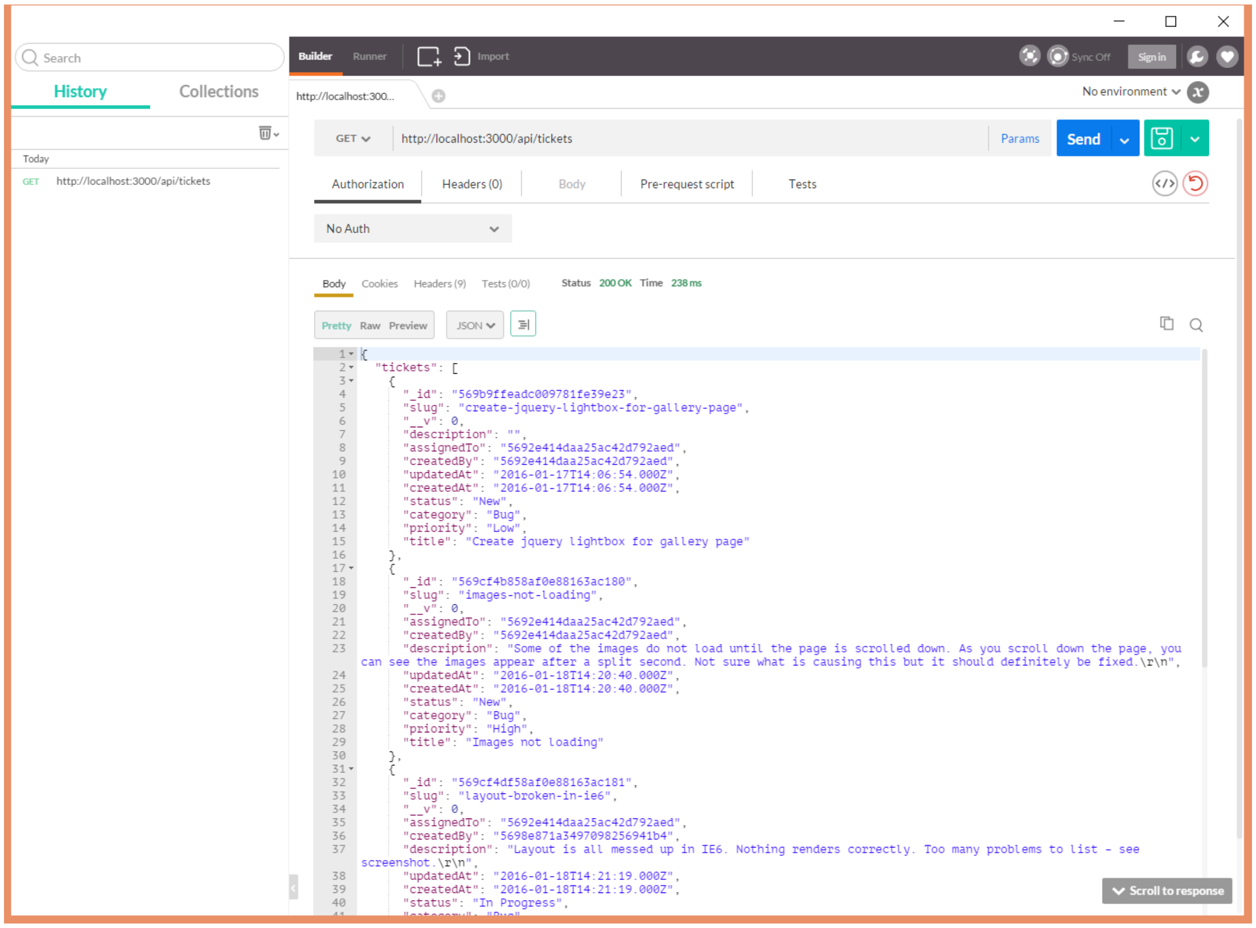
Installing POSTMAN REST Client is simple. Visit https://www.getpostman.com/apps[7] and click on the 'Get the chrome app' button. This will take you to the Google Chrome Web Store, and provide an option to add the extension to chrome. After installing the extension, launch it. You should be presented with a screen like below:



Nothing in your history yet. Requests that you send through Postman are automatically saved here.

POSTMAN provides a very intuitive interface to make any kind of requests to any endpoint. To test our API call to get a list of tickets, enter the URL http://localhost:3000/api/tickets in the Enter request URL here field and leave the dropdown next to it as GET since we would like to make a HTTP GET request to our endpoint. Click on the Send button. This will make a HTTP GET similar to a browser and render the response at the bottom half of the application.

[7] https://www.getpostman.com/apps



GET http://localhost:3000/api/tickets

No Auth

Status 200 OK Time 238 ms

```
{
  "tickets": [
    {
      "_id": "569b9ffeadc009781fe39e23",
      "slug": "create-jquery-lightbox-for-gallery-page",
      "__v": 0,
      "description": "",
      "assignedTo": "5692e414daa25ac42d792aed",
      "createdBy": "5692e414daa25ac42d792aed",
      "updatedAt": "2016-01-17T14:06:54.000Z",
      "createdAt": "2016-01-17T14:06:54.000Z",
      "status": "New",
      "category": "Bug",
      "priority": "Low",
      "title": "Create jquery lightbox for gallery page"
    },
    {
      "_id": "569cf4b858af0e88163ac180",
      "slug": "images-not-loading",
      "__v": 0,
      "assignedTo": "5692e414daa25ac42d792aed",
      "createdBy": "5692e414daa25ac42d792aed",
      "description": "Some of the images do not load until the page is scrolled down. As you scroll down the page, you
can see the images appear after a split second. Not sure what is causing this but it should definitely be fixed.\r\n",
      "updatedAt": "2016-01-18T14:20:40.000Z",
      "createdAt": "2016-01-18T14:20:40.000Z",
      "status": "New",
      "category": "Bug",
      "priority": "High",
      "title": "Images not loading"
    },
    {
      "_id": "569cf4df58af0e88163ac181",
      "slug": "layout-broken-in-ie6",
      "__v": 0,
      "assignedTo": "5692e414daa25ac42d792aed",
      "createdBy": "5698e871a3497098256941b4",
      "description": "Layout is all messed up in IE6. Nothing renders correctly. Too many problems to list - see
screenshot.\r\n",
      "updatedAt": "2016-01-18T14:21:19.000Z",
      "createdAt": "2016-01-18T14:21:19.000Z",
      "status": "In Progress",
```

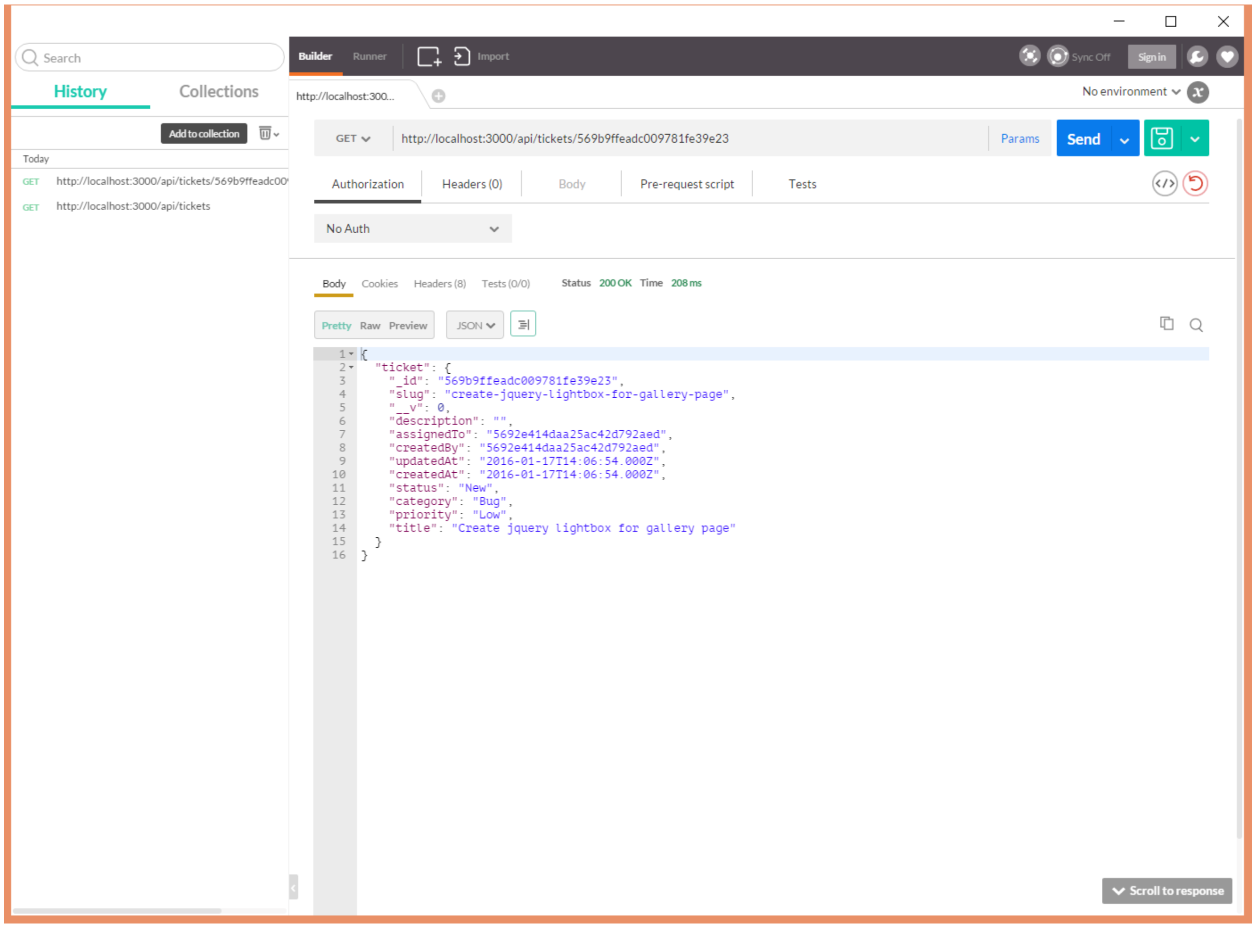
A great feature of POSTMAN is that it formats the reponse from requests to make it readable and easy to work with. In our case, it has pretty printed the JSON list of tickets. It also provides nice code collapsing and search feature for finding keywords in our response. The sidebar also maintains a history of requests that we have made which can be saved and replayed to various endpoints.

Serve Data With GET Requests

Exposing data from our application via a HTTP GET is fairly simple. For example, let us look at our implementation for getting a ticket by id. We use the Mongoose findById method to obtain a single document that matches the id passed via the request object. If there was an error querying the document, we use the api middleware method apiError to return a well formatted error object with a 404 status. If the query returns a matching document, we send back JSON with the result document assigned to the key - ‘ticket’, using the apiResponse middleware method.

```
Ticket.model.findById(req.params.id).exec(function(err, item) {

                if (err) return res.apiError('database error', err);
                if (!item) return res.apiError('not found');

                res.apiResponse({
                        ticket: item
                });

        });
```

The id for the document would be the _id field on the document that would be autogenerated by MongoDB for the tickets that we have created. Let us test the call to this end point using POSTMAN:


GET http://localhost:3000/api/tickets/569b9ffeadc009781fe39e23

Status 200 OK Time 208 ms

```
{
  "ticket": {
    "_id": "569b9ffeadc009781fe39e23",
    "slug": "create-jquery-lightbox-for-gallery-page",
    "__v": 0,
    "description": "",
    "assignedTo": "5692e414daa25ac42d792aed",
    "createdBy": "5692e414daa25ac42d792aed",
    "updatedAt": "2016-01-17T14:06:54.000Z",
    "createdAt": "2016-01-17T14:06:54.000Z",
    "status": "New",
    "category": "Bug",
    "priority": "Low",
    "title": "Create jquery lightbox for gallery page"
  }
}
```

We can see that our API correctly returns a single instance of the ticket matching the id that was requested.

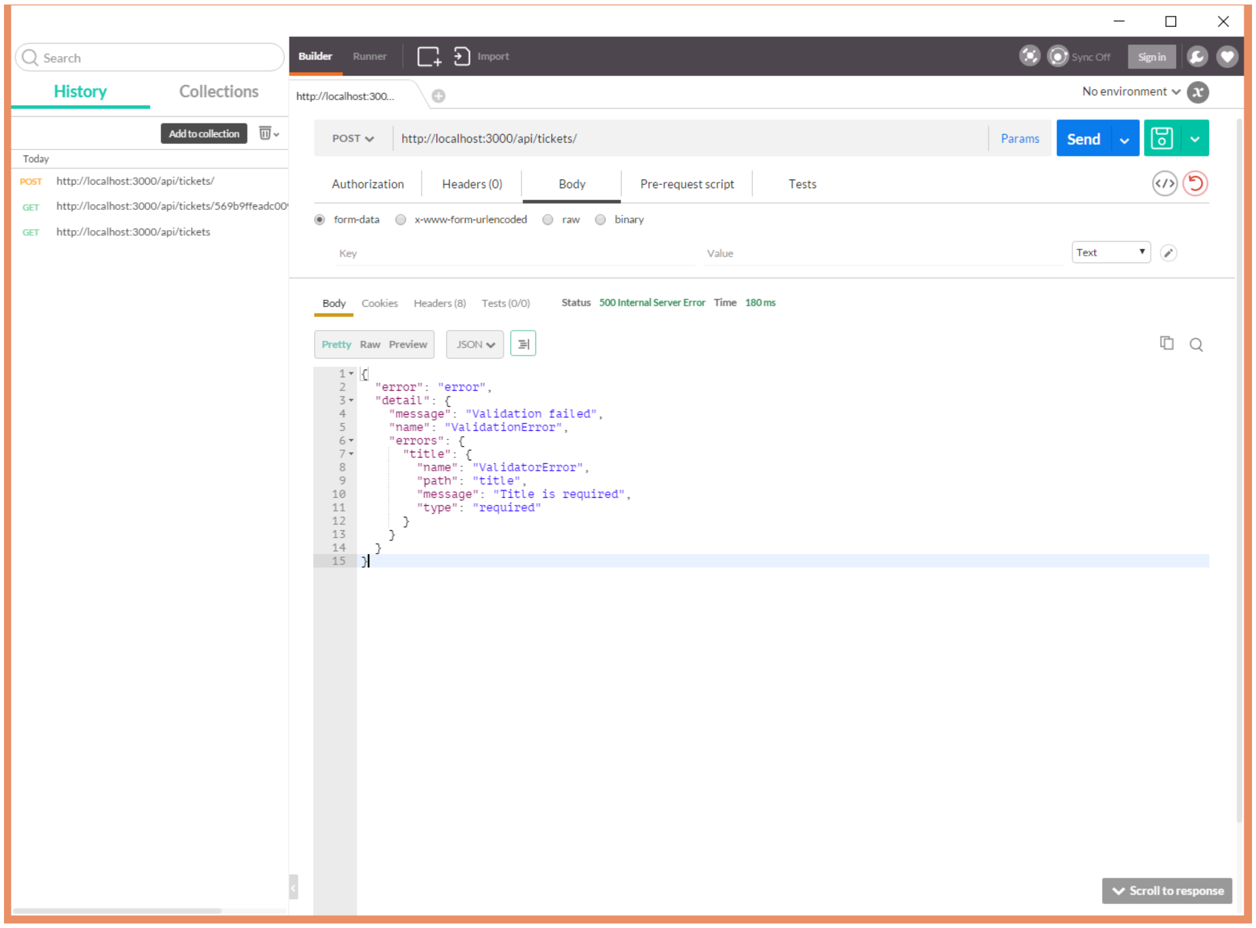
Update Data With POST and PUT

The most common HTTP verbs used to able to receive data on the server side are POST and PUT. POST is generally accepted as the verb to be used when we need to insert/save a new document. Let's take a look at endpoint code that accepts a POST request and inserts a ticket into our collection and returns the new document JSON.

```
var item = new Ticket.model(),
                data = req.body;

        item.getUpdateHandler(req).process(data, function(err) {

                if (err) return res.apiError('error', err);

                res.apiResponse({
                        ticket: item
                });

        });
```

The getUpdateHandler method is added to the underlying Mongoose Model for our Ticket Keystone.js List when we register the list during creation. The power of Keystone.js lies in its ability to be able to do most of the heavy lifting for the developer and the update handler is one such example. The method single handedly validates various criteria that have been specified during model definition. For example, we have specified that the title field is required. This will be properly validated automatically without the developer needing to check for such constraints programatically at every instance. The method is capable of returning flash error messages (if using a view to display the response) or a collection of validation errors. If fields were marked as uneditable using the noedit option during the creation of the model, then these fields will be skipped over automatically.

To check the validation in action, perform an empty POST to the /api/tickets end point.



Today

```
POST http://localhost:3000/api/tickets/
GET  http://localhost:3000/api/tickets/569b9ffeadc00
GET  http://localhost:3000/api/tickets
```

POST http://localhost:3000/api/tickets/

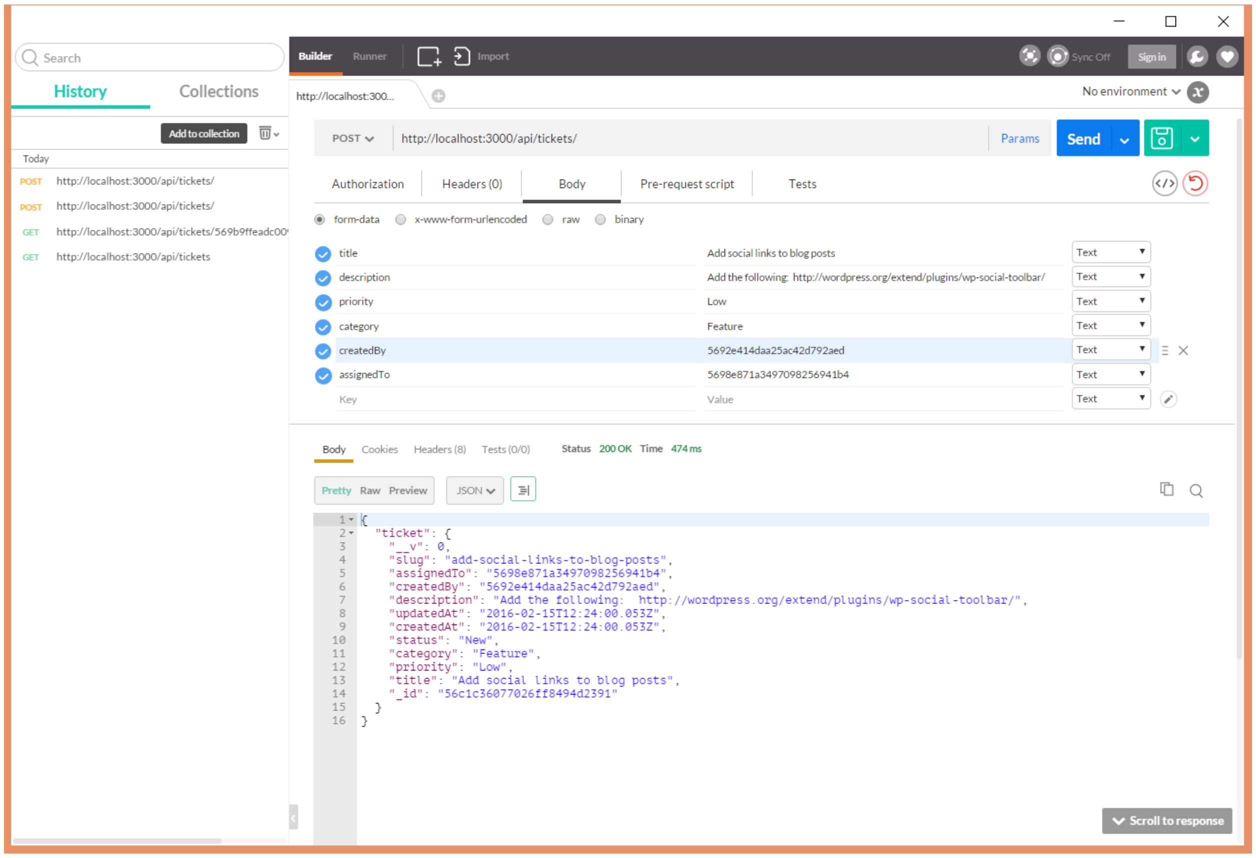
form-data [✓] x-www-form-urlencoded raw binary

Status 500 Internal Server Error Time 180 ms

```
{
  "error": "error",
  "detail": {
    "message": "Validation failed",
    "name": "ValidationError",
    "errors": {
      "title": {
        "name": "ValidatorError",
        "path": "title",
        "message": "Title is required",
        "type": "required"
      }
    }
  }
}
```

The reponse is a well formatted error message that clearly indicates the reason (Validation failed) and point of failure (Title is required). The HTTP status is also set to 500.

Next, provide the actual data for a new ticket using the form-data option in POSTMAN and specify each of the fields as a name/value pair with relevant data. The result indicates that our call was successful with a HTTP status 200 and returns the new ticket JSON data.



POST http://localhost:3000/api/tickets/

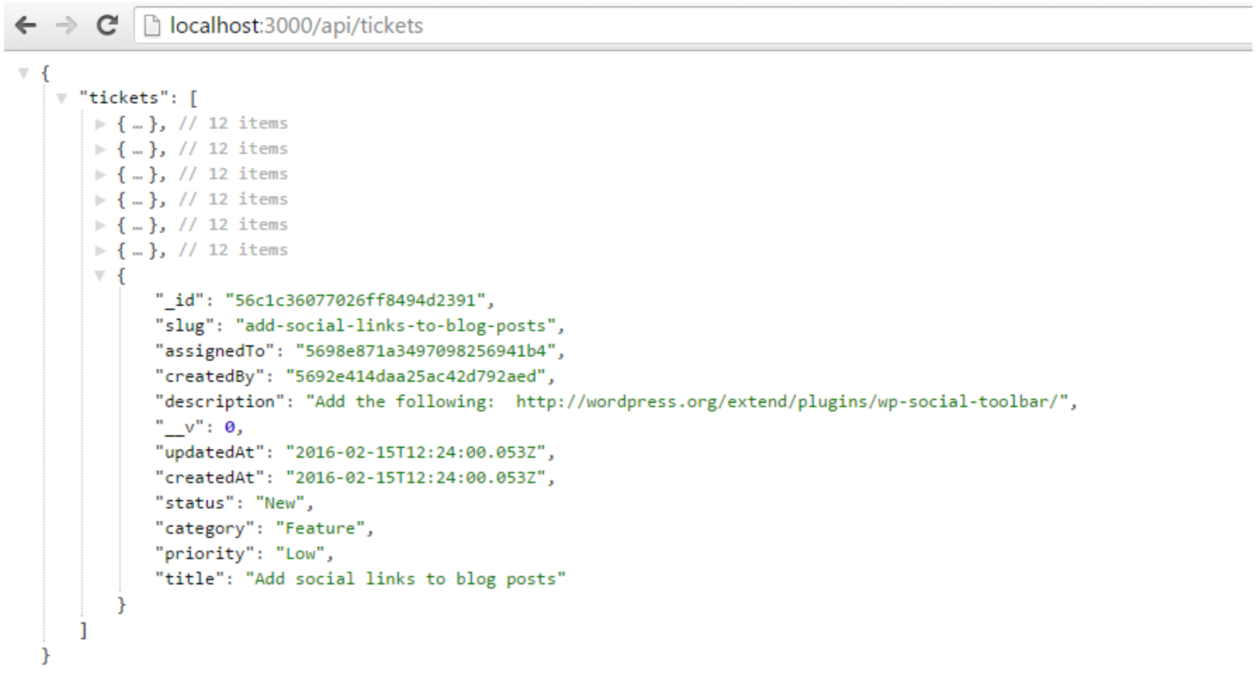
[✓ form-data] x-www-form-urlencoded raw binary

title	Add social links to blog posts	Text
description	Add the following: http://wordpress.org/extend/plugins/wp-social-toolbar/	Text
priority	Low	Text
category	Feature	Text
createdBy	5692e414daa25ac42d792aed	Text
assignedTo	5698e871a3497098256941b4	Text
Key	Value	Text

Status 200 OK Time 474 ms

```
{
  "ticket": {
    "__v": 0,
    "slug": "add-social-links-to-blog-posts",
    "assignedTo": "5698e871a3497098256941b4",
    "createdBy": "5692e414daa25ac42d792aed",
    "description": "Add the following:  http://wordpress.org/extend/plugins/wp-social-toolbar/",
    "updatedAt": "2016-02-15T12:24:00.053Z",
    "createdAt": "2016-02-15T12:24:00.053Z",
    "status": "New",
    "category": "Feature",
    "priority": "Low",
    "title": "Add social links to blog posts",
    "_id": "56c1c36077026ff8494d2391"
  }
}
```

Reloading the main /api/tickets endpoint in a browser confirms that the new ticket has indeed been added to the tickets collection



localhost:3000/api/tickets

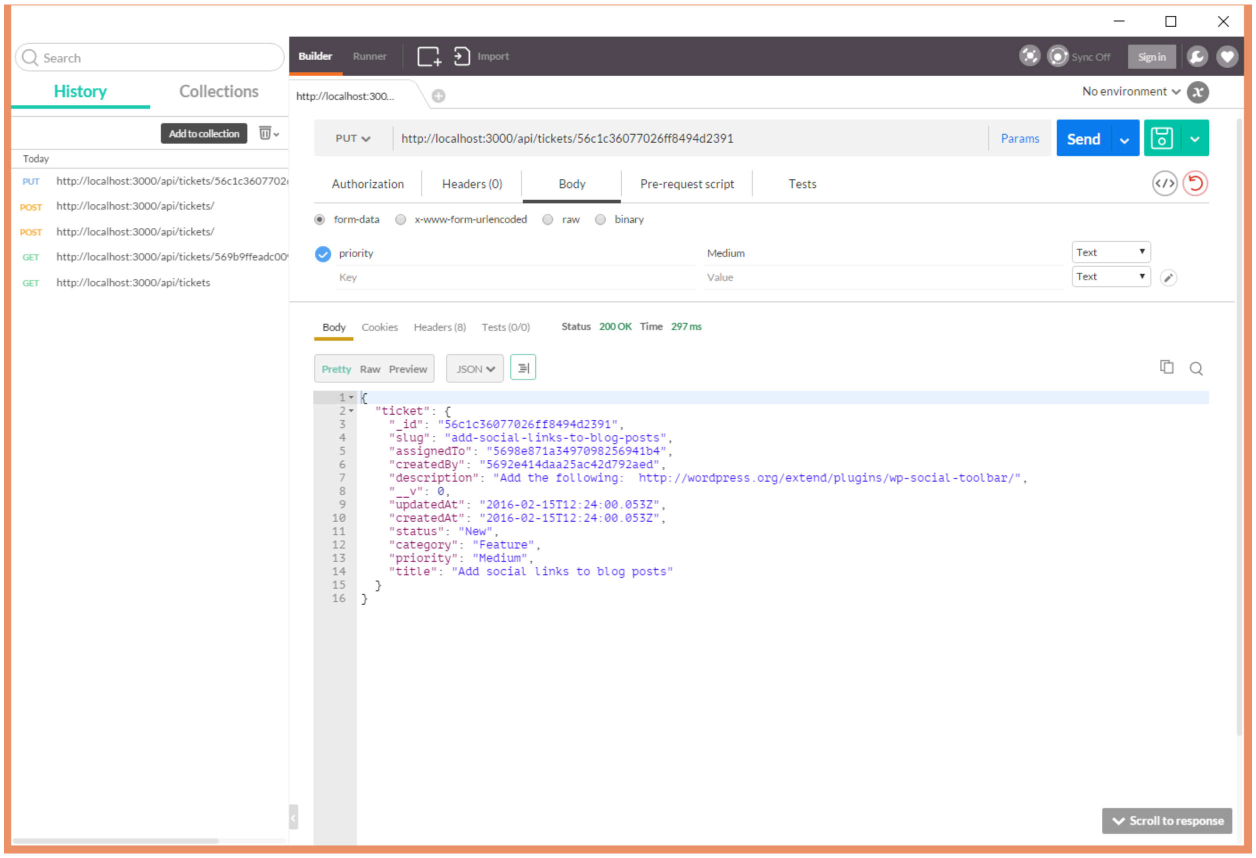
```
{
  "tickets": [
    {…}, // 12 items
    {…}, // 12 items
    {…}, // 12 items
    {…}, // 12 items
    {…}, // 12 items
    {…}, // 12 items
    {
      "_id": "56c1c36077026ff8494d2391",
      "slug": "add-social-links-to-blog-posts",
      "assignedTo": "5698e871a3497098256941b4",
      "createdBy": "5692e414daa25ac42d792aed",
      "description": "Add the following:  http://wordpress.org/extend/plugins/wp-social-toolbar/",
      "__v": 0,
      "updatedAt": "2016-02-15T12:24:00.053Z",
      "createdAt": "2016-02-15T12:24:00.053Z",
      "status": "New",
      "category": "Feature",
      "priority": "Low",
      "title": "Add social links to blog posts"
    }
  ]
}
```

PUT requests to the endpoint work very similar to how POST work except that the id of the resource we intend to modify is not passed through along with data we intend to change, instead it is passed via the URL. If you recall the route we defined, it included the id parameter. PUT requests are generally not used in scenarios where the id of the resource needs to be changed.

```
Ticket.model.findById(req.params.id).exec(function(err, item) {

                if (err) return res.apiError('database error', err);
                if (!item) return res.apiError('not found');

                var data = req.body;

                item.getUpdateHandler(req).process(data, function(err) {

                        if (err) return res.apiError('create error', err);

                        res.apiResponse({
                                ticket: item
                        });

                });
```

```

        });
```

Looking at the code, we see that we intend to first find the ticket that matches the id that was passed via the URL (req.params collection). If we do not find the document or encounter an error during the query, we return an error object to the client. If we do find the relevant document, we leverage the getUpdateHandler method to make updates to the document and save it. The update handler method will update only fields that we pass in and the leave the rest as is. The following screenshot shows a successful PUT request to update the ticket we created in the previous example. We have updated the ticket's priority field from Low to Medium. Note that only the priority field was updated and the rest of the ticket data remains the same as original.



PUT http://localhost:3000/api/tickets/56c1c3607702
POST http://localhost:3000/api/tickets/
POST http://localhost:3000/api/tickets/
GET http://localhost:3000/api/tickets/569b9ffeadc00
GET http://localhost:3000/api/tickets

PUT http://localhost:3000/api/tickets/56c1c36077026ff8494d2391

priority: Medium

Status 200 OK Time 297 ms

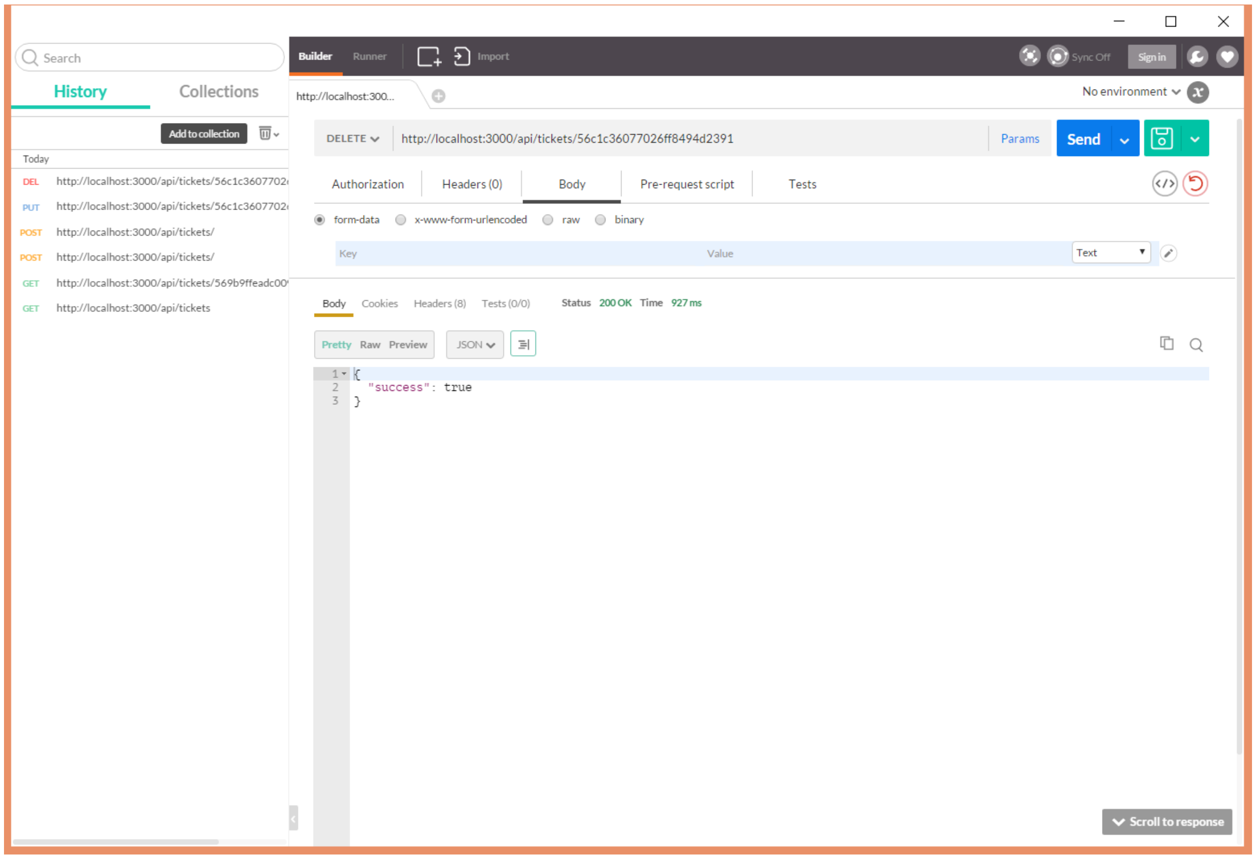
```
{
  "ticket": {
    "_id": "56c1c36077026ff8494d2391",
    "slug": "add-social-links-to-blog-posts",
    "assignedTo": "5698e871a3497098256941b4",
    "createdBy": "5692e414daa25ac42d792aed",
    "description": "Add the following:  http://wordpress.org/extend/plugins/wp-social-toolbar/",
    "__v": 0,
    "updatedAt": "2016-02-15T12:24:00.053Z",
    "createdAt": "2016-02-15T12:24:00.053Z",
    "status": "New",
    "category": "Feature",
    "priority": "Medium",
    "title": "Add social links to blog posts"
  }
}
```

Removing Data with DELETE

The last route we defined was to delete a ticket. The delete operation is pretty straight forward, we should call our endpoint with a HTTP DELETE verb along with the id of the ticket we want to be removed.

```
Ticket.model.findById(req.params.id).exec(function (err, item) {

        if (err) return res.apiError('database error', err);
        if (!item) return res.apiError('not found');

        item.remove(function (err) {
            if (err) return res.apiError('database error', err);

            return res.apiResponse({
                success: true
            });
        });

    });
```

We use the Mongoose findById method to retrieve the document we intend to delete. If we do not find the document or encounter exceptions while removing the document then we return an error to the client. If we do find the document, we remove it and return an object indicating the success status.



DEL http://localhost:3000/api/tickets/56c1c3607702
PUT http://localhost:3000/api/tickets/56c1c3607702
POST http://localhost:3000/api/tickets/
POST http://localhost:3000/api/tickets/
GET http://localhost:3000/api/tickets/569b9ffeadc00
GET http://localhost:3000/api/tickets

DELETE http://localhost:3000/api/tickets/56c1c36077026ff8494d2391

(●) form-data ( ) x-www-form-urlencoded ( ) raw ( ) binary

Status 200 OK Time 927 ms

```
{
  "success": true
}
```

**Note: **All of the endpoints defined in this chapter are extremely simple i.e they do not enforce strict role validation and authentication rules. They may not be appropriate to be used in production environments as is. However, those rules can be easily added by leveraging the Keystone.js middleware.

Another tool that can be used to interact with endpoints is cURL. cURL is a commandline tool for crafting requests and receiving responses from servers.

To install cURL on Mac/OSX, follow the below steps:

1. Download the cURL from http://curl.haxx.se/download.html
2. Open a Terminal and change directory to the folder where the file was downloaded
3. extract the compressed file with below command:

```
$tar zxf curl-7.47.1.tar
```

4. Change directory to the extracted cURL directory

```
$cd curl-7.47.1
```

5. Run the make file , as follows and install cURL

```
$make && sudo make install
```

cURL on windows is distributed as a standalone executable from http://curl.haxx.se/download.html.

Below are the cURL commands illustrating all the interactions we performed using POSTMAN:

Get Ticket By Id:

```
curl -X GET -H "Cache-Control: no-cache"
"http://localhost:3000/api/tickets/569b9ffeadc009781fe39e23"
```

Create Ticket using POST:

```
curl -X POST -H "Cache-Control: no-cache"
-H "Content-Type: multipart/form-data; boundary=----WebKitFormBoundary7MA4YWxkTr\
Zu0gW"
-F "title=Add social links to blog posts"
-F "description=Add the following:  http://wordpress.org/extend/plugins/wp-socia\
l-toolbar/"
-F "priority=Low"
-F "category=Feature"
-F "createdBy=5692e414daa25ac42d792aed"
-F "assignedTo=5698e871a3497098256941b4"
"http://localhost:3000/api/tickets/"
```

Update Ticket using PUT:

```
curl -X PUT -H "Cache-Control: no-cache"
-H "Content-Type: multipart/form-data; boundary=----WebKitFormBoundary7MA4YWxkTr\
Zu0gW"
-F "priority=Medium"
"http://localhost:3000/api/tickets/56c1c36077026ff8494d2391"
```

Delete Ticket By Id:

```
curl -X DELETE -H "Cache-Control: no-cache"
"http://localhost:3000/api/tickets/56c1c36077026ff8494d2391"
```

Chapter 10. Using template engines

By default, Keystone.js advises the use of Jade as its template language, but you can configure Keystone.js to support other rendering engines, such as Swig or Handlebars.

You can add a custom template engine by configuring the object passed to keystone.init method in /keystone.js script file:

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

keystone.init({
/* .. */
'view engine': 'swig',
'custom engine': swig.renderFile
/* .. */
});
```

Make sure to use NPM to bring in the necessary template engine files before requiring it in your project.

Introducing the Swig Template Engine

The majority of pages in a website generally display data that is dynamic in nature. Dynamic content refers to HTML pages whose content is generated automatically and maybe affected by conditional statements or the data source (such as a database table or document store). Dynamic data generally caters particularly to the context of the user who is logged in to the website. A web framework typically support one or more templating engines which makes it faster and easier to generate dynamic HTML content. Keystone.js supports a variety of templating engines such as Jade, Handlebars, EJS. Jade is the most common templating language used with Keystone.js. However, we will look at how to configure and use swig, a simple, powerful and extensible JavaScript templating engine.

Swig is robust, extendable, and customizable and supports object-oriented template inheritance. Swig's templating syntax and conventions are very intuitive and very similar to that followed by popular web frameworks such as Django, Jinja and Twig.

To install swig, we can use the node package manager as below.

```
npm install swig --save
```

Swig templates can either end with a .swig extension or a .html extension. You can control this in the keystone.init method in the keystone js file in the root of the application.

```
keystone.init({
    ...
    //use .html extension for template files
        'view engine': 'html',
    ...
});
```

Basic syntax for Swig

The basic syntax for swig is really quite simple. Let’s assume the following ticket JSON object is passed to a swig template via our view:

```
...
view.on('init', function(next) {

        var ticket = {
            "slug": "layout-broken-in-ie6",
            "title": "Layout broken in IE6",
            "status": "In Progress",
            "category": "Bug",
            "priority": "Medium",
            "description": "Layout is all messed up in IE6. Nothing renders corr\
ectly. Too many problems to list. see screenshot.\r\n",
            tags : ['layouts, ie, render, image']
        }

        locals.data.ticket = ticket;

    });

        // Render the view
        view.render('displayticket');
};
```

There are two main types of markup in Swig:

- Output Tags

- Logic Tags

Find a list of all Swig tags at http://paularmstrong.github.io/swig/docs/tags/[8]

Output Tags

Output tags are surrounded by double curly brackets and will render content of a variable. If a variable is not defined an empty-string will be output in its place. However, falsy values like null, false, 0 will be rendered as they are. To render variables in the template, we use the `{{ }}` in Swig. To render the title of the ticket, add the following markup to displayticket template:

```
    <div class="panel panel-primary">
        <!-- Default panel contents -->
        <div class="panel-heading">Ticket details - {{data.ticket.title}}
        </div>
        ...
    </div>
```

To output comments, use a curly brace followed by the hash sign. Comments are removed by the parser during rendering and will not be seen even if you do a view-source on the rendered HTML page.

```
{#
    This is a comment.
#}
```

Logic Tags

Logic tags begin with a curly bracket and then percent sign. Logic tags control output through common conditional operators and helpers. To check if the description was entered and then render it, add the following markup to the tempalate:

```
  <div>
    {% if data.ticket.description %}
        Ticket description - {{data.ticket.description}}
    {% endif %}
  </div>
```

Swig also has support for the if-else conditional check. For example, we can use the following to display alternate text if no description was provided.

[8] http://paularmstrong.github.io/swig/docs/tags/

```
  <div>
   {% if data.ticket.description %}
        Ticket description - {{data.ticket.description}}
    {% else %}
        No ticket description available.
   {% endif %}
  </div>
```

Adding boolean conditionals are also pretty easy. Boolean conditionals like **and**, **or** can be used within logic tags. Below is an example illustrating the use of the ‘or’ conditionals:

```
  <div>
   {% if data.ticket.category == 'Feature' or data.ticket.category == 'Enhanceme\
nt' %}
        <label class='info'>{{data.ticket.category}}</label>
    {% else %}
        <label class='warning'>{{data.ticket.category}}</label>
   {% endif %}
  </div>
```

Another way to express the ‘or’ conditional is to use the double pipe symbol - || `<div> {% if data.ticket.category == 'Feature' || data.ticket.category == 'Enhancement' %} <label class='info'> {% else %} <label class='warning'>{{data.ticket.category}}</label> {% endif %} </div>` Along the same lines, the ‘and’ condition can be specified using the ‘**and**’ keyword or the double ampersand symbol - ***&&***

We can also use built-in Javascript functions within the conditional statements.

```
{% if data.ticket.description.indexOf("critical") > -1 %}
   This is a critical ticket!
{% endif %}
```

Swig also supports looping statements to loop over arrays and objects. To iterate over the tags array in the ticket object, add the following markup to the template:

```
   <ul>
        {% for tag in data.ticket.tags %}
            <li> {{tag}} </li>
        {% endfor %}
    </ul>
```

The output on the page should be

```
<ul>
    <li>layouts</li>
    <li>ie</li>
    <li>render</li>
    <li>image</li>
</ul>
```

Swig has a collection of very helpful loop control helpers. These provide additional information about the state of the loop in an iteration.

```
    {% for tag in data.ticket.tags %}
        {% if loop.first %}<ul>{% endif %}
        <li>{{ loop.index }} - {{ tag }}</li>
        {% if loop.last %}</ul>{% endif %}
    {% endfor %}
```

The output should be

```
<ul>
    <li>1 - layouts</li>
    <li>2 - ie</li>
    <li>3 - render</li>
    <li>4 - image</li>
</ul>
```

During every for loop iteration, the following helper variables are available:

- **loop.index**: The current iteration of the loop (1-indexed)
- **loop.index0**: The current iteration of the loop (0-indexed)
- **loop.revindex**: The number of iterations from the end of the loop (1-indexed)
- **loop.revindex0** The number of iterations from the end of the loop (0-indexed)
- **loop.key** If the iterator is an object, this will be the key of the current item, otherwise it will be the same as the loop.index.
- **loop.first** True, if the current item is the first in the object or array.
- **loop.last** True, if the current item is the last in the object or array.

To reverse a loop, we can use the reverse filter:

```
<ul>
{% for tag in data.ticket.tags | reverse %}
    <li>{{tag}}</li>
{% endfor %}
</ul>
```

Layouts

Layouts, in web applications, allow you to create a consistent design for the pages in your application. A layout defines the look and feel and standard behavior that you want for all of the pages in your application. Web applications consist of design elements such as a header and footer that are common to all pages. Creating a layout will enable to prevent the repeating of such elements in all the content pages. Layout can be inherited by individual content pages that contain the content you want to display. When users request the content pages, they merge with the layout to produce output that combines the design of the layout page with the content from the content page.

The default layout generated by Keystone.js resides at `/templates/layouts.default.swig`

Layouts can define blocks of content areas that are placeholders for content from individual pages. Each page can reference a layout by using the **extends** tag. Below is a simple illustration of a using a layout file.

Layout.swig:

```
<!doctype html>
<html>
<head>
  <meta charset="utf-8">
  <title>{% block title %}IncTicket{% endblock %}</title>

  {% block head %}
  <link rel="stylesheet" href="/assets/css/incticket.css">
  {% endblock %}
</head>
<body>
  {% block content %}{% endblock %}
</body>
</html>
```

page.html:

```
{% extends "layout.html" %}

{% block title %}Ticket Details{% endblock %}

{% block head %}
  {% parent %}
  <link rel="stylesheet" href="/assets/css/singleticketcustom.css">
{% endblock %}

{% block content %}
<div class="panel panel-primary">
        <!-- Default panel contents -->
        <div class="panel-heading">Ticket details - {{data.ticket.title}}
        </div>
        ...
</div>
{% endblock %}
```

The rendered output would be:

```
<!doctype html>
<html>
<head>
  <meta charset="utf-8">
  <title>Ticket Details</title>

  <link rel="stylesheet" href="/assets/css/incticket.css">
  <link rel="stylesheet" href="/assets/css/singleticketcustom.css">
</head>
<body>
  <div class="panel panel-primary">
        <!-- Default panel contents -->
        <div class="panel-heading">Ticket details - Layout broken in IE6
        </div>
        ...
</div>
</body>
</html>
```

The **block** keyword defines an area in a template that can be overridden by a template extending this one and/or will override the current template's parent template block of the same name. The **extends** keyword makes the current template extend a parent template. This tag must be the first item in your template. The **parent** keyword injects the content from the parent template's block of the same name into the current block.

Advantages of using Layouts: * Layouts centralize the common functionality of your pages so that developers can make updates in just one place. * They make it easy to create one set of controls and apply the results to a set of pages. For example, you can use controls on the layout to create a menu that applies to all pages. * Layouts allow fine-grained control over the layout of the final page by allowing you to control how the blocks are rendered. * They provide the capability to customize the master page from individual content pages.

Template Partials

In the previous section, we looked at layouts which act as the wrapper for design elements of the website on every page. Let us now take a look at creating template partials, which are small pieces of template that we can reuse and inject inside our layouts or other templates.

Template partials can be used to create reusable components in an application and reduce code duplication. Suppose, we wanted to display a list of tickets on the main page, display a list of related tickets on the ticket details page and display a list of tickets created by the user on a user's profile page; Rather than redundantly copying the code to display a list of tickets, we can manage this within a separate template file (known as template partial) and then include it in the templates as desired. This allows us to make changes to a single file and affect the behaviour throughout our application.

We can include a template partial with the current local data available to it or by specifying a specific context. The **include** keyword is used to include template partials within other templates for rendering. The include function takes in the path to the template partial. We can use the '**with**' literal to specify an additional object that will become the data context for the partial when it is rendered. We can also specify the '**only**' keyword to restrict the context to be only the additional object that was passed in i.e. the included template will not be aware of any other local variables in the parent template.

Create a template partial named 'ticket.swig' in `/templates/views/tickets` and move the following code from ticketlist.swig to it.

ticket.swig partial:

```
<tr>
<td>
<div class=' col-md-1'>
    <span class="label label-info pull-right">{{ticket.status}}</span>
</div>

    <a href='{{ticket.url}}'><b>{{ticket.title |capitalize}}</b><a>

    <ul class="ticket-meta">
    <li>&nbsp;</li>
    <li>
        <small>Status</small><a href="" rel="tag">{{ticket.status}}</a>
    </li>
    <li>
        <small>Priority</small><a href="" rel="tag">{{ticket.priority}}</a>
    </li>
    <li>
        <small>Category</small><a href="" rel="tag">{{ticket.category}}</a>
    </li>
    <li>
        <small>Last Updated</small>
        <abbr class="last-updated">{{ticket._.createdAt.format('Do MMMM YYYY')}}\
</abbr>
    </li>
    </ul>
</td>
</tr>
```

Update the ticketlist.swig to then use the ticket.swig partial.

```
<table class="table  table-striped">
        {% for ticket in data.tickets.results %}
           {% include 'ticket.swig' %}
        {% endfor %}
</table>
```

By default, Swig will complain if the template partial is not available at path that was mentioned. We can use the '**ignore missing**' option to gracefully render an empty string if in case the template partial was not available.

```
{% include 'ticket.swig' ignore missing %}
```

Swig Filters

Filters are methods through which output tags can process content. The rendering of variables in templates can be modified by filters. Filters are special functions that are applied after any object token in a variable block using the pipe character (|). Filters can also be chained together, one after another.

If, for example, we wanted to covert the title of a ticket to Title Case and strip any HTML tags that might have been input, we can use the title and striptags filters:

```
<div class="panel-heading">
    Ticket details - {{data.ticket.title | title | striptags}}
 </div>
```

Here is a list of the available filters in Swig:

- **capitalize**: Capitalize words in the input
- **lower**: Convert an input string to lowercase
- **upper**: Convert an input string to uppercase
- **title**: Capitalizes every word given and lower-cases all other letters in input
- **date**: Reformats a date
- **default**: A default return value can be specified if the input is undefined, null, or false
- **json**: Converts input to JavaScript object
- **striptags**: Strip html from string
- **safe**: Forces the input to not be auto-escaped. Swig escapes data by default.
- **replace**: Replace each occurrence of a string
- **escape**: Escape special characters in a string
- **addslashes**: Add backslashes to characters that need to be escaped
- **url_encode**: URL-encode a string
- **url_decode**: URL-decode a string
- **first**: Get the first element of the input array, object or string
- **last**: Get the last element of the input array, object or string
- **reverse**: Reverse sort the input values
- **sort**: Sort the input in an ascending order
- **join**: Join elements of the array with a delimiter
- **groupBy**: Group an array of objects by a key
- **uniq**: Remove all duplicate elements from an array

Summary

In this chapter, you learnt about Swig, the powerful and flexible templating option for node.js. Consider using it the next time you need to support layouts, partials, filters in your Keystone.js projects. To learn more about swig, checkout the Swig Documentation[9].

[9]http://paularmstrong.github.io/swig

Chapter 11. Deploying to Ubuntu Cloud Server

Introduction

Let us look at how to provision a ubuntu server from Digital Ocean and deploy our IncTicket application on to the server. Ubuntu is the most common linux distribution used now accounting for around 26% of all Linux webservers. I will be using Ubuntu 14.04 for this chapter.

What is Digital Ocean?

Digital Ocean offers reliable, scalable, and inexpensive cloud computing services. They are a cloud infrastructure provider focused on simplifying web infrastructure for software developers. The service lets users deploy a complete linux/unix server in under a minute with ease and provides critical functionality such as backups. Unlike a dedicated server, where the price is fixed upfront on a monthly or yearly contractual basis, Digital Ocean like Amazon Web Services provides a hourly pricing based on usage without any contracts. This makes it a very attractive proposition for hosting web applications in a cost effective manner.

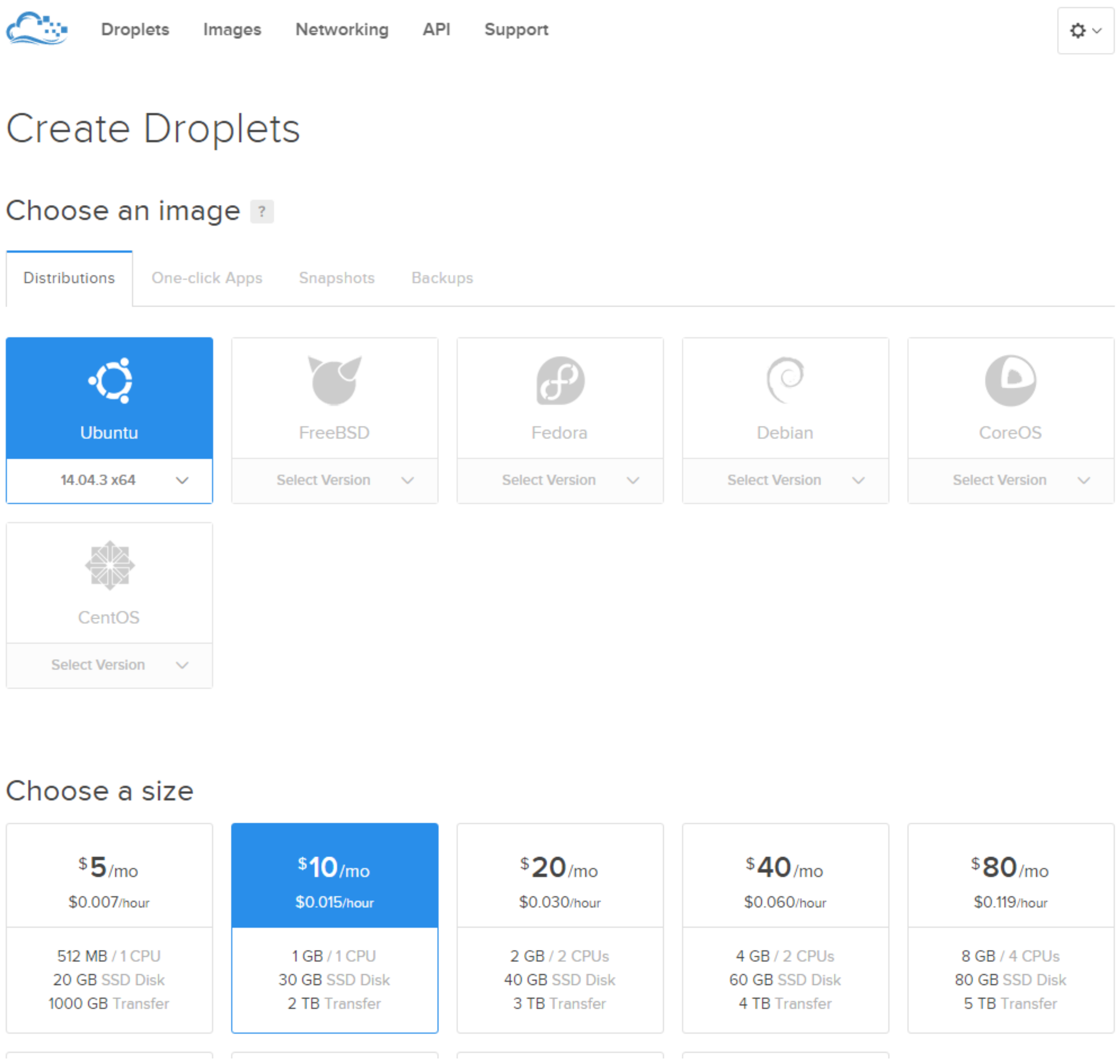
Other similar service providers include Amazon Web Services, Rackspace. This chapter is not specific for DigitalOcean and will work similarly on other service providers infrastructure.

Provision a Server

To be able to provision a server, first create an account with Digital Ocean at http://digitalocean.com[10]. Adding your SSH key to Digital Ocean at the time of provisioning a server makes it secure and easy to login to the server. However, this is not mandatory since we can also use the root password to login to the server which we will receive once we provision a server.

Now create a new droplet using the create droplet menu button on the top navigation. A droplet is Digital Ocean's terminology for a virtual private server. Select Ubuntu 14.04 as the distribution.

[10]http://digitalocean.com



Create Droplets

Choose an image

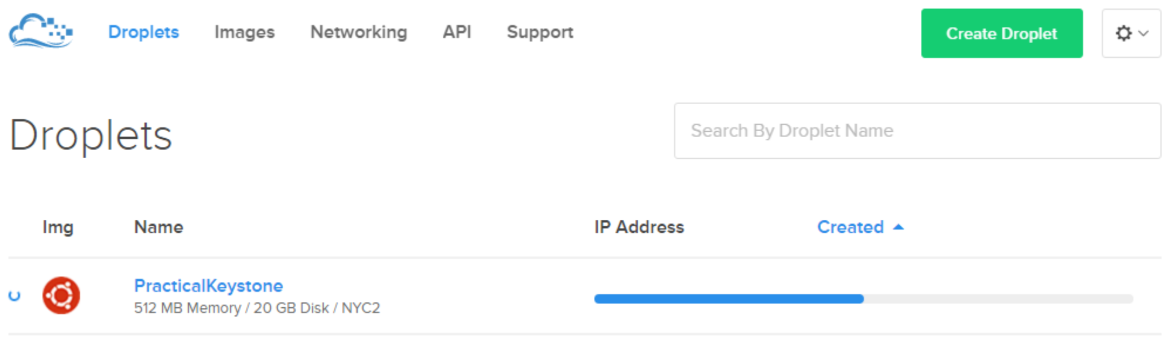
Ubuntu 14.04.3 x64	FreeBSD Select Version	Fedora Select Version	Debian Select Version	CoreOS Select Version
CentOS Select Version				

Choose a size

$5/mo $0.007/hour	$10/mo $0.015/hour	$20/mo $0.030/hour	$40/mo $0.060/hour	$80/mo $0.119/hour
512 MB / 1 CPU 20 GB SSD Disk 1000 GB Transfer	1 GB / 1 CPU 30 GB SSD Disk 2 TB Transfer	2 GB / 2 CPUs 40 GB SSD Disk 3 TB Transfer	4 GB / 2 CPUs 60 GB SSD Disk 4 TB Transfer	8 GB / 4 CPUs 80 GB SSD Disk 5 TB Transfer

Order a droplet

Provide a sensible hostname for purposes of tracking this server and click create. The server should be provisioned quickly and be available in your dashboard. Note down the ip address since we will need it to SSH into our server.

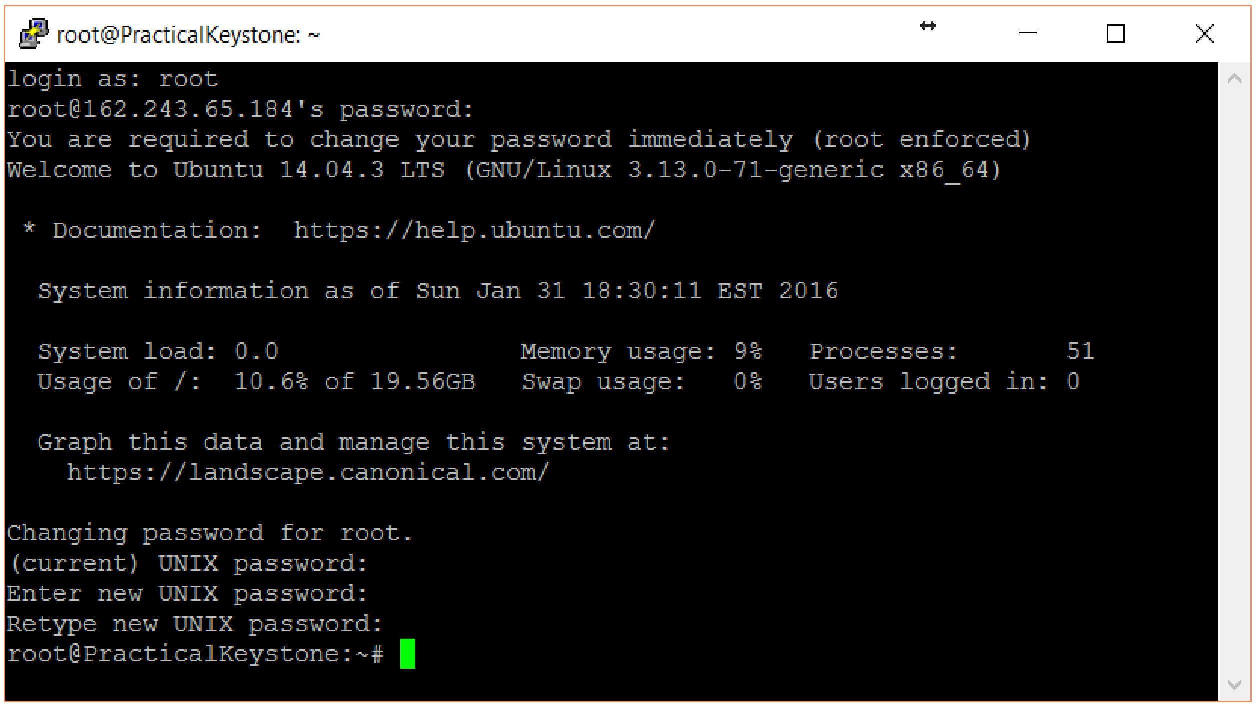


Droplets

Img	Name	IP Address	Created ▲
	PracticalKeystone 512 MB Memory / 20 GB Disk / NYC2		

Order a droplet

We can use either the mac terminal or putty on windows to login to our server. During the first login, we will be prompted to change our root password.



```
login as: root
root@162.243.65.184's password:
You are required to change your password immediately (root enforced)
Welcome to Ubuntu 14.04.3 LTS (GNU/Linux 3.13.0-71-generic x86_64)

 * Documentation:  https://help.ubuntu.com/

  System information as of Sun Jan 31 18:30:11 EST 2016

  System load: 0.0               Memory usage: 9%   Processes:       51
  Usage of /:  10.6% of 19.56GB   Swap usage:   0%   Users logged in: 0

  Graph this data and manage this system at:
    https://landscape.canonical.com/

Changing password for root.
(current) UNIX password:
Enter new UNIX password:
Retype new UNIX password:
root@PracticalKeystone:~#
```

Order a droplet

Installing Node

Let us install Node on the server. On Ubuntu, you use the package manager **APT** to install packages and libraries. Each distribution of Linux uses its own package manager (such as yum for Fedora) so keep in mind the command if you use a different distribution.

Begin by upgrading apt-get and then updating apt-get. This is to ensure that the latest tools are installed and the system is up-to-date.

```
root@PracticalKeystone:~# apt-get upgrade
root@PracticalKeystone:~# apt-get update
```

To install Node runtime, use the below command. You might need to provide a confirmation that the installation was intentional on the command line:

```
root@PracticalKeystone:~# apt-get install nodejs
```

Note: Due to a conflict with another package, the executable from the Ubuntu repositories is called nodejs instead of node.

We need to create link to use just node as the name of the executable. Use the below command to achieve this.

```
sudo ln -s "$(which nodejs)" /usr/bin/node
```

Next install npm, which is the Node.js package manager. NPM will allow you to easily install modules and packages to use with Node.js. You can install this by typing:

```
root@PracticalKeystone:~# apt-get install npm
```

Check to see whether Node and NPM were installed successfully by checking the versions, as shown below:

```
root@PracticalKeystone:~# node --version
v0.10.25
root@PracticalKeystone:~# npm --version
1.3.10
```

As we see, the Node version that was installed is 0.10.25 which is an outdated version. Let us update to the latest stable version of Node using **n**, which is a node helper package useful to install or upgrade a given Node version. Use the following commands to accomplish the update.

```
root@PracticalKeystone:~# npm cache clean -f
root@PracticalKeystone:~# npm install -g n
root@PracticalKeystone:~# n stable

root@PracticalKeystone:~# ln -sf /usr/local/n/versions/node/```<VERSION>```/bin/\
node /usr/bin/node
```

In the last command, replace the <VERSION> with the version of node in the /usr/local/n/version-s/node/ folder. At the time of writing this chapter, the stable version of node was 5.4.1.

Installing MongoDB

To install MongoDB package we will use APT package manager. The default Ubuntu package repositories already contain MongoDB but they are mostly outdated versions. To ensure that we install the latest stable version, we need to add the MongoDB official repository. The first step is to add the GPG keys for the repository using the below command:

```
root@PracticalKeystone:~# apt-key adv --keyserver hkp://keyserver.ubuntu.com:80 \
--recv 7F0CEB10
```

Next, we have to add the MongoDB repository details so APT will know where to download the packages from, using the below command:

```
echo "deb http://repo.mongodb.org/apt/ubuntu "$(lsb_release -sc)"/mongodb-org/3.\
0 multiverse" | sudo tee /etc/apt/sources.list.d/mongodb-org-3.0.list
```

After adding the repository details, we need to update the packages list using an apt-get update command.

```
root@PracticalKeystone:~# apt-get update
```

Now we are ready to install MongoDB using apt-get. Issue the below command to begin the installation.

```
root@PracticalKeystone:~# apt-get install -y mongodb-org
```

The above command will install several packages containing latest stable version of MongoDB along with helpful management tools for the MongoDB server. After the package installation has completed, MongoDB will be automatically started. You can check the status of MongoDB by running the following command.

```
root@PracticalKeystone:~# service mongod status
```

If MongoDB is running, you'll see an output like below:

```
root@PracticalKeystone:/# service mongod status
mongod start/running, process 9713
```

You can also stop, start, and restart MongoDB using the service command.

- service mongod stop
- service mongod start
- service mongod restart

Install Redis for Caching

Redis is a flexible key-value data store that is a very good alternative to memcache for caching data in web applications. Redis is currently not available as a package to be installed using the APT package manager and needs to be compiled & installed on our server.

The installation is very simple and straightforward. Start by installing the pre-requisites needed to compile and run Redis. We will need to download a compiler with build essential which will help us install Redis from source and then install TCL.

```
root@PracticalKeystone:~# apt-get install build-essential
root@PracticalKeystone:~# apt-get install tcl8.5
```

Then begin to install redis from source:

Download the latest stable release of Redis from Redis.io.

```
root@PracticalKeystone:~# wget http://download.redis.io/releases/redis-stable.ta\
r.gz
```

Extract and change into that directory:

```
root@PracticalKeystone:~# tar xzf redis-stable.tar.gz
root@PracticalKeystone:~# cd redis-stable
```

Invoke the make command to compile the source code:

```
root@PracticalKeystone:~/redis-stable# make
```

Now run the recommended make test:

```
root@PracticalKeystone:~/redis-stable# make test
```

Next run the make install command to install the compiled binaries to /usr/local/bin.

```
root@PracticalKeystone:~/redis-stable# make install
```

At this point, Redis is installed on our machine. Let's run as Redis as a daemon so it is running in the background. Redis comes with a shell script to install it as a background daemon. To run the script, change to the `utils` directory and run the `install_server.sh` script. The script will provide options to select the Redis port and configuration file. The default options are sufficient.

```
root@PracticalKeystone:~/redis-stable# cd ,
root@PracticalKeystone:~/redis-stable/utils# ./install_server.sh
```

The Redis should be automatically started after installation as a daemon. To test the status use the following command:

```
root@PracticalKeystone:~/redis-stable/utils# service redis_6379 status
Redis is running (19704)
```

You can also stop, start, and restart Redis using the service command.

- service redis_6379 stop
- service redis_6379 start
- service redis_6379 restart

To use redis within a Keystone.js application, I would recommend looking at cachegoose, a Mongoose caching module. Find more information at https://github.com/boblauer/cachegoose[11],

Install IncTicket Application

To be able to retrieve our application from the github repository, we need to install git on the server first. Use the following command to install git:

```
root@PracticalKeystone:~# apt-get install git
```

Once git is installed, let us checkout the repoository to a directory named incticket and change into it.

```
root@PracticalKeystone:~# git clone https://github.com/manikantapanati/incticket
root@PracticalKeystone:~# cd incticket
```

Now install the npm dependencies in package.json.

```
root@PracticalKeystone:/incticket# npm install --production
```

The –production flag isn't required but will save some time and prevent installing some of your testing code you don't need on the server.

Next, create a .env file to hold your configuration information specific to your deployment. An example would be:

[11] https://github.com/boblauer/cachegoose

```
COOKIE_SECRET=x/:dz9fvAALWMHrtAV9{P{8(T)UZnHZ}i@y)vM#0:3y~+u*ZV=|8B"GGoXb0Wl"P
MANDRILL_API_KEY=NY8RRKyv1Bure9bdP8-TOQ
MONGO_URI=mongodb://user:pass@server:port/practicalkeystone
```

Note: It is not recommended to run an application as root for security reasons. However, to keep this chapter simple, we will run the application as root. In production, it is advised to create a new non-root user to run the application.

Manage Application with PM2

PM2 is an excellent process manager for Node.js applications. PM2 provides an easy way to manage and run applications as a service. Until now we have been running our application on the shell directly which means the application will stop functioning if we close out of the terminal. To avoid this, we can use PM2 to keep our application running in the background. There are a few advantages to running the application using PM2 instead of just the terminal:

- PM2 will automatically restart your application if it crashes.
- PM2 will keep a log of your unhandled exceptions.
- PM2 can ensure that any applications it manages restart when the server reboots - as a service.

Use this command to install PM2 on our server:

```
root@PracticalKeystone:~/incticket# npm install pm2 -g
```

To confirm that PM2 is installed, try the `pm2 -h` command on the shell. You should see the help text.

Before we run our application under PM2, let us setup PM2 to launch on system startup (boot or reboot). This is pretty easy and we can accomplish it with the `startup` command. The startup option generates and configures a startup script to launch PM2 and its managed processes on server boot up. We must also specify the platform we are running on, which is ubuntu, in our case:

```
root@PracticalKeystone:~/incticket# pm2 startup ubuntu
```

Output:

```
[PM2] Generating system init script in /etc/init.d/pm2-init.sh
[PM2] Making script booting at startup...
[PM2] -linux- Using the command:
      su -c "chmod +x /etc/init.d/pm2-init.sh && update-rc.d pm2-init.sh default\
s"
 Adding system startup for /etc/init.d/pm2-init.sh ...
   /etc/rc0.d/K20pm2-init.sh -> ../init.d/pm2-init.sh
   /etc/rc1.d/K20pm2-init.sh -> ../init.d/pm2-init.sh
   /etc/rc6.d/K20pm2-init.sh -> ../init.d/pm2-init.sh
   /etc/rc2.d/S20pm2-init.sh -> ../init.d/pm2-init.sh
   /etc/rc3.d/S20pm2-init.sh -> ../init.d/pm2-init.sh
   /etc/rc4.d/S20pm2-init.sh -> ../init.d/pm2-init.sh
   /etc/rc5.d/S20pm2-init.sh -> ../init.d/pm2-init.sh
[PM2] Done.
```

Now, run our application under PM2 using the below command:

```
root@practicalkeystone:~/incticket# pm2 start keystone.js
```

You should a similar output indicating that the service has started:

```
[PM2] restartProcessId process id 0
[PM2] Process successfully started
+--------------------------------------------------------------------------------\
----+
¦ App name ¦ id ¦ mode ¦ pid   ¦ status ¦ restart ¦ uptime ¦ memory      ¦ watch\
ing ¦
+----------+----+------+-------+--------+---------+--------+-------------+------\
----¦
¦ keystone ¦ 0  ¦ fork ¦ 24820 ¦ online ¦ 0       ¦ 0s     ¦ 10.488 MB   ¦ disab\
led ¦
+--------------------------------------------------------------------------------\
----+

 Use `pm2 show <id|name>` to get more details about an app
```

PM2 automatically assigns an App name based on the filename, in our case - keystone.js and a PM2 id. PM2 also tracks information such as the PID of the process, its current status, and memory usage.

To stop our application, use this command:

```
root@practicalkeystone:~/incticket# pm2 stop keystone
```

To restart our application, use this command:

```
root@practicalkeystone:~/incticket# pm2 restart keystone
```

Install NGINX as Reverse Proxy Server

We have successfully setup our application and it will by default listen to port 3000. This is not very useful for web facing applications since it prevents users from accessing it over HTTP which runs on port 80. We will set up an NGINX web server as a reverse proxy for to address this. A reverse proxy server directs client requests to the appropriate back-end server and provides an additional level of abstraction between clients and servers. This can be useful for things such as load balancing, caching and security.

To install NGINX use APT as shown below:

```
root@practicalkeystone:~/incticket# sudo apt-get install nginx
```

Next, edit the NGINX configuration file:

```
root@practicalkeystone:~/incticket# vi /etc/nginx/sites-available/default
```

and replace the contents with the below configuration data:

```
server {
    listen 80;

    server_name practicalkeystone;

    location / {
        proxy_pass http://127.0.0.1:3000;
        proxy_http_version 1.1;
        proxy_set_header Upgrade $http_upgrade;
        proxy_set_header Connection 'upgrade';
        proxy_set_header Host $host;
        proxy_cache_bypass $http_upgrade;
    }
}
```

The above setting configures the web server to respond to requests at its root on port 80. Any requests to our web server domain/ip address via a web browser would send the request to the application server on port 3000, which would be received and replied to by the Keystone.js application.

After editing the configuration file, save and exit. Restart the NGINX service for the changes to take effect.

```
root@practicalkeystone:~/incticket# service nginx restart
```

Summary

In this chapter, you learnt about setting up an Ubuntu server at Digital Ocean and installing all the necessary depedencies for running our Keystone.js application. We installed NGINX as a reverse proxy in front of our Node process. Feel free to take this to the next level by configuring NGINX for load balancing, caching and security. Learn more about NGINX at https://www.nginx.com/resources/wiki/start/inde

[12]https://www.nginx.com/resources/wiki/start/index.html#