

# Learning Path

# Complete Vue.js 2

# Web Development

Practical guide to building end-to-end web development solutions  
with Vue.js 2



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Mike Street, Andrea Passaglia and Paul Halliday

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Practical guide to building end-to-end web development solutions with Vue.js 2

**Mike Street**  
**Andrea Passaglia**  
**Paul Halliday**



BIRMINGHAM - MUMBAI

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First Published: December 2018

Production Reference: 1211218

Published by Packt Publishing Ltd.  
Livery Place, 35 Livery Street  
Birmingham, B3 2PB, U.K.

ISBN 978-1-78995-990-1

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# Contributors

## About the Authors

**Mike Street** (aka mikestreety) is a frontend developer from Brighton, UK. Specializing in Gulp, SCSS, HTML, and Vue, he has been developing websites professionally since 2010. After making his first Vue app as an experimental side project, he's been hooked ever since. When not developing on the web, Mike likes to explore the Sussex countryside on his bike, start a new side-project without finishing the last, or heading to the cinema.

**Andrea Passaglia** was born in Genoa, in northern Italy. Interested in technology since his parents gave him a toy computer when he was a boy, he started studying web technologies at an early age. After obtaining his master's degree in computer engineering he worked on the design and implementation of web interfaces for companies of various sizes and in different industries (healthcare, fashion, tourism, and transport).

In 2016 he moves in the silicon valley of Europe to tackle new problems in the banking industry at the Edgeverve Dublin Research and Development Labs.

A backend technologist by trade, Vue.js is his first tool to bring to life his creations when it comes to the frontend.

Andrea is married to a lovely Russian girl from Siberia and they often cook together mixing culinary traditions.

**Paul Halliday** (BSc Hons) is a Developer Advocate with a focus on fast-moving technologies. His online courses have taught over 25,000 students across a wide variety of software development subjects. He's also a Progress Developer Expert with expertise in NativeScript and Kendo UI.

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# Table of Contents

<b>Preface</b>	1
<b>Chapter 1: Getting Started with Vue.js</b>	7
<b>Creating the workspace</b>	8
Application space	8
Vue library	9
<b>Initializing Vue and displaying the first message</b>	9
<b>Computed values</b>	12
<b>Methods and reusable functions</b>	15
<b>Summary</b>	18
<b>Chapter 2: Displaying, Looping, Searching, and Filtering Data</b>	19
<b>HTML declarations</b>	20
v-html	20
Declarative rendering	21
<b>Conditional rendering</b>	22
v-if	22
v-else	23
<b>v-for and displaying our data</b>	25
Creating links using v-html	27
Format balance	28
Format registered date	28
<b>Filtering our data</b>	29
Building the form	29
Binding the inputs	31
<b>Showing and hiding Vue content</b>	32
Filtering our content	34
Filtering our filters	39
<b>Changing CSS classes</b>	40
<b>Filtering and custom classes</b>	44
<b>Summary</b>	48
<b>Chapter 3: Optimizing your App and Using Components to Display Data</b>	49
<b>Optimizing the code</b>	49
Reducing the number of filter variables and grouping logically	51
Combining the format functions	54
Autodetection formatting	54
Passing in a second variable	55
Creating the method	56

Reducing the number of hard-coded variables and properties, and reducing redundancy	58
<b>Creating Vue components</b>	61
Creating and initializing your component	62
Using your component	63
<b>Using component data and methods</b>	64
<b>Passing data to your component – props</b>	65
<b>Passing data to your component – slots</b>	68
<b>Creating a repeatable component</b>	73
Creating component methods and computed functions	76
CSS class functions	76
Formatted value functions	77
Making the filtering work again with props	81
<b>Making the filters a component</b>	85
Creating the component	85
Resolving JavaScript errors	87
Using custom events to change the filter field	87
Updating the filter query	89
<b>Summary</b>	94
<b>Chapter 4: Getting a List of Files Using the Dropbox API</b>	95
<b>Getting started—loading the libraries</b>	96
<b>Creating a Dropbox app and initializing the SDK</b>	97
<b>Displaying your data and using Vue to get it</b>	98
Create the component	98
Retrieve the Dropbox data	99
The Vue life cycle hooks	100
Displaying the Dropbox data	102
More file meta information	104
Formatting the file sizes	105
<b>Adding a loading screen</b>	106
<b>Animating between states</b>	109
<b>Summary</b>	111
<b>Chapter 5: Navigating through the File Tree and Loading Folders from the URL</b>	112
<b>Separating out files and folders</b>	113
<b>Making file and folder components</b>	115
<b>Linking folders and updating the structure</b>	116
<b>Creating a breadcrumb from the current path</b>	120
<b>Adding the ability to download files</b>	127
<b>Updating the URL hash and using it to navigate through the folders</b>	129
Showing the folder based on the URL	131
Displaying an error message	131
Using the back and forward buttons in your browser	133

Removing unneeded code	133
Updating the structure with a URL change and setting Vue data outside of the instance	135
<b>Final Code</b>	139
<b>Summary</b>	143
<b>Chapter 6: Caching the Current Folder Structure Using Vuex</b>	144
<b>Including and initializing Vuex</b>	146
<b>Utilizing the store</b>	147
Retrieving the message	148
Updating the message	149
<b>Using the Vuex store for the folder path</b>	149
Updating the path methods to use store commits	150
Using the path variable	151
Updating the breadcrumb component	151
Updating the dropbox-viewer component to work with Vuex	152
<b>Caching the folder contents</b>	155
<b>Loading data from the store if it exists</b>	159
Loading the data from the store	159
Only storing new data	160
<b>Summary</b>	165
<b>Chapter 7: Pre-Caching Other Folders and Files for Faster Navigation</b>	166
<b>Caching subfolders</b>	167
Planning app methods	168
Creating the getFolderStructure method	169
Showing the data with the displayFolderStructure method	173
Set the loading state to true and create an empty structure object	174
Load the contents of the getFolderStructure method	174
Loop through the result and add each item to either the folders or files array	175
Update the global structure object and remove the loading state	176
Instigating the method	176
Caching the subfolders	178
Alternative caching method	179
<b>Caching parent folders</b>	181
Caching parent folders once	184
<b>Caching download links on files</b>	187
<b>The complete code—with added documentation</b>	189
<b>Summary</b>	198
<b>Chapter 8: Introducing Vue-Router and Loading URL-Based Components</b>	199
<b>Installing and initializing Vue-router</b>	200
<b>Changing the folder for Vue-router</b>	204
<b>Linking to the different routes</b>	204
<b>Linking to sub-routes</b>	206

<b>Dynamic routes with parameters</b>	207
GET parameters	212
Using props	212
Setting prop defaults	214
Using static props	216
<b>Nested routes</b>	217
<b>Creating a 404 page</b>	220
<b>Naming components, routes, and views</b>	221
Naming components	221
Naming routes	222
Named views	224
<b>Programmatically navigating with, redirecting, and adding an alias</b>	226
Navigating programmatically	227
Redirecting	227
Alias routes	228
<b>Summary</b>	229
<b>Chapter 9: Using Vue-Router Dynamic Routes to Load Data</b>	230
<b>Outline and plan your app</b>	230
Components	231
Route components	231
HTML components	232
Paths	232
<b>Create initial files</b>	233
<b>Server setup</b>	236
Storing the file locally	236
Using a remote server	237
Setting up local server	237
<b>Loading CSV</b>	238
Loading a CSV with d3	239
Loading a CSV with CSV Parser	241
Unifying Shopify CSV data	241
Storing the products	243
<b>Displaying a single product</b>	245
Page Not Found	246
Selecting the right product	247
Catching products not found	250
<b>Displaying product information</b>	253
Product images	255
<b>Product variations</b>	261
Variations display table	261
Using a key with loops	261
Displaying the variations in a table	262
Displaying variations in a select box	269
<b>Updating the product details when switching URLs</b>	276

<b>Summary</b>	280
<b>Chapter 10: Building an E-Commerce Store - Browsing Products</b>	281
<b>Listing the products</b>	281
Adding a new route	282
Looping through products	283
<b>Creating pagination</b>	283
Calculating the values	283
Displaying a paginated list	287
Creating paginating buttons	288
Updating the URL on navigation	290
Creating pagination links	291
Updating the items per page	294
<b>Creating the ListProducts component</b>	295
<b>Creating a curated list for the home page</b>	299
<b>Showing more information</b>	301
<b>Creating categories</b>	304
Creating a category list	304
Creating a "miscellaneous" category	309
<b>Displaying the categories</b>	311
<b>Displaying products in a category</b>	314
Code optimization	317
<b>Ordering products in a category</b>	319
Store the product price	320
Wiring up the ordering	322
<b>Creating Vuex getters</b>	324
<b>Building the filtering component based on products</b>	329
Dynamically creating filters	337
Resetting filters	339
<b>Updating the URL on checkbox filter change</b>	340
Preselecting filters on page load	341
<b>Filtering the products</b>	342
<b>Summary</b>	346
<b>Chapter 11: Building an E-Commerce Store - Adding a Checkout</b>	347
<b>Creating the basket array placeholder</b>	347
<b>Adding product information to the store</b>	349
Creating the store mutation to add products to the basket	349
<b>Updating the Add to basket button when adding an item</b>	352
<b>Showing the product count in the header of the app</b>	354
Calculating the basket quantity	355
<b>Finalizing the Shop Vue-router URLs</b>	356
<b>Building the Order process and ListProducts component</b>	358
Order Confirmation screen	359
Using Vue filters to format the price	361

Calculating a total price	362
<b>Creating an Order Checkout page</b>	364
Copying details between addresses	366
<b>Creating an editable basket</b>	369
Creating editable fields	370
Removing items from your cart	372
<b>Completing the shop SPA</b>	373
Summary	374
<b>Chapter 12: Using Vue Dev Tools and Testing Your SPA</b>	375
<b>Using the Vue.js developer tools</b>	376
Inspecting Vue components data and computed values	376
Viewing Vuex mutations and time-travel	377
Previewing event data	379
<b>Testing your SPA</b>	380
Command-line unit testing	380
Browser automation	381
Summary	382
<b>Chapter 13: Transitions and Animations</b>	383
<b>Introduction</b>	383
<b>Integrating with third-party CSS animation libraries such as animate.css</b>	384
Getting ready	384
How to do it...	385
How does it work...	387
<b>Adding your own transition classes</b>	388
Getting ready	388
How to do it...	388
How it works...	389
<b>Animating with JavaScript instead of CSS</b>	390
Getting ready	391
How to do it...	391
How it works...	392
There's more...	394
<b>Transitioning on the initial render</b>	396
Getting ready	396
How to do it...	396
How it works...	398
<b>Transitioning between elements</b>	399
Getting ready	399
How to do it...	399
How it works...	401
There's more...	402
Transitioning between more than two elements	402
Setting the key attribute dynamically	403

<b>Letting an element leave before the enter phase in a transition</b>	404
Getting ready	404
How to do it...	404
The two elements problem	404
Transition modes	406
How it works...	406
<b>Adding entering and leaving transitions for elements of a list</b>	407
Getting ready	407
How to do it...	407
How it works...	409
<b>Transitioning elements that move in a list</b>	409
Getting ready	410
How to do it...	410
How it works...	412
<b>Animating the state of your components</b>	413
Getting ready	414
How to do it...	414
How it works...	416
<b>Packaging reusable transitions into components</b>	417
Getting ready	418
How to do it...	418
Building the basic web page	418
Building the reusable transition	420
Using our transition with the elements in our page	420
How it works...	421
<b>Dynamic transitions</b>	422
Getting ready	422
How to do it...	422
How it works...	425
<b>Chapter 14: Vue Communicates with the Internet</b>	426
<b>    Introduction</b>	426
<b>    Sending basic AJAX requests with Axios</b>	427
Getting ready	427
How to do it...	427
How it works...	428
<b>    Validating user data before sending it</b>	431
Getting ready	431
How to do it...	431
How it works...	432
<b>    Creating a form and sending data to your server</b>	433
Getting ready	433
How to do it...	433
How it works...	436
There's more...	437
<b>    Recovering from an error during a request</b>	437

Getting ready	438
How to do it...	438
How it works...	442
<b>Creating a REST client (and server!)</b>	442
Getting ready	443
How to do it...	443
How it works...	446
<b>Implementing infinite scrolling</b>	447
Getting ready	447
How to do it...	447
How it works...	449
<b>Processing a request before sending it out</b>	450
Getting ready	450
How to do it...	450
How it works...	452
<b>Preventing XSS attacks to your app</b>	453
Getting ready	453
How to do it...	453
How it works...	454
<b>Chapter 15: Single Page Applications</b>	456
<b>Introduction</b>	456
<b>Creating an SPA with vue-router</b>	457
Getting ready	457
How to do it...	457
How it works...	460
There's more...	460
<b>Fetching data before switching route</b>	461
Getting ready	461
How to do it...	461
How it works...	463
<b>Using named dynamic routes</b>	464
Getting ready	464
How to do it...	465
How it works...	467
<b>Having more than one router-view in your page</b>	468
Getting ready	468
How to do it...	468
How it works...	470
<b>Compose your routes hierarchically</b>	471
Getting ready	471
How to do it...	471
How it works...	474
<b>Using route aliases</b>	475
Getting ready	475

How to do it...	476
How it works...	478
<b>Adding transitions between your routes</b>	478
Getting ready	478
How to do it...	478
How it works...	480
<b>Managing errors for your routes</b>	480
Getting ready	480
How to do it...	481
How it works...	483
<b>Adding a progress bar to load pages</b>	483
Getting ready	483
How to do it...	483
How it works...	485
<b>How to redirect to another route</b>	486
Getting ready	486
How to do it...	486
How it works...	488
There's more...	488
Redirecting to 404s	488
Named redirecting	488
Redirecting with parameters	489
Dynamic redirecting	489
<b>Saving scrolling position when hitting back</b>	489
Getting ready	490
How to do it...	490
How it works...	494
<b>Chapter 16: Organize + Automate + Deploy = Webpack</b>	495
<b>    Introduction</b>	495
<b>    Extracting logic from your components to keep the code tidy</b>	495
Getting ready	496
How to do it...	496
Creating a clean Webpack project	496
Building the compound interest calculator	497
How it works...	500
<b>    Bundling your component with Webpack</b>	500
Getting ready	500
How to do it...	501
How it works...	508
There's more...	508
<b>    Organizing your dependencies with Webpack</b>	509
Getting ready	509
How to do it...	509
How it works...	513
<b>Using external components in your Webpack project</b>	513

Getting ready	513
How to do it...	513
How it works...	516
<b>Developing with continuous feedback with hot reloading</b>	518
Getting ready	518
How to do it...	519
How it works...	522
<b>Using Babel to compile from ES6</b>	523
Getting ready	523
How to do it...	523
How it works...	525
<b>Running a code linter while developing</b>	526
Getting ready	526
How to do it...	526
How it works...	529
<b>Using only one command to build both a minified and a development .js file</b>	530
Getting ready	530
How to do it...	530
How it works...	532
<b>Releasing your components to the public</b>	532
Getting ready	533
How to do it...	533
How it works...	538
<b>Chapter 17: Advanced Vue.js - Directives, Plugins, and Render Functions</b>	541
<b>    Introduction</b>	541
<b>    Creating a new directive</b>	542
Getting ready	542
How to do it...	542
How it works...	544
<b>    Using WebSockets in Vue</b>	544
Getting ready	544
How to do it...	545
How it works...	547
<b>    Writing a plugin for Vue</b>	549
Getting ready	549
How to do it...	549
How it works...	553
<b>    Rendering a simple component manually</b>	553
Getting ready	553
How to do it...	554
How it works...	554
<b>    Rendering a component with children</b>	555

Getting ready	555
How to do it...	556
How it works...	558
<b>Using JSX to render a component</b>	559
Getting ready	559
How to do it...	559
How it works...	560
There's more...	560
<b>Creating a functional component</b>	561
Getting ready	561
How to do it...	561
How it works...	564
<b>Building a responsive table with higher-order components</b>	565
Getting ready	565
How to do it...	565
How it works...	569
<b>Chapter 18: Large Application Patterns with Vuex</b>	571
<b>    Introduction</b>	571
<b>    Dynamically loading pages in your vue-router</b>	572
Getting ready	572
How to do it...	572
How it works...	575
There's more...	576
<b>    Building a simple storage for the application state</b>	576
Getting ready	576
How to do it...	577
How it works...	581
<b>    Understanding Vuex mutations</b>	581
Getting ready	581
How to do it...	581
How it works...	583
There's more...	584
<b>    Listing your actions in Vuex</b>	585
Getting ready	586
How to do it...	586
How it works...	588
<b>    Separating concerns with modules</b>	589
Getting ready	589
How to do it...	589
How it works...	592
<b>    Building getters to help retrieve your data</b>	593
Getting ready	593
How to do it...	594
How it works...	595

Accessing other getters	595
Passing an argument	596
<b>Testing your store</b>	596
Getting ready	596
How to do it...	596
Software requirements	597
Testing mutations	597
Testing actions	599
How it works...	601
<b>Chapter 19: Integrating with Other Frameworks</b>	602
<b>Introduction</b>	602
<b>Building universal applications with Electron</b>	602
Getting ready	603
How to do it...	603
How it works...	606
<b>Using Vue with Firebase</b>	606
Getting ready	606
How to do it...	607
How it works...	609
<b>Creating a real-time app with Feathers</b>	610
Getting ready	610
How to do it...	610
How it works...	613
<b>Creating a reactive app with Horizon</b>	613
Getting ready	614
How to do it...	615
How it works...	620
<b>Chapter 20: Vue Router Patterns</b>	621
<b>Single Page Applications</b>	621
<b>Using the router</b>	622
Creating routes	623
Dynamic routes	624
Route props	625
Component Navigation Guards	626
beforeRouteUpdate	626
beforeRouteEnter	627
beforeRouteLeave	627
Global router hooks	627
beforeEach	627
beforeResolve	628
afterEach	628
Resolution stack	629
<b>Programmatic navigation</b>	630
router.replace	631
router.go	631

Lazy loading routes	632
<b>An SPA project</b>	
Enabling the router	635
Defining routes	636
Creating the UserList route	636
Getting data from an API	637
Creating a detail page	638
Child routes	639
Summary	642
646	
<b>Chapter 21: State Management with Vuex</b>	647
<b>What is Vuex?</b>	647
State Management Pattern (SMP)	648
Thinking about state	649
<b>Using Vuex</b>	651
Creating a new store	651
Defining action types	652
Actions	652
Mutations	653
Getters	653
Combining elements	654
Payloads	656
<b>Vuex and Vue devtools</b>	660
<b>Modules and scalability</b>	662
Summary	664
<b>Other Books You May Enjoy</b>	665
<b>Index</b>	668

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# Preface

This Learning Path is divided into three sections, with each section bringing you closer to developing high-end modern web applications with Vue.js 2. It starts with building example applications to get well versed with the Vue.js ecosystem. You will learn to use Vue.js by creating three single page applications that explore Vuex and vue-router, the standard Vue tools for caching data and routing URLs for your applications. Going further, the Learning Path will address some of the challenges in designing web applications with Vue.js.

The Learning Path will have easy-to-follow recipes to help you tackle the challenges and craft dynamic front end. You will learn to integrate web utilities like Babel and Webpack to enhance your development workflow. Finally, towards the end, the course will introduce you to several design patterns to help you write clean, maintainable, and reusable codes with Vue framework.

At the end of the Learning Path, you will be confident with expertise in leveraging all the components and productivity features of Vue.js and will be on your way to design your web applications and execute it by writing clean code.

## Who This Book Is For

The Learning Path is intended for JavaScript developers at any level of expertise who wants to learn Vue.js and develop productive web applications with the power of the latest Vue.js.

## What This Book Covers

*Chapter 1, Getting Started with Vue.js*, shows how to get started with Vue by including the JavaScript file. We then move onto initializing your first Vue instance and looking at the data object along with examining computed functions and properties and finally learning about Vue methods.

*Chapter 2, Displaying, Looping, Searching, and Filtering Data*, describes how to display lists and more complex data with Vue using `v-if`, `v-else` and `v-for`. It then looks at how to filter the lists using form elements, followed by applying conditional CSS classes based on the data.

*Chapter 3, Optimizing Our App and Using Components to Display Data*, is about optimizing our Vue.js code by reducing the repetition and logically organizing our code. Once complete, it looks at how to create Vue components and use them with Vue, how to use props and slots with components, and utilizing events to transfer data between components.

*Chapter 4, Getting a List of Files Using the Dropbox API*, presents loading and querying the Dropbox API and listing the directories and files from your Dropbox account. It then looks at adding a load state to your app along with using Vue animations.

*Chapter 5, Navigating through the File Tree and Loading Folders from the URL*, explains how to create a component for both files and folders, and add links to the folder component to update the directory listing. It also covers how to add a download button to the file component and create a breadcrumb component so the user can easily navigate back up the tree and dynamically update the browser URL, so if a folder is bookmarked or a link is shared, the correct folder loads.

*Chapter 6, Caching the Current Folder Structure Using Vuex*, shows how to get started with Vuex along with storing and retrieving data from the Vuex Store. It then looks at how to integrate Vuex with our Dropbox app, how to cache the current Dropbox folder's contents, and loading data from the store if required.

*Chapter 7, Pre-Caching Other Folders and Files for Faster Navigation*, describes the process of pre-caching folders, storing the parent folder's contents, and how to cache the download links for the files.

*Chapter 8, Introducing Vue-Router and Loading URL-Based Components*, explores Vue-Router initialization and its options and how to create links with Vue-Router. It then looks at how to make dynamic routes to update the View based on the URL. From there, it describes how to use props with URLs, nest and name routes, and navigate programmatically.

*Chapter 9, Using Vue-Router Dynamic Routes to Load Data*, is about outlining our components and routes, loading a product CSV file and creating an individual product page with images and product variations.

*Chapter 10, Building an E-Commerce Store, Browsing Products*, describes how to create a homepage listing page with specific products, create a category page with a reusable component, create an ordering mechanism, create filters dynamically, and allow the user to filter the products.

*Chapter 11, Building an E-Commerce Store, Adding a Checkout,* is about building the functionality to allow the user to add and remove products to their basket, allow a user to check out and add an order confirmation page.

*Chapter 12, Using Vue Dev Tools and Testing Your SPA,* covers the usage of the Vue developer tools with the applications we've developed and has an overview of testing tools and applications.

*Chapter 13, Transitions and Animations,* where you learn how transitions and animations work to bring more life to your apps. You will also integrate with external CSS libraries.

*Chapter 14, Vue Communicates with the Internet,* is where you make your first AJAX call and create forms and a full-fledged REST client (and server!).

*Chapter 15, Single Page Applications,* is where you use vue-router to create static and dynamic routes to create a modern SPA.

*Chapter 16, Organize + Automate + Deploy = Webpack,* is where you actually publish your accurately crafted components to npm and learn how Webpack and Vue play together in the process.

*Chapter 17, Advanced Vue.js,* is where you explore directives, plugins, functional components, and JSX.

*Chapter 18, Large Application Patterns with Vuex,* is where you structure your application with tested patterns using Vuex to make sure your apps are maintainable and performant.

*Chapter 19, Integrating with Other Frameworks,* is where you build four different applications with Vue and Electron, Firebase, Feathers, and Horizon.

*Chapter 20, Vue Router Patterns,* describes how routing is a vitally important part of any SPA. This chapter focuses on the Vue route and looks at routing a user between multiple pages. It goes through everything from matching paths and components to dynamic matching with navigation parameters, regular expressions, and more.

*Chapter 21, State Management with Vuex,* demonstrates state management with Vuex. It starts by looking at the Flux architecture and unidirectional data flow. Then, it takes a look at Vuex, a state management system for Vue. The chapter also looks at implementing this in an application, as well as common pitfalls and usage patterns. It goes on to the `Vue-devtools` to capture actions and Vue instance data.

# To Get the Most out of This Book

For this book, the reader will need the following:

- A text editor or IDE to write code. It can be as simple as Notepad orTextEdit, but one with syntax highlighting such as Sublime Text, Atom, or Visual Studio Code is recommended.
- A web browser.
- A Dropbox user account with files and folders.

## Download the Example Code Files

You can download the example code files for this book from your account at [www.packt.com](http://www.packt.com). If you purchased this book elsewhere, you can visit [www.packt.com/support](http://www.packt.com/support) and register to have the files emailed directly to you.

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1. Log in or register at [www.packt.com](http://www.packt.com).
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Once the file is downloaded, please make sure that you unzip or extract the folder using the latest version of:

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## Conventions Used

In this book, you will find a number of text styles that distinguish between different kinds of information. Here are some examples of these styles and an explanation of their meaning.

Code words in the text, database table names, folder names, filenames, file extensions, pathnames, dummy URLs, user input, and Twitter handles are shown as follows: "Just assign the names of the layers you want to activate to the `VK_INSTANCE_LAYERS` environment variable."

A block of code is set as follows:

```
<div id="app">  
    {{ calculateSalesTax(shirtPrice) }}  
</div>
```

Any command-line input or output is written as follows:

```
$ npm install  
$ npm run dev
```

**Bold:** New terms and important words are shown in bold. Words that you see on the screen, for example, in menus or dialog boxes, appear in the text like this: "Select **System info** from the **Administration** panel."

Warnings or important notes appear like this.



Tips and tricks appear like this.



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# 1

# Getting Started with Vue.js

Vue (pronounced view) is a very powerful JavaScript library created for building interactive user interfaces. Despite having the ability to handle large single-page applications, Vue is also great for providing a framework for small, individual use cases. Its small file size means it can be integrated into existing ecosystems without adding too much bloat.

It was built to have a simple API, which makes it easier to get started in comparison with its rivals: React and Angular. Although it borrows some of the logic and methodologies from these libraries, it has identified a need for developers for a simpler library for building applications.

Unlike React or Angular, one of the benefits of Vue is the clean HTML output it produces. Other JavaScript libraries tend to leave the HTML scattered with extra attributes and classes in the code, whereas Vue removes these to produce clean, semantic output.

In this chapter, we will look at:

- How to get started with Vue by including the JavaScript file
- How to initialize your first Vue instance and look at the data object
- Examining computed functions and properties
- Learning about Vue methods

## Creating the workspace

To use Vue, we first need to include the library in our HTML and initialize it. For the examples in the first section of this book, we are going to be building our application in a single HTML page. This means the JavaScript to initialize and control Vue will be placed at the bottom of our page. This will keep all our code contained, and means it will easily run on your computer. Open your favorite text editor and create a new HTML page. Use the following template as a starting point:

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <title>Vue.js App</title>
  </head>
  <body>
    <div id="app">
    </div>
    <script src="https://unpkg.com/vue"></script>
    <script type="text/javascript">
      // JS Code here
    </script>
  </body>
</html>
```

The main HTML tags and structure should be familiar to you. Let's run over a few of the other aspects.

## Application space

This is the container for your application and provides a canvas for Vue to work in. All the Vue code will be placed within this tag. The actual tag can be any HTML element - main, section, and so on. The ID of the element needs to be unique, but again, can be anything you wish. This allows you to have multiple Vue instances on one page or identify which Vue instance relates to which Vue code:

```
<div id="app">
</div>
```

During the tutorials, this element with the ID will be referred to as the app space or view. It should be noted that all HTML and tags and code for your application should be placed within this container.



Although you can use most HTML tags for your application space, you cannot initialize Vue on the `<body>` or `<HTML>` tags - if you do so, Vue will throw a JavaScript error and will fail to initialize. You will have to use an element inside your body.

## Vue library

For the examples in this book, we are going to be using a hosted version of Vue.js from a **CDN (Content Delivery Network)** unpkg. This ensures that we have the latest version of Vue in our application, and also means we do not need to create and host other JavaScript files. Unpkg is an independent site that hosts popular libraries. It enables you to quickly and easily add a JavaScript package to your HTML, without having to download and host the file yourself:

```
<script src="https://unpkg.com/vue"></script>
```

When deploying your code, it is a good practice to serve up your libraries from local files rather than relying on CDNs. This ensures that your implementation will work with the currently - saved version, should they release an update. It will also increase the speed of your application, as it will not need to request the file from another server.

The `script` block following the library include is where we are going to be writing all our JavaScript for our Vue application.

## Initializing Vue and displaying the first message

Now that we have a template set up, we can initialize Vue and bind it to the HTML app space by using the following code:

```
const app = new Vue().$mount('#app');
```

This code creates a new instance of Vue and mounts it on the HTML element with the ID of `app`. If you save your file and open it up in a browser, you will notice nothing has happened. However, under the hood, this one line of code has linked the `div` with the `app` variable, which is an instance of a Vue application.

Vue itself has many objects and properties that we can now use to build our app. The first one you will encounter is the `el` property. Using an HTML ID, this property tells Vue which element it should bind to and where the app is going to be contained. This is the most common way of mounting your Vue instance and all Vue code should happen within this element:

```
const app = new Vue({  
  el: '#app'  
});
```

When the `el` property isn't specified in the instance, Vue initializes in an unmounted state—this allows any functions or methods you may have specified to run before mounting, to run and complete. You can then independently call the mounting function when ready. Behind the scenes, when using the `el` property, Vue is mounting the instance using a `$.mount` function. If you do want to wait, the `$mount` function can be called separately, for example:

```
const app = new Vue();  
  
// When ready to mount app:  
app.$mount('#app');
```

However, as we will not need to delay the execution of our mount timing throughout the book, we can use the `el` element with the Vue instance. Using the `el` property is also the most common way of mounting the Vue app.

Alongside the `el` value, Vue has a `data` object that contains any data we need to access the app or app space. Create a new data object within the Vue instance and assign a value to a property by doing the following:

```
const app = new Vue({  
  el: '#app',  
  
  data: {  
    message: 'Hello!'  
  }  
});
```

Within the app space, we now have access to the `message` variable. To display data within the app, Vue uses the Mustache templating language to output data or variables. This is achieved by placing the variable name between double curly brackets `{{ variable }}`. Logic statements, such as `if` or `foreach`, get HTML attributes, which will be covered later in the chapter.

Within the app space, add the code to output the string:

```
<div id="app">  
  {{ message }}  
</div>
```

Save the file, open it up in your browser, and you should be presented with your **Hello!** string.



If you don't see any output, check the JavaScript console to see if there are any errors. Ensure the remote JavaScript file is loading correctly, as some browsers and operating systems require additional security steps before allowing some remote files to be loaded when viewing pages locally on your computer.

The `data` object can handle multiple keys and data types. Add some more values to the `data` object and see what happens - make sure you add a comma after each value. Data values are simple JavaScript and can handle basic math, too - try adding a new `price` key and setting the value to `18 + 6` to see what happens. Alternatively, try adding a JavaScript array and printing it out:

```
const app = new Vue({  
  el: '#app',  
  
  data: {  
    message: 'Hello!',  
    price: 18 + 6,  
    details: ['one', 'two', 'three']  
  }  
});
```

In your app space, you can now output each of those values - `{} price {}` and `{} details {}` now output data - although the list may not be quite what you had expected. We'll cover using and displaying lists in [Chapter 2, Displaying, Looping, Searching, and Filtering Data](#).

All the data in Vue is reactive and can be updated by either the user or the application. This can be tested by opening up the browser's JavaScript console and updating the content yourself. Try typing `app.message = 'Goodbye!'`; and pressing *Enter* - your app's content will update. This is because you are referencing the property directly - the first `app` refers to the `const app` variable that your app is initialized to in your JavaScript. The period denotes a property within there, and the `message` refers to the `data` key. You could also update `app.details` or `price` to anything you want!

## Computed values

The `data` object in Vue is great for storing and retrieving data directly, however, there may be times where you want to manipulate the data before outputting it in your applications. We can do that using the `computed` object in Vue. Using this technique, we are able to start adhering to the **MVVM (Model-View-ViewModel)** methodology.

MVVM is a software architectural pattern where you separate out various parts of your application into distinct sections. The **Model** (or data) is your raw data input - be it from an API, database, or hardcoded data values. In the context of Vue, this is typically the `data` object we used earlier.

The **view** is the frontend of your application. This should just be used for outputting the data from the Model, and should not contain any logic or data manipulation, with the exception of some unavoidable `if` statements. For the Vue applications, this is all the code placed within the `<div id="app"></div>` tags.

The **ViewModel** is the bridge between the two. It allows you to manipulate the data from the Model before it is output by the view. Examples of this could range from changing a string to uppercase or prefixing a currency symbol, up to filtering out discounted products from a list or calculating the total value of a field across an array. In Vue, this is where the `computed` object comes in.

The computed object can have as many properties as required - however, they must be functions. These functions can utilize data already on the Vue instance and return a value, be it a string, number, or array that can then be used in the view.

The first step is to create a computed object within our Vue application. In this example, we are going to use a computed value to convert our string to lowercase, so set the value of `message` back to a string:

```
const app = new Vue({
  el: '#app',
  data: {
    message: 'Hello Vue!'
  },
  computed: {
  }
});
```



Don't forget to add a comma (,) after the closing curly bracket () of your data object so Vue knows to expect a new object.

The next step is to create a function inside the computed object. One of the hardest parts of development is naming things - make sure the name of your function is descriptive. As our application is quite small and our manipulation basic, we'll name it `messageToLower`:

```
const app = new Vue({
  el: '#app',
  data: {
    message: 'Hello Vue!'
  },
  computed: {
    messageToLower() {
      return 'hello vue!';
    }
  }
});
```

In the preceding example, I've set it to return a hardcoded string, which is a lowercased version of the contents of the `message` variable. Computed functions can be used exactly as you would use a data key in the view. Update the view to output `{} messageToLower {}` instead of `{} message {}` and view the result in your browser.

There are a few issues with this code, however. Firstly, if the value of `messageToLower` was being hardcoded, we could have just added it to another data property. Secondly, if the value of `message` changes, the lowercase version will now be incorrect.

Within the Vue instance, we are able to access both data values and computed values using the `this` variable - we'll update the function to use the existing `message` value:

```
computed: {
  messageToLower() {
    return this.message.toLowerCase();
  }
}
```

The `messageToLower` function now references the existing `message` variable and, using a native JavaScript function, converts the string to lower case. Try updating the `message` variable in your application, or in the JavaScript console, to see it update.

Computed functions are not just limited to basic functionality - remember, they are designed to remove all logic and manipulations from the view. A more complex example might be the following:

```
const app = new Vue({
  el: '#app',
  data: {
    price: 25,
    currency: '$',
    salesTax: 16
  },
  computed: {
    cost() {
      // Work out the price of the item including
      // salesTax
      let itemCost = parseFloat(
        Math.round((this.salesTax / 100) *
        this.price) + this.price).toFixed(2);
      // Add text before displaying the currency and
      // amount
      let output = 'This item costs ' +
      this.currency + itemCost;
      // Append to the output variable the price
      // without salesTax
      output += ' (' + this.currency + this.price +
      ' excluding salesTax)';
      // Return the output value
      return output;
    }
  }
});
```

Although this might seem advanced at first glance, the code is taking a fixed price and calculating what it would be with sales tax added. The `price`, `salesTax`, and `currency` symbol are all stored as values on the `data` object and accessed within the `cost()` computed function. The view outputs `{{ cost }}`, which produces the following:

**This item costs \$29.00 (\$25 excluding sales tax)**

Computed functions will recalculate and update if any data is updated, by either the user or the application itself. This allows for our function to dynamically update based on the `price` and `salesTax` values. Try one of the following commands in the console in your browser:

```
app.salesTax = 20
app.price = 99.99
```

The paragraph and prices will update instantly. This is because computed functions are reactive to the `data` object and the rest of the application.

## Methods and reusable functions

Within your Vue application, you may wish to calculate or manipulate data in a consistent or repetitive way or run tasks that require no output to your view. For example, if you wanted to calculate the sales tax on every price or retrieve some data from an API before assigning it to some variables.

Rather than creating computed functions for each time, we need to do this, Vue allows you to create functions or methods. These get declared in your application and can be accessed from anywhere - similar to the `data` or `computed` functions.

Add a method object to your Vue application and note the updates to the data object:

```
const app = new Vue({
  el: '#app',
  data: {
    shirtPrice: 25,
    hatPrice: 10,
    currency: '$',
    salesTax: 16
  },
  methods: {
  }
});
```

Within the `data` object, the `price` key has been replaced with two prices - `shirtPrice` and `hatPrice`. We'll create a method to calculate the sales tax for each of these prices.

Similar to creating a function for the `computed` object, create a method function title called `calculateSalesTax`. This function needs to accept a single parameter, which will be the `price`. Inside, we will use the code from the previous example to calculate the sales tax. Remember to replace `this.price` with just the parameter name: `price`, as shown here:

```
methods: {
  calculateSalesTax(price) {
    // Work out the price of the item including
    // sales tax
    return parseFloat(
      Math.round((this.salesTax / 100) * price)
      + price).toFixed(2);
  }
};
```

```
    }
}
```

Pressing save will not do anything to our application - we need to call the function. In your view, update the output to use the function and pass in the `shirtPrice` variable:

```
<div id="app">
  {{ calculateSalesTax(shirtPrice) }}
</div>
```

Save your documents and check the result in the browser - is it what you expected? The next task is to prepend the currency. We can do that by adding a second method that returns the parameter passed into the function with the currency at the beginning of the number:

```
methods: {
  calculateSalesTax(price) {
    // Work out the price of the item including
    sales tax
    return parseFloat(
      Math.round((this.salesTax / 100) * price) +
      price).toFixed(2);
  },
  addCurrency(price) {
    return this.currency + price;
}
}
```

In our view, we then update our output to utilize both methods. Rather than assigning to a variable, we can pass the first function, `calculateSalesTax`, as the parameter for the second `addCurrency` function. This works because of the first method, `calculateSalesTax`, accepts the `shirtPrice` parameter and returns the new amount. Instead of saving this as a variable and passing the variable into the `addCurrency` method, we pass the result directly into this function, which is the calculated amount:

```
  {{ addCurrency(calculateSalesTax(shirtPrice)) }}
```

However, it would start to get tiresome having to write these two functions every time we needed to output the price. From here, we have two options:

- We can create a third method, titled `cost()` - which accepts the `price` parameter and passes the input through the two functions
- Create a computed function, such as `shirtCost`, which uses `this.shirtPrice` instead of having a parameter passed in

We could, alternatively, create a method titled `shirtCost` that does the same as our computed function; however, it's better to practice to use computed in this case.

This is because computed functions are cached, whereas method functions are not. If you imagine our methods being a lot more complicated than they currently are, calling function after function repeatedly (for example, if we wanted to display the price in several locations) could have a performance impact. With computed functions, as long as the data does not change, you can call it as many times as you want, with the result being cached by the application. If the data does change, it only needs to recalculate once, and re-cache that result.

Make a computed function for both the `shirtPrice` and `hatPrice`, so that both variables can be used in the view. Don't forget that to call the functions internally you must use the `this` variable - for example, `this.addCurrency()`. Use the following HTML code as the template for your view:

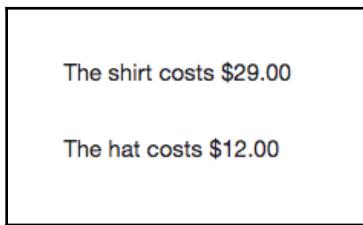
```
<div id="app">
  <p>The shirt costs {{ shirtCost }}</p>
  <p>The hat costs {{ hatCost }}</p>
</div>
```

Have a go at creating the computed functions yourself before comparing against the following code. Don't forget that there are many ways to do things in development, so don't worry if your code works but doesn't match the following example:

```
const app = new Vue({
  el: '#app',
  data: {
    shirtPrice: 25,
    hatPrice: 10,
    currency: '$',
    salesTax: 16
  },
  computed: {
    shirtCost() {
      return this.addCurrency(this.calculateSalesTax(
        this.shirtPrice))
    },
    hatCost() {
      return this.addCurrency(this.calculateSalesTax(
        this.hatPrice))
    },
  },
  methods: {
    calculateSalesTax(price) {
```

```
// Work out the price of the item including  
sales tax  
return parseFloat(  
    Math.round((this.salesTax / 100) * price) +  
    price).toFixed(2);  
},  
addCurrency(price) {  
    return this.currency + price;  
}  
}  
});
```

The result, although basic, should look like the following:



## Summary

In this chapter, we learned how to get started with the Vue JavaScript framework. We examined the `data`, `computed`, and `methods` objects within the Vue instance. We covered how to use each one within the framework and utilize each of its advantages.

# 2

# Displaying, Looping, Searching, and Filtering Data

In Chapter 1, *Getting Started with Vue.js*, we covered the `data`, `computed`, and `method` objects within Vue and how to display static data values. In this chapter, we are going to cover:

- Displaying lists and more complex data with Vue using `v-if`, `v-else`, and `v-for`
- Filtering the lists using form elements
- Applying conditional CSS classes based on the data

The data we are going to be using is going to be randomly generated by the JSON generator service (<http://www.json-generator.com/>). This website allows us to get dummy data to practice with. The following template was used to generate the data we will be using. Copy the following into the left-hand side to generate data of the same format so the attributes match with the code examples, as follows:

```
[  
  '{{repeat(5)}}',  
  {  
    index: '{{index()}}',  
    guid: '{{guid()}}',  
    isActive: '{{bool()}}',  
    balance: '{{floating(1000, 4000, 2, "00.00")}}',  
    name: '{{firstName()}} {{surname()}}',  
    email: '{{email()}}',  
    registered: '{{date(new Date(2014, 0, 1), new Date(), "YYYY-MM-ddThh:mm:ss")}}'  
  }  
]
```

Before we get into building our simple app and displaying our users, we'll cover some more of the features of Vue and the HTML-specific attributes available in your view. These range from dynamically rendering content to looping through arrays.

## HTML declarations

Vue allows you to use HTML tags and attributes to control and alter the view of your application. This involves setting attributes dynamically, such as `alt` and `href`. It also allows you to render tags and components based on data in the application. These attributes begin with a `v-` and, as mentioned at the beginning of this book, get removed from the HTML on render. Before we start outputting and filtering our data, we'll run through a few of the common declarations.

### v-html

The `v-html` directive allows you to output content without using the mustache-style curly bracket syntax. It can also be used if your output contains HTML tags – it will render the output as HTML instead of plain text. The value of the `HTML` attribute is that of the `data` key or computed function name:

#### View:

In your view app space, add the `v-html` attribute to an element:

```
<div id="app">
  <div v-html="message"></div>
</div>
```

#### JavaScript:

In the JavaScript, set the `message` variable to a string which contains some HTML elements:

```
const app = new Vue({
  el: '#app',
  data: {
    message: '<h1>Hello!</h1>'
  }
});
```

You should try and avoid adding HTML to your Vue instance, as it starts to mix up the View in the ViewModel and Model of our MVVM structure. There is also the danger you output an invalid HTML tag inside another. You should only use `v-html` with data you trust, because using it with an external API could be a security concern as it would allow the API to have control over your application. A potentially malicious API could use `v-html` to inject undesired content and HTML. Only use `v-html` with data you can fully trust.

## Declarative rendering

Regular HTML attributes, such as the `src` of the `<img>` tag, can be dynamically populated with Vue using the `v-bind:` attribute. This allows you to populate any existing attribute with data from your Vue application. This might be an image source or element ID.

The `bind` option gets used by prepending the attribute you wish to populate. For example, if you wished to populate an image source with the value of a data key called `imageSource`, you would do the following:

### View:

Create an `img` tag in your view app space, with a dynamic `src` attribute, using `v-bind` and a variable called `imageSource`.

```
<div id="app">
  
</div>
```

### JavaScript:

Create a variable in your Vue JavaScript code called `imageSource`. Add the URL to the desired image:

```
const app = new Vue({
  el: '#app',

  data: {
    imageSource: 'http://via.placeholder.com/350x150'
  }
});
```

The `v-bind:` attribute can be shortened to just `:`, so, for example, `v-bind:src` would become `:src`.

# Conditional rendering

Using custom HTML declarations, Vue allows you to render elements and contents conditionally based on data attributes or JavaScript declarations. These include `v-if`, for showing a container whether a declaration equates to true, and `v-else`, to show an alternative.

## v-if

The most basic example of this would be the `v-if` directive – determining a value or function if the block should be displayed.

Create a Vue instance with a single `div` inside the view and a data key, `isVisible`, set to `false`.

### View:

Start off with the view code as the following:

```
<div id="app">
  <div>Now you see me</div>
</div>
```

### JavaScript:

In the JavaScript, initialize Vue and create an `isVisible` data property:

```
const app = new Vue({
  el: '#app',

  data: {
    isVisible: false
  }
});
```

Right now, your Vue app would be displaying the contents of your element. Now add the `v-if` directive to your HTML element with the value of `isVisible`:

```
<div id="app">
  <div v-if="isVisible">Now you see me</div>
</div>
```

Upon pressing save, your text should disappear. That is because the tag is being conditionally rendered based on the value, which is currently `false`. If you open up your JavaScript console and run the following code, your element should reappear:

```
app.isVisible = true
```

`v-if` doesn't just work with Boolean true/false values. You can check whether a data property is equal to a specific string:

```
<div v-if="selected == 'yes'">Now you see me</div>
```

For example, the preceding code checks whether a selected data property is equal to the value of `yes`. The `v-if` attribute accepts JavaScript operators, so can check not equals, bigger, or less than.

The danger here is that your logic starts to creep into your View away from your ViewModel. To combat this, the attribute also takes functions as a value. The method can be as complicated as required but ultimately must return a `true` if you wish to show the code and a `false` if not. Bear in mind that if the function returns anything other than a `false` value (such as `0` or `false`) then the result will be interpreted as true.

This would look something like this:

```
<div v-if="isSelected">Now you see me</div>
```

And your method could be as this:

```
isSelected() {  
    return selected == 'yes';  
}
```

If you don't wish to completely remove the element and only hide it, there is a more appropriate directive, `v-show`. This applies a CSS `display` property rather than manipulating the DOM – `v-show` is covered later in the chapter.

## v-else

`v-else` allows you to render an alternative element based on the opposite of the `v-if` statement. If that results in `true`, the first element will be displayed; otherwise, the element containing `v-else` will.



The element with `v-else` needs to directly follow the one containing `v-if`; otherwise, your application will throw an error.

`v-else` has no value and is placed within the element tag.

```
<div id="app">
  <div v-if="isVisible">
    Now you see me
  </div>
  <div v-else>
    Now you don't
  </div>
</div>
```

Adding the preceding HTML to your app space will only show one of the `<div>` elements – toggling the value in your console as we did earlier will reveal the other container. You can also use `v-else-if` should you wish to chain your conditions. An example of `v-else-if` is as follows:

```
<div id="app">
  <div v-if="isVisible">
    Now you see me
  </div>
  <div v-else-if="otherVisible">
    You might see me
  </div>
  <div v-else>
    Now you don't
  </div>
</div>
```

**You might see me** will be displayed if the `isVisible` variable equates to `false`, but the `otherVisible` variable equates to `true`.

`v-else` should be used sparingly as can be ambiguous and might lead to false positive situation.

## v-for and displaying our data

The next HTML declaration means we can start displaying our data and putting some of these attributes into practice. As our data is an array, we will need to loop through it to display each element. To do this, we will use the `v-for` directive.

Generate your JSON and assign it to a variable called `people`. During these examples, the generated JSON loop will be displayed in the code blocks as `[ ... ]`. Your Vue app should look like the following:

```
const app = new Vue({  
  el: '#app',  
  
  data: {  
    people: [...]  
  }  
});
```

We now need to start displaying each person's name in our View as a bulleted list. This is where the `v-for` directive comes in:

```
<div id="app">  
  <ul>  
    <li v-for="person in people">  
      {{ person }}  
    </li>  
  </ul>  
</div>
```

The `v-for` loops through the JSON list and for every entry temporarily assigns it the `person` variable. We can then output the value or attributes of the variable.

The `v-for` loop needs to be applied to the HTML element you want to be repeated, in this case, `<li>`. If you don't have a wrapping element or don't wish to use the HTML you can use the Vue `<template>` elements. These get removed at runtime while still creating a container for you to output the data with:

```
<div id="app">  
  <ul>  
    <template v-for="person in people">  
      <li>  
        {{ person }}  
      </li>  
    </template>  
  </ul>  
</div>
```

The template tag also hides the contents until the app has initialized, which may be handy if your network is slow or your JavaScript takes a while to fire.

Just leaving our view to output `{{ person }}` will create a long string of information, without any use to us. Update the output to target the `name` property of the `person` object:

```
<li v-for="person in people">
  {{ person.name }}
</li>
```

Viewing the result in the browser should reveal a list of the user's names. Update the HTML to list the users in a table showing their names, email addresses, and balance. Apply the `v-for` to the `<tr>` element:

```
<table>
  <tr v-for="person in people">
    <td>{{ person.name }}</td>
    <td>{{ person.email }}</td>
    <td>{{ person.balance }}</td>
    <td>{{ person.registered }}</td>
  </tr>
</table>
```

Add an extra cell to your table. This is going to display **Active** if they are active and **Inactive** if not, using the `isActive` property on the `person` object. This can be achieved in two ways – using the `v-if` directive or alternatively using a ternary `if`. Ternary ifs are inline `if` statements that can be placed within the curly brackets of your View. We would use the `v-if` if we wanted to use HTML elements to apply some styling.

If we were using a ternary 'if', the cell would look like the following:

```
<td>{{ (person.isActive) ? 'Active' : 'Inactive' }}</td>
```

And if we opted for the `v-if` option with `v-else`, allowing us to use the HTML we wish, it would look like this:

```
<td>
  <span class="positive" v-if="person.isActive">Active</span>
  <span class="negative" v-else>Inactive</span>
</td>
```

This active element is a perfect example of where a Vue Component would be ideal – we'll cover that in Chapter 3, *Optimizing our App and Using Components to Display Data*. As an alternative that is more in keeping with our MVVM methodology, we could create a method, which returns the status text. This would tidy up our view and moves the logic to our app:

```
<td>{{ activeStatus(person) }}</td>
```

Our method would then carry out the same logic as our view was:

```
activeStatus(person) {  
    return (person.isActive) ? 'Active' : 'Inactive';  
}
```

Our table will now look like the following:

Morales Ochoa	moralesochoa@savvy.com	2570.32	2016-02-22T10:11:31	Active
Tyson Beard	tysonbeard@savvy.com	1892.1	2016-01-27T01:06:57	Active
Hawkins Gibbs	hawkinsgibbs@savvy.com	3423.69	2016-04-23T11:19:49	Inactive
Conley Boyle	conleyboyle@savvy.com	3277.41	2014-06-04T04:22:31	Active
Joy Mosley	joymosley@savvy.com	2180.15	2016-04-21T11:52:18	Active

## Creating links using v-html

The next step is to link the email address so that it is clickable for users viewing the list of people. In this instance, we need to concatenate strings by adding a `mailto:` before the email address.

The first instinct is to do the following:

```
<a href="mailto:{{person.email}}">{{ person.email }}</a>
```

But Vue doesn't allow interpolation inside attributes. Instead, we must use the `v-bind` directive on the `href` attribute. This turns the attribute into a JavaScript variable, so any raw text must be written in quotes, and the concatenated with the desired variable:

```
<a v-bind:href="'mailto:' + person.email">{{ person.email }}</a>
```

Note the addition of `v-bind:`, the single quotes and concatenation + identifier.

## Format balance

Before we move on to filtering the users, add a method to correctly format the balance, prepending a currency symbol defined in the data object and ensuring there are two numbers after the decimal point. We can adapt our method from [Chapter 1, Getting Started with Vue.js](#), to achieve this. Our Vue application should now look like this:

```
const app = new Vue({
  el: '#app',

  data: {
    people: [...],
    currency: '$'
  },
  methods: {
    activeStatus(person) {
      return (person.isActive) ? 'Active' : 'Inactive';
    },
    formatBalance(balance) {
      return this.currency + balance.toFixed(2);
    }
  }
});
```

We can utilize this new method in our View:

```
<td>{{ formatBalance(person.balance) }}</td>
```

## Format registered date

The registered date field in the data is computer friendly, which is not very human-friendly to read. Create a new method titled `formatDate` that takes one parameter — similar to the `formatBalance` method previously.

If you want full customization of the display of your date, there are several libraries available, such as `moment.js`, that give you much more flexibility over the output of any date and time-based data. For this method, we are going to use a native JavaScript function, `toLocaleString()`:

```
formatDate(date) {  
    let registered = new Date(date);  
    return registered.toLocaleString('en-US');  
}
```

With the registered date, we pass it to the native `Date()` function so JavaScript knows to interpret the string as a date. Once stored in the registered variable, we return the object as a string with the `toLocaleString()` function. This function accepts a huge array of options (as outlined on MDN) to customize the output of your date. For now, we'll pass it the locale we wish to display and use the defaults for that location. We can now utilize our method in the view:

```
<td>{{ formatDate(person.registered) }}</td>
```

Each table row should now look like the following:

Morales Ochoa	<a href="mailto:moralesochoa@savvy.com">moralesochoa@savvy.com</a>	\$2570.32	2/22/2016, 10:11:31 AM	Active
---------------	--	-----------	------------------------	--------

## Filtering our data

With our data being listed out, we are now going to build filtering ability. This will allow a user to select a field to filter by and a text field to enter their query. The Vue application will then filter the rows as the user types. To do this, we are going to bind some form inputs to various values in the `data` object, create a new method, and use a new directive on the table rows; `v-show`.

## Building the form

Start off by creating the HTML in your view. Create a `<select>` box with an `<option>` for each field you want to filter, an `<input>` for the query, and a pair of radio buttons – we'll use these to filter active and non-active users. Make sure the `value` attribute of each `<option>` reflects the key in the user data – this will save on code required and will make the purpose of the select box more obvious.

The data you are filtering by does not need to be displayed for our filtering to work, although a user experience consideration needs to come into play here. Would it make sense if a table row was being displayed without the data you're filtering it on?

Create the form that will be used for filtering:

```
<form>
  <label for="filterField">
    Field:
    <select id="filterField">
      <option value="">Disable filters</option>
      <option value="isActive">Active user</option>
      <option value="name">Name</option>
      <option value="email">Email</option>
      <option value="balance">Balance</option>
      <option value="registered">Date registered</option>
    </select>
  </label>

  <label for="filterQuery">
    Query:
    <input type="text" id="filterQuery">
  </label>

  <span>
    Active:
    <label for="userStateActive">
      Yes:
      <input type="radio" value="true" id="userStateActive" checked>
    </label>
    <label for="userStateInactive">
      No:
      <input type="radio" value="false" id="userStateInactive">
    </label>
  </span>
</form>
```

This form includes a select box for selecting a field a filter by, an input box that would allow the user to enter a query to filter on, and a pair of radio buttons for when we wish to filter by active and non-active users. The imagined user flow is this: the user would select the field they wish to filter the data by and either enter their query or select the radio buttons. When the `isActive` (Active user) option is selected in the select box, the radio buttons will be displayed and the input box will be hidden. We have ensured the first radio button is selected by default to help.

The filtering inputs do not need to be included in a form to work; however, it is good practice to retain semantic HTML, even in a JavaScript application.

## Binding the inputs

To bind inputs to a variable that can be accessed through your Vue instance requires an HTML attribute to be added to the fields and a corresponding key added to the `data` object. Create a variable in the `data` object for each of the fields so we can bind the form elements to them:

```
data: {  
  people: [...],  
  
  currency: '$',  
  
  filterField: '',  
  filterQuery: '',  
  filterUserState: ''  
}
```

The `data` object now has three additional keys: `filterField`, which will be used for storing the value of the dropdown; `filterQuery`, the placeholder for data entered into the textbox; and `filterUserState`, which allows us to store the radio button checkboxes.

Now there are data keys to utilize, we are able to bind form elements to them. Apply a `v-model=""` attribute to each form field, with the value of the data key.

Here's an example:

```
<input type="text" id="filterQuery" v-model="filterQuery">
```

Make sure the two radio buttons have exactly the same `v-model=""` attribute: this is so they can update the same value. To verify that it has worked, you can now output the data variables and get the value of the fields.

Try outputting `filterField` or `filterQuery` and changing the fields.

```
{{ filterField }}
```

One thing you may notice if you were to output the `filterUserState` variable is it appears to be in working. But, it is not getting the actual results desired. The output of the variable would be `true` and `false` as set in the value attributes.

On closer inspection, the values are actually strings, rather than a Boolean value. A Boolean value is a hard `true` or `false`, `1` or `0`, which you can easily compare against, whereas a string would require exact checking on a hardcoded string. This can be verified by outputting the `typeof` variable that it is:

```
{} typeof filterUserState {}
```

This can be resolved by binding the values of the radio buttons with the `v-bind:value` attribute. This attribute allows you to specify the value for Vue to interpret and can take Boolean, string, or object values. For now, we'll pass it `true` and `false`, as we were already doing with the standard value attribute, but Vue will know to interpret it as Boolean:

```
<span>
  Active:
    <label for="userStateActive">
      Yes:
        <input type="radio" v-bind:value="true" id="userStateActive"
          v-model="filterUserState" selected>
    </label>
    <label for="userStateInactive">
      No:
        <input type="radio" v-bind:value="false"
          id="userStateInactive" v-model="filterUserState">
    </label>
</span>
```

The next step is to show and hide the table rows based on these filters.

## Showing and hiding Vue content

Along with `v-if` for showing and hiding content, you can also use the `v-show=""` directive. `v-show` is very similar to `v-if`; they both get added to the HTML wrapper and can both accept the same parameters, including a function.

The difference between the two is `v-if` alters the markup, removing and adding HTML elements as required, whereas `v-show` renders the element regardless, hiding and showing the element with inline CSS styles. `v-if` is much more suited to runtime renders or infrequent user interactivities as it could potentially be restructuring the whole page. `v-show` is favorable when lots of elements are quickly coming in and out of view, for example, when filtering!

When using `v-show` with a method, the function needs to return just a `true` or `false`. The function has no concept of where it is being used, so we need to pass in the current person being rendered to calculate if it should be shown.

Create a method on your Vue instance titled `filterRow()` and inside, set it to return `true`:

```
filterRow(person) {  
    return true;  
}
```

The function takes one parameter, which is the person will we pass in from though from the HTML. In your view, add the `v-show` attribute to the `<tr>` element with `filterRow` as the value while passing in the person object:

```
<table>  
  <tr v-for="person in people" v-show="filterRow(person)">  
    <td>{{ person.name }}</td>  
    ...
```

As a simple test, return the `isActive` value to the person. This should instantly filter out anyone who is inactive, as their value will return `false`:

```
filterRow(person) {  
    return person.isActive;  
}
```

## Filtering our content

Now we have control over our people rows and some filter controls in our view, we need to make our filters work. We are already filtering by our `isActive` key, so the radio buttons will be the first to be wired up. We already have the value in a Boolean form for both the radio buttons values and the key we will be filtering by. For this filter to work, we need to compare the `isActive` key with the radio button's value.

- If the `filterUserState` value is `true`, show users where `isActive` is `true`
- If the `filterUserState` value is `false`, however, only show users where their `isActive` value is `false` as well

This can be written in one line by comparing the two variables:

```
filterRow(person) {
    return (this.filterUserState === person.isActive);
}
```

On page load, no users will be shown as the `filterUserState` key is set to neither `true` nor `false`. Clicking one of the radio buttons will reveal the corresponding users.

Let's make the filter work only if the active user option is selected in the dropdown:

```
filterRow(person) {
    let result = true;
    if(this.filterField === 'isActive') {
        result = this.filterUserState === person.isActive;
    }

    return result;
}
```

This code sets a variable to `true` as a default. We can then return the variable immediately and our row will show. Before returning, however, it checks the value of the select box and if is the desired value, will then filter by our radio buttons. As our select box is bound to the `filterField` value, as with the `filterUserState` variable, it updates while we interact with the app. Try selecting the **Active user** option in the select box and changing the radio buttons.

The next step is to use the input query box when the active user option is not selected. We also want our query to be a *fuzzy* search — for example, to match words containing the search query rather than matching exactly. We also want it to be case insensitive:

```
filterRow(person) {
    let result = true;

    if(this.filterField) {

        if(this.filterField === 'isActive') {
            result = this.filterUserState === person.isActive;
        } else {
            let query = this.filterQuery.toLowerCase(),
                field = person[this.filterField].toString().toLowerCase();
            result = field.includes(query);
        }

    }

    return result;
}
```

There are a few things we had to add to this method in order to work. The first step is to check that our select field has a value to begin the filtering. As the first option in our select field has a `value=""`, this equates to `false`. If this is the case, the method returns the default of `true`.

If it does have a value, it then goes to our original `if` statement. This checks on the specific value to see whether it matches `isActive` – if it does, it runs the code we wrote previously. If not, we start our alternate filtering. A new variable of `query` is established, which takes the value of the input and converts it to lowercase.

The second variable is the data we are going to be filtering against. This uses the value of the select box, which is the field key on the `person`, to extract the value to filter with. This value is converted to a string (in the case of the date or balance), converted to lowercase and stored as the `field` variable. Lastly, we then use the `includes` function to check whether the field includes the query entered. If it does, we return `true` and the row is shown; if not, the row is hidden.

The next issue we can address is when filtering with numbers. It is not intuitive for the user to enter the exact balance of the user they are after — a much more natural way of searching is to find users with a balance under or over a certain amount, for example, < 2000.

The first step in doing this is to only apply this type of filtering when it is the balance field. We can approach this two ways – we can either check that the field name is balance, similar to how we check the isActive field, or we can check the type of data we are filtering on.

Checking against the field name is simpler. We can do an `else if()` in our method or even migrate to a `switch` statement for easier reading and expansion. The alternative of checking the field type, however, is more scalable. It means we can expand our dataset with more numeric fields without having to extend or change our code. It does mean, however, that there will be further `if` statements in our code.

What we will do first is alter our storing method, as we don't want to necessarily lowercase the field or query:

```
if(this.filterField === 'isActive') {  
    result = this.filterUserState === person.isActive;  
} else {  
  
    let query = this.filterQuery,  
        field = person[this.filterField];  
  
}
```

The next step is to establish the type of data in the field variable. This can be established by, once again, using the `typeof` operator. This can be used in an `if` statement, to check whether the type of field is a number:

```
if(this.filterField === 'isActive') {  
    result = this.filterUserState === person.isActive;  
} else {  
  
    let query = this.filterQuery,  
        field = person[this.filterField];  
  
    if(typeof field === 'number') {  
        // Is a number  
    } else {  
        // Is not a number  
        field = field.toLowerCase();  
        result = field.includes(query.toLowerCase());  
    }  
  
}
```

Once our check is complete, we can default back to our original query code. It will use this if the select option is *not* `isActive` and the data were are filtering on *is not* a number. If this is the case, then it will lowercase the field and see if it includes what has been written in the query box when converted to lowercase as before.

The next stage is to actually compare our numbered data against what has been written in the query box. To do this, we are going to use the native JavaScript `eval` function.

The `eval` function can be a potentially dangerous function and should not be used in production code without some serious input sanitizing checks, plus, it is less performant than lengthier alternatives. It runs everything inside as native JavaScript and so can be open to abuse. However, as we are using this for a dummy application, with the focus being on Vue itself rather than creating a fully web-safe application, it is fine in this instance. You can read more about `eval` in 24 ways:

```
if(this.filterField === 'isActive') {
  result = this.filterUserState === person.isActive;
} else {

  let query = this.filterQuery,
      field = person[this.filterField];
  if(typeof field === 'number') {
    result = eval(field + query);
  } else {
    field = field.toLowerCase();
    result = field.includes(query.toLowerCase());
  }
}
```

This passes both the field and the query to the `eval()` function and passes the result (either `true` or `false`) to our `result` variable to determine the visibility of the row. The `eval` function literally evaluates the expression and determines if it is `true` or `false`. Here's an example:

```
eval(500 > 300); // true
eval(500 < 400); // false
eval(500 - 500); // false
```

In this example, the number 500 is our field, or in this specific example, `balance`. Anything that is after that is what is written by our user. Your filtering code is now ready to go. Try selecting the **balance** from the dropdown and filtering for users with a balance higher than 2000.

Before we move on, we need to add some error checking. If you have your JavaScript console open, you may have noticed an error when you typed the first greater or less than. This was because the `eval` function is unable to evaluate `x >` (where `x` is the balance). You may have also been tempted to type `$2000` with the currency and realized this doesn't work. This is because the currency is applied while rendering the view, whereas we are filtering the data before this is rendered.

In order to combat these two errors, we must remove any currency symbols typed in the query and test our `eval` function before relying on it to return the results. Remove the currency symbol with the native JavaScript `replace()` function. If it changes, uses the currency symbol stored in the app, rather than hardcoding the currently used one.

```
if(typeof field == 'number') {
    query = query.replace(this.currency, '');
    result = eval(field + query);
}
```

We now need to test the `eval` function so it does not throw an error with every key pressed. To do this, we use a `try...catch` statement:

```
if(typeof field == 'number') {
    query = query.replace(this.currency, '');
    try {
        result = eval(field + query);
    } catch(e) {}
}
```

As we don't want to output anything when an error is entered, we can leave the `catch` statement empty. We could put the `field.includes(query)` statement in here, so it falls back to the default functionality. Our full `filterRow()` method now looks like this:

```
filterRow(person) {
    let result = true;
    if(this.filterField) {

        if(this.filterField === 'isActive') {

            result = this.filterUserState === person.isActive;

        } else {

            let query = this.filterQuery,
            field = person[this.filterField];
            if(typeof field === 'number') {
                query = query.replace(this.currency, '');
                try {


```

```
        result = eval(field + query);
    } catch (e) {}

} else {

    field = field.toLowerCase();
    result = field.includes(query.toLowerCase());

}

}

return result;
}
```

## Filtering our filters

Now we have our filtering in place, we need to only show the radio buttons when the `isActive` option is selected in our dropdown. Using the knowledge we've learned, this should be relatively straightforward.

Create a new method that checks the select box value and returns `true` when **Active User** is selected in our dropdown:

```
isActiveFilterSelected() {
    return (this.filterField === 'isActive');
}
```

We can now use `v-show` for both the input and radio buttons, reversing the effect when on the query box:

```
<label for="filterQuery" v-show="!isActiveFilterSelected()">
    Query:
    <input type="text" id="filterQuery" v-model="filterQuery">
</label>
<span v-show="isActiveFilterSelected()">
    Active:
    <label for="userStateActive">
        Yes:
        <input type="radio" v-bind:value="true" id="userStateActive"
            v-model="filterUserState">
    </label>
    <label for="userStateInactive">
        No:
        <input type="radio" v-bind:value="false" id="userStateInactive" v-
```

```
model="filterUserState">
  </label>
</span>
```

Take note of the exclamation point before the method call on the input field. This means not, and effectively reverses the result of the function, for example not true is the same as false and vice versa.

To improve user experience, we can also check that the filtering is active at all before showing either of the inputs. This can be added by including a secondary check in our `v-show` attribute:

```
<label for="filterQuery" v-show="this.filterField &&
!isActiveFilterSelected()">
  Query:
  <input type="text" id="filterQuery" v-model="filterQuery">
</label>
```

This now checks that `filterField` has a value and that the select box is not set to `isActive`. Make sure you add this to the radio buttons too.

A further user experience enhancement would be to ensure all the users don't disappear when the `isActive` option is chosen. This currently happens because the default is set to a string, which does not match with either the `true` or `false` values of the field. Before filtering in this field, we should check that the `filterUserState` variable is either `true` or `false`, that is a Boolean. We can do this by using `typeof` once more:

```
if(this.filterField === 'isActive') {
  result = (typeof this.filterUserState === 'boolean') ?
    (this.filterUserState === person.isActive) : true;
}
```

We are using a ternary operator to check that the result to filter on is boolean. If it is, then filter as we were; if it is not then simply show the row.

## Changing CSS classes

As with any HTML attribute, Vue is able to manipulate CSS classes. As with everything in Vue, this can be done in a myriad of ways ranging from attributes on the object itself to utilizing methods. We'll start off adding a class if the user is active.

Binding a CSS class is similar to other attributes. The value takes an object that can calculate logic from within the view or be abstracted out into our Vue instance. This all depends on the complexity of the operation.

First, let's add a class to the cell containing the `isActive` variable if the user is active:

```
<td v-bind:class="{ active: person.isActive }">
  {{ activeStatus(person) }}
</td>
```

The class HTML attribute is first prepended by `v-bind:` to let Vue know it needs to process the attribute. The value is then an object, with the CSS class as the key and the condition as the value. This code toggles the `active` class on the table cell if the `person.isActive` variable equates to `true`. If we wanted to add an `inactive` class if the user was not active, we could add it to the object:

```
<td v-bind:class="{ active: person.isActive, inactive:
  !person.isActive }">
  {{ activeStatus(person) }}
</td>
```

Here's we've used the exclamation point again to reverse the status. If you run this app, you should find the CSS classes applied as expected.

If we're just applying two classes based on one condition, a ternary `if` statement can be used inside of the `class` attribute:

```
<td v-bind:class="person.isActive ? 'active' : 'inactive'">
  {{ activeStatus(person) }}
</td>
```

Note the single quotes around the class names. Once again, however, logic has started to creep into our View and, should we wish to also use this class elsewhere, is not very scalable.

Create a new method on our Vue instance called `activeClass` and abstract the logic into that — not forgetting to pass the `person` object in:

```
activeClass(person) {
  return person.isActive ? 'active' : 'inactive';
}
```

We can now call that method in our view:

```
<td v-bind:class="activeClass(person)">
  {{ activeStatus(person) }}
</td>
```

I appreciate this is quite a simple execution; let's try a slightly more complex one. We want to add a conditional class to the balance cell depending on the value. If their balance is under \$2000, we will add an `error` class. If it is between \$2000 and \$3000, a `warning` class will be applied and if it is over \$3000 a `success` class will be added.

Along with the `error`, `warning` and `success` classes, a class of `increasing` will be added if the balance is over \$500. For example, a balance of \$2,600 will get both the `warning`, and `increasing` classes, whereas \$2,400 would only receive the `warning` class.

As this contains several bits of logic, we will create a use a method in our instance. Create a `balanceClass` method and bind it to the `class` HTML attribute of the cell containing the balance. To begin with, we'll add the `error`, `warning` and `success` classes.

```
<td v-bind:class="balanceClass(person)">
  {{ formatBalance(person.balance) }}
</td>
```

In the method, we need to access the `balance` property of the `person` passed in and return the name of the class we wish to add. For now, we'll return a fixed result to verify that it's working:

```
balanceClass(person) {
  return 'warning';
}
```

We now need to evaluate our balance. As it's already a number, comparing it against our criteria won't involve any conversions:

```
balanceClass(person) {
  let balanceLevel = 'success';

  if(person.balance < 2000) {
    balanceLevel = 'error';
  } else if (person.balance < 3000) {
    balanceLevel = 'warning';
  }

  return balanceLevel;
}
```

In the preceding method, the class output gets set to `success` by default, as we only need to change the output if it is less than 3000. The first `if` checks whether the balance is below our first threshold – if it does, it sets the output to `error`. If not, it tries the second condition, which is to check whether the balance is below 3000. If successful, the class applied becomes `warning`. Lastly, it outputs the chosen class, which applies directly to the element.

We now need to consider how we can do the `increasing` class. To get it to output alongside the existing `balanceLevel` class, we need to convert the output from a single variable to an array. To verify that this works, hardcode the extra class to the output:

```
balanceClass(person) {
  let balanceLevel = 'success';
  if(person.balance < 2000) {
    balanceLevel = 'error';
  } else if (person.balance < 3000) {
    balanceLevel = 'warning';
  }
  return [balanceLevel, 'increasing'];
}
```

This adds the two classes to the element. Convert the string to a variable and set to `false` by default. Vue won't output anything for a `false` value passed in the array.

To work out if we need the `increasing` class, we need to do some calculations on the balance. As we want the `increasing` class if the balance is above 500 no matter what range it is in, we need to round the number and compare:

```
let increasing = false,
  balance = person.balance / 1000;

if(Math.round(balance) == Math.ceil(balance)) {
  increasing = 'increasing';
}
```

Initially, we set the `increasing` variable to `false` as a default. We also store a version of the balance divided by 1000. This means our balances turn out to be 2.45643 instead of 2456.42. From there, we compare the number after it has been rounded by JavaScript (For example 2.5 becomes 3, whereas 2.4 becomes 2) to the number that has been forced to round up (example 2.1 becomes 3, along with 2.9).

If the number output is the same, the `increasing` variable is set to the string of the class we want to set. We can then pass this variable along with the `balanceLevel` variable out as an array. The full method now looks like the following:

```
balanceClass (person) {
    let balanceLevel = 'success';

    if(person.balance < 2000) {
        balanceLevel = 'error';
    } else if (person.balance < 3000) {
        balanceLevel = 'warning';
    }

    let increasing = false,
        balance = person.balance / 1000;

    if(Math.round(balance) == Math.ceil(balance)) {
        increasing = 'increasing';
    }

    return [balanceLevel, increasing];
}
```

## Filtering and custom classes

We now have a fully fledged user list/register that has filtering on selected fields and custom CSS classes depending on the criteria. To recap, this is what our view looks like now we have the filter in place:

```
<div id="app">
<form>
    <label for="filterField">
        Field:
        <select id="filterField" v-model="filterField">
            <option value="">Disable filters</option>
            <option value="isActive">Active user</option>
            <option value="name">Name</option>
            <option value="email">Email</option>
            <option value="balance">Balance</option>
            <option value="registered">Date registered</option>
        </select>
    </label>

    <label for="filterQuery" v-show="this.filterField &&
        !isActiveFilterSelected()">
```

```
Query:  
  <input type="text" id="filterQuery" v-model="filterQuery">  
</label>  
  
<span v-show="isActiveFilterSelected()">  
  Active:  
    <label for="userStateActive">  
      Yes:  
        <input type="radio" v-bind:value="true" id="userStateActive" v-  
          model="filterUserState">  
    </label>  
    <label for="userStateInactive">  
      No:  
        <input type="radio" v-bind:value="false" id="userStateInactive" v-  
          model="filterUserState">  
    </label>  
  </span>  
</form>  
  
<table>  
  <tr v-for="person in people" v-show="filterRow(person)">  
    <td>{{ person.name }}</td>  
    <td>  
      <a v-bind:href="'mailto:' + person.email">{{ person.email }}</a>  
    </td>  
    <td v-bind:class="balanceClass(person)">  
      {{ formatBalance(person.balance) }}  
    </td>  
    <td>{{ formatDate(person.registered) }}</td>  
    <td v-bind:class="activeClass(person)">  
      {{ activeStatus(person) }}  
    </td>  
  </tr>  
</table>  
  
</div>
```

And the JavaScript for our Vue app should look something like this:

```
const app = new Vue({  
  el: '#app',  
  
  data: {  
    people: [...],  
  
    currency: '$',
```

```
        filterField: '',
        filterQuery: '',
        filterUserState: ''
    },
    methods: {
        activeStatus(person) {
            return (person.isActive) ? 'Active' : 'Inactive';
        },

        activeClass(person) {
            return person.isActive ? 'active' : 'inactive';
        },
        balanceClass(person) {
            let balanceLevel = 'success';

            if(person.balance < 2000) {
                balanceLevel = 'error';
            } else if (person.balance < 3000) {
                balanceLevel = 'warning';
            }

            let increasing = false,
            balance = person.balance / 1000;

            if(Math.round(balance) == Math.ceil(balance)) {
                increasing = 'increasing';
            }

            return [balanceLevel, increasing];
        },
        formatBalance(balance) {
            return this.currency + balance.toFixed(2);
        },
        formatDate(date) {
            let registered = new Date(date);
            return registered.toLocaleString('en-US');
        },
        filterRow(person) {
            let result = true;
            if(this.filterField) {

                if(this.filterField === 'isActive') {

                    result = (typeof this.filterUserState === 'boolean') ?
                    (this.filterUserState === person.isActive) : true;
                } else {

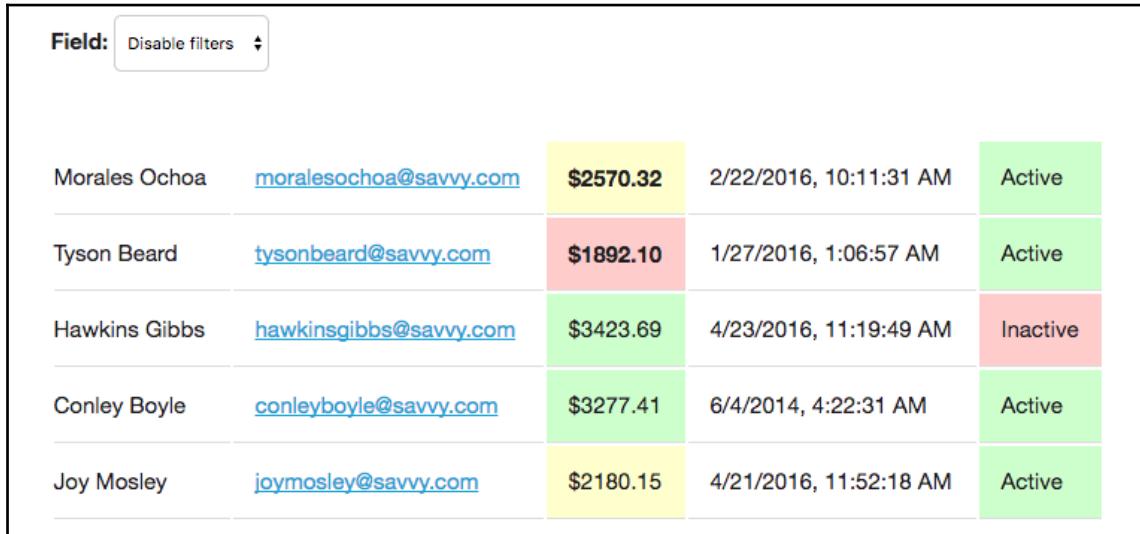
```

```
let query = this.filterQuery,
    field = person[this.filterField];

if(typeof field === 'number') {
    query.replace(this.currency, '');
    try {
        result = eval(field + query);
    } catch(e) {}
} else {
    field = field.toLowerCase();
    result = field.includes(query.toLowerCase());
}
}

return result;
},
isActiveFilterSelected() {
    return (this.filterField === 'isActive');
}
);
});
```

With a small amount of CSS, our people filtering app now looks like the following:



The screenshot shows a user interface for filtering a list of people. At the top left is a dropdown menu labeled "Field:" with the option "Disable filters". Below it is a table with five rows of data.

Morales Ochoa	<a href="mailto:moralesochoa@savvy.com">moralesochoa@savvy.com</a>	\$2570.32	2/22/2016, 10:11:31 AM	Active
Tyson Beard	<a href="mailto:tysonbeard@savvy.com">tysonbeard@savvy.com</a>	\$1892.10	1/27/2016, 1:06:57 AM	Active
Hawkins Gibbs	<a href="mailto:hawkingsgibbs@savvy.com">hawkingsgibbs@savvy.com</a>	\$3423.69	4/23/2016, 11:19:49 AM	Inactive
Conley Boyle	<a href="mailto:conleyboyle@savvy.com">conleyboyle@savvy.com</a>	\$3277.41	6/4/2014, 4:22:31 AM	Active
Joy Mosley	<a href="mailto:joymosley@savvy.com">joymosley@savvy.com</a>	\$2180.15	4/21/2016, 11:52:18 AM	Active

## Summary

In this chapter, we looked at Vue HTML declarations, conditionally rendering our HTML and showing an alternative if required. We also put into practice what we learned about methods. Lastly, we built a filtering component for our table, allowing us to show active and inactive users, find users with specific names and emails, and filter out rows based on the balance.

Now we've got to a good point in our app, it's a good opportunity to take a look at our code to see if it can be optimized in any way. By optimizations, I mean reducing repetition, making the code simpler if possible, and abstracting logic out into smaller, readable, and reusable chunks.

In [Chapter 3, Optimizing Our App and Using Components to Display Data](#), we will optimize our code and look at Vue components as a way of separating out logic into separate segments and sections.

# 3

# Optimizing your App and Using Components to Display Data

In Chapter 2, *Displaying, Looping, Searching, and Filtering Data*, we got our Vue app displaying our people directory, we can use this opportunity to optimize our code and separate it out into components. This makes the code more manageable, easier to understand, and makes it easier for other developers to work out the flow of data (or you, when you come back and look at your code in a few months!).

This chapter is going to cover:

- Optimizing our Vue.js code by reducing the repetition, and logically organizing our code
- How to create Vue components and use them with Vue
- How to use props and slots with components
- Utilizing events to transfer data between components

## Optimizing the code

As we wrote the code while we were figuring out the problem, there comes a point when you need to take a step back and look at your code to optimize it. This could include reducing the number of variables and methods or creating methods, to reduce repeating functionality. Our current Vue app looks like the following:

```
const app = new Vue({  
  el: '#app',  
  data: {  
    people: [...],  
    currency: '$',  
    filterField: '',  
    filterQuery: '',  
    filterUserState: ''  
  }  
})
```

```
  },
  methods: {
    activeStatus(person) {
      return (person.isActive) ? 'Active' :
        'Inactive';
    },
    activeClass(person) {
      return person.isActive ? 'active' :
        'inactive';
    },
    balanceClass(person) {
      let balanceLevel = 'success';
      if(person.balance < 2000) {
        balanceLevel = 'error';
      } else if (person.balance < 3000) {
        balanceLevel = 'warning';
      }
      let increasing = false,
      balance = person.balance / 1000;
      if(Math.round(balance) ==
        Math.ceil(balance)) {
        increasing = 'increasing';
      }
      return [balanceLevel, increasing];
    },
    formatBalance(balance) {
      return this.currency + balance.toFixed(2);
    },
    formatDate(date) {
      let registered = new Date(date);
      return registered.toLocaleString('en-US');
    },
    filterRow(person) {
      let result = true;
      if(this.filterField) {
        if(this.filterField === 'isActive') {
          result = (typeof this.filterUserState
            === 'boolean') ? (this.filterUserState
              === person.isActive) : true;
        } else {
          let query = this.filterQuery,
            field = person[this.filterField];
          if(typeof field === 'number') {
            query.replace(this.currency, '');
          try {
            result = eval(field + query);
          } catch(e) {}
        } else {
      
```

```
        field = field.toLowerCase();
        result =
            field.includes(query.toLowerCase());
        }
    }
    return result;
},
isActiveFilterSelected() {
    return (this.filterField === 'isActive');
}
);
});
```

Looking at the preceding code, there are some improvements we can make. These include:

- Reducing the number of filter variables and grouping logically
- Combining the format functions
- Reducing the number of hard-coded variables and properties
- Re-ordering methods into a more logical order

We'll cover these points individually so we have a clean code base for building components with.

## Reducing the number of filter variables and grouping logically

The filtering currently uses up three variables, `filterField`, `filterQuery`, and `filterUserState`. The only thing that currently links these variables is the name, rather than being in an object of their own to link them systematically. Doing this avoids any ambiguity as to whether they are related to the same component or just coincidentally the same. In the data object, create a new object titled `filter` and move each variable inside:

```
data: {
  people: [...],
  currency: '$',
  filter: {
    field: '',
    query: '',
    userState: '',
  }
}
```

To access the data, update any references of `filterField` to `this.filter.field`. Note the extra dot, denoting it is a key of the filter object. Don't forget to update `filterQuery` and `filterUserState` references as well. For example, the `isActiveFilterSelected` method would become:

```
isActiveFilterSelected() {  
    return (this.filter.field === 'isActive');  
}
```

You will also need to update the `v-model` and `v-show` attributes in your view—there are five occurrences of the various variables.

While updating the filtering variables, we can take this opportunity to remove one. With our current filtering, we can only have one filter active at a time. This means the `query` and `userState` variables are only being used at any one time, which gives us the opportunity to combine these two variables. To do so, we'll need to update the view and application code to cater for this.

Remove the `userState` variable from your filter data object and update any occurrence of `filter.userState` in your view to `filter.query`. Now do a *find and replace* in your Vue JavaScript code for `filter.userState`, again replacing it with `filter.query`.

Viewing your app in the browser, it will appear to initially work, being able to filter users by the field. However, if you filter by status, then switch to any other field, the query field won't show. This is because using the radio buttons sets the value to a Boolean which, when trying to convert to lowercase for the query field, fails to do so. To tackle this, we can convert whatever value is in the `filter.query` variable to a string using the native JavaScript `String()` function. This ensures that our filtering function can work with any filtering input:

```
if(this.filter.field === 'isActive') {  
    result = (typeof this.filter.query ===  
    'boolean') ? (this.filter.query ===  
    person.isActive) : true;  
} else {  
    let query = String(this.filter.query),  
        field = person[this.filter.field];  
    if(typeof field === 'number') {  
        query.replace(this.currency, '');  
    } try {  
        result = eval(field + query);  
    } catch(e) {}  
} else {
```

```
        field = field.toLowerCase();
        result = field.includes(query.toLowerCase());
    }
```

Adding this to our code now ensures our query data is usable no matter what the value. The issue this now creates is when the user is switching between fields to filter. If you select the **Active user** and chose a radio button, the filtering works as expected, however, if you now switch to **Email**, or another field, the input box is prepopulated with either `true` or `false`. This instantly filters and will often return no results. This also occurs when switching between two text filtering fields, which is not the desired effect.

What we want is, whenever the select box is updated, the filter query should clear. Whether it is the radio buttons or input box, selecting a new field should reset the filter query, this ensures a new search can begin.

This is done by removing the link between the select box and the `filter.field` variable and creating our own method to handle the update. We then trigger the method when the select box is changed. This method will then clear the `query` variable and set the `field` variable to the select box value.

Remove the `v-model` attribute on the select box and add a new `v-on:change` attribute. We will pass a method name into this that will fire every time the select box is updated.

`v-on` is a new Vue binding that we've not encountered before. It allows you to bind actions from elements to Vue methods. For example, `v-on:click` is one that is used the most commonly - which allows you to bind a `click` function to the element. We'll cover more on this in the next section of the book.

Where `v-bind` can be abbreviated to just a colon, `v-on` can be shortened to an @ symbol, allowing you to use `@click=""`, for example:

```
<select v-on:change="changeFilter($event)"
        id="filterField">
    <option value="">Disable filters</option>
    <option value="isActive">Active user</option>
    <option value="name">Name</option>
    <option value="email">Email</option>
    <option value="balance">Balance</option>
    <option value="registered">Date
        registered</option>
</select>
```

This attribute is firing the `changeFilter` method on every update and passing it the `$event` data of the change. This default Vue event object contains a lot of information that we could utilize, but the `target.value` data is the key we are after.

Create a new method in your Vue instance that accepts the event parameter and updates both the `query` and `field` variables. The `query` variable needs to be cleared, so set it to an empty string, whereas the `field` variable can be set to the value of the select box:

```
changeFilter(event) {
  this.filter.query = '';
  this.filter.field = event.target.value;
}
```

Viewing your application now should clear whatever the filter query is, while still operating as expected.

## Combining the format functions

Our next optimization will be to combine the `formatBalance` and `formatDate` methods in our Vue instance. This would then allow us to scale our format functions without bloating the code with several methods with similar functionality. There are two ways to approach a format style function—we can either auto-detect the format of the input or pass the desired format option in as a second option. Both have their pros and cons, but we'll walk through both.

## Autodetection formatting

Autodetection of the variable type, when passed into a function, is great for cleaner code. In your view, you could invoke the function and pass the one parameter you wish to format. For example:

```
{{ format(person.balance) }}
```

The method would then contain a `switch` statement and format the variable based on the `typeof` value. A `switch` statement can evaluate a single expression and then execute different code based on the output. `Switch` statements can be very powerful as they allow clauses to be built up—utilizing several different bits of code based on the result. More can be read about `switch` statements on MDN.

Switch statements are a great alternative to if statements if you are comparing the same expression. You are also able to have several cases for one block of code and even include a default if none of the previous cases was met. As an example of one in use, our format method might look like:

```
format(variable) {  
    switch (typeof variable) {  
        case 'string':  
            // Formatting if the variable is a string  
            break;  
        case 'number':  
            // Number formatting  
            break;  
        default:  
            // Default formatting  
            break;  
    }  
}
```

The important thing to note is the break; lines. These finish each switch case. If a break was omitted, the code would carry on and execute the following case—which sometimes is the desired effect.

Autodetecting the variable type and formatting is a great way of simplifying your code. However, for our app, it is not a suitable solution as we are formatting the date, which when outputting the typeof results in a string, and would not be identifiable from other strings we may wish to format.

## Passing in a second variable

The alternative to the preceding autodetection is to pass the second variable into the format function. This gives us greater flexibility and scalability should we wish to format other fields. With the second variable, we can either pass in a fixed string that matches a preselected list in our switch statement or we could pass in the field itself. An example of the fixed string approach in the view would be:

```
{{ format(person.balance, 'currency') }}
```

This would work perfectly and would be great if we had several different fields that all needed to be formatted like balance currently does, but there seems to be some slight repetition in using the balance key and currency format.

As a compromise, we are going to pass the `person` object as the first parameter, so we can access all the data, and the name of the field as the second parameter. We will then use this for both identifying the format method required and to return the specific data.

## Creating the method

In your view, replace both the `formatDate` and `formatBalance` functions with a singular `format` one, passing in the `person` variable as the first parameter, and the field enclosed quotes as the second:

```
<td v-bind:class="balanceClass(person)">
  {{ format(person, 'balance') }}
</td>
<td>
  {{ format(person, 'registered') }}
</td>
```

Create a new `format` method inside your Vue instance, which accepts two parameters: `person` and `key`. As the first step, retrieve the field using the `person` object and the `key` variable:

```
format(person, key) {
  let field = person[key],
      output = field.toString().trim();
  return output;
}
```

We have also created a second variable inside the function titled `output`—this will be what is returned at the end of the function and is set to the `field` by default. This ensures that if our formatting key does not match the one passed in, the untouched field data is returned—we do, however, convert the field to a string and trim any whitespace from the variable. Running the app now will return the fields without any formatting.

Add a `switch` statement, setting the expression to be just the `key`. Add two cases to the `switch` statement—one being `balance` and the other `registered`. As we do not wish for anything to happen to our input when it does not match a case, there is no need for us to have a `default` statement:

```
format(person, key) {
  let field = person[key],
      output = field.toString().trim();

  switch(key) {
    case 'balance':
```

```
        break;
    case 'registered':
        break;
    }
    return output;
}
```

We now just need to copy the code from our original formatting functions into the individual cases:

```
format(person, key) {
    let field = person[key],
        output = field.toString().trim();
    switch(key) {
        case 'balance':
            output = this.currency + field.toFixed(2);
            break;
        case 'registered':
            let registered = new Date(field);
            output = registered.toLocaleString('en-US');
            break;
    }
    return output;
}
```

This format function is now a lot more flexible. We can add more `switch` cases should we need to cater for more fields (process the `name` field, for example) or we can add new cases to existing code. An example of this would be if our data contained a field that detailed the date on which the user deactivated their account, we could easily display it in the same format as registered:

```
case 'registered':
case 'deactivated':
    let registered = new Date(field);
    output = registered.toLocaleString('en-US');
    break;
```

## Reducing the number of hard-coded variables and properties, and reducing redundancy

When looking at the Vue JavaScript, it is quickly evident that it can be optimized by introducing global variables and setting more local variables in the functions to make it more readable. We can also use existing functionality to stop repeating ourselves.

The first optimization is in our `filterRow()` method where we check whether `filter.field` is active. This is also repeated in the `isActiveFilterSelected` method we use to show and hide our radio buttons. Update the `if` statement to use this method instead, so the code is as follows:

```
...
if(this.filter.field === 'isActive') {
  result = (typeof this.filter.query === 'boolean') ?
    (this.filter.query === person.isActive) : true;
  } else {

...
}
```

The preceding code has the `this.filter.field === 'isActive'` code removed and replaced with the `isActiveFilterSelected()` method. It should now look like this:

```
...
if(this.isActiveFilterSelected()) {
  result = (typeof this.filter.query === 'boolean') ?
    (this.filter.query === person.isActive) : true;
  } else {

...
}
```

While we're in the `filterRow` method, we can reduce the code by storing the `query` and `field` as variables at the start of the method. `result` is also not the right keyword for this, so let's change it to `visible`. First, create and store our two variables at the start and rename `result` to `visible`:

```
filterRow(person) {
  let visible = true,
    field = this.filter.field,
    query = this.filter.query;

...
}
```

Replace all instances in that function of the variables, for example, the first part of the method would look like this:

```
if(field) {
    if(this.isActiveFilterSelected()) {
        visible = (typeof query === 'boolean') ?
            (query === person.isActive) : true;
    } else {
        query = String(query),
        field = person[field];
```

Save your file and open the app in the browser to ensure your optimizations haven't broken the functionality.

The last stage is to reorder the methods into an order that makes sense to you. Feel free to add comments to separate out the different method types—for example, ones that relate to CSS classes or filtering. I have also removed the `activeStatus` method, as we are able to utilize our `format` method to *format* the output of this field. After the optimizations, the JavaScript code now looks like the following:

```
const app = new Vue({
    el: '#app',
    data: {
        people: [...],
        currency: '$',
        filter: {
            field: '',
            query: ''
        }
    },
    methods: {
        isActiveFilterSelected() {
            return (this.filter.field === 'isActive');
        },
        /**
         * CSS Classes
         */
        activeClass(person) {
            return person.isActive ? 'active' :
                'inactive';
        },
        balanceClass(person) {
            let balanceLevel = 'success';
            if(person.balance < 2000) {
                balanceLevel = 'error';
            } else if (person.balance < 3000) {
                balanceLevel = 'warning';
            }
        }
    }
});
```

```
        }
        let increasing = false,
            balance = person.balance / 1000;
    if(Math.round(balance) ==
       Math.ceil(balance)) {
        increasing = 'increasing';
    }
    return [balanceLevel, increasing];
},
/**/
/* Display
 */
format(person, key) {
    let field = person[key],
        output = field.toString().trim();
    switch(key) {
        case 'balance':
            output = this.currency +
            field.toFixed(2);
            break;
        case 'registered':
            let registered = new Date(field);
            output = registered.toLocaleString('en-US');
            break;
        case 'isActive':
            output = (person.isActive) ? 'Active' :
            'Inactive';
            break;
    }
    return output;
},
/**/
/* Filtering
 */
changeFilter(event) {
    this.filter.query = '';
    this.filter.field = event.target.value;
},
filterRow(person) {
    let visible = true,
        field = this.filter.field,
        query = this.filter.query;
    if(field) {
        if(this.isActiveFilterSelected()) {
            visible = (typeof query === 'boolean') ?
            (query === person.isActive) : true;
        } else {
            query = String(query),
            field = person[field];
        }
    }
    return visible;
}
```

```
        if(typeof field === 'number') {
            query.replace(this.currency, '');
            try {
                visible = eval(field + query);
            } catch(e) {}
        } else {
            field = field.toLowerCase();
            visible =
                field.includes(query.toLowerCase());
        }
    }
    return visible;
}
);
});
```

## Creating Vue components

Now we're confident our code is cleaner, we can move on to making Vue components for the various parts of our app. Put aside your code for now and open a new document while you get to grips with components.

Vue components are extremely powerful and a great addition to any Vue app. They allow you to make packages of reusable code that include their own data, methods, and computed values.

For our app, we have the opportunity to create two components: one for each person and one for the filtering section of our app. I would encourage you to always look at breaking your app into components where possible—this helps group your code into related functions.

Components look like mini Vue instances as each one has its own data, methods, and computed objects—along with some component-specific options that we will cover shortly.

When a component is registered, you create a custom HTML element to use in your view, for example:

```
<my-component></my-component>
```

When naming your component, you can use kebab-case (hyphens), PascalCase (no punctuation, but each word is capitalized) or camelCase (similar to Pascal but the first word is not capitalized). Vue components are not restricted by, or associated with, the W3C web components/custom element rules, but it is good practice to follow this convention of using kebab-case.

## Creating and initializing your component

Vue components are registered using the `Vue.component(tagName, options)` syntax. Each component must have an associated tag name. The `Vue.component` registration **must** happen before you initialize your Vue instance. As a minimum, each component should have a `template` property—denoting what should be displayed when the component is used. Templates must always have a single wrapping element; this is so the custom HTML tag can be replaced with the parent container.

For example, you couldn't have the following as your template:

```
<div>Hello</div><div>Goodbye</div>
```

If you do pass a template of this format, Vue will throw an error in the browser's JavaScript console warning you.

Create a Vue component yourself, with a simple fixed template:

```
Vue.component('my-component', {
  template: '<div>hello</div>'
});

const app = new Vue({
  el: '#app',

  // App options
});
```

With this component declared, it would now give us a `<my-component></my-component>` HTML tag to use in our view.

You can also specify components on the Vue instance itself. This would be used if you had multiple Vue instances on one site and wished to contain a component to one instance. To do this, create your component as a simple object and assign the `tagName` within the `components` object of your Vue instance:

```
let Child = {
  template: '<div>hello</div>'
}

const app = new Vue({
  el: '#app',
  // App options

  components: {
    'my-component': Child
  }
});
```

For our app though, we are going to stick with the `Vue.component()` method of initializing our components.

## Using your component

In your view, add your custom HTML element component:

```
<div id="app">
  <my-component></my-component>
</div>
```

Viewing this in the browser should replace the `<my-component>` HTML tag with a `<div>` and a **hello** message.

There may be some cases where a custom HTML tag won't be parsed and accepted - these cases tend to be in `<table>`, `<ol>`, `<ul>`, and `<select>` elements. If this is the case, you can use the `is=""` attribute on a standard HTML element:

```
<ol>
  <li is="my-component"></li>
</ol>
```

## Using component data and methods

As Vue components are self-contained elements of your Vue app, they each have their own data and functions. This helps when re-using components on the same page, as the information is self-contained per instance of a component. `methods` and `computed` functions are declared the same as you would on the Vue app, however, the `data` key should be a function that returns an object.



The data object of a component must be a function. This is so that each component has its own self-contained data, rather than getting confused and sharing data between different instances of the same component. The function must still return an object as you would in your Vue app.

Create a new component called `balance`, add a `data` function and `computed` object to your component and an empty `<div>` to the `template` property for now:

```
Vue.component('balance', {  
  template: '<div></div>',  
  data() {  
    return {  
    }  
  },  
  computed: {  
  }  
});
```

Next, add a key/value pair to your `cost` data object with an integer and add the variable to your template. Add the `<balance></balance>` custom HTML element to your view and you should be presented with your integer:

```
Vue.component('balance', {  
  template: '<div>{{ cost }}</div>',  
  data() {  
    return {  
      cost: 1234  
    }  
  },  
  computed: {  
  }  
});
```

As with our Vue instance in Chapter 1, *Getting Started with Vue.js*, add a function to the computed object that appends a currency symbol to the integer and ensures there are two decimal places. Don't forget to add the currency symbol to your data function.

Update the template to output the computed value instead of the raw cost:

```
Vue.component('balance', {
  template: '<div>{{ formattedCost }}</div>',
  data() {
    return {
      cost: 1234,
      currency: '$'
    }
  },
  computed: {
    formattedCost() {
      return this.currency + this.cost.toFixed(2);
    }
  }
});
```

This is a basic example of a component, however, it is quite restricted with the fixed `cost` on the component itself.

## Passing data to your component – props

Having the balance as a component is great, but not very good if the balance is fixed. Components really come into their own when you add the ability to pass in arguments and properties via HTML attributes. In the Vue world, these are called **props**. Props can be either static or variable. In order for your component to expect these properties, you need to create an array on the component by using the `props` property.

An example of this would be if we wanted to make a `heading` component:

```
Vue.component('heading', {
  template: '<h1>{{ text }}</h1>',
  props: ['text']
});
```

The component would then be used in the view like so:

```
<heading text="Hello!"></heading>
```

With props, we don't need to define the `text` variable in the data object, as defining it in the props array automatically makes it available for use in the template. The props array can also take further options, allowing you to define the type of input expected, whether it is required or a default value to use if omitted.

Add a prop to the balance component so we can pass the cost as an HTML attribute. Your view should now look like this:

```
<balance cost="1234"></balance>
```

We can now add the `cost` prop to the component in the JavaScript, and remove the fixed value from our data function:

```
template: '<div>{{ formattedCost }}</div>',
props: ['cost'],
data() {
  return {
    currency: '$'
  }
},
```

Running this in our browser, however, will throw an error in our JavaScript console. This is because, natively, props being passed in are interpreted as strings. We can address this in two ways; we can either convert our prop to a number in our `formatCost()` function or, alternatively, we can use the `v-bind:` HTML attribute to tell Vue to accept the input for what it is.

If you remember, we used this technique with our filters for the `true` and `false` values—allowing them to be used as Boolean instead of strings. Add `v-bind:` in front of your `cost` HTML attribute:

```
<balance v-bind:cost="15234"></balance>
```

There is an extra step we can do to ensure Vue knows what kind of input to expect and informs other users of your code as to what they should be passing to the component. This can be done in the component itself and, along with the format, allows you to specify default values along with whether the prop is required or not.

Convert your `props` array to an object, with `cost` as the key. If you are just defining the field type, you can use the Vue shorthand for declaring this by setting the value as the field type. These can be String, Number, Boolean, Function, Object, Array, or Symbol. As our `cost` attribute should be a number, add that as the key:

```
props: {  
    cost: Number  
},
```

It would be nice if, rather than throwing an error when nothing is defined, our component rendered `$0.00`. We can do this by setting the default to just `0`. To define a default we need to convert our prop into an object itself - containing a `type` key that has the value of `Number`. We can then define another `default` key and set the value to `0`:

```
props: {  
    cost: {  
        type: Number,  
        default: 0  
    }  
},
```

Rendering the component in the browser should show whatever value is passed into the `cost` attribute—but removing this will render `$0.00`.

To recap, our component looks like :

```
Vue.component('balance', {  
    template: '<div>{{ formattedCost }}</div>',  
  
    props: {  
        cost: {  
            type: Number,  
            default: 0  
        }  
    },  
  
    data() {  
        return {  
            currency: '$'  
        }  
    },  
  
    computed: {  
        formattedCost() {  
            return this.currency +  
                this.cost.toFixed(2);  
        }  
    }  
}
```

```
});
```

We should be able to expand on this example when we make the `person` component of our listing app.

## Passing data to your component – slots

There are times when you may need to pass chunks of HTML to your component that are not stored in a property or that you want to format before appearing in the component. Rather than trying to pre-format in a computed variable or similar, you can use slots with your component.

Slots are like placeholders and allow you to place content between the opening and closing tags of your component and determine where they are going to display.

A perfect example of this would be a modal window. These normally have several tags and often consist of a lot of HTML to copy and paste if you wish to use it in your application multiple times. Instead, you can create a `modal-window` component and pass your HTML with a slot.

Create a new component titled `modal-window`. This accepts one prop of `visible`, which accepts a Boolean value and is `false` by default. For the template, we'll use the HTML from the *Bootstrap modal* as a good example of how a component using slots can easily simplify your application. To ensure the component is styled, make sure you include the bootstrap *asset files* in your document:

```
Vue.component('modal-window', {
  template: `<div class="modal fade">
    <div class="modal-dialog" role="document">
      <div class="modal-content">
        <div class="modal-header">
          <button type="button" class="close"
            data-dismiss="modal" aria-label="Close">&times;</span>
        </button>
      </div>
      <div class="modal-body">
      </div>
      <div class="modal-footer">
        <button type="button" class="btn btn-primary">Save changes</button>
        <button type="button" class="btn btn-secondary" data-dismiss="modal">Close
      </div>
    </div>
  </div>`});
```

```
</button>
</div>
</div>
</div>`,

props: {
  visible: {
    type: Boolean,
    default: false
  }
},
});
```

We will be using the `visible` prop to determine whether the modal window is open or not. Add a `v-show` attribute to your outer container that accepts the `visible` variable:

```
Vue.component('modal-window', {
  template: `<div class="modal fade" v-
    show="visible">
    ...
</div>`,

  props: {
    visible: {
      type: Boolean,
      default: false
    }
  }
});
```

Add your `modal-window` component to the app, specifying `visible` to be `true` for now, so we can understand and see what is going on:

```
<modal-window :visible="true"></modal-window>
```

We now need to pass some data to our modal box. Add a heading and some paragraphs between the two tags:

```
<modal-window :visible="true">
  <h1>Modal Title</h1>
  <p>Lorem ipsum dolor sit amet, consectetur
  adipiscing elit. Suspendisse ut rutrum ante, a
  ultrices felis. Quisque sodales diam non mi
  blandit dapibus. </p>
  <p>Lorem ipsum dolor sit amet, consectetur
  adipiscing elit. Suspendisse ut rutrum ante, a
  ultrices felis. Quisque sodales diam non mi
```

```
blandit dapibus. </p>
</modal-window>
```

Pressing refresh in the browser won't do anything, as we need to tell the component what to do with the data. Inside your template, add a `<slot></slot>` HTML tag where you want your content to appear. Add it to the `div` with the `modal-body` class:

```
Vue.component('modal-window', {
  template: `<div class="modal fade" v-
show="visible">
  <div class="modal-dialog" role="document">
    <div class="modal-content">
      <div class="modal-header">
        <button type="button" class="close" data-
dismiss="modal" aria-label="Close">
          <span aria-hidden="true">&times;</span>
        </button>
      </div>
      <div class="modal-body">
        <slot></slot>
      </div>
      <div class="modal-footer">
        <button type="button" class="btn btn-
primary">Save changes</button>
        <button type="button" class="btn btn-
secondary" data-
dismiss="modal">Close</button>
      </div>
    </div>
  </div>
</div>`,
  props: {
    visible: {
      type: Boolean,
      default: false
    }
  }
});
```

Viewing your app will now reveal the content you passed in inside the modal window. Already, the app is looking cleaner with this new component.

Viewing the Bootstrap HTML, we can see there is space for a header, body, and footer. We can identify these sections with named slots. This allows us to pass specific content to specific areas of our component.

Create two new `<slot>` tags in the header and footer of the modal window. Give these new ones a name attribute, but leave the existing one empty:

```
template: `<div class="modal fade" v-
show="visible">
  <div class="modal-dialog" role="document">
    <div class="modal-content">
      <div class="modal-header">
        <slot name="header"></slot>
        <button type="button" class="close" data-
          dismiss="modal" aria-label="Close">
          <span aria-hidden="true">&times;</span>
        </button>
      </div>
      <div class="modal-body">
        <slot></slot>
      </div>
      <div class="modal-footer">
        <slot name="footer"></slot>
        <button type="button" class="btn btn-
          primary">Save changes</button>
        <button type="button" class="btn btn-
          secondary" data-
          dismiss="modal">Close</button>
      </div>
    </div>
  </div>
</div>`,
```

In our app, we can now specify what content goes where by specifying a `slot` attribute in the HTML. This can either go on a specific tag or a container around several tags. Any HTML without a `slot` attribute will also default to your unnamed slot:

```
<modal-window :visible="true">
  <h1 slot="header">Modal Title</h1>
  <p>Lorem ipsum dolor sit amet, consectetur
  adipiscing elit. Suspendisse ut rutrum ante, a
  ultrices felis. Quisque sodales diam non mi
  blandit dapibus. </p>

  <p slot="footer">Lorem ipsum dolor sit amet,
  consectetur adipiscing elit. Suspendisse ut
  rutrum ante, a ultrices felis. Quisque sodales
```

```
diam non mi blandit dapibus. </p>
</modal-window>
```

We can now specify and direct our content to specific places.

The last thing you can do with slots is specified a default value. For example, you may want to display the buttons in the footer most of the time, but want to have the ability to replace them if desired. With a `<slot>`, any content placed between the tags will be displayed unless overwritten when specifying the component in your app.

Create a new slot titled `buttons`, and place the buttons in the footer inside. Try replacing them with some other content.

The template becomes:

```
template: `<div class="modal fade" v-
show="visible">
  <div class="modal-dialog" role="document">
    <div class="modal-content">
      <div class="modal-header">
        <slot name="header"></slot>
        <button type="button" class="close" data-
dismiss="modal" aria-label="Close">
          <span aria-hidden="true">&times;</span>
        </button>
      </div>
      <div class="modal-body">
        <slot></slot>
      </div>
      <div class="modal-footer">
        <slot name="footer"></slot>
        <slot name="buttons">
          <button type="button" class="btn btn-
primary">Save changes</button>
          <button type="button" class="btn btn-
secondary" data-
dismiss="modal">Close</button>
        </slot>
      </div>
    </div>
  </div>
</div>`,
```

And the HTML:

```
<modal-window :visible="true">
  <h1 slot="header">Modal Title</h1>
  <p>Lorem ipsum dolor sit amet, consectetur
  adipiscing elit. Suspendisse ut rutrum ante, a
  ultrices felis. Quisque sodales diam non mi blandit
  dapibus. </p>

  <p slot="footer">Lorem ipsum dolor sit amet,
  consectetur adipiscing elit. Suspendisse ut rutrum
  ante, a ultrices felis. Quisque sodales diam non mi
  blandit dapibus. </p>

  <div slot="buttons">
    <button type="button" class="btn btn-
      primary">Ok</button>
  </div>
</modal-window>
```

Although we won't be utilizing slots with our people listing app, it's good to be aware of the capabilities of a Vue component. If you wished to use a modal box like this, you can set the visibility to a variable that is false by default. You can then add a button with a click method that changes the variable from `false` to `true`—displaying the modal box.

## Creating a repeatable component

The beauty of components is being able to use them multiple times in the same view. This gives you the ability to have one single "source of truth" for the layout of that data. We're going to make a repeatable component for our people list and a separate component for the filtering section.

Open your people listing code you created in the last couple of chapters and create a new component titled `team-member`. Don't forget to define the component before your Vue app is initialized. Add a `prop` to the component to allow the person object to be passed in. For validation purposes, only specify that it can be an `Object`:

```
Vue.component('team-member', {
  props: {
    person: Object
  }
});
```

We now need to integrate our template into the component, which is everything inside (and including) the `tr` in our View.

The template variable in the component just accepts a normal string without new lines, so we need to do one of the following:

- inline our HTML template—great for small templates but in this case will sacrifice readability
- add new lines with the `+ string concatenation`—great for one or two lines, but would bloat our JavaScript
- create a template block—Vue gives us the option to use external templates that are defined in the view using the `text/x-template` syntax and an ID

As our template is quite big, we are going to choose the third option of declaring our template at the end of our view.

In your HTML, outside of your app, create a new script block and add a `type` and `ID` attribute:

```
<script type="text/x-template" id="team-member-template">
</script>
```

We can then move our person template into this block and remove the `v-for` attribute—we'll still use that in the app itself:

```
<script type="text/x-template" id="team-member-template">
  <tr v-show="filterRow(person)">
    <td>
      {{ person.name }}
    </td>
    <td>
      <a v-bind:href="'mailto:' + person.email">{{ person.email }}</a>
    </td>
    <td v-bind:class="balanceClass(person)">
      {{ format(person, 'balance') }}
    </td>
    <td>
      {{ format(person, 'registered') }}
    </td>
    <td v-bind:class="activeClass(person)">
      {{ format(person, 'isActive') }}
    </td>
  </tr>
</script>
```

```
</td>
</tr>
</script>
```

We now need to update the view to use the `team-member` component instead of the fixed code. To make our view cleaner and easier to understand, we are going to utilize the `<template>` HTML attribute mentioned earlier. Create a `<template>` tag and add the `v-for` loop we had before. To avoid confusion, update the loop to use `individual` as the variable for each person. They can be the same, but it makes the code easier to read if the variables, components, and props have different names. Update the `v-for` to be `v-for="individual in people"`:

```
<table>
<template v-for="individual in people">
</template>
</table>
```

Inside the `template` tags of your view, add a new instance of the `team-member` component, passing the `individual` variable to the `person` prop. Don't forget to add `v-bind:` to the `person` prop, otherwise, the component will interpret it as a fixed string with the value of the `individual`:

```
<table>
<template v-for="individual in people">
<team-member v-bind:person="individual"></team-
member>
</template>
</table>
```

We now need to update the component to use the template we have declared using the `template` property and the ID of the script block as the value:

```
Vue.component('team-member', {
  template: '#team-member-template',
  props: {
    person: Object
  }
});
```

Viewing the app in the browser will create several errors in the JavaScript console. This is because we are referencing several methods that are no longer available - as they are on the parent Vue instance, not on the component. If you want to verify that your component is working, change the code to only output the name of the person, and press refresh:

```
<script type="text/x-template" id="team-member-  
template">  
  <tr v-show="filterRow()">  
    <td>  
      {{ person.name }}  
    </td>  
  </tr>  
</script>
```

## Creating component methods and computed functions

We now need to create the methods we had created on the Vue instance on the child component, so they are available to use. One thing we could do is cut and paste the methods from the parent into the child in the hope they would work; however, those methods rely on parent properties (such as filtering data) and we also have the opportunity to utilize `computed` properties, which cache the data and can speed up your app.

For now, remove the `v-show` attribute from the `tr` element—as this involves the filtering, and that will be covered once we have our rows displaying correctly. We'll step through the errors and resolve them one at a time to help you understand problem-solving with Vue.

## CSS class functions

The first error we encounter when viewing the application in the browser is:

*Property or method "balanceClass" is not defined*

The first error is with regards to both the `balanceClass` and `activeClass` functions we use. Both of these functions add CSS classes based on the data of the person, which does not change once the component has been rendered.

Because of this, we are able to use the caching found in Vue. Move the methods across to the component but put them in a new `computed` object, instead of the `methods` one.

With components, a new instance is created every time it is called, so we can rely on the person object we passed in via a prop and no longer need to pass the person into the function. Remove the parameter from the function and the view—also update any reference to person *inside* the function to this.person to reference the object stored on the component:

```
computed: {
    /**
     * CSS Classes
     */
    activeClass() {
        return this.person.isActive ? 'active' :
        'inactive';
    },
    balanceClass() {
        let balanceLevel = 'success';
        if(this.person.balance < 2000) {
            balanceLevel = 'error';
        } else if (this.person.balance < 3000) {
            balanceLevel = 'warning';
        }
        let increasing = false,
            balance = this.person.balance / 1000;
        if(Math.round(balance) == Math.ceil(balance)) {
            increasing = 'increasing';
        }

        return [balanceLevel, increasing];
    }
},
```

The part of our component template that utilizes this function should now look like:

```
<td v-bind:class="balanceClass">
    {{ format(person, 'balance') }}
</td>
```

## Formatted value functions

When it comes to moving the format() function to the component for formatting our data, we are faced with two options. We can move it like-for-like and put it in the methods object, or we can take advantage of the Vue caching and conventions and create a computed function for each value.

We are building this app for scalability, so it's advisable to make computed functions for each value—it will also have the advantage of tidying up our template. Create three functions in the computed object titled `balance`, `dateRegistered`, and `status`. Copy the corresponding parts of the `format` function across to each one, updating the reference of `person` to `this.person` once more.

Where we were retrieving the field using a function parameter, you can now fix the value in each function. You will also need to add a data object with the currency symbol for the `balance` function—add this after the `props`:

```
data() {
  return {
    currency: '$'
  }
},
```

As the `team-member` component is the only place our currency symbol is used, we can remove it from the Vue app itself. We can also remove the `format` function from our parent Vue instance.

In total, our Vue `team-member` component should look like:

```
Vue.component('team-member', {
  template: '#team-member-template',
  props: {
    person: Object
  },
  data() {
    return {
      currency: '$'
    }
  },
  computed: {
    /**
     * CSS Classes
     */
    activeClass() {
      return this.person.isActive ? 'active' :
        'inactive';
    },
    balanceClass() {
      let balanceLevel = 'success';
      if(this.person.balance < 2000) {
        balanceLevel = 'error';
      } else if (this.person.balance < 3000) {
        balanceLevel = 'warning';
      }
    }
  }
});
```

```
        }
        let increasing = false,
            balance = this.person.balance / 1000;
        if(Math.round(balance) == Math.ceil(balance))
        {
            increasing = 'increasing';
        }
        return [balanceLevel, increasing];
    },
    /**
     * Fields
     */
    balance() {
        return this.currency +
            this.person.balance.toFixed(2);
    },
    dateRegistered() {
        let registered = new
            Date(this.person.registered);
        return registered.toLocaleString('en-US');
    },
    status() {
        return (this.person.isActive) ? 'Active' :
            'Inactive';
    }
}
});
```

And our team-member-template should look fairly simple in comparison to what it did look like:

```
<script type="text/x-template" id="team-member-
template">
<tr v-show="filterRow()">
    <td>
        {{ person.name }}
    </td>
    <td>
        <a v-bind:href="'mailto:' + person.email">{{
            person.email }}</a>
    </td>
    <td v-bind:class="balanceClass">
        {{ balance }}
    </td>
    <td>
        {{ dateRegistered }}
    </td>
    <td v-bind:class="activeClass">
```

```
    {{ status }}  
  </td>  
  </tr>  
</script>
```

And lastly, our Vue instance should look significantly smaller:

```
const app = new Vue({  
  el: '#app',  
  data: {  
    people: [...],  
    filter: {  
      field: '',  
      query: ''  
    }  
  },  
  methods: {  
    isActiveFilterSelected() {  
      return (this.filter.field === 'isActive');  
    },  
    /**  
     * Filtering  
     */  
    filterRow(person) {  
      let visible = true,  
        field = this.filter.field,  
        query = this.filter.query;  
      if(field) {  
        if(this.isActiveFilterSelected()) {  
          visible = (typeof query === 'boolean') ?  
            (query === person.isActive) : true;  
        } else {  
          query = String(query),  
          field = person[field];  
        }  
      }  
      if(typeof field === 'number') {  
        query.replace(this.currency, '');  
        try {  
          visible = eval(field + query);  
        } catch(e) {}  
      } else {  
        field = field.toLowerCase();  
        visible =  
          field.includes(query.toLowerCase())  
      }  
    }  
    return visible;  
  }  
})
```

```
        changeFilter(event) {
            this.filter.query = '';
            this.filter.field = event.target.value;
        }
    });
});
```

Viewing the app in the browser, we should be presented with our list of people with the correct classes added to the table cells and formatting added to the fields.

## Making the filtering work again with props

Re-add the `v-show="filterRow()"` attribute to the containing `tr` element in your template. As our component has the person cached on each instance, we no longer need to pass the person object to the method. Refreshing the page will give you a new error in your JavaScript console:

```
Property or method "filterRow" is not defined on the instance but
referenced during render
```

This error is because our component has the `v-show` attribute, showing and hiding based on our filtering and properties, but not the corresponding `filterRow` function. As we don't use it for anything else, we can move the method from the Vue instance to the component, adding it to the `methods` component. Remove the `person` parameter and update the method to use `this.person`:

```
filterRow() {
    let visible = true,
        field = this.filter.field,
        query = this.filter.query;
    if(field) {
        if(this.isActiveFilterSelected()) {
            visible = (typeof query === 'boolean') ?
                (query === this.person.isActive) : true;
        } else {
            query = String(query),
            field = this.person[field];
            if(typeof field === 'number') {
                query.replace(this.currency, '');
            try {
                visible = eval(field + query);
            } catch(e) {}
            } else {
                field = field.toLowerCase();
                visible =
```

```
        field.includes(query.toLowerCase());
    }
}
return visible;
}
```

The next error in the console is:

```
Cannot read property 'field' of undefined
```

The reason the filtering does not work is that the `filterRow` method is looking for `this.filter.field` and `this.filter.query` on the component, not the parent Vue instance where it belongs.



As a quick fix, you can use `this.$parent` to reference data on the parent element—however, this is not recommended and should only be used in extreme circumstances or to quickly pass the data through.

To pass the data through to the component we are going to use another prop - similar to how we are passing the person into the component. Fortunately, we had grouped our filtering data already, so we are able to pass that one object instead of individual properties of `query` or `field`. Create a new prop on your component titled `filter` and ensure you only allow an `Object` to be passed through:

```
props: {
  person: Object,
  filter: Object
},
```

We can then add the prop to the `team-member` component, allowing us to pass the data:

```
<table>
  <template v-for="individual in people">
    <team-member v-bind:person="individual" v-
      bind:filter="filter"></team-member>
  </template>
</table>
```

In order for our filtering to work, we need to pass in one more property—the `isActiveFilterSelected()` function. Create another prop, titled `statusFilter`, allowing only a Boolean to be the value (as this is what the function equates to), and pass the function through. Update the `filterRow` method to use this new value. Our component now looks like:

```
Vue.component('team-member', {
  template: '#team-member-template',
  props: {
    person: Object,
    filter: Object,
    statusFilter: Boolean
  },
  data() {
    return {
      currency: '$'
    }
  },
  computed: {
    /**
     * CSS Classes
     */
    activeClass() {
      return this.person.isActive ? 'active' :
        'inactive';
    },
    balanceClass() {
      let balanceLevel = 'success';
      if(this.person.balance < 2000) {
        balanceLevel = 'error';
      } else if (this.person.balance < 3000) {
        balanceLevel = 'warning';
      }
      let increasing = false,
        balance = this.person.balance / 1000;
      if(Math.round(balance) == Math.ceil(balance)) {
        increasing = 'increasing';
      }
      return [balanceLevel, increasing];
    },
    /**
     * Fields
     */
    balance() {
      return this.currency +
        this.person.balance.toFixed(2);
    },
  }
});
```

```
dateRegistered() {
  let registered = new Date(this.registered);
  return registered.toLocaleString('en-US');
},
status() {
  return output = (this.person.isActive) ?
    'Active' : 'Inactive';
},
methods: {
  filterRow() {
    let visible = true,
      field = this.filter.field,
      query = this.filter.query;
    if(field) {
      if(this.statusFilter) {
        visible = (typeof query === 'boolean') ?
          (query === this.person.isActive) : true;
      } else {
        query = String(query),
        field = this.person[field];
        if(typeof field === 'number') {
          query.replace(this.currency, '');
          try {
            visible = eval(field + query);
          } catch(e) {
          }
        } else {
          field = field.toLowerCase();
          visible = field.includes(query.toLowerCase());
        }
      }
    }
    return visible;
  }
}
});
```

And the component within the View with the extra props now looks like the following. Note that the camel-cased prop becomes snake case (hyphenated) when used as an HTML attribute:

```
<template v-for="individual in people">
  <team-member v-bind:person="individual" v-
bind:filter="filter" v-bind:status-
filter="isActiveFilterSelected()"></team-
member>
</template>
```

# Making the filters a component

We now need to make the filtering section its own component. This isn't strictly necessary in this scenario, but it's good practice and gives us more challenges.

The problem we face in making the filtering a component is a challenge of transferring filter data between the filtering component and the team-member component. Vue addresses this with custom events. These let you pass (or "emit") data to the parent or other components from the child component.

We are going to create a filtering component which, on filtering change, passes the data back to the parent Vue instance. This data is already passed through to the team-member component to filter.

## Creating the component

As with the team-member component, declare a new `Vue.component()` in your JavaScript, referencing a template ID of `#filtering-template`. Create a new `<script>` template block in your view and give it the same ID. Replace the filtering form in the view with a `<filtering>` custom HTML template and put the form inside your `filtering-template` script block.

Your view should look like the following:

```
<div id="app">
  <filtering></filtering>
  <table>
    <template v-for="individual in people">
      <team-member v-bind:person="individual" v-
        bind:filter="filter" v-
        bind:statusfilter="isActiveFilterSelected()">
        </team-
      member>
      </template>
    </table>
  </div>

  <script type="text/x-template" id="filtering-
  template">
    <form>
      <label for="filterField">
        Field:
        <select v-on:change="changeFilter($event)">
          id="filterField"
          <option value="">Disable filters</option>
```

```
<option value="isActive">Active user</option>
<option value="name">Name</option>
<option value="email">Email</option>
<option value="balance">Balance</option>
<option value="registered">Date
    registered</option>
</select>
</label>
<label for="filterQuery" v-show="this.filter.field
&& !isActiveFilterSelected()">
    Query:
    <input type="text" id="filterQuery" v-
    model="filter.query">
</label>
<span v-show="isActiveFilterSelected()">
    Active:
<label for="userStateActive">
    Yes:
    <input type="radio" v-bind:value="true"
id="userStateActive" v-model="filter.query">
</label>
    <label for="userStateInactive">
        No:
        <input type="radio" v-bind:value="false"
id="userStateInactive" v-model="filter.query">
    </label>
</span>
</form>
</script>
<script type="text/x-template" id="team-member-
template">
    // Team member template
</script>
```

And you should have the following in your JavaScript:

```
Vue.component('filtering', {
    template: '#filtering-template'
});
```

## Resolving JavaScript errors

As with the `team-member` component, you are going to experience some errors in your JavaScript console. These can be resolved by copying the `filter` data object and both the `changeFilter` and `isActiveFilterSelected` methods from the parent instance. We'll leave them in both the component and parent instance for now, but we'll remove the duplication later:

```
Vue.component('filtering', {
  template: '#filtering-template',
  data() {
    return {
      filter: {
        field: '',
        query: ''
      }
    }
  },
  methods: {
    isActiveFilterSelected() {
      return (this.filter.field === 'isActive');
    },
    changeFilter(event) {
      this.filter.query = '';
      this.filter.field = event.target.value;
    }
  }
});
```

Running the app will show both the filters and person listing, but the filters won't update the people list as they are not communicating yet.

## Using custom events to change the filter field

With custom events, you can pass data back up to the parent instances using the `$on` and `$emit` functions. For this app, we are going to store the filtering data on the parent Vue instance and update it from the component. The `team-member` component can then read the data from the Vue instance and filter accordingly.

The first step is to utilize the filter object on the parent Vue instance. Remove the data object from your component and pass in the parent one via a prop - just as we did with the team-member component:

```
<filtering v-bind:filter="filter"></filtering>
```

We are now going to modify the changeFilter function to emit the event data so the parent instance, so it can update the filter object.

Remove the existing changeFilter method from the filtering component and create a new one called change-filter-field. Within this method, we just need to \$emit the name of the field selected in the drop-down menu. The \$emit function takes two parameters: a key and the value. Emit a key of change-filter-field and pass the event.target.value as the data. When using variables with multiple words (For example, changeFilterField), ensure these are hyphenated for the event name (the first parameter of the \$emit function) and the HTML attribute:

```
changeFilterField(event) {
  this.$emit('change-filter-field',
  event.target.value);
}
```

In order to then pass the data to the changeFilter method on our parent Vue instance, we need to add a new prop to our <filtering> element. This uses v-on and binds to the custom event name. It then has the parent method name as the attribute value. Add the attribute to your element:

```
<filtering v-bind:filter="filter" v-on:change-filter-
field="changeFilter"></filtering>
```

This attribute preceding tells Vue to trigger the changeFilter method when a change-filter-field event is emitted. We can then tweak our method to accept the parameter as the value:

```
changeFilter(field) {
  this.filter.query = '';
  this.filter.field = field;
}
```

This then clears the filters and updates the field value, which then ripples down to our components via props.

## Updating the filter query

To emit the query field, we are going to use a new Vue key that we have not used before, called `watch`. The `watch` function tracks a data property and can run methods based on the output. The other thing it is able to do is to emit events. As both, our text field and radio buttons are set to update the `filter.query` variable, we will create a new `watch` function on this.

Create a new `watch` object after the methods on your component:

```
watch: {  
  'filter.query': function() {  
  }  
}
```

The key is the variable you wish to watch. As ours contains a dot, it needs to be wrapped in quotes. Within this function, create a new `$emit` event of `change-filter-query` that outputs the value of `filter.query`:

```
watch: {  
  'filter.query': function() {  
    this.$emit('change-filter-query',  
    this.filter.query)  
  }  
}
```

We now need to bind this method and custom event to the component in the view, so it is able to pass the data to the parent instance. Set the value of the attribute to `changeQuery`—we'll make a method to handle this:

```
<filtering v-bind:filter="filter" v-on:change-  
filter-field="changeFilter" v-on:change-filter-  
query="changeQuery"></filtering>
```

On the parent Vue instance, make a new method, titled `changeQuery`, that simply updates the `filter.query` value based on the input:

```
changeQuery(query) {  
  this.filter.query = query;  
}
```

Our filtering is now working again. Both updating the select box and the input box (or radio buttons) will now update our person list. Our Vue instance is significantly smaller and our templates and methods are contained with separate components.

The last step is to avoid the repetition of the `isActiveFilterSelected()` method, as this is only used once on the `team-member` component, but several times on the `filtering` component. Remove the method from the parent Vue instance, the prop from the `team-member` HTML element, and replace the `statusFilter` variable in the `filterRow` method within the `team-member` component with the contents of the function being passed through.

The final JavaScript now looks like:

```
Vue.component('team-member', {
  template: '#team-member-template',
  props: {
    person: Object,
    filter: Object
  },
  data() {
    return {
      currency: '$'
    }
  },
  computed: {
    /**
     * CSS Classes
     */
    activeClass() {
      return this.person.isActive ? 'active' :
    'inactive';
    },
    balanceClass() {
      let balanceLevel = 'success';
      if(this.person.balance < 2000) {
        balanceLevel = 'error';
      } else if (this.person.balance < 3000) {
        balanceLevel = 'warning';
      }
      let increasing = false,
      balance = this.person.balance / 1000;
      if(Math.round(balance) == Math.ceil(balance)) {
        increasing = 'increasing';
      }
      return [balanceLevel, increasing];
    },
    /**
     * Fields
     */
    balance() {
      return this.currency +
```

```
        this.person.balance.toFixed(2);
    },
    dateRegistered() {
        let registered = new Date(this.registered);
        return registered.toLocaleString('en-US');
    },
    status() {
        return output = (this.person.isActive) ?
        'Active' : 'Inactive';
    }
},
methods: {
    filterRow() {
        let visible = true,
        field = this.filter.field,
        query = this.filter.query;
        if(field) {
            if(this.filter.field === 'isActive') {
                visible = (typeof query === 'boolean') ?
                (query === this.person.isActive) : true;
            } else {
                query = String(query),
                field = this.person[field];
                if(typeof field === 'number') {
                    query.replace(this.currency, '');
                try {
                    visible = eval(field + query);
                } catch(e) {}
            } else {
                field = field.toLowerCase();
                visible = field.includes(query.toLowerCase());
            }
        }
    }
    return visible;
}
}
});
Vue.component('filtering', {
template: '#filtering-template',
props: {
    filter: Object
},
methods: {
    isActiveFilterSelected() {
        return (this.filter.field === 'isActive');
    },
    changeFilterField(event) {
```

```
        this.$emit('change-filter-field',
          event.target.value);
      },
    },
    watch: {
      'filter.query': function() {
        this.$emit('change-filter-query', this.filter.query)
      }
    }
  });
const app = new Vue({
  el: '#app',

  data: {
    people: [...],
    filter: {
      field: '',
      query: ''
    }
  },
  methods: {
    changeFilter(field) {
      this.filter.query = '';
      this.filter.field = field;
    },
    changeQuery(query) {
      this.filter.query = query;
    }
  }
});
```

And the view is now:

```
<div id="app">
  <filtering v-bind:filter="filter" v-on:change-
    filter-field="changeFilter" v-on:change-filter-
    query="changeQuery"></filtering>
  <table>
    <template v-for="individual in people">
      <team-member v-bind:person="individual" v-
        bind:filter="filter"></team-member>
    </template>
  </table>
</div>
<script type="text/x-template" id="filtering-
  template">
  <form>
```

```
<label for="filterField">
  Field:
  <select v-on:change="changeFilterField($event)" id="filterField">
    <option value="">Disable filters</option>
    <option value="isActive">Active user</option>
    <option value="name">Name</option>
    <option value="email">Email</option>
    <option value="balance">Balance</option>
    <option value="registered">Date registered</option>
  </select>
</label>
<label for="filterQuery" v-show="this.filter.field && !isActiveFilterSelected()">
  Query:
  <input type="text" id="filterQuery" v-model="filter.query">
  </label>
  <span v-show="isActiveFilterSelected()">
    Active:
    <label for="userStateActive">
      Yes:
      <input type="radio" v-bind:value="true" id="userStateActive" v-model="filter.query">
    </label>
    <label for="userStateInactive">
      No:
      <input type="radio" v-bind:value="false" id="userStateInactive" v-model="filter.query">
    </label>
  </span>
</form>
</script>
<script type="text/x-template" id="team-member-template">
  <tr v-show="filterRow()">
    <td>
      {{ person.name }}
    </td>
    <td>
      <a v-bind:href="'mailto:' + person.email">{{ person.email }}</a>
    </td>
    <td v-bind:class="balanceClass">
      {{ balance }}
    </td>
  </tr>
</script>
```

```
<td>
  {{ dateRegistered }}
</td>
<td v-bind:class="activeClass">
  {{ status }}
</td>
</tr>
</script>
```

## Summary

Over the last three chapters, you have learned how to initialize a new Vue instance, what the meaning behind computed, method, and data objects are, and how to list out data from an object and manipulate it to be displayed correctly. You have also learned how to make components and what benefits there are to keeping your code clean and optimized.

In the next section of the book, we are going to introduce Vuex, something which helps us store and manipulate stored data better.

# 4

# Getting a List of Files Using the Dropbox API

Over the next few chapters, we are going to be building a Vue-based Dropbox browser. This app will take your Dropbox API key and allow you to navigate to folders and download files. You will learn about interacting with an API within a Vue app, the Vue life cycle hooks, including the `created()` method, and finally we will introduce a library called `Vuex` to handle the caching and state of the app. The app will have shareable URLs and retrieve the contents of the folder passed in via the # URL parameter.

This kind of app would be useful if you wanted to give users access to the contents of your Dropbox without giving out a username and password. Be warned, however, a tech-savvy user could find your API key in the code and abuse it, so don't publish this code to the World Wide Web.

This chapter is going to cover:

- Loading and querying the Dropbox API
- Listing the directories and files from your Dropbox account
- Adding a loading state to your app
- Using Vue animations

You will need a Dropbox account to follow these next few chapters. If you don't have one, sign up and add a few dummy files and folders. The contents of the Dropbox don't matter, but having folders to navigate through will help with understanding the code.

# Getting started—loading the libraries

Create a new HTML page for your app to run in. Create the HTML structure required for a web page and include your app view wrapper:

```
<!DOCTYPE html>
<html>
<head>
    <title>Dropbox App</title>
</head>
<body>
    <div id="app">
    </div>
</body>
</html>
```

It's called `#app` here, but call it whatever you want - just remember to update the JavaScript.

As our app code is going to get quite chunky, make a separate JavaScript file and include it at the bottom of the document. You will also need to include Vue and the Dropbox API SDK.

As with before, you can either reference the remote files or download a local copy of the library files. Download a local copy for both speed and compatibility reasons. Include your three JavaScript files at the bottom of your HTML file:

```
<script src="js/vue.js"></script>
<script src="js/dropbox.js"></script>
<script src="js/app.js"></script>
```

Create your `app.js` and initialize a new Vue instance, using the `el` tag to mount the instance onto the ID in your view.

```
new Vue({
    el: '#app'
});
```

# Creating a Dropbox app and initializing the SDK

Before we interact with the Vue instance, we need to connect to the Dropbox API through the SDK. This is done via an API key that is generated by Dropbox itself to keep track of what is connecting to your account and where Dropbox requires you to make a custom Dropbox app.

Head to the Dropbox developers area and select **Create your app**. Choose **Dropbox API** and select either a restricted folder *or* full access. This depends on your needs, but for testing, choose **Full Dropbox**. Give your app a name and click the button **Create app**.

Generate an access token to your app. To do so, when viewing the app details page, click the **Generate** button under the **Generated access token**. This will give you a long string of numbers and letters - copy and paste that into your editor and store it as a variable at the top of your JavaScript. In this book, the API key will be referred to as **xxxx**:

```
/**  
 * API Access Token  
 */  
let accessToken = 'xxxx';
```

Now that we have our API key, we can access the files and folders from our Dropbox. Initialize the API and pass in your `accessToken` variable to the `accessToken` property of the Dropbox API:

```
/**  
 * Dropbox Client  
 * @type {Dropbox}  
 */  
const dbx = new Dropbox({  
    accessToken: accessToken  
});
```

We now have access to Dropbox via the `dbx` variable. We can verify our connection to Dropbox is working by connecting and outputting the contents of the root path:

```
dbx.filesListFolder({path: ''})  
.then(response => {  
    console.log(response.entries);  
})  
.catch(error => {  
    console.log(error);  
});
```

This code uses JavaScript promises, which are a way of adding actions to code without requiring callback functions. If you are unfamiliar with promises, check out this blog post from Google (<https://developers.google.com/web/fundamentals/primers/promises>).

Take a note of the first line, particularly the path variable. This lets us pass in a folder path to list the files and folders within that directory. For example, if you had a folder called `images` in your Dropbox, you could change the parameter value to `/images` and the file list returned would be the files and folders within that directory.

Open your JavaScript console and check the output; you should get an array containing several objects - one for each file or folder in the root of your Dropbox.

## Displaying your data and using Vue to get it

Now that we can retrieve our data using the Dropbox API, it's time to retrieve it within our Vue instance and display in our view. This app is going to be entirely built using components so we can take advantage of the compartmentalized data and methods. It will also mean the code is modular and shareable, should you want to integrate into other apps.

We are also going to take advantage of the native Vue `created()` function - we'll cover it when it gets triggered in a bit.

## Create the component

First off, create your custom HTML element, `<dropbox-viewer>`, in your View. Create a `<script>` template block at the bottom of the page for our HTML layout:

```
<div id="app">
  <dropbox-viewer></dropbox-viewer>
</div>
<script type="text/x-template" id="dropbox-viewer-
template">
  <h1>Dropbox</h1>
</script>
```

Initialize your component in your `app.js` file, pointing it to the template ID:

```
Vue.component('dropbox-viewer', {
  template: '#dropbox-viewer-template'
});
```

Viewing the app in the browser should show the heading from the template. The next step is to integrate the Dropbox API into the component.

## Retrieve the Dropbox data

Create a new method called `dropbox`. In there, move the code that calls the `Dropbox` class and returns the instance. This will now give us access to the Dropbox API through the component by calling `this.dropbox()`:

```
Vue.component('dropbox-viewer', {
    template: '#dropbox-viewer-template',
    methods: {
        dropbox() {
            return new Dropbox({
                accessToken: this.accessToken
            });
        }
    }
});
```

We are also going to integrate our API key into the component. Create a `data` function that returns an object containing your access token. Update the `Dropbox` method to use the local version of the key:

```
Vue.component('dropbox-viewer', {
    template: '#dropbox-viewer-template',
    data() {
        return {
            accessToken: 'XXXX'
        }
    },
    methods: {
        dropbox() {
            return new Dropbox({
                accessToken: this.accessToken
            });
        }
    }
});
```

We now need to add the ability for the component to get the directory list. For this, we are going to create another method that takes a single parameter—the path. This will give us the ability later to request the structure of a different path or folder if required.

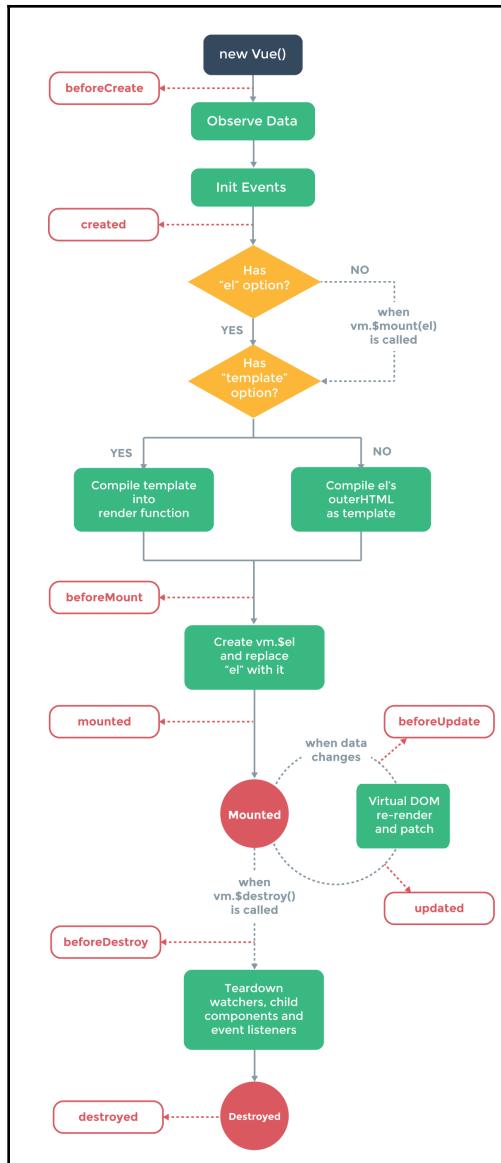
Use the code provided earlier - changing the `dbx` variable to `this.dropbox()`:

```
getFolderStructure(path) {
  this.dropbox().filesListFolder({path: path})
    .then(response => {
      console.log(response.entries);
    })
    .catch(error => {
      console.log(error);
    });
}
```

Update the Dropbox `filesListFolder` function to accept the path parameter passed in, rather than a fixed value. Running this app in the browser will show the Dropbox heading, but won't retrieve any folders because the methods have not been called yet.

## The Vue life cycle hooks

This is where the `created()` function comes in. The `created()` function gets called once the Vue instance has initialized the data and methods, but has yet to mount the instance on the HTML component. There are several other functions available at various points in the life cycle; more about these can be read at [Alligator.io](https://alligator.io). The life cycle is as follows:



Using the `created()` function gives us access to the methods and data while being able to start our retrieval process as Vue is mounting the app. The time between these various stages is split-second, but every moment counts when it comes to performance and creating a quick app. There is no point waiting for the app to be fully mounted before processing data if we can start the task early.

Create the `created()` function on your component and call the `getFolderStructure` method, passing in an empty string for the path to get the root of your Dropbox:

```
Vue.component('dropbox-viewer', {
  template: '#dropbox-viewer-template',
  data() {
    return {
      accessToken: 'XXXX'
    }
  },
  methods: {
    ...
  },
  created() {
    this.getFolderStructure('');
  }
});
```

Running the app now in your browser will output the folder list to your console, which should give the same result as before.

We now need to display our list of files in the view. To do this, we are going to create an empty array in our component and populate it with the result of our Dropbox query. This has the advantage of giving Vue a variable to loop through in the view, even before it has any content.

## Displaying the Dropbox data

Create a new property in your data object titled `structure`, and assign this to an empty array. In the response function of the folder retrieval, assign `response.entries` to `this.structure`. Leave `console.log` as we will need to inspect the entries to work out what to output in our template:

```
Vue.component('dropbox-viewer', {
  template: '#dropbox-viewer-template',
  data() {
    return {
      accessToken: 'XXXX',
      structure: []
    }
  },
  methods: {
    dropbox() {
      return new Dropbox({
        accessToken: this.accessToken
      })
    }
  }
});
```

```
        });
    },
    getFolderStructure(path) {
      this.dropbox().filesListFolder({path: path})
        .then(response => {
          console.log(response.entries);
          this.structure = response.entries;
        })
        .catch(error => {
          console.log(error);
        });
    }
},
created() {
  this.getFolderStructure('');
}
});
```

We can now update our view to display the folders and files from your Dropbox. As the structure array is available in our view, create a `<ul>` with a repeatable `<li>` looping through the structure.

As we are now adding a second element, Vue requires templates to have one containing the element, wrap your heading and list in a `<div>`:

```
<script type="text/x-template" id="dropbox-viewer-
template">
<div>
  <h1>Dropbox</h1>
  <ul>
    <li v-for="entry in structure">
    </li>
  </ul>
</div>
</script>
```

Viewing the app in the browser will show a number of empty bullet points when the array appears in the JavaScript console. To work out what fields and properties you can display, expand the array in the JavaScript console and then further for each object. You should notice that each object has a collection of similar properties and a few that vary between folders and files.

The first property, `.tag`, helps us identify whether the item is a file or a folder. Both types then have the following properties in common:

- `id`: A unique identifier to Dropbox
- `name`: The name of the file or folder, irrespective of where the item is
- `path_display`: The full path of the item with the case matching that of the files and folders
- `path_lower`: Same as `path_display` but all lowercase

Items with a `.tag` of a file also contain several more fields for us to display:

- `client_modified`: This is the date when the file was added to Dropbox.
- `content_hash`: A hash of the file, used for identifying whether it is different from a local or remote copy. More can be read about this on the Dropbox website.
- `rev`: A unique identifier of the version of the file.
- `server_modified`: The last time the file was modified on Dropbox.
- `size`: The size of the file in bytes.

To begin with, we are going to display the name of the item and the size, if present. Update the list item to show these properties:

```
<li v-for="entry in structure">
  <strong>{{ entry.name }}</strong>
  <span v-if="entry.size"> - {{ entry.size }}</span>
</li>
```

## More file meta information

To make our file and folder view a bit more useful, we can add more rich content and metadata to files such as images. These details are available by enabling the `include_media_info` option in the Dropbox API.

Head back to your `getFolderStructure` method and add the parameter after `path`. Here are some new lines of readability:

```
getFolderStructure(path) {
  this.dropbox().filesListFolder({
    path: path,
    include_media_info: true
  })
  .then(response => {
```

```
        console.log(response.entries);
        this.structure = response.entries;
    })
    .catch(error => {
        console.log(error);
    });
}
```

Inspecting the results from this new API call will reveal the `media_info` key for videos and images. Expanding this will reveal several more pieces of information about the file, for example, dimensions. If you want to add these, you will need to check that the `media_info` object exists before displaying the information:

```
<li>
  <strong>{{ f.name }}</strong>
  <span v-if="f.size"> - {{ bytesToSize(f.size) }}</span>
  <span v-if="f.media_info">
    [
      {{ f.media_info.metadata.dimensions.width }}px x
      {{ f.media_info.metadata.dimensions.height }}px
    ]
  </span>
</li>
```

Try updating the path when retrieving the data from Dropbox. For example, if you have a folder called `images`, change the `this.getFolderStructure` parameter to `/images`. If you're not sure what the path is, analyze the data in the JavaScript console and copy the value of the `path_lower` attribute of a folder, for example:

```
created() {
  this.getFolderStructure('/images');
}
```

## Formatting the file sizes

With the file size being output in plain bytes it can be quite hard for a user to decipher. To combat this, we can add a formatting method to output a file size which is more user-friendly, for example displaying `1kb` instead of `1024`.

First, create a new key on the data object that contains an array of units called `byteSizes`:

```
data() {
  return {
    accessToken: 'XXXXX',
```

```
        structure: [],
        byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB']
    }
}
```

This is what will get appended to the figure, so feel free to make these properties either lowercase or full words, for example, *megabyte*.

Next, add a new method, `bytesToSize`, to your component. This will take one parameter of `bytes` and output a formatted string with the unit at the end:

```
bytesToSize(bytes) {
    // Set a default
    let output = '0 Byte';
    // If the bytes are bigger than 0
    if (bytes > 0) {
        // Divide by 1024 and make an int
        let i = parseInt(Math.floor(Math.log(bytes) /
            Math.log(1024)));
        // Round to 2 decimal places and select the
        // appropriate unit from the array
        output = Math.round(bytes / Math.pow(1024, i),
            2) + ' ' + this.byteSizes[i];
    }
    return output
}
```

We can now utilize this method in our view:

```
<li v-for="entry in structure">
    <strong>{{ entry.name }}</strong>
    <span v-if="entry.size"> - {{  

        bytesToSize(entry.size) }}</span>
</li>
```

## Adding a loading screen

The last step of this chapter is to make a loading screen for our app. This will tell the user the app is loading, should the Dropbox API be running slowly (or you have a lot of data to show!).

The theory behind this loading screen is fairly basic. We will set a loading variable to `true` by default that then gets set to `false` once the data has loaded. Based on the result of this variable, we will utilize view attributes to show, and then hide, an element with the loading text or animation in and also reveal the loaded data list.

Create a new key in the data object titled `isLoading`. Set this variable to `true` by default:

```
data() {
  return {
    accessToken: 'XXXX',
    structure: [],
    byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB'],
    isLoading: true
  }
}
```

Within the `getFolderStructure` method on your component, set the `isLoading` variable to `false`. This should happen within the promise after you have set the structure:

```
getFolderStructure(path) {
  this.dropbox().filesListFolder({
    path: path,
    include_media_info: true
  })
  .then(response => {
    console.log(response.entries);
    this.structure = response.entries;
    this.isLoading = false;
  })
  .catch(error => {
    console.log(error);
  });
}
```

We can now utilize this variable in our view to show and hide a loading container.

Create a new `<div>` before the unordered list containing some loading text. Feel free to add a CSS animation or an animated gif—anything to let the user know the app is retrieving data:

```
<h1>Dropbox</h1>
<div>Loading...</div>
<ul>
  ...
```

We now need to only show the loading div if the app is loading and the list once the data has loaded. As this is just one change to the DOM, we can use the `v-if` directive. To give you the freedom of rearranging the HTML, add the attribute to both instead of using `v-else`.

To show or hide, we just need to check the status of the `isLoading` variable. We can prepend an exclamation mark to the list to only show if the app is not loading:

```
<div>
  <h1>Dropbox</h1>
  <div v-if="isLoading">Loading...</div>
  <ul v-if="!isLoading">
    <li v-for="entry in structure">
      <strong>{{ entry.name }}</strong>
      <span v-if="entry.size">- {{ bytesToSize(entry.size) }}</span>
    </li>
  </ul>
</div>
```

Our app should now show the loading container once mounted, and then it should show the list once the app data has been gathered. To recap, our complete component code now looks like this:

```
Vue.component('dropbox-viewer', {
  template: '#dropbox-viewer-template',
  data() {
    return {
      accessToken: 'XXXX',
      structure: [],
      byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB'],
      isLoading: true
    }
  },
  methods: {
    dropbox() {
      return new Dropbox({
        accessToken: this.accessToken
      });
    },
    getFolderStructure(path) {
      this.dropbox().filesListFolder({
        path: path,
        include_media_info: true
      })
      .then(response => {
```

```
        console.log(response.entries);
        this.structure = response.entries;
        this.isLoading = false;
    })
    .catch(error => {
        console.log(error);
    });
},
bytesToSize(bytes) {
    // Set a default
    let output = '0 Byte';
    // If the bytes are bigger than 0
    if (bytes > 0) {
        // Divide by 1024 and make an int
        let i = parseInt(Math.floor(Math.log(bytes)
            / Math.log(1024)));
        // Round to 2 decimal places and select the
        // appropriate unit from the array
        output = Math.round(bytes / Math.pow(1024,
            i), 2) + ' ' + this.byteSizes[i];
    }
    return output
},
created() {
    this.getFolderStructure('');
}
});
```

## Animating between states

As a nice enhancement for the user, we can add some transitions between components and states. Helpfully, Vue includes some built-in transition effects. Working with CSS, these transitions allow you to add fades, swipes, and other CSS animations easily when DOM elements are being inserted. More information about transitions can be found in the Vue documentation.

The first step is to add the Vue custom HTML `<transition>` element. Wrap both your loading and list with separate transition elements and give it an attribute of `name` and a value of `fade`:

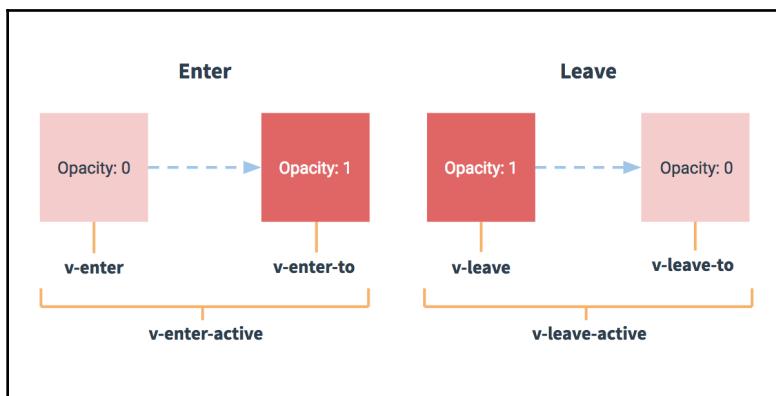
```
<script type="text/x-template" id="dropbox-viewer-
template">
<div>
    <h1>Dropbox</h1>
```

```
<transition name="fade">
  <div v-if="isLoading">Loading...</div>
</transition>
<transition name="fade">
  <ul v-if="!isLoading">
    <li v-for="entry in structure">
      <strong>{{ entry.name }}</strong>
      <span v-if="entry.size">- {{ bytesToSize(entry.size) }}</span>
    </li>
  </ul>
</transition>
</div>
</script>
```

Now add the following CSS to either the head of your document or a separate style sheet if you already have one:

```
.fade-enter-active,
.fade-leave-active {
  transition: opacity .5s
}
.fade-enter,
.fade-leave-to {
  opacity: 0
}
```

With the transition element, Vue adds and removes various CSS classes based on the state and time of the transition. All of these begin with the name passed in via the attribute and are appended with the current stage of transition:



Try the app in your browser, you should notice the loading container fading out and the file list fading in. Although in this basic example, the list jumps up once the fading has completed, it's an example to help you understand using transitions in Vue.

## Summary

In this chapter, we learned how to make a Dropbox viewer, which is a single-page application that lists out files and folders from our Dropbox account and allows us to show different folder contents by updating the code. We have learned how to add a basic loading state to our apps and use the Vue animations for navigation.

In Chapter 5, *Navigating through the File Tree and Loading Folders from the URL*, we are going to navigate through our app folders and add download links to our files.

# 5

# Navigating through the File Tree and Loading Folders from the URL

In Chapter 4, *Getting a List of Files Using the Dropbox API*, we created an app that listed the file and folder contents of a specified Dropbox folder. We now need to make our app easy to navigate. This means the user will be able to click the folder names to navigate into and list the contents of, and also give the user the ability to download the file.

Before you proceed, ensure you have the Vue and Dropbox JavaScript files included in your HTML.

In this chapter, we are going to be:

- Creating a component for both files and folders
- Adding links to the folder component to update the directory listing
- Adding a download button to the file component
- Creating a breadcrumb component, so the user can easily navigate back up the tree
- Dynamically updating the browser URL, so if a folder is bookmarked or a link shared, the correct folder loads

## Separating out files and folders

Before we create the components, we need to separate our files and folders in our structure, so we can easily identify and display our different types. Thanks to the `.tag` attribute on each item, we can split up our folders and files.

First, we need to update our `structure` data property to be an object containing both the `files` and the `folders` array:

```
data() {
  return {
    accessToken: 'XXXX',
    structure: {
      files: [],
      folders: []
    },
    byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB'],
    isLoading: true
  }
}
```

This gives us the ability to append our files and folders to different arrays, meaning we can display them differently in our view.

The next step is to populate these arrays with the data of the current folder. All the following code takes place in the first `then()` function of the `getFolderStructure` method.

Create a JavaScript loop to cycle through the entries and check the `.tag` property of the item. If it is equal to `folder`, append it to the `structure.folder` array, otherwise, add it to the `structure.files` array:

```
getFolderStructure(path) {
  this.dropbox().filesListFolder({
    path: path,
    include_media_info: true
  })
  .then(response => {
    for (let entry of response.entries) {
      // Check ".tag" prop for type
      if(entry['.tag'] === 'folder') {
        this.structure.folders.push(entry);
      } else {
        this.structure.files.push(entry);
      }
    }
  })
}
```

```
        this.isLoading = false;
    })
    .catch(error => {
        console.log(error);
    });
},
```

This code loops through the entries, as we were in the view and checks the `.tag` attribute. As the attribute itself begins with a `.`, we are unable to use the object style notation to access the property like we would, for example, do for the name - `entry.name`. We then append the entry to either the `files` or `folders` array using JavaScript push, depending on the type.

To display this new data, we need to update the view to loop through both types of array. This is a perfect use case for using the `<template>` tag as we want to append both arrays to the same unordered list.

Update the view to list the two arrays separately. We can remove the `size` option from the folder display section, as it will never feature a `size` property:

```
<ul v-if="!isLoading">
    <template v-for="entry in structure.folders">
        <li>
            <strong>{{entry.name }}</strong>
        </li>
    </template>
    <template v-for="entry in structure.files">
<li>
    <strong>{{ entry.name }}</strong>
    <span v-if="entry.size">- {{ bytesToSize(entry.size) }}</span>
</li>
</template>
</ul>
```

This now gives us the opportunity to create components for both types.

## Making file and folder components

With our data types separated out, we can create individual components to compartmentalize the data and methods. Create a `folder` component that accepts a single property, allowing the `folder` object variable to be passed through. As the template is so small, there is no need for a view or `<script>` block-based template; instead, we can pass it in as a string on the component:

```
Vue.component('folder', {
  template: '<li><strong>{{ f.name }}</strong>
</li>',
  props: {
    f: Object
  },
});
```

To make our code smaller and less repetitive, the prop is called `f`. This tidies up the view and lets the component name determine the display type without repeating the word `folder` several times.

Update the view to use the `folder` component, and pass in the `entry` variable to the `f` property:

```
<template v-for="entry in structure.folders">
  <folder :f="entry"></folder>
</template>
```

Repeat the process with files by creating a `file` component. When creating the `file` component, we can move both the `bytesToSize` method and `byteSizes` data property from the parent `dropbox-viewer` component as it would only ever be used when displaying files:

```
Vue.component('file', {
  template: '<li><strong>{{ f.name }}</strong><span           v-
if="f.size"> - {{ bytesToSize(f.size) }}</span>           </li>',
  props: {
    f: Object
  },
  data() {
    return {
      byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB']
    }
  },
  methods: {
    bytesToSize(bytes) {
      // Set a default
```

```
let output = '0 Byte';
// If the bytes are bigger than 0
if (bytes > 0) {
    // Divide by 1024 and make an int
    let i = parseInt(Math.floor(Math.log(bytes)
        / Math.log(1024)));
    // Round to 2 decimal places and select the
    // appropriate unit from the array
    output = Math.round(bytes / Math.pow(1024, i),
        2) + ' ' + this.byteSizes[i];
}
return output
}
});
});
```

Once again, we can use `f` for the prop name to reduce repetition (and the file size of our app). Update the view once again to use this new component:

```
<template v-for="entry in structure.files">
<file :f="entry"></file>
</template>
```

## Linking folders and updating the structure

Now that we have our folders and files separated, we can transform our folder names into links. These links will then update the structure to show the contents of the selected folder. For this, we are going to use the `path_lower` property in each folder to build the link target.

Create a dynamic link to each folder name, linking to the folder's `path_lower`. As we are getting more familiar with Vue, the `v-bind` property has been shortened to just the colon notation:

```
Vue.component('folder', {
    template: '<li><strong><a :href="f.path_lower">{
        f.name }</a></strong></li>',
    props: {
        f: Object
    },
});
```

We now need to add a `click` listener for this link. When clicked, we need to trigger the `getFolderStructure` method on the `dropbox-viewer` component. Although the `click` method will use the `f` variable on each instance to get the data, it's good practice to have the `href` attribute set to the folder URL.

Using what we learned in the early chapters of the book, create a method on the `folder` component that, when triggered, emits the folder path to the parent component. The `dropbox-viewer` component also needs a new method to update the structure with the given parameter when fired.

Create the new method on the `folder` component and add the `click` event to the folder link. As with the `v-bind` directive, we are now using the shorthand notation for `v-on`, represented by an `@` symbol:

```
Vue.component('folder', {
  template: '<li><strong><a
    @click.prevent="navigate()" :href="f.path_lower">{{
      f.name }}</a></strong></li>',
  props: {
    f: Object
  },
  methods: {
    navigate() {
      this.$emit('path', this.f.path_lower);
    }
  }
});
```

Along with defining the `click` event, an event modifier has also been added. Using `.prevent` after the `click` event adds `preventDefault` to the link action, this stops the link from actually going to the specified URL and instead lets the `click` method handle everything. More event modifiers and details about them can be found in the Vue documentation.

When clicked, the `navigate` method is fired, which emits the folder's lower path using the `path` variable.

Now that we have our `click` handler and the variable being emitted, we need to update the view to trigger a method on the parent `dropbox-viewer` component:

```
<template v-for="entry in structure.folders">
  <folder :f="entry" @path="updateStructure">
    </folder>
  </template>
```

Create a new method on the Dropbox component with the same name as the value of the v-on attribute, in this case updateStructure. This method will have one parameter, which is the path we emitted earlier. From here, we can trigger our original getFolderStructure method using the path variable:

```
updateStructure(path) {  
    this.getFolderStructure(path);  
}
```

Viewing our app in the browser should now list the folders and links and, when clicked, show the contents of the new folder.

When doing so, however, there are a couple of issues that are raised. Firstly, the files and folders are appended to the existing list rather than replacing it. Secondly, there is no feedback to the user that the app is loading the next folder.

The first issue can be resolved by clearing the folder and file arrays before appending the new structure. The second can be addressed by utilizing the loading screen we used at the beginning of the app - this will give the user some feedback.

To address the first issue, create a new structure object inside the success promise function for the getFolderStructure method. This object should replicate that of the structure object in the data object. This should set blank arrays for both files and folders. Update the for loop to use the local structure arrays rather than the component ones. Lastly, update the component structure object with the new version, including the updated files and folders:

```
getFolderStructure(path) {  
    this.dropbox().filesListFolder({  
        path: path,  
        include_media_info: true  
    })  
    .then(response => {  
        const structure = {  
            folders: [],  
            files: []  
        }  
        for (let entry of response.entries) {  
            // Check ".tag" prop for type  
            if(entry['.tag'] == 'folder') {  
                structure.folders.push(entry);  
            } else {  
                structure.files.push(entry);  
            }  
        }  
        this.structure = structure;  
    })  
}
```

```
        this.isLoading = false;
    })
    .catch(error => {
        console.log(error);
    });
}
}
```

As this method gets called when the app gets mounted and creates its own version of the structure object, there is no need to declare the arrays in the data function. Update the data object to just initialize the `structure` property as an object:

```
data() {
    return {
        accessToken: 'XXXX',
        structure: {},
        isLoading: true
    }
}
```

Running the app now will render the file list, which will be cleared and updated when a new folder is clicked into. To give the user some feedback and let them know the app is working, let's toggle the loading screen after each click.

Before we do this, however, let's fully understand where the delay comes from and where is best to trigger the loading screen.

The click on the link is instantaneous, which triggers the `navigate` method on the `folder` component, which in turn fires the `updateStructure` method on the `Dropbox` component. The delay comes when the app gets to the `filesListFolder` function on the `Dropbox` instance, inside the `getFolderStructure` method. As we may want to fire the `getFolderStructure` method at a later date without triggering the loading screen, set the `isLoading` variable to `true` inside the `updateStructure` method:

```
updateStructure(path) {
    this.isLoading = true;
    this.getFolderStructure(path);
}
```

With the animations in place, the app fades between both the loading screen and folder structure when navigating through folders.

# Creating a breadcrumb from the current path

When navigating through folders or a nested structure of any kind, it's always nice to have a breadcrumb available so the user knows where they are, how far they've gone, and also so they can get back to a previous folder easily. We are going to make a component for the breadcrumb as it is going to feature various properties, computed functions, and methods.

The breadcrumb component is going to list each folder depth as a link to a folder icon. Clicking the link will take the user directly to that folder - even if it is several layers up. To achieve this, we will need to have a list of links we can loop through, each with two properties - one being the full path to the folder and the other just being the folder name.

For example, if we had the folder structure of `/images/holiday/summer/iphone`, we would want to be able to click on `Holiday` and for the app to navigate to `/images/holiday`.

Create your breadcrumb component — for now, add an empty `<div>` to the template property:

```
Vue.component('breadcrumb', {  
  template: '<div></div>'  
});
```

Add the component to your view. We're going to want the breadcrumb to fade in and out with the structure list, so we need to tweak the HTML to wrap both the list and breadcrumb component in a container that has the `v-if` declaration:

```
<transition name="fade">  
  <div v-if="!isLoading">  
    <breadcrumb></breadcrumb>  
    <ul>  
      <template v-for="entry in structure.folders">  
        <folder :f="entry" @path="updateStructure">  
      </template>  
      <template v-for="entry in structure.files">  
        <file :f="entry"></file>  
      </template>  
    </ul>  
  </div>  
</transition>
```

We now need to make a variable available to us that stores the current folder path. We can then manipulate this variable within the breadcrumb component. This will be stored and updated on the Dropbox component and passed down to the breadcrumb component.

Create a new property called `path` on the `dropbox-viewer` component:

```
data() {
  return {
    accessToken: 'XXXXXX',
    structure: {},
    isLoading: true,
    path: ''
  }
}
```

We now need to ensure this path gets updated whenever the structure is retrieved from the Dropbox API. Do this within the `getFolderStructure` method, just before the `isLoading` variable is disabled. This ensures it only gets updated once the structure has been loaded, but before the files and folders are displayed:

```
getFolderStructure(path) {
  this.dropbox().filesListFolder({
    path: path,
    include_media_info: true
  })
  .then(response => {
    const structure = {
      folders: [],
      files: []
    }
    for (let entry of response.entries) {
      // Check ".tag" prop for type
      if(entry['.tag'] == 'folder') {
        structure.folders.push(entry);
      } else {
        structure.files.push(entry);
      }
    }
    this.path = path;
    this.structure = structure;
    this.isLoading = false;
  })
  .catch(error => {
    console.log(error);
  });
},
```

Now that we have a variable populated with the current path, we can pass it through to the breadcrumb component as a prop. Add a new attribute to the breadcrumb with the path variable as the value:

```
<breadcrumb :p="path"></breadcrumb>
```

Update the component to accept the prop as a string:

```
Vue.component('breadcrumb', {  
  template: '<div></div>',  
  props: {  
    p: String  
  }  
});
```

The p attribute now contains the full path of where we are (for example /images/holiday/summer). We want to break up this string so we can identify the folder name and build the breadcrumb for the component to render.

Create a computed object on the component and create a new function titled `folders()`. This is going to create the breadcrumb array for us to loop through in the template:

```
computed: {  
  folders() {  
  }  
}
```

We now need to set up some variables for us to use. Create a new, empty array called `output`. This is where we are going to build up our breadcrumb. We also need an empty variable titled `slug` as a string. The `slug` variable refers to a part of a URL and its use was made popular by WordPress. The last variable is the path created as an array. As we know, each folder is separated by a /, we can use this to explode or split the string into various parts:

```
computed: {  
  folders() {  
    let output = [],  
    slug = '',  
    parts = this.p.split('/');  
  }  
}
```

If we were to look at the `parts` variable for our `Summer` folder, it would look like the following:

```
['images', 'holiday', 'summer']
```

We can now loop through the array to create the breadcrumb. Each breadcrumb item is going to be an object with the name of the individual folder, for example, `holiday` or `summer`, and the `slug`, which would be `/images/holiday` for the former and `/images/holiday/summer` for the latter.

Each object will be constructed and then added to the `output` array. We can then return the output for our template to use:

```
folders() {
  let output = [],
    slug = '',
    parts = this.p.split('/');
  for (let item of parts) {
    slug += item;
    output.push({ 'name': item, 'path': slug });
    slug += '/';
  }
  return output;
}
```

This loop creates our breadcrumb by taking the following steps. For this example, we'll assume we are in the `/images/holiday` folder:

1. `parts` will now be an array containing three items, `[ '', 'images', 'holiday' ]`. If the string you split on begins with the item you're splitting, an empty item will be made as the first item.
2. At the beginning of the loop, the first `slug` variable will be equal to `''`, as it is the first item.
3. The `output` array will have a new item appended to it with the object of `{ 'name': '', 'path': '' }`.
4. The `slug` variable then has a `/` added to the end.
5. Looping through the next item, the `slug` variable gets the name of the item (`images`) added to it.
6. `output` now has a new object added, with the value of `{ 'name': 'images', 'path': '/images' }`.
7. For the last item, another `/` is added along with the next name, `holiday`.
8. `output` gets the last object added, the value being `{ 'name': 'holiday', 'path': '/images/holiday' }` - note the path is building up whereas the name remains the singular folder name.

We now have our breadcrumb output array that we can loop through in the view.



The reason we add the slash after we've appended to the output array is that the API states that to get the root of the Dropbox we pass in an empty string, whereas all other paths must begin with a /.

The next step is to output the breadcrumb into our view. As this template is small, we are going to use the multiline JavaScript notation. Loop through the items within the `folders` computed variable, outputting a link for each of the items. Don't forget to keep a containing element around all the links:

```
template: '<div>' +
  '<span v-for="f in folders">' +
    '<a :href="f.path">{{ f.name }}</a>' +
  '</span>' +
'</div>'
```

Rendering this app in the browser should reveal a breadcrumb - albeit a bit squished together and missing a home link (as the first item didn't have a name). Head back to the `folders` function and add an `if` statement - checking whether the item has a name and, if it doesn't, adding a hard-coded value:

```
folders() {
  let output = [],
    slug = '',
    parts = this.p.split('/');
  console.log(parts);
  for (let item of parts) {
    slug += item;
    output.push({name: item || 'home', path:
      slug});
    slug += '/';
  }
  return output;
}
```

The other option is to add the `if` statement in the template itself:

```
template: '<div>' +
  '<span v-for="f in folders">' +
    '<a :href="f.path">{{ f.name || 'Home' }}</a>' +
  '</span>' +
'</div>'
```

If we wanted to display a divider between the folder names, such as a slash or chevron, this can be easily added. However, a slight hurdle arises when we want to display the separator between the links, but not at the beginning or end. To resolve this, we are going to utilize the `index` keyword available when doing a loop. We are then going to compare this against the length of the array and operate a `v-if` declaration on an element.

When looping through an array, Vue allows you to utilize another variable. This, by default, is the index (the position of the item in the array); however, the index may be set to a value if your array is constructed in a key/value fashion. If this is the case, you can still access the index by adding a third variable. As our array is a simple list, we can easily use this variable:

```
template: '<div>' +
  '<span v-for="(f, i) in folders">' +
    '<a :href="f.path">{{ f.name || 'Home' }}</a>' +
    '<span v-if="i !== (folders.length - 1)">' +
      '</span>' +
    '</span>' +
  '</div>'
```

Update the `f` variable to a pair of brackets containing an `f` and an `i`, comma separated. The `f` variable is the current folder in the loop, while the `i` variable that has been created is the index of the item. Bear in mind that the array indexes start at 0 instead of 1.

The separator we've added is contained in a span tag with a `v-if` attribute, the contents of which could look confusing. This is confusing the current index with the length of the `folders` array (how many items it has) minus 1. The `- 1` is because of the index starting at 0 and not 1, as you would expect. If the numbers do not match, then the span element is displayed.

The last thing we need to do is make our breadcrumb navigate to the selected folder. We can do this by adapting the `navigate` function we wrote for the `folder` component. However, because our whole component is the breadcrumb and not each individual link, we need to alter it so it accepts a parameter.

Start off by adding the `click` event to the link, passing in the `folder` object:

```
template: '<div>' +
  '<span v-for="(f, i) in folders">' +
    '<a @click.prevent="navigate(f)"'
      ':href="f.path">
        {{ f.name || 'Home' }}</a>' +
    '<i v-if="i !== (folders.length - 1)"> &raquo;';
      '</i>' +
    '</span>' +
```

```
'</div>>,
```

Next, create the `navigate` method on your breadcrumb component, making sure you accept the `folder` parameter and emit the path:

```
methods: {
  navigate(folder) {
    this.$emit('path', folder.path);
  }
}
```

The last step is to trigger the parent method when the path gets emitted. For this, we can utilize the same `updateStructure` method on the `dropbox-viewer` component:

```
<breadcrumb :p="path" @path="updateStructure">
</breadcrumb>
```

We now have a fully operational breadcrumb that allows the user to navigate down the folder structure using the folder links and back up via breadcrumb links.

Our full breadcrumb component looks like is:

```
Vue.component('breadcrumb', {
  template: '<div>' +
    '<span v-for="(f, i) in folders">' +
      '<a @click.prevent="navigate(f)"'
        :href="f.path"><{ f.name || 'Home' }></a>' +
        '<i v-if="i !== (folders.length - 1)">' +
        '</i>' + '</span>' +
    '</div>',

  props: {
    p: String
  },

  computed: {
    folders() {
      let output = [],
        slug = '',
        parts = this.p.split('/');
      console.log(parts);
      for (let item of parts) {
        slug += item;
        output.push({ 'name': item || 'home', 'path':
          slug });
        slug += '/';
      }
    }
  }
})
```

```
        return output;
    }
},
methods: {
    navigate(folder) {
        this.$emit('path', folder.path);
    }
}
});
```

## Adding the ability to download files

Now that our users can navigate through the folder structure, we need to add the ability to download the files. Unfortunately, this isn't as simple as accessing a link attribute on the file. To get the download link, we have to query the Dropbox API for each file.

We will query the API on the creation of the file component, this will asynchronously get the download link and show it once available. Before we can do this, we need to make the Dropbox instance available to the file component.

Add a new attribute to the file component in the view, and pass the Dropbox method through as the value:

```
<file :d="dropbox()" :f="entry"></file>
```

Add the `d` variable to the `props` object of your component accepting an Object:

```
props: {
    f: Object,
    d: Object
},
```

We are now going to add a data attribute of `link`. This should be set to `false` by default, so we can hide the link, and we'll populate it with the download link once the API has returned with the value.

Add the `created()` function to the file component, and inside add the API call:

```
created() {
    this.d.filesGetTemporaryLink({path:
        this.f.path_lower}).then(data => {
        this.link = data.link;
    });
}
```

This API method accepts an object, similar to the `filesListFolder` function. We're passing the path of the current file. Once the data is returned, we can set the component's `link` attribute to the download link.

We can now add a download link to the template of the component. Add a `v-if` to only show the `<a>` once the download link has been retrieved:

```
template: '<li><strong>{{ f.name }}</strong><span v-  
if="f.size"> - {{ bytesToSize(f.size) }}</span><span  
v-if="link"> - <a :href="link">Download</a></span>  
</li>'
```

Browsing through the files, we can now see a download link appearing next to each file, the speed of which will depend on your internet connection and the API speed.

The full file component, with the download link added, now looks like:

```
Vue.component('file', {  
  template: '<li><strong>{{ f.name }}</strong><span v-  
if="f.size"> - {{ bytesToSize(f.size) }}</span><span  
v-if="link"> - <a :href="link">Download</a></span>  
</li>',  
  props: {  
    f: Object,  
    d: Object  
  },  
  data() {  
    return {  
      byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB'],  
      link: false  
    }  
  },  
  methods: {  
    bytesToSize(bytes) {  
      // Set a default  
      let output = '0 Byte';  
      // If the bytes are bigger than 0  
      if (bytes > 0) {  
        // Divide by 1024 and make an int  
        let i = parseInt(Math.floor(Math.log(bytes) /  
          Math.log(1024)));  
        // Round to 2 decimal places and select the  
        // appropriate unit from the array  
        output = Math.round(bytes / Math.pow(1024, i), 2)  
          + ' ' + this.byteSizes[i];  
      }  
      return output  
    }  
  }  
});
```

```
        },
        created() {
      this.d.filesGetTemporaryLink({path:
        this.f.path_lower}).then(data => {
        this.link = data.link;
      });
    },
  );
});
```

## Updating the URL hash and using it to navigate through the folders

With our Dropbox web app now fully navigable via both the structure list and breadcrumb, we can now add and update the browser URL for quick folder access and sharing. We can do this in two ways: we can either update the hash, for example, `www.domain.com/#/images/holiday/summer`, or we can redirect all the paths to the single page and handle the routing without the hash in the URL.

For this app, we will use the `#` method in the URL. We'll cover the URL routing technique in the third section of the book when we introduce `vue-router`.

Before we get the app to show the corresponding folder of the URL, we first need to get the URL to update when navigating to a new folder. We can do this using the native `window.location.hash` JavaScript object. We want to update the URL as soon as the user clicks a link, rather than waiting for the data to load to update.

As the `getFolderStructure` method gets fired whenever we update the structure, add the code to the top of this function. This would mean the URL gets updated and then the Dropbox API is called to update the structure:

```
getFolderStructure(path) {
  window.location.hash = path;

  this.dropbox().filesListFolder({
    path: path,
    include_media_info: true
  })
  .then(response => {
    const structure = {
      folders: [],
      files: []
    }
  })
```

```
        for (let entry of response.entries) {
            // Check ".tag" prop for type
            if(entry['.tag'] == 'folder') {
                structure.folders.push(entry);
            } else {
                structure.files.push(entry);
            }
        }
        this.path = path;
        this.structure = structure;
        this.isLoading = false;
    })
    .catch(error => {
        console.log(error);
    });
}
```

As you navigate through your app, it should be updating the URL to include the current folder path.

However, what you will find when you press refresh with a folder; is that the URL resets to just having a hash with no folder afterward as it is being reset by the empty path passed in via the method in the `created()` function.

We can remedy this by passing in the current hash to the `getFolderStructure` within the `created` function, however, there will be a few checks and error catching we will need to do if we do this.

First, when calling `window.location.hash`, you also get the hash returned as part of the string, so we will need to remove that. Second, we need to handle the instance of an incorrect URL, should the user enter an incorrect path or the folder gets moved. Lastly, we need to let the user use the back and forward buttons (or keyboard shortcuts) in their browsers.

## Showing the folder based on the URL

When our app mounts, it already calls a function to request the structure for the base folder. We wrote this function to allow the path to be passed in and, within the `created()` function, we have fixed the value to be the root folder of '''. This gives us the flexibility to adapt this function to pass in the hash from the URL, instead of a fixed string.

Update the function to accept the hash of the URL and, if it doesn't have one, the original fixed string:

```
created() {
  let hash = window.location.hash.substring(1);
  this.getFolderStructure(hash || '');
}
```

Create a new variable called `hash` and assign `window.location.hash` to it. Because the variable starts with #, which is not needed for our app, use the `substring` function to remove the first character from the string. We can then use a logical operator to use either the `hash` variable, or if that equates to nothing, the original fixed string.

You should now be able to still navigate through your app with the URL updating. If you press refresh at any time or copy and paste the URL into a different browser window, the folder you were in should load.

## Displaying an error message

With our app accepting URLs, we need to handle a case where someone is entering a URL and makes a mistake, or a folder is shared that has since been moved.

As this error is an edge case, we are going to hijack the `isLoading` parameter if there is an error in loading the data. In the `getFolderStructure` function, we have a `catch` function returned as a promise that gets fired if there is an error with the API call. In this function, set the `isLoading` variable to 'error':

```
getFolderStructure(path) {
  window.location.hash = path;
  this.dropbox().filesListFolder({
    path: path,
    include_media_info: true
  })
  .then(response => {
    const structure = {
      folders: [],
      files: []
    }
    // ...
  })
  .catch(error => {
    this.isLoading = 'error';
    // ...
  })
}
```

```
        }
        for (let entry of response.entries) {
            // Check ".tag" prop for type
            if(entry['.tag'] == 'folder') {
                structure.folders.push(entry);
            } else {
                structure.files.push(entry);
            }
        }
        this.path = path;
        this.structure = structure;
        this.isLoading = false;
    })
    .catch(error => {
        this.isLoading = 'error';
        console.log(error);
    });
}
}
```

The `console.log` has been left in, should we need to diagnose a problem beyond a wrong file path. Although the API can throw several different errors, we are going to assume for this app that the error is due to a wrong path. If you wanted to cater for other errors in the app, you can identify the error type by its `status_code` attribute. More details on this can be found in the Dropbox API documentation.

Update your view to handle this new `isLoading` variable property. When set to `error`, the `isLoading` variable is still "true," so within your loading element, add a new `v-if` to check whether the loading variable is set to `error`:

```
<transition name="fade">
<div v-if="isLoading">
    <div v-if="isLoading === 'error'">
        <p>There seems to be an issue with the URL entered.
        </p>
        <p><a href="">Go home</a></p>
    </div>
    <div v-else>
        Loading...
    </div>
</div>
</transition>
```

This is set to display the first element of the `isLoading` variable is set to `error`; otherwise, show the loading text. In the error text, a link is included to send the user back to the current URL without any URL hash. This will "reset" them back to the top of the document tree so they can navigate back down. An improvement could be to break the current URL down and suggest the same URL with the last folder removed.

Verify the error code is loading by adding a nonexistent path to the end of your URL and ensuring the error message is displayed. Bear in mind your user may experience a false positive on this error message in the sense that if the Dropbox API throws any kind of error, this message will be displayed.

## Using the back and forward buttons in your browser

To use the back and forward buttons in our browser, we are going to need to update our code significantly. Currently, when the user clicks on a folder from either the structure or breadcrumb, we prevent the default behavior of the browser by using `.prevent` on our `click` handlers. We then immediately update the URL before we process the folder.

However, if we allow the app to update the URL using native behavior, we can then watch for a hash URL update and use this to retrieve our new structure. Using this methodology, the back and forward buttons would work without any further intervention, as they would be updating the URL hash.

This would also improve the readability of our app, and reduce code weight as we would be able to remove the `navigate` methods and `click` handlers on the links.

## Removing unneeded code

The first step, before we add more code, is to remove the unnecessary code from our components. Starting with the breadcrumb, remove the `navigate` method from the component and the `@click.prevent` attribute from the link in the template.

We also need to update the `slug` of each of the items to prepend a # - this ensures the app doesn't try and navigate to a brand new page when clicked. As we are looping through our breadcrumb items in the `folders` computed function, add a hash to each `slug` when pushing the object to the output array:

```
Vue.component('breadcrumb', {
  template: '<div>' +
    '<span v-for="(f, i) in folders">' +
      '<a :href="f.path">{{ f.name || 'Home' }}</a>' +
      '<i v-if="i !== (folders.length - 1)"> &raquo;' +
      '</i>' + '</span>' +
    '</div>',
  props: {
    p: String
  },
  computed: {
    folders() {
      let output = [],
        slug = '',
        parts = this.p.split('/');
      for (let item of parts) {
        slug += item;
        output.push({name: item || 'home', 'path': '#' + slug});
        slug += '/';
      }
      return output;
    }
  }
});
```

We can also remove the `v-on` declaration on the breadcrumb component in the `dropbox-viewer-template`. It should only have the path being passed in as a prop:

```
<breadcrumb :p="path"></breadcrumb>
```

We can now repeat the same pattern for the folder component. Remove the `@click.prevent` declaration from the link and delete the `navigate` method.

As we are not looping through or editing the folder object before displaying it, we can prepend the # in the template. As we are telling Vue the `href` is bound to a JavaScript object (with the colon), we need to encapsulate the hash in quotes and concatenate it with the folder path using the JavaScript + notation.

We are already inside both single and double quotes, so we need to inform JavaScript we *literally* mean a single quote and this is done by using a backslash in front of the single quote character:

```
Vue.component('folder', {
  template: '<li><strong><a :href="#" + 
    f.path_lower">{{ f.name }}</a></strong></li>',
  props: {
    f: Object
  }
});
```

We can also remove the @path attribute from the <folder> component in the view:

```
<template v-for="entry in structure.folders">
  <folder :f="entry"></folder>
</template>
```

Already our code is looking cleaner, less cluttered, and smaller in file size. Viewing the app in the browser will render the structure of the folder you are in; however, clicking links will update the URL but not change what is displayed.

## Updating the structure with a URL change and setting Vue data outside of the instance

Now that we have our URL updating correctly, we can get the new structure whenever the hash changes. This can be done natively with JavaScript with the onhashchange function.

We are going to create a function that fires whenever the hash of the URL updates, which, in turn, will update a path variable on the parent Vue instance. This variable will be passed to the child dropbox-viewer component as a prop. This component will be watching for a change in the variable and, upon update, it will retrieve the new structure.

To begin with, update the parent Vue instance to have a data object with a path key - set to the empty string property. We are also going to assign our Vue instance to a constant variable of app—this allows us to set data and call methods outside of the instance:

```
const app = new Vue({
  el: '#app',
  data: {
    path: ''
  }
});
```

The next step is to update this data property every time the URL gets updated. This is done using `window.onhashchange`, which is a native JavaScript function that fires every time the hash changes in the URL.

Copy and paste the hash modifier from the `created` function on the Dropbox component, and use that to modify the hash and store the value on the Vue instance. If the hash doesn't exist, we will pass an empty string to the path variable:

```
window.onhashchange = () => {
  let hash = window.location.hash.substring(1);
  app.path = (hash || '');
}
```

We now need to pass this path variable through to the Dropbox component. Add a prop of `p` with the `path` variable as the value in your view:

```
<div id="app">
  <dropbox-viewer :p="path"></dropbox-viewer>
</div>
```

Add the `props` object to the Dropbox component to accept a string:

```
props: {
  p: String
},
```

We are now going to add a `watch` function to the `dropbox-viewer` component. This function will watch the `p` prop and, when updated, call the `updateStructure()` method with the modified path:

```
watch: {
  p() {
    this.updateStructure(this.p);
  }
}
```

Heading back to the browser we should now be able to navigate through our Dropbox structure, as before, using both the folder links and breadcrumb as navigation. We should now be able to use the back and forward browser buttons, plus any keyboard shortcuts, to also navigate back through the folders.

Before we head to Chapter 6, *Caching the Current Folder Structure Using Vuex*, and introduce folder caching to our app using `vuex`, there are a few optimizations we can make to our Dropbox component.

First, in the `getFolderStructure` function, we can remove the first line where the URL hash gets set to the path. This is because the URL has already been updated when the link is used. Remove this line from your code:

```
window.location.hash = path;
```

Second, there is now repetition in the Dropbox component with the `this.path` variable and the `p` prop. Eliminating this requires some slight reworking, as you are not allowed to modify a prop directly as you are with the path; however, it needs to be kept in sync so the breadcrumb can be correctly rendered.

Remove the `path` property from the data object in the Dropbox component, and also delete the `this.path = path` line from the `getFolderStructure` function.

Next, update the prop to be equal to `path`, not `p`. This will also require the `watch` function to be updated to watch the `path` variable and not `p()`.

Update the created method to just use `this.path` as the parameter to the function. The Dropbox component should now look like this:

```
Vue.component('dropbox-viewer', {
  template: '#dropbox-viewer-template',
  props: {
    path: String
  },
  data() {
    return {
      accessToken: 'XXXX',
      structure: {},
      isLoading: true
    }
  },
  methods: {
    dropbox() {
      return new Dropbox({
        accessToken: this.accessToken
      });
    },
    getFolderStructure(path) {
      this.dropbox().filesListFolder({
        path: path,
        include_media_info: true
      })
      .then(response => {
        const structure = {
          folders: [],
          files: []
        };
        response.entries.forEach(item => {
          if (item.type === 'file') {
            structure.files.push(item);
          } else if (item.type === 'folder') {
            structure.folders.push(item);
            this.getFolderStructure(item.path);
          }
        });
        this.structure = structure;
      })
    }
  }
});
```

```
        files: []
    }
    for (let entry of response.entries) {
        // Check ".tag" prop for type
        if(entry['.tag'] == 'folder') {
            structure.folders.push(entry);
        } else {
        }
    }
    this.structure = structure;
    this.isLoading = false;
})
.catch(error => {
    this.isLoading = 'error';
    console.log(error);
});
},
updateStructure(path) {
    this.isLoading = true;
    this.getFolderStructure(path);
}
},
created() {
    this.getFolderStructure(this.path);
},
watch: {
    path() {
        this.updateStructure(this.path);
    }
},
});
});
```

Update the view to accept the prop as path:

```
<dropbox-viewer :path="path"></dropbox-viewer>
```

We now need to ensure the parent Vue instance has the correct path on both page load and hash change. To avoid repetition, we are going to extend our Vue instance with both a method and a `created()` function.

Keep the path variable set to an empty string. Create a new method titled `updateHash()` that removes the first character from the window hash and then sets the `path` variable either to the hash or an empty string. Next, create a `created()` function that runs the `updateHash` method.

The Vue instance now looks like this:

```
const app = new Vue({
  el: '#app',
  data: {
    path: ''
  },
  methods: {
    updateHash() {
      let hash = window.location.hash.substring(1);
      this.path = (hash || '');
    }
  },
  created() {
    this.updateHash()
  }
});
```

Lastly, to remove repetition, we can fire the `updateHash` method when the hash changes in the address bar:

```
window.onhashchange = () => {
  app.updateHash();
}
```

## Final Code

With our code now complete your view and JavaScript file should look like the following. Firstly, the view should look like this:

```
<div id="app">
  <dropbox-viewer :path="path"></dropbox-viewer>
</div>
<script type="text/x-template" id="dropbox-viewer-
template">
<div>
  <h1>Dropbox</h1>
  <transition name="fade">
    <div v-if="isLoading">
      <div v-if="isLoading == 'error'">
        <p>There seems to be an issue with the URL
        entered.</p>
        <p><a href="">Go home</a></p>
      </div>
    <div v-else>
```

```
        Loading...
      </div>
    </div>
  </transition>
<transition name="fade">
  <div v-if="!isLoading">
    <breadcrumb :p="path"></breadcrumb>
    <ul>
      <template v-for="entry in structure.folders">
        <folder :f="entry"></folder>
      </template>
      <template v-for="entry in structure.files">
        <file :d="dropbox()" :f="entry"></file>
      </template>
    </ul>
  </div>
</transition>
</div>
</script>
```

The accompanying JavaScript app should look like this:

```
Vue.component('breadcrumb', {
  template: '<div>' +
    '<span v-for="(f, i) in folders">' +
    '<a :href="f.path">{{ f.name || "Home" }}</a>' +
    '<i v-if="i !== (folders.length - 1)"> &raquo;' +
    '</i>' + '</span>' +
  '</div>',
  props: {
    p: String
  },
  computed: {
    folders() {
      let output = [],
        slug = '',
        parts = this.p.split('/');
      for (let item of parts) {
        slug += item;
        output.push({name: item || 'home', path: '#' + slug});
        slug += '/';
      }
      return output;
    }
  }
});
```

```
Vue.component('folder', {
    template: '<li><strong><a :href="' + 
    f.path_lower">{{ f.name }}</a></strong></li>',
    props: {
        f: Object
    }
});
Vue.component('file', {
    template: '<li><strong>{{ f.name }}</strong><span>
    v-if="f.size"> - {{ bytesToSize(f.size) }}</span>
    <span v-if="link"> - <a :href="link">Download</a>
    </span></li>',
    props: {
        f: Object,
        d: Object
    },
    data() {
        return {
            byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB'],
            link: false
        }
    },
    methods: {
        bytesToSize(bytes) {
            // Set a default
            let output = '0 Byte';
            // If the bytes are bigger than 0
            if (bytes > 0) {
                // Divide by 1024 and make an int
                let i = parseInt(Math.floor(Math.log(bytes) /
                    Math.log(1024)));
                // Round to 2 decimal places and select the
                // appropriate unit from the array
                output = Math.round(bytes / Math.pow(1024, i), 2)
                + ' ' + this.byteSizes[i];
            }
            return output
        }
    },
    created() {
        this.d.filesGetTemporaryLink({path:
        this.f.path_lower}).then(data => {
            this.link = data.link;
        });
    },
});
Vue.component('dropbox-viewer', {
    template: '#dropbox-viewer-template',
```

```
props: {
  path: String
},
data() {
  return {
    accessToken: 'XXXX',
    structure: {},
    isLoading: true
  }
},
methods: {
  dropbox() {
    return new Dropbox({
      accessToken: this.accessToken
    });
  },
  getFolderStructure(path) {
    this.dropbox().filesListFolder({
      path: path,
      include_media_info: true
    })
    .then(response => {
      const structure = {
        folders: [],
        files: []
      }
      for (let entry of response.entries) {
        // Check ".tag" prop for type
        if(entry['.tag'] == 'folder') {
          structure.folders.push(entry);
        } else {
          structure.files.push(entry);
        }
      }
      this.structure = structure;
      this.isLoading = false;
    })
    .catch(error => {
      this.isLoading = 'error';
      console.log(error);
    });
  },
  updateStructure(path) {
    this.isLoading = true;
    this.getFolderStructure(path);
  }
},
created() {
```

```
        this.getFolderStructure(this.path);
    },
watch: {
    path() {
        this.updateStructure(this.path);
    }
},
});
const app = new Vue({
el: '#app',

data: {
path: ''
},
methods: {
updateHash() {
    let hash = window.location.hash.substring(1);
    this.path = (hash || '');
}
},
created() {
    this.updateHash()
}
});
window.onhashchange = () => {
app.updateHash();
}
}
```

## Summary

We now have a fully functioning Dropbox viewer app featuring navigation for folders and download links for files. We can use either the folder links or breadcrumb for navigation and use the back and/or forward buttons. We can also share or bookmark a link and load the contents of that folder.

In Chapter 6, *Caching the Current Folder Structure Using Vuex*, we are going to speed up the navigation process by caching the current folder contents using Vuex.

# 6

# Caching the Current Folder Structure Using Vuex

In this chapter, we are going to introduce an official Vue plugin called Vuex. Vuex is a state management pattern and library that allows you to have a centralized store for all your Vue components, irrelevant of whether they are child components or a Vue instance. It gives us a centralized, simple way of keeping our data in sync across the whole app.

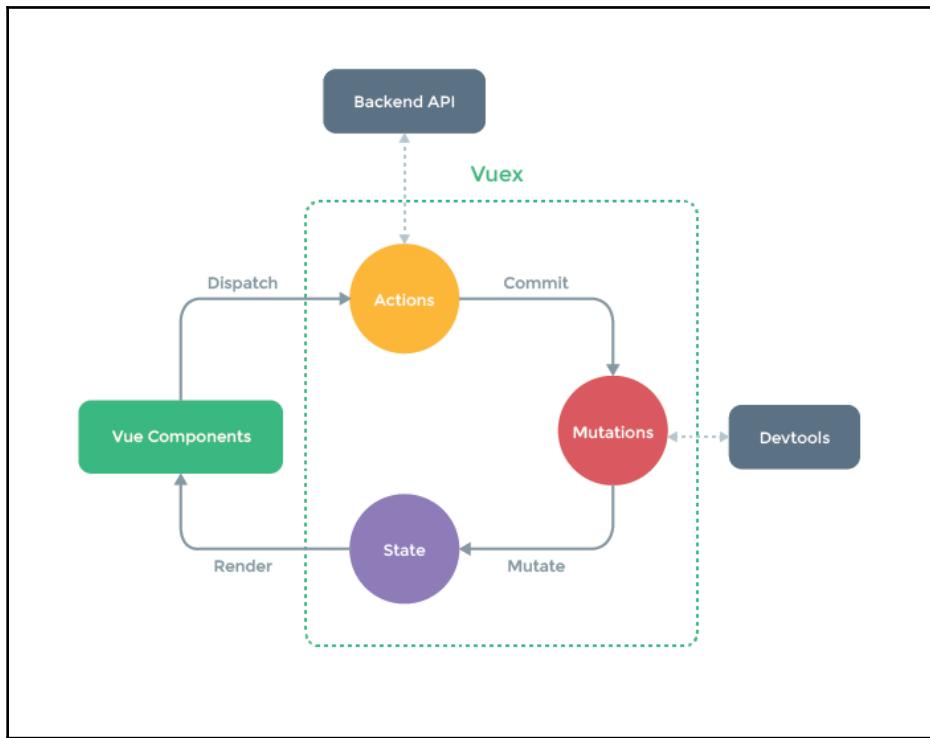
This chapter is going to cover:

- Getting started with Vuex
- Storing and retrieving data from the Vuex store
- Integrating Vuex with our Dropbox app
- Caching the current Dropbox folder contents and loading data from the store if required

Instead of requiring custom events and the `$emit` functions on every component, and trying to keep components and child components up to date, every part of your Vue app can update the central store, and others can react and update their data and state based on that information. It also gives us a common place to store data so, rather than trying to decide whether it is more semantic to place the data object on the component, a parent component, or the Vue instance, we can use the Vuex store.

Vuex is also integrated into the Vue dev tools—something that is covered in Chapter 12, *Using Vue Dev Tools and Testing Your SPA*. With the integration of the library, it makes debugging and viewing the current and past states of the store easy. The dev tools reflect state changes, or data updates, and allow you to inspect each part of the store.

As mentioned, Vuex is a state management pattern, which is the source of truth for your Vue app. For example, keeping track of a shopping basket or logged in user is vital for some apps and could wreak havoc if this data got out of sync between components. It is also impossible to pass data between child components without using the parent to handle the exchange. Vuex removes this complication by handling the storage, mutation, and actions on the data.



When initially using Vuex, it may seem quite verbose and like overkill for what is required; however, this is a great example of getting to grips with the library. More information about Vuex can be found in their documentation.

For our Dropbox app, the Vuex store can be utilized to store the folder structure, file list, and download links. This means if a user visits the same folder more than once, the API will not need to be queried as all the information is stored already. This will speed up the navigation of the folders.

## Including and initializing Vuex

The Vuex library is included the same way as Vue itself. You can either use a hosted version by using the previously mentioned unpkg service (<https://unpkg.com/vuex>) or you can download the JavaScript library from their <https://github.com/vuejs/vuex>.

Add a new `<script>` block to the bottom of your HTML file. Ensure the Vuex library is included after your `vue.js` library but before your application JavaScript:

```
<script type="text/javascript" src="js/vue.js"></script>
<script type="text/javascript" src="js/vuex.js"></script>
<script type="text/javascript" src="js/dropbox.js"></script>
<script type="text/javascript" src="js/app.js"></script>
```



If you are deploying an app with several JavaScript files, it is worth investigating whether it is more efficient to combine and compress them into one file or configure your server to use HTTP/2 push.

With the library included, we can initialize and include the store within our app. Create a new variable called `a store` and initialize the `Vuex.Store` class, assigning it to the variable:

```
const store = new Vuex.Store({
});
```

With the Vuex store initialized, we can now utilize its functionality with the `store` variable. Using `store`, we can access the data within and alter that data with mutations. With an independent `store`, many Vue instances could update the same `store`; this may be desired in some instances, but, it could be an undesirable side effect in others.

To circumvent this, we can associate a store with a specific Vue instance. This is done by passing the `store` variable to our Vue class. Doing this also injects the `store` instance into all our child components. Although not strictly required for our app, it's good practice to get into the habit of associating the store with the app:

```
const app = new Vue({
  el: '#app',

  store,
  data: {
    path: ''
  },
  methods: {
    updateHash() {
```

```
        let hash = window.location.hash.substring(1);
        this.path = (hash || '');
    }
},
created() {
    this.updateHash()
}
});
```

With the `store` variable added, we can now access the `store` in our components using the `this.$store` variable.

## Utilizing the store

To help us get to grips with how to use the store, let's move the `path` variable that is currently stored on the parent Vue instance. Before we start writing and moving code, there are a few phrases and words that are different when using the Vuex store and we should familiarize ourselves with them:

- **state**: This is the store's equivalent of the data object; the raw data is stored within this object.
- **getters**: These are the Vuex equivalent of computed values; the function of the store that may process the raw state value before returning it for use in a component.
- **mutations**: Vuex doesn't allow modification of the state object directly outside of the store and this must be done via a mutation handler; these are functions on the store that then allow the state to be updated. They always take state as the first parameter.

These objects belong directly in the `store`. Updating the `store`, however, is not as simple as calling `store.mutationName()`. Instead, we must call the method by using a new `commit()` function. This function accepts two parameters: the name of the mutation and the data being passed to it.

Although initially difficult to understand, the verbose nature of the Vuex store allows for powerful capabilities. An example of the store in action, adapting the original example from Chapter 1, *Getting Started with Vue.js*, is as follows:

```
const store = new Vuex.Store({
  state: {
    message: 'Hello Vue!'
  },
})
```

```
getters: {
  message: state => {
    return state.message.toLowerCase();
  }
},
mutations: {
  updateMessage(state, msg) {
    state.message = msg;
  }
}
});
```

The preceding `store` example includes the `state` object, which is our raw data store; a `getters` object, which includes our processing of the state; and finally, a `mutations` object, which allows us to update the message. Notice how both the `message` getter and the `updateMessage` mutation have the store's state as the first parameter.

To use this `store`, you could do the following:

```
new Vue({
  el: '#app',

  store,
  computed: {
    message() {
      return this.$store.state.message
    },
    formatted() {
      return this.$store.getters.message
    }
  }
});
```

## Retrieving the message

In the `{} message {}` computed function, we have retrieved the raw, unprocessed message from the `state` object and used the following path:

```
this.$store.state.message
```

This is literally accessing the `store`, then the `state` object, followed by the message object key.

In a similar vein, the `{} formated {}` computed value uses the getter from the `store`, which lowercases the string. This is retrieved by accessing the `getters` object instead:

```
this.$store.getters.message
```

## Updating the message

To update the message, you need to call the `commit` function. This accepts the method name as the first parameter with the payload, or data, being the second. The payload can be either a simple variable, an array, or an object if several variables need to be passed.

The `updateMessage` mutation in the `store` accepts a single parameter and sets the message to equal that, so to update our message the code would be:

```
store.commit('updateMessage', 'VUEX Store');
```

This can be run anywhere in the app and will automatically update the previous values used, as they all rely on the same `store`.

Returning our message getter now would return **VUEX Store**, as we've updated the state. With that in mind, let's update our app to use a path variable in the `store`, rather than the Vue instance.

## Using the Vuex store for the folder path

The first step in using the Vue store for our global Dropbox path variable is to move the data object from the Vue instance to the `Store`, and rename it to `state`:

```
const store = new Vuex.Store({
  state: {
    path: ''
  }
});
```

We also need to create a mutation to allow the path to be updated from the hash of the URL. Add a `mutations` object to the store and move the `updateHash` function from the Vue instance—don't forget to update the function to accept the store as the first parameter. Also, change the method so it updates `state.path` rather than `this.path`:

```
const store = new Vuex.Store({
  state: {
    path: ''
  },
  mutations: {
    updateHash(state) {
      let hash = window.location.hash.substring(1);
      state.path = (hash || '');
    }
  }
});
```

By moving the path variable and mutation to the store, it makes the Vue instance significantly smaller, with both the `methods` and `data` objects being removed:

```
const app = new Vue({
  el: '#app',

  store,
  created() {
    this.updateHash()
  }
});
```

We now need to update our app to use the path variable from the `store`, instead of on the Vue instance. We also need to ensure we call the `store` mutation function to update the path variable instead of the method on the Vue instance.

## Updating the path methods to use store commits

Start with the Vue instance, changing `this.updatehash` to `store.commit('updateHash')` instead. Don't forget to also update the method in the `onhashchange` function. The second function should reference the `store` object on our Vue instance, rather than the `store` directly. This is done by accessing the Vue instance variable, `app`, and then referencing the Vuex store in this instance.

When referring to the Vuex store on a Vue instance, it is saved under the variable as `$store`, regardless of the variable name it was initially declared against:

```
const app = new Vue({
  el: '#app',
  store,
  created() {
    store.commit('updateHash');
  }
});
window.onhashchange = () => {
  app.$store.commit('updateHash');
}
```

## Using the path variable

We now need to update the components to use the path from the `store`, rather than one passed down through components. Both `breadcrumb` and `dropbox-viewer` need to be updated to accept this new variable. We can also remove unnecessary props from the components.

### Updating the breadcrumb component

From the HTML, remove the `:p` prop, leaving a simple breadcrumb HTML tag:

```
<breadcrumb></breadcrumb>
```

Next, remove the `props` object from the component in the JavaScript file. The `parts` variable will also need to be updated to use `this.$store.state.path`, instead of `this.p`:

```
Vue.component('breadcrumb', {
  template: '<div>' +
    '<span v-for="(f, i) in folders">' +
      '<a :href="f.path">[F] {{ f.name }}</a>' +
      '<i v-if="i !== (folders.length - 1)"> &raquo; </i>' +
    '</span>' +
  '</div>',

  computed: {
    folders() {
      let output = [],
        slug = '',
        current = this.$store.state.path;
      for (let i = 0; i < output.length; i++) {
        if (output[i].name === current) {
          slug += '/' + output[i].name;
        } else {
          break;
        }
      }
      return output;
    }
  }
});
```

```
        parts = this.$store.state.path.split('/');
        for (let item of parts) {
            slug += item;
            output.push({name: item || 'home', path: '#' + slug});
            slug += '/';
        }
        return output;
    }
};

});
```

## Updating the dropbox-viewer component to work with Vuex

As with the breadcrumb component, the first step is to remove the HTML prop from the view. This should simplify the view of your app even more and you should be left with a handful of HTML tags:

```
<div id="app">
  <dropbox-viewer></dropbox-viewer>
</div>
```

The next step is to clean up the JavaScript, removing any unnecessary function parameters. Remove the `props` object from the `dropbox-viewer` component. Next, update the `filesListFolder` Dropbox method located inside `getFolderStructure` to use the `store` path, instead of using the `path` variable:

```
this.dropbox().filesListFolder({
  path: this.$store.state.path,
  include_media_info: true
})
```

As this method is now using the `store`, instead of a function parameter, we can remove the variable from the method declaration itself, along with removing it from the `updateStructure` method and from whenever these two functions get called. For example:

```
updateStructure (path) {
  this.isLoading = true;
  this.getFolderStructure (path);
}
```

This would become the following:

```
updateStructure() {
  this.isLoading = true;
  this.getFolderStructure();
}
```

We do, however, still need to store the path as a variable on this component. This is due to our `watch` method, which calls the `updateStructure` function. To do this, we need to store our path as a computed value, rather than a fixed variable. This is so it can dynamically update when the `store` updates, rather than a fixed value when the component gets initialized.

Create a computed object on the `dropbox-viewer` component with a method called `path`—this should just return the `store` path:

```
computed: {
  path() {
    return this.$store.state.path
  }
}
```

We now have it as a local variable, so the Dropbox `filesListFolder` method can be updated to once again use `this.path`.

The newly-updated `dropbox-viewer` component should look like the following. Viewing the app in your browser, it should appear as though nothing has changed—however, the inner workings of the app are now reliant on the new Vuex store, rather than a variable stored on the Vue instance:

```
Vue.component('dropbox-viewer', {
  template: '#dropbox-viewer-template',
  data() {
    return {
      accessToken: 'XXXX',
      structure: {},
      isLoading: true
    }
  },
  computed: {
    path() {
      return this.$store.state.path
    }
  },
  methods: {
    dropbox() {

```

```
        return new Dropbox({
            accessToken: this.accessToken
        });
    },
    getFolderStructure() {
        this.dropbox().filesListFolder({
            path: this.path,
            include_media_info: true
        })
        .then(response => {
            const structure = {
                folders: [],
                files: []
            }
            for (let entry of response.entries) {
                // Check ".tag" prop for type
                if(entry['.tag'] == 'folder') {
                    structure.folders.push(entry);
                } else {
                    structure.files.push(entry);
                }
            }
            this.structure = structure;
            this.isLoading = false;
        })
        .catch(error => {
            this.isLoading = 'error';
            console.log(error);
        });
    },
    updateStructure() {
        this.isLoading = true;
        this.getFolderStructure();
    }
},
created() {
    this.getFolderStructure();
},
watch: {
    path() {
        this.updateStructure();
    }
},
});
```

## Caching the folder contents

Now that we have Vuex in our app and are utilizing it for the path, we can begin to look at storing the contents of the currently-displayed folder so that if the user returns to the same place, the API does not need to be queried to retrieve the results. We are going to do this by storing the object returned by the API the Vuex store.

When the folder gets requested, the app will check whether the data exists in the store. If it does, the API call will be omitted and the data loaded from the storage. If it doesn't exist, the API will be queried and the results saved in the Vuex store.

The first step is to separate out the data processing into its own method. This is because the files and folders are going to need to be split regardless of whether the data comes from the store or API.

Create a new method in the `dropbox-viewer` component titled `createFolderStructure()` and move the code from inside the `then()` function, following the Dropbox `filesListFolder` method. Call the new method inside this function instead.

Your two methods should now look like the following, and your app should still be working as it was before:

```
createFolderStructure(response) {
  const structure = {
    folders: [],
    files: []
  }

  for (let entry of response.entries) {
    // Check ".tag" prop for type
    if(entry['.tag'] == 'folder') {
      structure.folders.push(entry);
    } else {
      structure.files.push(entry);
    }
  }
  this.structure = structure;
  this.isLoading = false;
}

getFolderStructure() {
  this.dropbox().filesListFolder({
    path: this.path,
    include_media_info: true
})
```

```
.then(this.createFolderStructure)
  .catch(error => {
    this.isLoading = 'error';
    console.log(error);
  });
}
```

Using promises, we can use `createFolderStructure` as the action for the API call.

The next step is to store the data we are processing. To do this, we are going to take advantage of the ability to pass an object to the `commit` function of the store and use the path as the key in the storage object. Rather than nest the file structures, we are going to store the information in a flat structure. For example, after we've navigated through a few folders, our store would look like this:

```
structure: {
  'images': [...],
  'images-holiday': [...],
  'images-holiday-summer': [...]
}
```

There will be several transformations made to the path to make it object key-friendly. It will be lowercased and any punctuation will be removed. We will also replace all spaces and slashes with hyphens.

To begin, create an empty object in the Vuex store state object titled `structure`; this is where we are going to store the data:

```
state: {
  path: '',
  structure: {}
}
```

We now need to create a new mutation, to allow us to store the data as we load it. Create a new function inside the `mutations` object. Call it `structure`; it needs to accept the `state` as a parameter, plus a `payload` variable which will be an object passed in:

```
structure(state, payload) {
```

The path object will consist of a path variable, plus the data returned from the API. For example:

```
{  
  path: 'images-holiday',  
  data: [...]  
}
```

With this object being passed in, we can use the path as the key and the data as the value. Store the data with a key of the path inside the mutation:

```
structure(state, payload) {  
  state.structure[payload.path] = payload.data;  
}
```

We can now commit this data at the end of our new `createFolderStructure` method in our component:

```
createFolderStructure(response) {  
  const structure = {  
    folders: [],  
    files: []  
  }  
  
  for (let entry of response.entries) {  
    // Check ".tag" prop for type  
    if(entry['.tag'] == 'folder') {  
      structure.folders.push(entry);  
    } else {  
      structure.files.push(entry);  
    }  
  }  
  this.structure = structure;  
  this.isLoading = false;  
  
  this.$store.commit('structure', {  
    path: this.path,  
    data: response  
  });  
}
```

This will now store each folder's data when navigating through the app. This can be verified by adding a `console.log(state.structure)` inside the `structure` mutation.

Although this works as is, it would be good practice to sanitize the path when using it as the key in an object. To do this, we are going to remove any punctuation, replace any spaces and slashes with hyphens, and change the path to lowercase.

Create a new computed function called `slug` on the `dropbox-viewer` component. The term `slug` is often used for sanitized URLs and originates from newspapers and how editors used to reference stories. This function will run several JavaScript `replace` methods to create a safe object key:

```
slug() {
  return this.path.toLowerCase()
    .replace(/^\//g, '')
    .replace(/ /g, '-')
    .replace(/\//g, '-')
    .replace(/[ -]+/g, '-')
    .replace(/\w+/g, '');
}
```

The `slug` function carries out the following operations. An example path of `/images/iPhone/mom's Birthday - 40th` would be affected in the following way:

- Convert the string to lowercase: `/images/iphone/mom's birthday - 40th`
- Remove any slashes at the beginning and end of the path: `images/iphone/mom birthday - 40th`
- Replace any spaces with hyphens: `images/iphone/mom-birthday---40th`
- Replace any slashes with hyphens: `images-iphone-mom-birthday---40th`
- Replace any multiple hyphens with just a singular hyphen: `images-iphone-mom-birthday-40th`
- Finally, remove any punctuation: `images-iphone-moms-birthday-40th`

With the `slug` now created, we can use this as the key when storing the data:

```
this.$store.commit('structure', {
  path: this.slug,
  data: response
});
```

With our folder contents now being cached in the Vuex store, we can add a check to see whether the data exists in the store and if it does, load it from there.

## Loading data from the store if it exists

Loading our data from the store requires a couple of changes to our code. The first step is to check whether the structure exists in the `store` and if it does, load it. The second step is to only commit the data to storage if it is new data—calling the existing `createFolderStructure` method will update the structure but also re-commit the data to storage. Although not detrimental to the user as it currently stands, unnecessarily writing data to the `store` could cause issues when your app grows. This will also help us when we come to precaching the folders and files.

## Loading the data from the store

As a `store` is a JavaScript object and our `slug` variable is a consistent computed value on our component, we can check whether the object key exists with an `if` statement:

```
if(this.$store.state.structure[this.slug]) {  
    // The data exists  
}
```

This gives us the flexibility to load the data from the `store` if it exists, using the `createFolderStructure` method and, if not, trigger the Dropbox API call.

Update the `getFolderStructure` method to include the `if` statement and add the method call if the data exists:

```
getFolderStructure() {  
    if(this.$store.state.structure[this.slug]) {  
        this.createFolderStructure(this.$store.state.structure[this.slug]);  
    } else {  
        this.dropbox().filesListFolder({  
            path: this.path,  
            include_media_info: true  
        })  
        .then(this.createFolderStructure)  
        .catch(error => {  
            this.isLoading = 'error';  
            console.log(error);  
        });  
    }  
}
```

The path to the data is quite long and can make our code unreadable. To make it easier to understand, assign the data to a variable, which allows us to check whether it exists and returns the data with cleaner, smaller, and less repeatable code. It also means we only have to update one line if the path to our data changes:

```
getFolderStructure() {
  let data = this.$store.state.structure[this.slug];
  if(data) {
    this.createFolderStructure(data);
  } else {
    this.dropbox().filesListFolder({
      path: this.path,
      include_media_info: true
    })
    .then(this.createFolderStructure)
    .catch(error => {
      this.isLoading = 'error';
      console.log(error);
    });
  }
}
```

## Only storing new data

As mentioned earlier, the current `createFolderStructure` method both displays the structure and caches the response in the `store`, thus re-saving the structure even when the data is loaded from the cache.

Create a new method that the Dropbox API will fire once the data has loaded. Call it `createStructureAndSave`. This should accept the response variable as its only parameter:

```
createStructureAndSave(response) {  
}
```

We can now move the `store commit` function from the `createFolderStructure` method into this new one, along with a call to fire the existing method with the data:

```
createStructureAndSave(response) {
  this.createFolderStructure(response)
  this.$store.commit('structure', {
    path: this.slug,
    data: response
  });
}
```

Lastly, update the Dropbox API function to call this method:

```
getFolderStructure() {
  let data = this.$store.state.structure[this.slug];
  if(data) {
    this.createFolderStructure(data);
  } else {
    this.dropbox().filesListFolder({
      path: this.path,
      include_media_info: true
    })
    .then(this.createStructureAndSave)
    .catch(error => {
      this.isLoading = 'error';
      console.log(error);
    });
  }
},
```

Open your app in the browser and navigate through the folders. When you navigate back up using the breadcrumb, the response should be a lot quicker—as it is now loading from the cache you've created instead of querying the API every time.

In Chapter 7, *Pre-Caching Other Folders and Files for Faster Navigation*, we will be looking at precaching the folders to try and preempt where the user is heading next. We will also look at caching the download links for the files.

Our full app JavaScript should now look like:

```
Vue.component('breadcrumb', {
  template: '<div>' +
    '<span v-for="(f, i) in folders">' +
      '<a :href="f.path">[F] {{ f.name }}</a>' +
      '<i v-if="i !== (folders.length - 1)"> &raquo; </i>' +
    '</span>' +
  '</div>',
  computed: {
    folders() {
      let output = [],
        slug = '',
        parts = this.$store.state.path.split('/');
      for (let item of parts) {
        slug += item;
        output.push({name: item || 'home', 'path': '#' + slug});
        slug += '/';
      }
    }
  }
});
```

```
        return output;
    }
}
});
Vue.component('folder', {
  template: '<li><strong><a :href="' + f.path_lower">{{ f.name }}</a></strong></li>',
  props: {
    f: Object
  }
});
Vue.component('file', {
  template: '<li><strong>{{ f.name }}</strong><span v-if="f.size"> - {{ bytesToSize(f.size) }}</span> - <a v-if="link" :href="link">Download</a></li>',
  props: {
    f: Object,
    d: Object
  },
  data() {
    return {
      byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB'],
      link: false
    }
  },
  methods: {
    bytesToSize(bytes) {
      // Set a default
      let output = '0 Byte';
      // If the bytes are bigger than 0
      if (bytes > 0) {
        // Divide by 1024 and make an int
        let i = parseInt(Math.floor(Math.log(bytes) / Math.log(1024)));
        // Round to 2 decimal places and select the appropriate unit from
        // the array
        output = Math.round(bytes / Math.pow(1024, i), 2) + ' ' +
        this.byteSizes[i];
      }
      return output
    }
  },
  created() {
    this.d.filesGetTemporaryLink({path: this.f.path_lower}).then(data => {
      this.link = data.link;
    });
  }
});
Vue.component('dropbox-viewer', {
```

```
template: '#dropbox-viewer-template',
data() {
  return {
    accessToken: 'XXXXX',
    structure: {},
    isLoading: true
  }
},
computed: {
  path() {
    return this.$store.state.path
  },
  slug() {
    return this.path.toLowerCase()
      .replace(/^\//g, '')
      .replace(/\//g, '-')
      .replace(/\//g, '-')
      .replace(/[-]+/g, '-')
      .replace(/^[\w-]+/g, '');
  }
},
methods: {
  dropbox() {
    return new Dropbox({
      accessToken: this.accessToken
    });
  },
  createFolderStructure(response) {
    const structure = {
      folders: [],
      files: []
    }

    for (let entry of response.entries) {
      // Check ".tag" prop for type
      if(entry['.tag'] == 'folder') {
        structure.folders.push(entry);
      } else {
        structure.files.push(entry);
      }
    }
    this.structure = structure;
    this.isLoading = false;
  }
},
```

```
createStructureAndSave(response) {
  this.createFolderStructure(response)
  this.$store.commit('structure', {
    path: this.slug,
    data: response
  });
},

getFolderStructure() {
  let data = this.$store.state.structure[this.slug];
  if(data) {
    this.createFolderStructure(data);
  } else {
    this.dropbox().filesListFolder({
      path: this.path,
      include_media_info: true
    })
    .then(this.createStructureAndSave)
    .catch(error => {
      this.isLoading = 'error';
      console.log(error);
    });
  }
}

},
updateStructure() {
  this.isLoading = true;
  this.getFolderStructure();
}
},
created() {
  this.getFolderStructure();
},
watch: {
  path() {
    this.updateStructure();
  }
},
});

const store = new Vuex.Store({
  state: {
    path: '',
    structure: {}
  },
  mutations: {
    updateHash(state) {
      let hash = window.location.hash.substring(1);
```

```
        state.path = (hash || '');
    },
    structure(state, payload) {
        state.structure[payload.path] = payload.data;
    }
}
});
const app = new Vue({
    el: '#app',

    store,
    created() {
        store.commit('updateHash');
    }
});
window.onhashchange = () => {
    app.$store.commit('updateHash');
}
```

## Summary

After this chapter, your app should now be integrated with Vuex and be caching the contents of the Dropbox folders. The Dropbox folder path should also be utilizing the store to make the app more efficient. We are also querying the API only when we need to.

In Chapter 7, *Pre-Caching Other Folders and Files for Faster Navigation*, we will look at precaching the folders—actively querying the API in advance to speed up the app navigation and usability.

# 7

# Pre-Caching Other Folders and Files for Faster Navigation

In this chapter, the last of this section, we are going to look at speeding up our Dropbox file explorer further by introducing, even more, caching to the app. So far, we have built an app that can query the Dropbox API, and return files and folders. From there, we added folder navigation, including updating the URL for link sharing and being able to use the back and forward buttons. With that in place, in *Chapter 6, Caching the Current Folder Structure Using Vuex*, we introduced Vuex for storing the current folder path and the contents of the folders we had visited.

This chapter is going to look at:

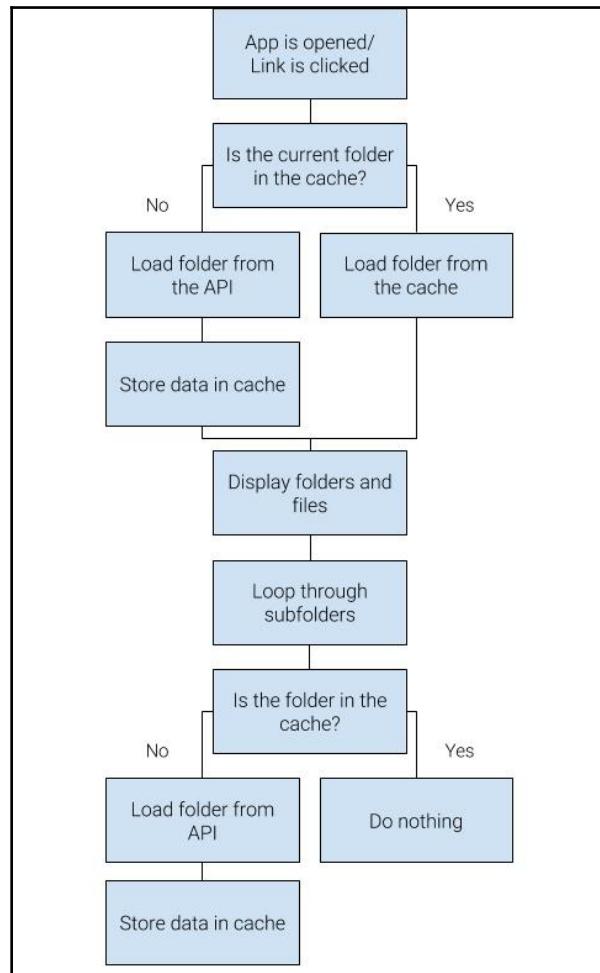
- Pre-caching not only the folder the user is currently in but also the child folders. This will be done by looping through the folders in the current display and checking if they have been cached yet. If not, we can gather the data from the API.
- Storing the parent folder's contents, should the user have entered via a direct URL. This will be done by utilizing the breadcrumb path to traverse up the tree.
- Cache the download links for the files. This currently requires an API for every file encountered, regardless of whether the folder has been cached by our code or not.

With these improvements, we can ensure the app only contacts the API once for every item, rather than the countless times it was originally doing.

# Caching subfolders

With both the subfolder and parent folder caching, we won't necessarily be writing new code, but reorganizing and repurposing the existing code into a more modular system, so that each part can be called separately.

The following flowchart should help you visualize the steps required to cache the current folder and subfolders:



When looking at the flowchart, you can immediately see some duplication in events required for the app. At two points the app needs to decide whether a folder exists in the cache and, if it does not, query the API to get the data and store the result. Although it appears only twice on the flowchart, this functionality is required several times, once for every folder in the current location.

We will also need to separate out our displaying logic from our querying and storing logic, as we may need to load from the API and store, without updating the view.

## Planning app methods

With the previous section in mind, we can take the opportunity to revise and refactor the methods on our `dropbox-viewer` app, ensuring each action has its own method. This would allow us to call each action as and when we want to. Before we head into the code, let's plan out the methods we need to create based on the preceding flowchart.

The first thing to note is that every time the API is queried, we need to store the result in the cache. As we don't need to store anything in the cache *unless* the API is called, we can combine these two actions in the same method. We also often need to check whether there are contents in the cache for a particular path and either load it or retrieve it from the API. We can add this to its own method that returns the data.

Let's map out the methods we need to create:

- `getFolderStructure`: This method will accept a single parameter of the path and return an object of the folder entries. This will be responsible for checking if the data is in the cache and, if not, querying the Dropbox API.
- `displayFolderStructure`: This method will fire the preceding function and use the data to update the `structure` object on the component to display the files and folders in the View.
- `cacheFolderStructure`: This method will include the `getFolderStructure` method to cache each subfolder—we'll explore a couple of ways this can be triggered.

We may need to create more methods than this, but these three will be the backbone of the component. We will keep the path and slug-computed properties, along with the `dropbox()` method. Remove the rest of the objects, methods, and functions so your `dropbox-viewer` is back to basics:

```
Vue.component('dropbox-viewer', {  
  template: '#dropbox-viewer-template',  
  data() {
```

```
        return {
          accessToken: 'XXXX',
          structure: {},
          isLoading: true
        }
      },
      computed: {
        path() {
          return this.$store.state.path
        },
        slug() {
          return this.path.toLowerCase()
            .replace(/^\|\/$/g, '')
            .replace(/\ /g, '-')
            .replace(/\//g, '-')
            .replace(/[-]+/g, '-')
            .replace(/\[^w-]+\+/g, '');
        }
      },
      methods: {
        dropbox() {
          return new Dropbox({
            accessToken: this.accessToken
          });
        }
      }
    );
  }
};
```

## Creating the `getFolderStructure` method

Create a new method on your component called `getFolderStructure`. As mentioned previously, this method needs to accept a single path parameter. This is so we can use with both the current path and children paths:

```
getFolderStructure(path) {  
}
```

This method needs to check the cache and return the data. Make a new variable, titled `output`, inside the method and return it:

```
getFolderStructure(path) {  
  let output;  
  
  return output;  
}
```

When caching the data in Chapter 6, *Caching the Current Folder Structure Using Vuex*, we were using the `slug` as the key in the store. The `slug` was generated by using the current path; however, we cannot use this in the new methods as it is fixed to its current location.

Create a new method called `generateSlug`. This will accept one parameter, the path, and return a converted string using the replacements from the `slug`-computed function:

```
generateSlug(path) {
  return path.toLowerCase()
    .replace(/^\/|\/$/g, '')
    .replace(/ /g, '-')
    .replace(/\//g, '-')
    .replace(/[ -]+/g, '-')
    .replace(/\[^w-]+\g, '');
}
```

We can now delete the computed `slug` function, so we don't have any repeating code.

Going back to our `getFolderStructure` method, create a new variable that stores the `slug` version of the path using the new method. For this, we are going to use `const` to create a variable that cannot be changed:

```
getFolderStructure(path) {
  let output;

  const slug = this.generateSlug(path);

  return output;
}
```

The last variable we will create is the data `path`, as we did in Chapter 8, *Introducing Vue-Router and Loading URL-Based Components*. This will use the new `slug` variable we've just created:

```
getFolderStructure(path) {
  let output;

  const slug = this.generateSlug(path),
        data = this.$store.state.structure[slug];
  return output;
}
```

We can now use the `data if` statement from the previous code inside of here, with space for the Dropbox function call. We can assign the `data` to `output` straight away if it exists in the store:

```
getFolderStructure(path) {
  let output;

  const slug = this.generateSlug(path),
        data = this.$store.state.structure[slug];
  if(data) {
    output = data;
  } else {

  }

  return output;
}
```

With the Dropbox API call, however, we can tweak it to suit this new code. Previously, it was retrieving the data from the API and then firing a method that then saved and displayed the structure. As we need to store the data retrieved in the `output` variable, we are going to alter the flow of data. Instead of firing a method, we are going to use this opportunity to first store the response in the cache and then return the data to the `output` variable.

As we only use the entries from the API call, we are also going to update the store to only cache this part of the response. This will reduce the code and complexity of the app:

```
getFolderStructure(path) {
  let output;

  const slug = this.generateSlug(path),
        data = this.$store.state.structure[slug];
  if(data) {
    output = data;
  } else {

    output = this.dropbox().filesListFolder({
      path: path,
      include_media_info: true
    })
    .then(response => {
      let entries = response.entries;
      this.$store.commit('structure', {
        path: slug,
        data: entries
      });
    });
  }
}
```

```
        return entries;
    })
    .catch(error => {
      this.isLoading = 'error';
      console.log(error);
    });
  });

  return output;
}
```

The Dropbox `filesListFolder` method uses the passed-in `path` variable, rather than the global one it was previously using. The entries from the response are then stored in a variable before being cached in the Vuex store using the same mutation. The `entries` variable is then returned from the promise, which stores the result in `output`. The `catch()` function is the same as before.

With the data being returned from either the cache or the API, we can trigger and process this data when the component is created and when the path is updated. Before we do that, however, we have a mix of data types to deal with.

When returned from the API, the data is still a promise that needs to be resolved; assigning it to a variable merely passes on the promise to be resolved later. Data from the store, however, is a plain array that is handled very differently. To give us a single data type to deal with, we are going to `resolve` the stored array as a promise, meaning the `getFolderStructure` returns a promise, regardless of where the data is loaded from:

```
getFolderStructure(path) {
  let output;

  const slug = this.generateSlug(path),
    data = this.$store.state.structure[slug];
  if(data) {
    output = Promise.resolve(data);
  } else {

    output = this.dropbox().filesListFolder({
      path: path,
      include_media_info: true
    })
    .then(response => {
      let entries = response.entries;

      this.$store.commit('structure', {
        path: slug,
```

```
        data: entries
    });

    return entries;
})
.catch(error => {
    this.isLoading = 'error';
    console.log(error);
});

}
return output;
}
```

With this `getFolderStructure` method, we now have the ability to load some data from the API and store the result in the global cache without updating the view. The function does, however, return the information should we wish to process it further with a JavaScript promise.

We can now proceed with creating our next method, `displayFolderStructure`, which will take the result of the method we have just created and update our View, so the app is navigable once again.

## Showing the data with the `displayFolderStructure` method

With our data now ready to be cached and served up from the store, we can go ahead and actually *display* the data with our new method. Create a new method in your `dropbox-viewer` component labeled `displayFolderStructure`:

```
displayFolderStructure() {  
}
```

This method will borrow a lot of code from the previous incarnation of this component. Remember, this method is used purely for displaying the folder and has nothing to do with caching the contents.

The process of the method will be:

1. Set the loading state as `active` in the app. This lets the user know something is happening.
2. Create an empty `structure` object.
3. Load the contents of the `getFolderStructure` method.
4. Loop through the result and add each item to either the `folders` or `files` array.
5. Set the global structure object to the new one created.
6. Set the loading state to `false` so the contents can be displayed.

## Set the loading state to true and create an empty structure object

The first step of this method is to hide the structure tree and show the loading message. This can be done as before, by setting the `isLoading` variable to `true`. We can also create our empty `structure` object here, ready to be populated by the data:

```
displayFolderStructure() {
  this.isLoading = true;

  const structure = {
    folders: [],
    files: []
  }
}
```

## Load the contents of the `getFolderStructure` method

As the `getFolderStructure` method returns a promise, we need to resolve the result before proceeding on to manipulate it. This is done with the `.then()` function; we have already used this with the `Dropbox` class. Call the method and then assign the result to a variable:

```
displayFolderStructure() {
  this.isLoading = true;

  const structure = {
    folders: [],
    files: []
  }
```

```
this.getFolderStructure(this.path).then(data => {
  });
}
```

This code passes the `path` object of the component into the method. This path is the *current* path that the user is trying to view. Once the data is returned, we can assign it to the `data` variable, which can then be used inside the function.

## Loop through the result and add each item to either the folders or files array

We are already familiar with the code that loops through the entries and examines the `.tag` attribute of each one. If this results in a folder, it is added to the `structure.folders` array, otherwise it is appended to `structure.files`.

We are only storing the entries in the cache, so make sure the `for` loop is updated to use the `data` as is, rather than accessing the property of entries:

```
displayFolderStructure() {
  this.isLoading = true;

  const structure = {
    folders: [],
    files: []
  };
  this.getFolderStructure(this.path).then(data => {
    for (let entry of data) {
      // Check ".tag" prop for type
      if(entry['.tag'] == 'folder') {
        structure.folders.push(entry);
      } else {
        structure.files.push(entry);
      }
    }
  });
}
```

## Update the global structure object and remove the loading state

The last task in this method is to update the global structure and remove the loading state. This code is unchanged from before:

```
displayFolderStructure() {
  this.isLoading = true;

  const structure = {
    folders: [],
    files: []
  }
  this.getFolderStructure(this.path).then(data => {
    for (let entry of data) {
      // Check ".tag" prop for type
      if(entry['.tag'] == 'folder') {
        structure.folders.push(entry);
      } else {
        structure.files.push(entry);
      }
    }
    this.structure = structure;
    this.isLoading = false;
  });
}
```

We now have a method that will display the result of our data retrieval.

## Instigating the method

This method can now be called when the `dropbox-viewer` component gets created. The path will already be populated, thanks to the `created` function on the global Vue instance that commits the URL hash to the store, thus creating the `path` variable. Because of this, we don't need to pass anything to the function. Add the `created` function to your component and call the new method inside:

```
Vue.component('dropbox-viewer', {
  template: '#dropbox-viewer-template',
  data() {
    return {
      accessToken: 'XXXX',
      structure: {},
      isLoading: true
    }
  }
})
```

```
  },
  computed: {
    ...
  },
  methods: {
    ...
  },
  created() {
    this.displayFolderStructure();
  }
});
```

Refreshing the app now will load your folder contents. Updating the URL hash and reloading the page will also show the contents of that folder; however, clicking any folder links will update the breadcrumb, but not the data structure. This can be resolved by watching the computed path variable. This will get updated when the hash updates and so can trigger a function in the `watch` object. Add a function that watches for the `path` variable to update and fires the new method when it has:

```
created() {
  this.displayFolderStructure();
},
watch: {
  path() {
    this.displayFolderStructure();
  }
}
```

With this, we have created an app that, once again, caches any folder you have visited. Clicking through the structure the first time will seem quite slow, but once you navigate back up the tree and re-enter subfolders you will barely see the loading screen.

Despite the app having the same functionality as it did at the beginning of the chapter, we have refactored the code to separate out the retrieval and caching and the displaying of the data. Let's move on to enhancing our app further by pre-caching the subfolders of the selected path.

## Caching the subfolders

Now that we have the ability to cache a folder without updating the Vue, we can use our `structure` object to get the contents of the subfolders. Using the `folders` array in the `structure` object, we can loop through this and cache each folder in turn.

We have to make sure we do not hinder the performance of the app; the caching must be done asynchronously, so the user is not aware of this process. We also need to make sure we aren't running the caching unnecessarily.

To achieve this, we can watch the `structure` object. This only gets updated once the data has been loaded from the cache or the API and the Vue has updated. With the user viewing the contents of the folder, we can proceed with looping through the folders to store their contents.

There is a slight issue, however. If we watch the `structure` variable, our code will never run as the direct *contents* of the object does not update, despite the fact we replace the `structure` object with a new one every time. From folder to folder, the `structure` object always has two keys, of `files` and `folders`, which are both arrays. As far as Vue and JavaScript are concerned, the `structure` object never changes.

Vue can, however, detect nested changes with the `deep` variable. This can be enabled on a per variable basis. Similar to the `props` on a component, to enable more options on a `watch` property, you pass it an object instead of a direct function.

Create a new `watch` key for `structure`, which is an object with two values, `deep` and `handler`. The `deep` key will be set to `true`, while the `handler` will be the function fired when the variable is changed:

```
watch: {
  path() {
    this.displayFolderStructure();
  },
  structure: {
    deep: true,
    handler() {
    }
  }
}
```

Inside this handler, we can now loop through each of the folders and run the `getFolderStructure` method for each one, using the `path_lower` property of each one as the function argument:

```
structure: {
  deep: true,
  handler() {
    for (let folder of this.structure.folders) {
      this.getFolderStructure(folder.path_lower);
    }
  }
}
```

With this simple piece of code, our app appears to speed up tenfold. Every subfolder you navigate to loads instantly (unless you have a particularly long folder list and you navigate to the last one very quickly). To give you an idea of the speed and timing of the caching, add a `console.log()` inside your `getFolderStructure` method and open the browser developer tools:

```
if(data) {
  output = Promise.resolve(data);
} else {

  console.log(`API query for ${path}`);
  output = this.dropbox().filesListFolder({
    path: path,
    include_media_info: true
  })
  .then(response => {
    console.log(`Response for ${path}`);
    ...
  })
}
```

This allows you to see all the API calls are done asynchronously too—the app isn't waiting for the previous folder to be loaded and cached before moving on to the next one. This has the advantage of allowing smaller folders to be cached without waiting for bigger ones to be returned from the API.

## Alternative caching method

As with everything, when making an app, there are many approaches to achieving the same result. The downside with this method is that even if your folder contains only files, this function will trigger—albeit with nothing to do.

An alternative approach would be to use our `created` function once again, this time on the `folder` component itself, triggering the parent method with the path as the argument.

One way of doing this is using the `$parent` property. When in the `folder` component, using `this.$parent` will allow access to the variables, methods, and computed values on the `dropbox-viewer` component.

Add a `created` function to the `folder` component and delete the `structure` `watch` property from the `Dropbox` component. From there, call the parent `getFolderStructure` method:

```
Vue.component('folder', {
  template: '<li><strong><a :href="#" + f.path_lower">{{ f.name }}</a></strong></li>',
  props: {
    f: Object
  },
  created() {
    this.$parent.getFolderStructure(this.f.path_lower);
  }
});
```

Previewing the app proves the validity of this method. Only triggering when there are folders in the structure, this cleaner technique ties the folder-caching with the folder itself, rather than getting mixed in with the `Dropbox` code.

However, `this.$parent` should be avoided unless necessary, and should only be used in edge cases. As we have the opportunity to use `props`, we should do so. It also gives us the chance to give the function a more meaningful name in the folder context.

Navigate to your HTML view and update the `folder` component to accept a new prop. We'll call the prop `cache` and pass the function in as the value. As the property is dynamic, don't forget to add a preceding colon:

```
<folder :f="entry" :cache="getFolderStructure"></folder>
```

Add the `cache` keyword to the `props` key in the JavaScript `folder` component. Inform Vue that the input will be a function:

```
Vue.component('folder', {
  template: '<li><strong><a :href="#" + f.path_lower">{{ f.name }}</a></strong></li>',
  props: {
    f: Object,
    cache: Function
  }
});
```

```
});
```

Lastly, we can call our new `cache()` method in the `created` function:

```
Vue.component('folder', {
  template: '<li><strong><a :href="' + f.path_lower">{{ f.name
}}</a></strong></li>',
  props: {
    f: Object,
    cache: Function
  },
  created() {
    this.cache(this.f.path_lower);
  }
});
```

The caching can be verified, once again, by using the console logs as before. This creates cleaner code that is easier for yourself, and any other developers, to read.

With our Dropbox app now progressing, we can move on to caching parent folders, should you enter a subfolder using a hash in the URL.

## Caching parent folders

Caching the parent structure is the next preemptive thing we can do to help speed up our app. Say we had navigated to our images directory, `/images/holiday/summer`, and wished to share this with a friend or colleague. We would send them the URL with this in the URL hash and, on page load, they would see the contents. If they then navigated up the tree using the breadcrumb to `/images/holiday`, for example, they would need to wait for the app to retrieve the contents.

Using the `breadcrumb` component, we can cache the parent directories and so, on navigating to the `holiday` folder, the user would be presented instantly with its contents. While the user is then browsing this folder, all of its subfolders are being cached with the previous methods.

To cache the parent folders, we already have a component displaying the path with access to the slugs of all the parent folders we can loop through—the breadcrumb.

Before we start the caching process, we need to update the `folders` computed function within the component. This is because currently, we store the path with the hash prepended, which creates an invalid path for the Dropbox API. Remove the hash from the object being pushed to the output array and add it in the template, in a similar fashion to the `folder` component:

```
Vue.component('breadcrumb', {
  template: '<div>' +
    '<span v-for="(f, i) in folders">' +
      '<a :href="#' + f.path">{{ f.name || 'Home' }}</a>' +
      '<i v-if="i !== (folders.length - 1)"> &raquo; </i>' +
    '</span>' +
  '</div>',
  computed: {
    folders() {
      let output = [],
        slug = '',
        parts = this.$store.state.path.split('/');
      for (let item of parts) {
        slug += item;
        output.push({name: item || 'home', path: slug});
        slug += '/';
      }

      return output;
    }
  }
});
```

We can now use the output for both displaying the breadcrumb and caching the parent structure.

The first step is to allow the `breadcrumb` component access to the caching function. In a similar fashion to the `folder` component, add the function as a prop to the `breadcrumb` component in your View:

```
<breadcrumb :cache="getFolderStructure"></breadcrumb>
```

Add the `props` object to the component in the JavaScript code. Declare the `cache` prop as a function so Vue knows what to expect:

```
Vue.component('breadcrumb', {
  template: '...',
  props: {
    cache: Function
  },
  computed: {
```

```
folders() {  
  ...  
}  
});
```

The parent structure is going to be on the creation of the `breadcrumb` component. However, as we don't want this to hold up the loading process, we are going to trigger it when the component is mounted, not created.

Add a mounted function to your component and assign the folder's computed value to a variable:

```
Vue.component('breadcrumb', {  
  template: '...',  
  props: {  
    cache: Function  
  },  
  computed: {  
    folders() {  
      ...  
    }  
  },  
  mounted() {  
    let parents = this.folders;  
  }  
});
```

We now need to start caching the folders; however, we can be smart in the order that we do it. We can assume that the user will generally go back up the folder tree, so we should ideally cache the direct parent before moving onto its parent, and so on and so forth. As our folder's variable goes from the top down, we need to reverse it.

The other thing we can do to improve performance is to remove the current folder; as we are already in it, the app would have cached it already. In your component, reverse the array and remove the first item:

```
mounted() {  
  let parents = this.folders;  
  parents.reverse().shift();  
}
```

If we add a console log to the function of the parent's variable, we can see it contains the folders we now wish to cache. We can now loop through this array, calling the cache function for each item in the array:

```
mounted() {
  let parents = this.folders;
  parents.reverse().shift();

  for(let parent of parents) {
    this.cache(parent.path);
  }
}
```

With this, our parent and child folders are being cached by the app, making navigation both up and down the tree lightning fast. However, running a `console.log()` inside the `mounted` function reveals the breadcrumb gets re-mounted every time a folder gets navigated to. This is because of the `v-if` statements in the View, which removes and adds the HTML each time.

As we only need to cache the parent folders once, on initial app load, let's look at changing where it gets triggered. We only need to run this function the first time; once the user has started navigating up and back down the tree, all the folders visited will be cached along the way.

## Caching parent folders once

To ensure we are using the least amount of resources, we can keep the array of folders used for the breadcrumb in the store. This means that both the `breadcrumb` component and our parent caching function can access the same array.

Add a `breadcrumb` key to your store state—this is where we will store the array:

```
const store = new Vuex.Store({
  state: {
    path: '',
    structure: {},
    breadcrumb: []
  },
  mutations: {
    updateHash(state) {
      let hash = window.location.hash.substring(1);
      state.path = (hash || '');
    },
    structure(state, payload) {
```

```
        state.structure[payload.path] = payload.data;
    }
}
});
```

Next, move the code from the breadcrumb component into the updateHash mutation so we can update both the path and breadcrumb variables:

```
updateHash(state) {
  let hash = window.location.hash.substring(1);
  state.path = (hash || '');

  let output = [],
    slug = '',
    parts = state.path.split('/');
  for (let item of parts) {
    slug += item;
    output.push({name: item || 'home', path: slug});
    slug += '/';
  }
  state.breadcrumb = output;
},
```

Note that rather than returning the output array, it is getting stored in the state object. We can now update the folder's computed function on the breadcrumb component to return the store data:

```
computed: {
  folders() {
    return this.$store.state.breadcrumb;
  }
}
```

With the data now available globally, we can create a new method on the dropbox-viewer component, cacheParentFolders, which triggers the code we wrote for the breadcrumb component.

Create a new method on the Dropbox component and move your code to it. Update the location of the parents and ensure you are firing the correct path:

```
cacheParentFolders() {
  let parents = this.$store.state.breadcrumb;
  parents.reverse().shift();
```

```
    for(let parent of parents) {
      this.getFolderStructure(parent.path);
    }
}
```

We can now fire this method once when the Dropbox component gets created. Add it after the existing method call in the `created` function:

```
created() {
  this.displayFolderStructure();
  this.cacheParentFolders();
}
```

We can now do some housekeeping and delete the `mounted` method from the breadcrumb component, along with the `props` object and the `:cache` prop from the view. This means our breadcrumb component is now simpler than it was before:

```
Vue.component('breadcrumb', {
  template: '<div>' +
    '<span v-for="(f, i) in folders">' +
      '<a :href="#' + f.path">{{ f.name || 'Home' }}</a>' +
      '<i v-if="i !== (folders.length - 1)"> &raquo; </i>' +
    '</span>' +
  '</div>',
  computed: {
    folders() {
      return this.$store.state.breadcrumb;
    }
  }
});
```

The HTML returns to what it was:

```
<breadcrumb></breadcrumb>
```

We can also tidy up the `updateHash` mutation in the store to be a bit neater and more understandable:

```
updateHash(state, val) {
  let path = (window.location.hash.substring(1) || ''),
    breadcrumb = [],
    slug = '',
    parts = path.split('/');

  for (let item of parts) {
    slug += item;
    breadcrumb.push({name: item || 'home', path: slug});
    slug += '/';
  }
}
```

```
        }

        state.path = path
        state.breadcrumb = breadcrumb;
    }
}
```

All the variables are now being declared at the top, with the `state` being updated at the bottom. The number of variables has also been reduced.

Viewing the app now, it appears to work correctly; however, upon closer inspection, the `breadcrumb` seems to lag a bit with the folder structure on initial page load. Once a folder has been navigated to, it catches up but on the first load it seems to have one fewer item, and when viewing the root of the Dropbox none at all.

This is because the store has not been fully initialized before we are committing the `updateHash` mutation. If we remember back to the Vue instance lifecycle, covered in Chapter 4, *Getting a List of Files Using the Dropbox API*, we can see the created function gets fired very early on. Updating the main Vue instance to trigger the mutation on `mounted` instead resolves the issue:

```
const app = new Vue({
  el: '#app',

  store,
  mounted() {
    store.commit('updateHash');
  }
});
```

With all the folders being cached as well as they can be, we can move on to caching more API calls by storing the download link for each file.

We could also look into caching subfolders of subfolders, looping through the contents of each cached folder to eventually cache the whole tree. We won't go into that, but feel free to give it a go yourself.

## Caching download links on files

When the user is navigating around the document tree, the Dropbox API is still being queried more than necessary. This is because every time a file is displayed, we query the API to retrieve the download link. Extra API queries can be negated by storing the download link response in the cache and re-displaying the folder it is navigated back into.

Every time a file is displayed, a new component gets initialized using data from the store. We can use this to our advantage as it means we only need to update the component instance and then the result gets cached.

In your file component, update the API response to not only save the result on the `link` property of the data attribute but the on the file instance, `f`, as well. This will be stored as a new key, `download_link`.

When storing the data, rather than having two separate commands, we can combine them into one with two equal signs:

```
Vue.component('file', {
  template: '<li><strong>{{ f.name }}</strong><span v-if="f.size" - {{ bytesToSize(f.size) }}</span> - <a v-if="link" :href="link">Download</a></li>',
  props: {
    f: Object,
    d: Object
  },
  data() {
    return {
      byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB'],
      link: false
    }
  },
  methods: {
    bytesToSize(bytes) {
      // Set a default
      let output = '0 Byte';
      // If the bytes are bigger than 0
      if (bytes > 0) {
        // Divide by 1024 and make an int
        let i = parseInt(Math.floor(Math.log(bytes) / Math.log(1024)));
        // Round to 2 decimal places and select the appropriate unit from
        the array
        output = Math.round(bytes / Math.pow(1024, i), 2) + ' ' +
        this.byteSizes[i];
      }
      return output
    }
  },
  created() {
    this.d.filesGetTemporaryLink({path: this.f.path_lower})
      .then(data => {
```

```
        this.f.download_link = this.link = data.link;
    });
}
});
```

This essentially means `this.f.download_link` is equal to `this.link`, which is also equal to `data.link`, the download link from the API. With this being stored and displayed when the folder is navigated to, we can add an `if` statement to see whether the data exists and, if not, query the API to get it.

```
created() {
    if(this.f.download_link) {
        this.link = this.f.download_link;
    } else {
        this.d.filesGetTemporaryLink({path: this.f.path_lower})
            .then(data => {
                this.f.download_link = this.link = data.link;
            });
    }
}
```

Doing this on file creation saves the API being queried unnecessarily. If we obtained this information when caching the folders, we could slow down the app and be storing non-essential information. Imagine a folder with hundreds of photos in it—we wouldn't want to query the API for every one of these just on the off chance the user might enter that folder.

This means everything in our app only needs to query the API once to get the information. The user can navigate up and down folder structures as many times as they want, with the app only getting faster as they do so.

## The complete code—with added documentation

With our app complete, we can now add some much-needed documentation. It's always good to document your code as this gives it reasoning and explanation. Good documentation should not just say what the code does, but why it does it, what is allowed, and what is not allowed.

A popular method for documentation is the JavaScript DocBlock standard. This set of conventions lays out style guide-like rules for you to follow when documenting your code. DocBlock is formatted in a comment block and features keywords starting with an @, such as @author, @example, or listing what parameters a function can accept with the @param keyword. An example would be:

```
/**
 * Displays a folder with a link and cache its contents
 * @example <folder :f="entry" :cache="getFolderStructure"></folder>
 *
 * @param {object} f The folder entry from the tree
 * @param {function} cache The getFolderStructure method from the dropbox-
viewer component
 */
```

Starting off with a description, DocBlock has several keywords to help lay out the documentation. We'll walk through our completed Dropbox app with added documentation.

Let us first take a look at the breadcrumb component:

```
/**
 * Displays the folder tree breadcrumb
 * @example <breadcrumb></breadcrumb>
 */
Vue.component('breadcrumb', {
  template: '<div>' +
    '<span v-for="(f, i) in folders">' +
      '<a :href="#" + f.path">{{ f.name || 'Home' }}</a>' +
      '<i v-if="i !== (folders.length - 1)"> &raquo; </i>' +
    '</span>' +
  '</div>',
  computed: {
    folders() {
      return this.$store.state.breadcrumb;
    }
  }
});
```

Moving on to the folder component:

```
/**
 * Displays a folder with a link and cache its contents
 * @example <folder :f="entry" :cache="getFolderStructure"></folder>
 *
 * @param {object} f The folder entry from the tree
 * @param {function} cache The getFolderStructure method from the dropbox-
```

```
viewer component
*/
Vue.component('folder', {
  template: '<li><strong><a :href="' + f.path_lower">{{ f.name
}}</a></strong></li>',
  props: {
    f: Object,
    cache: Function
  },
  created() {
    // Cache the contents of the folder
    this.cache(this.f.path_lower);
  }
});
```

Next, in line, we see the file component:

```
/**
 * File component display size of file and download link
 * @example <file :d="dropbox()" :f="entry"></file>
 *
 * @param {object} f The file entry from the tree
 * @param {object} d The dropbox instance from the parent component
 */
Vue.component('file', {
  template: '<li><strong>{{ f.name }}</strong><span v-if="f.size"> - {{ bytesToSize(f.size) }}</span> - <a v-if="link"
:href="link">Download</a></li>',
  props: {
    f: Object,
    d: Object
  },
  data() {
    return {
      // List of file size
      byteSizes: ['Bytes', 'KB', 'MB', 'GB', 'TB'],
      // The download link
      link: false
    }
  },
  methods: {
    /**
     * Convert an integer to a human readable file size
     * @param {integer} bytes
     * @return {string}
     */
    bytesToSize(bytes) {
```

```
// Set a default
let output = '0 Byte';
// If the bytes are bigger than 0
if (bytes > 0) {
    // Divide by 1024 and make an int
    let i = parseInt(Math.floor(Math.log(bytes) / Math.log(1024)));
    // Round to 2 decimal places and select the appropriate unit from
the array
    output = Math.round(bytes / Math.pow(1024, i), 2) + ' ' +
this.byteSizes[i];
}
return output
},
created() {
    // If the download link has been retrieved from the API, use it
    // if not, aquerry the API
    if(this.f.download_link) {
        this.link = this.f.download_link;
    } else {
        this.d.filesGetTemporaryLink({path: this.f.path_lower})
            .then(data => {
                this.f.download_link = this.link = data.link;
            });
    }
}
});
```

Now we take a look at the `dropbox-viewer` component:

```
/**
 * The dropbox component
 * @example <dropbox-viewer></dropbox-viewer>
 */
Vue.component('dropbox-viewer', {
    template: '#dropbox-viewer-template',
    data() {
        return {
            // Dropbox API token
            accessToken: 'XXXX',

            // Current folder structure
            structure: {},
            isLoading: true
        }
    },
    computed: {
        // The current folder path
```

```
path() {
    return this.$store.state.path
}
},
methods: {

    /**
     * Dropbox API instance
     * @return {object}
     */
    dropbox() {
        return new Dropbox({
            accessToken: this.accessToken
        });
    },
    /**
     * @param {string} path The path to a folder
     * @return {string} A cache-friendly URL without punctuation/symbols
     */
    generateSlug(path) {
        return path.toLowerCase()
            .replace(/^\//g, '')
            .replace(/\ /g, '-')
            .replace(/\//g, '-')
            .replace(/\-/g, '-')
            .replace(/\w-/g, '');
    },
    /**
     * Retrieve the folder structure form the cache or Dropbox API
     * @param {string} path The folder path
     * @return {Promise} A promise containing the folder data
     */
    getFolderStructure(path) {
        let output;

        const slug = this.generateSlug(path),
              data = this.$store.state.structure[slug];
        if(data) {
            output = Promise.resolve(data);
        } else {
            output = this.dropbox().filesListFolder({
                path: path,
                include_media_info: true
            })
            .then(response => {
                let entries = response.entries;

```

```
        this.$store.commit('structure', {
          path: slug,
          data: entries
        });

        return entries;
      })
      .catch(error => {
        this.isLoading = 'error';
        console.log(error);
      });
    }

    return output;
  },
}

/**
 * Display the contents of getFolderStructure
 * Updates the output to display the folders and folders
 */
displayFolderStructure() {
  // Set the app to loading
  this.isLoading = true;

  // Create an empty object
  const structure = {
    folders: [],
    files: []
  }
  // Get the structure
  this.getFolderStructure(this.path).then(data => {

    for (let entry of data) {
      // Check ".tag" prop for type
      if(entry['.tag'] == 'folder') {
        structure.folders.push(entry);
      } else {
        structure.files.push(entry);
      }
    }

    // Update the data object
    this.structure = structure;
    this.isLoading = false;
  });
}
}

/**
```

```
    * Loop through the breadcrumb and cache parent folders
    */
cacheParentFolders() {
  let parents = this.$store.state.breadcrumb;
  parents.reverse().shift();

  for(let parent of parents) {
    this.getFolderStructure(parent.path);
  }
}

created() {
  // Display the current path & cache parent folders
  this.displayFolderStructure();
  this.cacheParentFolders();
},

watch: {
  // Update the view when the path gets updated
  path() {
    this.displayFolderStructure();
  }
}
});
```

Let us also check the Vuex store:

```
/**
 * The Vuex Store
 */
const store = new Vuex.Store({
  state: {
    // Current folder path
    path: '',

    // The current breadcrumb
    breadcrumb: [],

    // The cached folder contents
    structure: {},
  },
  mutations: {
    /**
     * Update the path & breadcrumb components
     * @param {object} state The state object of the store
     */
    updateHash(state) {
```

```
let path = (window.location.hash.substring(1) || ''),
  breadcrumb = [],
  slug = '',
  parts = path.split('/');

for (let item of parts) {
  slug += item;
  breadcrumb.push({name: item || 'home', 'path': slug});
  slug += '/';
}

state.path = path
state.breadcrumb = breadcrumb;
},

/**
 * Cache a folder structure
 * @param {object} state The state object of the store
 * @param {object} payload An object containing the slug and data to
store
 */
structure(state, payload) {
  state.structure[payload.path] = payload.data;
}
}
});
```

We furthermore move to the Vue app:

```
/**
 * The Vue app
 */
const app = new Vue({
  el: '#app',

  // Initialize the store
  store,

  // Update the current path on page load
  mounted() {
    store.commit('updateHash');
  }
});
```

And in the end, we go through the `window.onhashchange` function:

```
/**  
 * Update the path & store when the URL hash changes  
 */  
window.onhashchange = () => {  
    app.$store.commit('updateHash');  
}
```

Finally, the HTML from the view looks like this:

```
<div id="app">  
  <dropbox-viewer></dropbox-viewer>  
</div>
```

And the template for the Dropbox viewer looks like this:

```
<script type="text/x-template" id="dropbox-viewer-template">  
  <div>  
    <h1>Dropbox</h1>  
    <transition name="fade">  
      <div v-if="isLoading">  
        <div v-if="isLoading == 'error'">  
          <p>There seems to be an issue with the URL entered.</p>  
          <p><a href="">Go home</a></p>  
        </div>  
        <div v-else>  
          Loading...  
        </div>  
      </div>  
    </transition>  
  
    <transition name="fade">  
      <div v-if="!isLoading">  
        <breadcrumb></breadcrumb>  
        <ul>  
          <template v-for="entry in structure.folders">  
            <folder :f="entry" :cache="getFolderStructure"></folder>  
          </template>  
          <template v-for="entry in structure.files">  
            <file :d="dropbox()" :f="entry"></file>  
          </template>  
        </ul>  
      </div>  
    </transition>  
  
</div>  
</script>
```

You will notice not *everything* has been documented. A simple function or variable assignment doesn't need to re-explain what it does, but a note of the main variables will help anyone looking at it in the future.

## Summary

In this section of the book, we've covered quite a lot! We started with querying the Dropbox API to get a list of files and folders. We then moved on to adding navigation, allowing the user to click on folders and download files. We then introduced Vuex and the store into our app, which meant we could centralize the path, breadcrumb, and most importantly, cache the folder contents. Lastly, we looked at caching sub-folders and the file download link.

In the next section of the book, we are going to look at making a shop. This will include browsing products in a category and product pages using a new Vue plugin called Vue router. We will also look at adding products to a basket and storing both the product list and preferences in the Vuex store.

# 8

# Introducing Vue-Router and Loading URL-Based Components

In the next few chapters, we are going to be creating a shop interface. This shop is going to combine everything we have learned so far while introducing some more techniques, plugins, and functionality. We are going to look at retrieving a list of products from a CSV file, displaying them and their variations, and filtering the products by manufacturer or tags. We will also look at creating a product detail view and allowing the user to add and remove products and product variations, such as size or color, to their online shopping basket.

All of this will be achieved using Vue, Vuex, and a new Vue plugin, Vue-router. Vue-router is used for building **Single Page Applications (SPAs)** and allows you to map components to URLs, or in `VueRouter` terms, routes, and paths. This is an extremely powerful plugin and handles a lot of the intricate details required for the processing of URLs.

This chapter is going to cover:

- Initializing Vue-router and its options
- Creating links with Vue-router
- Making dynamic routes to update the View based on URL
- Using props with URLs
- Nesting and naming routes
- How to navigate programmatically with Vue-router

# Installing and initializing Vue-router

Similar to how we added Vue and Vuex to our applications, you can either directly include the library from unpkg, or head to the following URL and download a local copy for yourself: <https://unpkg.com/Vue-router>. Add the JavaScript to a new HTML document, along with Vue, and your application's JavaScript. Create an application container element, your view, as well. In the following example, I have saved the Vue-router JavaScript file as `router.js`:

```
<!DOCTYPE html>
<html>
<head>
  <title></title>
</head>
<body>
  <div id="app"></div>

  <script type="text/javascript" src="js/vue.js"></script>
  <script type="text/javascript" src="js/router.js"></script>
  <script type="text/javascript" src="js/app.js"></script>
</body>
</html>
```

Initialize a new Vue instance in your application JavaScript:

```
new Vue({
  el: '#app'
});
```

We are now ready to add `VueRouter` and utilize its power. Before we do that, however, we need to create some very simple components which we can load and display based on the URL. As we are going to be loading the components with the router, we don't need to register them with `Vue.component`, but instead create JavaScript objects with the same properties as we would a Vue component.

For this first exercise, we are going to create two pages—Home and About pages. Found on most websites, these should help give you context as to what is loading where and when. Create two templates in your HTML page for us to use:

```
<script type="text/x-template" id="homepage">
<div>
  <h1>Hello & Welcome</h1>
  <p>Welcome to my website. Feel free to browse around.</p>
</div>
</script>
```

```
<script type="text/x-template" id="about">
<div>
  <h1>About Me</h1>
  <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Vivamus sed
metus magna. Vivamus eget est nisi. Phasellus vitae nisi sagittis, ornare
dui quis, pharetra leo. Nullam eget tellus velit. Sed tempor lorem augue,
vitae luctus urna ultricies nec. Curabitur luctus sapien elit, non pretium
ante sagittis blandit. Nulla egestas nunc sit amet tellus rhoncus, a
ultrices nisl varius. Nam scelerisque lacus id justo congue maximus. Etiam
rhoncus, libero at facilisis gravida, nibh nisi venenatis ante, sit amet
viverra justo urna vel neque.</p>
  <p>Curabitur et arcu fermentum, viverra lorem ut, pulvinar arcu. Fusce
ex massa, vehicula id eros vel, feugiat commodo leo. Etiam in sem rutrum,
porttitor velit in, sollicitudin tortor. Interdum et malesuada fames ac
ante ipsum primis in faucibus. Donec ac sapien efficitur, pretium massa at,
vehicula ligula. Vestibulum turpis quam, feugiat sed orci id, eleifend
pretium urna. Nullam faucibus arcu eget odio venenatis ornare.</p>
</div>
</script>
```



Don't forget to encapsulate all your content in one "root" element (represented here by the wrapping `<div>` tags). You also need to ensure you declare the templates *before* your application JavaScript is loaded.

We've created a Home page template, with the `id` of `homepage`, and an About page, containing some placeholder text from *lorem ipsum*, with the `id` of `about`. Create two components in your JavaScript which reference these two templates:

```
const Home = {
  template: '#homepage'
};

const About = {
  template: '#about'
};
```

The next step is to give the router a placeholder to render the components in the view. This is done by using a custom `<router-view>` HTML element. Using this element gives you control over where your content will render. It allows us to have a header and footer right in the app view, without needing to deal with messy templates or includes the components themselves.

Add a header, main, and footer element to your app. Give yourself a logo in the header and credits in the footer; in the main HTML element, place the `router-view` placeholder:

```
<div id="app">
  <header>
    <div>LOGO</div>
  </header>

  <main>
    <router-view></router-view>
  </main>

  <footer>
    <small>© Myself</small>
  </footer>
</div>
```

Everything in the app view is optional, except the `router-view`, but it gives you an idea of how the router HTML element can be implemented into a site structure.

The next stage is to initialize the Vue-router and instruct Vue to use it. Create a new instance of `VueRouter` and add it to the `Vue` instance—similar to how we added `Vuex` in the previous section:

```
const router = new VueRouter();

new Vue({
  el: '#app',

  router
});
```

We now need to tell the router about our routes (or paths), and what component it should load when it encounters each one. Create an object inside the Vue-router instance with a key of `routes` and an array as the value. This array needs to include an object for each route:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
```

```
        path: '/about',
        component: About
    },
]
});
```

Each route object contains a `path` and `component` key. The `path` is a string of the URL that you want to load the `component` on. Vue-router serves up components based on a first-come-first-served basis. For example, if there are several routes with the same path, the first one encountered is used. Ensure each route has the beginning slash—this tells the router it is a root page and not a sub-page, we will cover sub-pages later on in the chapter.

Press `save` and view your app in the browser. You should be presented with the content of the `Home` template component. If you observe the URL, you will notice that on page load a hash and forward slash (`#/`) is appended to the path. This is the router creating a method for browsing the components and utilizing the address bar. If you change this to the path of your second route, `#/about`, you will see the contents of the `About` component.

Vue-router is also able to use the JavaScript history API to create prettier URLs. For example, `yourdomain.com/index.html#about` would become `yourdomain.com/about`. This is activated by adding `mode: 'history'` to your `VueRouter` instance:

```
const router = new VueRouter({
  mode: 'history',

  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About
    }
  ]
});
```

However, it also requires some server configuration to catch all requests and redirect them to your `index.html` page, which is beyond the scope of this book but is fully outlined in the Vue-router documentation.

## Changing the folder for Vue-router

There may be scenarios where you want to host your Vue app in a sub-folder of your website. In this instance, you will need to declare the base folder of your project so Vue-router can construct, and listen out for, the correct URLs.

For example, if your app was based on a `/shop/` folder, you would declare it using the `base` parameter on the Vue-router instance:

```
const router = new VueRouter({
  base: '/shop/',

  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About
    }
  ]
});
```

The value of this needs the slash at both the beginning and end.

Along with `base`, there are several other configuration options available for Vue-router—it is well worth being familiar with them, as they may solve a problem you have later on.

## Linking to the different routes

With the router working as expected, we can now proceed with adding links into our application, allowing the user to navigate around the website. Links can be achieved in two ways: we can use a conventional `<a href="#/about">` tag, or alternatively we can utilize a new HTML element provided with the router of `<router-link to="/about">`. When using the `router-link` element, it works the same as an `<a>` tag, and in fact gets converted to one when running in the browser, but allows a lot more customization and integration with the router.

It is highly advised to use the `router-link` element wherever possible, as it carries several advantages over the standard link:

- **Mode changes:** The first advantage is linked to the `mode` of the router. Using the router link allows you to change the mode of your router, say from hash to history, and not have to change every single link in your app.
- **CSS classes:** Another advantage that comes with using the router link is a CSS class that gets applied to links active in the "tree" and pages which are currently being viewed. Links in the tree are parent pages which also include the root page (for example, any links to "/" will always have the active class). This is one of the big benefits of using the router, as adding and removing these classes manually would require complex coding. These classes can be customized and we will do that later.
- **URL parameters and named routes:** The other advantage to using the router element is the power it gives you over using named routes and passing URL parameters. This further allows you to have one source of truth for the URL of a page and use names and shortcuts to reference a route. More on this will be covered later in the chapter.

Add the links to your pages within your view so you can navigate between pages. Within the `<header>` of your website, create a new `<nav>` element that contains an unordered list. For each page, add a new list item with a `router-link` element inside. Add a `to` attribute to the link path:

```
<nav>
  <ul>
    <li>
      <router-link to="/">Home</router-link>
    </li>
    <li>
      <router-link to="/about">About</router-link>
    </li>
  </ul>
</nav>
```

Viewing the app in the browser should show your two links, allowing you to switch between the two content pages. You will also notice that, by clicking the link, the URL updates too.

If you inspect the links with the browser's HTML inspector, you will notice the change in CSS classes. The **Home** link will always have a class of `router-link-active`—this is because it is either active itself, or it has an active child, such as the `About` page. There is another CSS class which gets added and removed as you navigate between the two pages—`router-link-exact-active`. This *only* gets applied to the links on the currently active page.

Let's customize the classes that get applied to the view. Head to the initialization of the router in your JavaScript and add two new keys to the object - `linkActiveClass` and `linkExactActiveClass`:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

The keys should be fairly self-explanatory, but `linkExactActiveClass` gets applied to the current page, the one being viewed, while `linkActiveClass` is the class that gets applied when the page, or one of its children, is active.

## Linking to sub-routes

There may be times you want to have links to children pages. For example `/about/meet-the-team`. Fortunately, there is not much work required to get this working. Create a new object in the `routes` array, pointing to a new component with a template:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
```

```
        component: About
    },
    {
      path: '/about/meet-the-team',
      component: MeetTheTeam
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

When navigating to this page, you will notice both the Home and About links have the active class and neither have the current class we created. If you were to create a link in your navigation to this page, a current class would be applied to that.

## Dynamic routes with parameters

Vue router easily allows you to have dynamic URLs. A dynamic URL allows you to use the same component to display different data while using the same template. An example of this would be for a shop, where all the category pages look the same but display different data based on the URL. Another example would be a product detail page—you don't want to have to create a component for every product, so instead, you use one component with a URL parameter.

URL parameters can appear anywhere in the path, and there can be one or many. Each parameter gets assigned a key, so it can be created and accessed consistently. We'll go into dynamic routes and parameters in more detail during [Chapter 9, Using Vue-Router Dynamic Routes to Load Data](#). For now, we'll build a basic example.

Before we head into creating the component, let's examine a new variable available to us—`this.$route`. In a similar way to how we accessed the global store with Vuex, this variable allows us to access a lot of information about the routes, URLs, and parameters.

In your Vue instance, as a test, add a `mounted()` function. Inside `console.log`, insert the `this.$route` parameter:

```
new Vue({
  el: '#app',
  router,
  mounted() {
    console.log(this.$route);
```

```
  }  
});
```

If you open up your browser and look at the developer tools, you should see an object being output. Viewing this object will reveal several bits of information, such as the path and the components which match the current path. Heading to the /about URL will reveal different information about the object:

```
▼ {name: undefined, meta: {...}, path: "/about", hash: "", query: {...}, ...} ⓘ  
  fullPath: "/about"  
  hash: ""  
  ▼ matched: Array(1)  
    ▼ 0:  
      beforeEnter: undefined  
      ▼ components:  
        ▼ default:  
          ► methods: {someAction: f}  
          name: "About"  
          template: "#about"  
          ► _Ctor: {0: f}  
          ► __proto__: Object  
          ► __proto__: Object  
          ► instances: {default: VueComponent}  
          matchAs: undefined  
          ► meta: {}  
          name: undefined  
          parent: undefined  
          path: "/about"  
          ► props: {}  
          redirect: undefined  
          ► regex: /^\/about(?:\/(?:=*))?$/i  
          ► __proto__: Object  
          length: 1  
          ► __proto__: Array(0)  
          ► meta: {}  
          name: undefined  
          ► params: {}  
          path: "/about"  
          ► query: {}
```

Let's create a component that uses the parameters from this object. Create a new object in your routes array:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About
    },
    {
      path: '/user/:name',
      component: User
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

The thing you'll notice that is different with this path is the colon preceding the `name` in the path. This tells Vue-router that this part of the URL is dynamic, but the variable name for that section is `name`.

Now create a new component called `User`, and create a template for it. For this example, our template will be inline and we will be using the ES2015 template syntax. This uses backticks and allows the passing of variables and new lines directly into the template without the need to escape them:

```
const User = {
  template: `<h1>Hello {{ $route.params.name }}</h1>`
};
```

The variable being output within the template is from the global router instance and is the `name` variable within the `parameters` object. The variable `name` references the variable preceded by the colon in the route path, within the `routes` array. Within the component template, we can also omit this variable from the `$route`.

Head back to your browser and enter `#/user/sarah` at the end of your URL. You should see **Hello sarah** in the main body of your web page. Viewing the JavaScript browser console, you should see the `params` object has a key/value pair of `name: sarah` within it:

```
▼ {name: undefined, meta: {...}, path: "/user/sarah", hash: "", query: {...}, ...} ⓘ  
  fullPath: "/user/sarah"  
  hash: ""  
  ▶ matched: [{...}]  
  ▶ meta: {}  
  name: undefined  
  ▶ params:  
    name: "sarah" ⓘ  
    ▶ __proto__: Object  
    path: "/user/sarah"  
  ▶ query: {}
```

This variable is also available to us within the component itself. For example, if we wanted to capitalize the first letter of our user's name, we could make a computed variable which takes the route parameter and transforms it:

```
const User = {  
  template: `<h1>Hello {{ name }}</h1>`,  
  computed: {  
    name() {  
      let name = this.$route.params.name;  
      return name.charAt(0).toUpperCase() + name.slice(1);  
    }  
  }  
};
```

If you're not familiar with what the preceding code is doing, it takes the first character of the string and makes it uppercase. It then splits the string after the first character (that is, the rest of the word) and appends it on the uppercase letter.

Adding this `computed` function and refreshing the app will yield **Hello sarah**.

As mentioned, the route can accept as many parameters as you want and can be separated by static or dynamic variables.

Changing the path to the following (while keeping the component name the same):

```
/:name/user/:emotion
```

Would mean you would need to go to `/sarah/user/happy` to see the user component. You would, however, have access to a new parameter titled `emotion`, which means you could use the following template to render **sarah is happy!**:

```
const User = {
  template: `<h1>{{ name }} is {{ $route.params.emotion }}</h1>`,
  computed: {
    name() {
      let name = this.$route.params.name;
      return name.charAt(0).toUpperCase() + name.slice(1);
    }
  }
};

const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About
    },
    {
      path: '/:name/user/:emotion',
      component: User
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

Dynamic routes will come in handy when we come to build our shop over the next few chapters, as we'll be using it for both products and categories.

## GET parameters

Along with the dynamic routes, Vue-router handles GET parameters in a really simple way. GET parameters are extra URL parameters you can pass to a web page that appear as key/value pairs. With GET parameters, the first one is preceded by a ?—this tells the browser to expect parameters. Any further parameters are separated by an ampersand. An example would be:

```
example.com/?name=sarah&emotion=happy
```

This URL would yield `sarah` as the value of `name` and `happy` as the value for `emotion`. They are normally used for filtering or search—next time you search for something on Google, take a look at the URL and you will notice `?q=Your+search+query` in the address bar.

Vue router makes these parameters available to the developer within the `query` object in the `this.$route` variable. Try adding `?name=sarah` to the end of your URL and opening the JavaScript developer tool. Inspecting the `query` object will reveal an object with `name` as the key and `sarah` as the value:

```
▼ {name: undefined, meta: {...}, path: "/user/sarah", hash: "", query: {...}, ...} ⓘ  
  fullPath: "/user/sarah?name=sarah&emotion=happy"  
  hash: ""  
  ▶ matched: [{}]  
  ▶ meta: {}  
  name: undefined  
  ▶ params: {name: "sarah"}  
  path: "/user/sarah"  
  ▶ query:  
    emotion: "happy"  
    name: "sarah"
```

We'll be using the `query` object when we build the filtering in our shop categories.

## Using props

Although using router parameters directly within the component works perfectly fine, it is not good practice as it ties the component directly to the route. Instead, `props` should be used—in the same way, we used them earlier in the book for HTML components. When enabled and declared, the parameter passed in via the URL becomes available to use as though it had been passed in via an HTML attribute.

Using props for your route component is a better way to pass options and parameters into your route, as it has many benefits. Firstly, it decouples the component from a specific URL structure—as you'll see, we can pass props straight to the component itself. It also helps make your route component clearer; the incoming parameters are clearly laid out within the component itself, and the code is cleaner throughout the component.

Props only work with the dynamic routes—GET parameters would still be accessed with the preceding technique.

Using the preceding example, declare the props for both the name and emotion parameters. When using props with a URL-based variable, you will want to use the String data type:

```
const User = {
  template: `<h1>{{ name }} is {{ $route.params.emotion }}</h1>`,
  props: {
    name: String,
    emotion: String
  },
  computed: {
    name() {
      let name = this.$route.params.name;
      return name.charAt(0).toUpperCase() + name.slice(1);
    }
  }
};
```

We now have this.name available to us twice—through the props and through the computed value. However, as we have this.name and this.emotion via the props, we can update our component to use these variables, rather than the \$route parameters.

To avoid conflicts with the prop, update the computed function to be called formattedName(). We can also remove the variable declaration from the function, as the new variable is a lot more readable:

```
const User = {
  template: `<h1>{{ formattedName }} is {{ this.emotion }}</h1>`,
  props: {
    name: String,
    emotion: String
  },
  computed: {
    formattedName() {
      return this.name.charAt(0).toUpperCase() + this.name.slice(1);
    }
  }
};
```

```
};
```

Before the `props` work, Vue-router needs to be told to use them with a particular route. This is enabled within the `routes` array, on a route-by-route basis and, initially, is set with a `props: true` value:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About
    },
    {
      path: '/:name/user/:emotion',
      component: User,
      props: true
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

## Setting prop defaults

With the route parameters now available as `props`, this gives us the flexibility of easily creating a default. If we had wanted to make a parameter optional, we would have needed to add several `if()` statements to check the existence of the variables.

With `props`, however, we can declare defaults as we did earlier. Add a default for the `emotion` variable:

```
const User = {
  template: `<h1>{{ formattedName }} is {{ this.emotion }}</h1>`,
  props: {
    name: String,
    emotion: {
      type: String,
      default: 'happy'
    }
  },
  computed: {
```

```
        formattedName() {
          return this.name.charAt(0).toUpperCase() + this.name.slice(1);
        }
      };
    };
  };
};


```

We can now create a new route within our router, which uses the same component without the final variable. Don't forget to enable `props` for the new route too:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About
    },
    {
      path: '/:name/user',
      component: User,
      props: true
    },
    {
      path: '/:name/user/:emotion',
      component: User,
      props: true
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

Now, by visiting `/sarah/user`, we should be presented with text that declares **sarah is happy**.

## Using static props

Along with a Boolean value, the `props` parameter in the route can also accept an object with a list of the props to pass. This allows you to utilize the same component and alter its state based on the URL, without requiring the variables to be passed via the path for example, if you want to activate or deactivate part of the template.



When passing the `props` object in via the URL, it overwrites the whole `props` object, meaning you either have to declare none or all of them. The `props` variables will also take priority over the dynamic, URL-based variables.

Update your new `/:name/user` path to include the `props` in the route - remove the `:name` variable from the path so it becomes just `/user`:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About
    },
    {
      path: '/user',
      component: User,
      props: {
        name: 'Sarah',
        emotion: 'happy'
      }
    },
    {
      path: '/:name/user/:emotion',
      component: User,
      props: true
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

Navigating to `/user` should reveal the same sentence as we had before. Passing `props` "behind the scenes" (not using the URL) is ideal in some scenarios where you may not want the user to share the specific URL or alter the app's state based on easily altered parameters.

## Nested routes

Nested routes differ from sub-routes as they exist *within* a component already matching the beginning part of a route. This allows you to show different content within an existing view.

A good example of this would be Twitter. If you visit a Twitter user's profile page, you are able to view who they are following, who follows them, and what lists they've created. If you observe the URL while you navigate through the pages, you will notice a recurring pattern: the username followed by the different page. The difference between nested routes and sub-routes is that nested routes allow you to keep components the same throughout the different sub-pages (for example, the header and sidebar).

The advantages of this are that the user can bookmark and share the link, it makes the page more accessible, and is good for SEO reasons. None of these advantages could be easily achieved using simple toggle or tab boxes to show different content in the view.

To reproduce the Twitter pattern into a Vue route, it would look like the following:

```
https://twitter.com/:user/:page
```

If we were to create this with the previous route method, we would have to build components for each page which contain the header and user information in the sidebar in their templates—that would be a pain if you needed to update the code!

Let's make some nested routes for our About page. We won't be using nested routes in our shop app, but it's important to understand the capabilities of Vue router.

Create two new components—`AboutContact`, which will display contact information, and `AboutFood`, a component that will detail the food you like to eat! Although not required, it's a good idea to keep a reference to the parent component (in this case, `About`) in the component name—this ties together the components when you come to look at them later on! Give each component a template with some fixed content:

```
const AboutContact = {
  template: `<div>
    <h2>This is some contact information about me</h2>
    <p>Find me online, in person or on the phone</p>
  </div>`
```

```
};

const AboutFood = {
  template: `<div>
    <h2>Food</h2>
    <p>I really like chocolate, sweets and apples.</p>
  </div>`;
};
```

The next step is to create the placeholder in your `#about` template for the nested routes to render in. The element is exactly the same as one we've seen before—the `<router-view>` element. To demonstrate that this can be placed anywhere, add it between two paragraphs in your template:

```
<script type="text/x-template" id="about">
  <div>
    <h1>About Me</h1>
    <p>Lorem ipsum dolor sit amet, consectetur adipiscing elit. Vivamus sed
    metus magna. Vivamus eget est nisi. Phasellus vitae nisi sagittis, ornare
    dui quis, pharetra leo. Nullam eget tellus velit. Sed tempor lorem augue,
    vitae luctus urna ultricies nec. Curabitur luctus sapien elit, non pretium
    ante sagittis blandit. Nulla egestas nunc sit amet tellus rhoncus, a
    ultrices nisl varius. Nam scelerisque lacus id justo congue maximus. Etiam
    rhoncus, libero at facilisis gravida, nibh nisi venenatis ante, sit amet
    viverra justo urna vel neque.</p>

    <router-view></router-view>

    <p>Curabitur et arcu fermentum, viverra lorem ut, pulvinar arcu. Fusce
    ex massa, vehicula id eros vel, feugiat commodo leo. Etiam in sem rutrum,
    porttitor velit in, sollicitudin tortor. Interdum et malesuada fames ac
    ante ipsum primis in faucibus. Donec ac sapien efficitur, pretium massa at,
    vehicula ligula. Vestibulum turpis quam, feugiat sed orci id, eleifend
    pretium urna. Nullam faucibus arcu eget odio venenatis ornare.</p>
  </div>
</script>
```

Viewing the About page in the browser won't render anything, nor will it break the app. The next step is to add the nested routes for these components to the router. Rather than adding them to the top level `routes` array, we create an array inside the `/about` route—with the key of `children`. The syntax of this array is an exact replica of the main array—that is, an array of route objects.

Add an object for each of the `routes` containing the `path` and `component` keys. The thing to note about the path is that it shouldn't start with a / if you want the path to be added to the end of the parent.

For example, if you wanted the URL to be /about/contact to render the `AboutContact` component, you would make the route component like the following:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About,
      children: [
        {
          path: 'contact',
          component: AboutContact
        },
        {
          path: 'food',
          component: AboutFood
        }
      ]
    },
    {
      linkActiveClass: 'active',
      linkExactActiveClass: 'current'
    }
  ];
})
```

However, if you wanted the URL to be simply /contact, but still render the `AboutContact` component inside the `About` component, you could add the preceding slash. Try viewing the app without the slash, and then with it added, to see the difference it makes. If you wanted a sub-route to show when the parent is loaded without a second part of the URL, you would use an empty path—`path: ''`.

For now, leave it without the slash and add the preceding `children` array. Head to your browser and navigate to the `About` page. Add `/contact` or `/food` to the end of the URL, and notice the new content appear in place of the `<router-link>` element you added to the template earlier.

Links can be created to these components from anywhere, in the same fashion that you linked the Home and About pages. You can either add them to the `about` template, so they only appear when that page has been navigated to, or add them to the main navigation in your app view.

## Creating a 404 page

When building an app or website, despite all good intentions, problems, issues, and mistakes do happen. For this reason, it's a good idea to have error pages in place. The most common page would be a 404 page—a message displayed when a link is incorrect or a page has moved. 404 is the official HTTP code for page not found.

As mentioned earlier, Vue-router will match the routes based on a first-come-first-served principle. We can use this to our advantage by using a wildcard (\*) character as the last route. As the wildcard matches *every* route, only URLs which have not matched a previous route will be caught by this one.

Create a new component titled `PageNotFound` with a simple template, and add a new route which uses the wildcard character as the path:

```
const PageNotFound = {
  template: `<h1>404: Page Not Found</h1>`
};

const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About,
      children: [
        {
          path: 'contact',
          component: AboutContact
        },
        {
          path: 'food',
          component: AboutFood
        }
      ]
    },
  ],
});
```

```
{  
  path: '*',  
  component: PageNotFound  
}  
,  
  
linkActiveClass: 'active',  
linkExactActiveClass: 'current'  
});
```

Open the app up in the browser and type anything at the end of the URL (except `about`) and press *Enter*—you should be presented with the 404 heading.



Although this is simulating a page not found request, it is not actually sending the correct HTTP code to the browser. If you are using a Vue web app in production it is a good idea to set up server-side error checking, so in the instance of an incorrect URL the browser can be correctly notified.

## Naming components, routes, and views

Adding names to your routes and components is not required when using `Vue-router`, but is good practice to do so and a good habit to get into.

### Naming components

Components with names allow you to debug your errors more easily. In Vue, when a JavaScript error is thrown from a component, it will give you the name of that component, rather than listing `Anonymous` as the component.

An example of this would be if you tried to output a variable of `{} test {}` in the food component—one that isn't available. By default, a JavaScript console error would look like the following:

```
✖ ▶ [Vue warn]: Property or method "test" is not defined on the instance but  
referenced during render. Make sure to declare reactive data properties in the data option. vue.js:440  
found in  
    ---> <Anonymous>  
        <Anonymous>  
        <Root>
```

Note the two <Anonymous> components in the stack.

By adding names to our components, we can easily identify where the problem lies. Names have been added to both the About and AboutFood components in the following example:

```
✖ ▶ [Vue warn]: Property or method "test" is not defined on the instance but      vue.js:440  
referenced during render. Make sure to declare reactive data properties in the data option.  
  found in  
    ---> <AboutFood>  
      <About>  
        <Root>
```

You can easily see the error is in the <AboutFood> component.

Adding a name to a component is as simple as adding a key of name to your object, with the name as the value. These names adhere to the same rules as to when we were creating our HTML element components: no spaces, but hyphens and letters are allowed. To allow me to quickly identify the code, I chose to name my component the same as the variable defining it:

```
const About = {  
  name: 'About',  
  template: '#about'  
};  
  
const AboutFood = {  
  name: 'AboutFood',  
  template: `<div>  
    <h2>Food</h2>  
    <p>I really like chocolate, sweets and apples.</p>  
  </div>`  
}
```

## Naming routes

Another object you are able to name when using `VueRouter` is the route itself. This gives you the ability to simplify a route's location and update the path, without needing to find and replace all the instances in the app.

Add the name key to your routes, as shown in the following example:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      component: About,
      children: [
        {
          name: 'contact',
          path: 'contact',
          component: AboutContact
        },
        {
          name: 'food',
          path: 'food',
          component: AboutFood
        }
      ]
    },
    {
      path: '*',
      component: PageNotFound
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

You can now use that name when creating your `router-link` component, like so:

```
<router-link :to="{name: 'food'}">Food</router-link>
```

Note the colon before the `to` attribute. This ensures the contents are parsed as an object, not a literal string. Another advantage of using named routes is being able to pass specific attributes to our dynamic paths. Using the example from earlier in this chapter, we can build the URL in a programmatic way, abstracting the data away from the path construction. This is where named routes really come into their own. Say we had the following path:

```
{ name: 'user', path: '/:name/user/:emotion', component: User }
```

We need to pass in a name and emotion variable to the URL for the component to render. We can pass in as we did before, directly to the URL or, alternatively, use the `:to` object notation with a named route:

```
<router-link :to="{name: 'user', params: { name: 'sarah', emotion: 'happy' } }">  
  Sarah is Happy  
</router-link>
```

Viewing this in the browser will show the anchor link has been generated correctly:

```
/sarah/user/happy
```

This gives us the flexibility to rearrange the URL, using the variables, without needing to update the rest of the app. If you wanted to pass parameters at the end of the URL (for example, `?name=sarah`), the `params` key can be changed to `query`, as it follows the same format:

```
<router-link :to="{name: 'user', query: { name: 'sarah', emotion: 'happy' } }">  
  Sarah is Happy  
</router-link>
```

With the path reconfigured not to accept parameters, it will generate the following link:

```
/user?name=sarah&emotion=happy
```



Be careful when interchanging `params` and `query` - as they can affect whether you use `path` or `name`. When using `path`, the `params` object will be ignored, whereas the `query` one will not. To use the `params` object, you need to use a named route. Alternatively, pass the parameters into the `path` with the `$` variable.

## Named views

Vue router also allows you to name the views, letting you pass in different components to different sections of the app. An example of this might be a shop, where you have a sidebar and main content area. Different pages may utilize these areas in different ways.

The About page may use the main content to show the About content while using the sidebar to show contact details. The shop page, however, will use the main content to list the products and the sidebar for displaying the filters.

To do this, create a second `router-view` element as a sibling to your original one. Leave the original one in place, but add a `name` attribute to the second, with an appropriate title:

```
<main>
  <router-view></router-view>
</main>

<aside>
  <router-view name="sidebar"></router-view>
</aside>
```

When declaring your routes in the router instance, we are now going to use a new key, `components`, and remove the previous singular `component` key. This accepts an object with key-value pairs of the name of the view and the name of the component.



It's advisable to leave your main route unnamed, so you don't need to update every route. If you decide to name your main route, you would be required to do this next step for every route in your app.

Update the `About` route to use this new key and make it into an object. The next step is to tell the code where each component will go.

Using `default` as the key, set the `About` component as the value. This puts the content from the `About` component in your unnamed `router-view`, the main one. This is also what using the singular `component` key is shorthand for:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      components: {
        default: About
      }
    },
    {
      path: '*',
      component: PageNotFound
    }
  ],
  linkActiveClass: 'active',
```

```
    linkExactActiveClass: 'current'  
});
```

Next, add a second key-value, specifying the name of the second router-view, `sidebar`. Name the component you want to populate this area when the `/about` URL is navigated to. For this, we will use the `AboutContact` component:

```
const router = new VueRouter({  
  routes: [  
    {  
      path: '/',
      component: Home  
    },  
    {  
      path: '/about',
      components: {
        default: About,
        sidebar: AboutContact
      }
    },  
    {  
      path: '*',
      component: PageNotFound
    }
  ],  
  
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'  
});
```

Running the app in your browser will render both components, with the contents of the contact component appearing in the sidebar.

## Programmatically navigating with, redirecting, and adding an alias

While building your app, there may be situations that require some different navigation techniques. These may be navigating programmatically, for example in a component or the main Vue instance, redirecting users when they hit a specific URL, or loading the same component with various URLs.

## Navigating programmatically

You may want to alter the path, URL, or user flow from the code, a component, or action. An example of this might be sending the user to the basket after they've added an item.

To do this, you use a `push()` function on the router instance. The value of push can either be a string for a direct URL or it can accept an object to pass named routes or route parameters. The allowed contents of the `push` function are exactly the same as the `to=""` attribute on the `router-link` element. For example:

```
const About = {
  name: 'About',
  template: '#about',
  methods: {
    someAction() {
      /* Some code here */
      // direct user to contact page
      this.$router.push('/contact');
    }
  }
};
```

Alternatively, you could direct to a named route with parameters:

```
this.$router.push({name: 'user', params: { name: 'sarah', emotion: 'happy' }});
```

## Redirecting

Redirecting using `VueRouter` is fairly straightforward. An example of a redirect might be if you move your `/about` page to the `/about-us` URL. You will want to redirect the first URL to the second, in case anyone has shared or bookmarked your link, or in case a search engine has cached the URL.

You may be tempted to create a basic component which, when created, uses the `router.push()` function to send the user to the new URL.

Instead, you can add a route and specify the redirect within that:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      redirect: '/about-us'
    },
    {
      path: '/about-us',
      component: About
    },
    {
      path: '*',
      component: PageNotFound
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

Once again, the contents of the redirect key can be a literal string or an object—much like the `push()` function. With the preceding, if the user visits `/about`, they will instantly be redirected to `/about-us` and the `About` component shown.

## Alias routes

There may be circumstances where you want to show the same component under two URLs. Although not recommended as standard practice, there are some edge cases where this is required.

The alias key gets added to an existing route and accepts just a string of the path. Using the preceding example, the following will show the `About` component, whether the user visits `/about` or `/about-us`:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      component: Home
    },
    {
      path: '/about',
      alias: '/about-us',
      component: About,
    },
    {
      path: '*',
      component: PageNotFound
    }
  ],
  linkActiveClass: 'active',
  linkExactActiveClass: 'current'
});
```

## Summary

You should now be familiar with Vue-router, how to initialize it, what options are available, and how to create new routes—both static and dynamic. In the next few chapters, we'll begin creating our shop, starting with loading some shop data and creating a product page.

# 9

# Using Vue-Router Dynamic Routes to Load Data

In Chapter 8, *Introducing Vue-Router and Loading URL-Based Components*, we explored Vue-router and its capabilities and functionality. With that knowledge, we can now progress on to making our shop with Vue. Before we jump into the code and start creating, we should first plan how our shop is going to work, what URLs we need, and what components we need to make. Once we've planned our app we can move on to creating a product page.

In this chapter, we are going to:

- Outline our components and routes, and create placeholder files
- Load a product CSV file, process it, and cache in Vuex
- Create an individual product page with images and product variations

## Outline and plan your app

First, let's think about the overall app and the user flow.

We are going to be creating a shop without a payment processing gateway. The shop homepage will display a hand-picked list of products. The user will be able to browse the products using categories and narrow down the selection using filters we've made. They will be able to select a product and view more details about it. The product will have variations (size, color, and such) and may have several product images. The user will be able to add a variation to their basket. From there, they can either continue browsing the products and add more to their basket, or proceed to checkout, where they will be asked for their name and address, and to pay. An order confirmation screen will be shown.

The whole shop app will be created in Vue and will run client-side. This will not cover any server-side code needed for payment, user accounts, stock management, or validation.

The app will use Vue-router for handling URLs and Vuex for storing products, basket contents, and user details.

## Components

With a user flow outlined, we need to plan which components we need to make for our shop and what they will be called. This helps with developing the app, as we have a clear idea of what components we need to create. We will also decide on the component names. Following the Vue style guide (<https://vuejs.org/v2/style-guide/index.html>), all our components will consist of two names.

## Route components

The following components will be used in conjunction with Vue-router to form the pages for our app:

- **Shop homepage**—`HomePage`: The shop homepage will display a list of products that are curated by the shop owner. This will use a pre-selected list of product handles to display.
- **Category page**—`CategoryPage`: This will list the products from a specific category. The category listing page will also have filters.
- **Product page**—`ProductPage`: The product page will display product details, images, and variations of the product.
- **Basket**—`OrderBasket`: In the basket, the user will be able to review the products they've added, remove unwanted items, and alter the quantity of each item. It will also show the overall cost of the order.
- **Checkout**—`OrderCheckout`: The checkout will lock down the basket – taking away the ability to remove and update products, and will have a form for the user to enter their address.
- **Order confirmation**—`OrderConfirmation`: This component will be displayed after the order has been placed, confirming the products purchased, the delivery address, and the total price.
- **404 page**—`PageNotFound`: An error page when an incorrect URL is entered.

## HTML components

The HTML components will be used within the page components to help reduce repetition in our code for recurring layouts:

- **Product in a list**—`ListProducts`: This will display a paginated list of products when viewing in a list view – such as in the `HomePage` or `CategoryPage` components.
- **Category listing**—`ListCategories`: This will create a list of categories for navigation.
- **List of Purchases**—`ListPurchases`: This component will appear in the basket, checkout, and order confirmation page; it will list the products in a table form – detailing the variation, price, and quantity. It will also feature the total price of all the products in the basket.
- **Filtering**—`ProductFiltering`: A component used on the side of a category page will offer the user the ability to filter and will update the URL, using the GET parameters we covered in Chapter 8, *Introducing Vue-Router and Loading URL-Based Components*.

## Paths

With our components outlined, we can plan the paths and URLs to our shop, and which components or actions they are going to take. We also need to consider erroneous URLs and whether we should redirect the user to a suitable place or display an error message:

- `/`: Home
- `/category/:slug`: `CategoryPage`, using the `:slug` unique identifier to identify which products to show
- `/category`: This will redirect to `/`
- `/product/:slug`: `ProductPage` – once again, using the `:slug` to identify the product
- `/product`: This will redirect to `/`
- `/basket`: `OrderBasket`
- `/checkout`: `OrderCheckout` – if there are no products, however, it will redirect the user to `/basket`
- `/complete`: `OrderConfirmation` – if the user did not come from the `OrderCheckout` component, then they will be redirected to `/basket`

- \*: PageNotFound – this will catch any unspecified routes

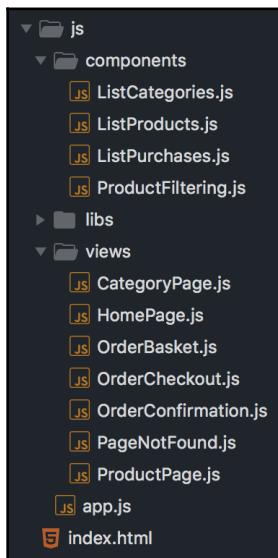
With our routes and components decided upon, we can begin to create our app.

## Create initial files

With the app outlined in the preceding section, we can create the skeletons for our file structure and components. With this app being a large-scale app, we are going to split our files into individual files for each component. This means our files are much more manageable and our main app JavaScript file does not grow out of control.

Although acceptable for development, deploying an app with this number of files could potentially increase your load times depending on how your server is set up. With the traditional HTTP/1.1, browsers have to request and load each file – which is a hindrance if there are multiple files. However, with HTTP/2, you are able to push several files to the user at the same time – in which case, multiple files can somewhat improve the performance of your app.

Whichever method you choose to use with your deployment, it is highly advised you minify your JavaScript when deploying the code to a production environment. This ensures your code is as small as possible when being served up to your user:



Create a file for each component, view, and library, such as Vue, Vuex, and Vue-router. Then, create a folder for each type of file. Finally, add an `app.js`—which is where the libraries will be initialized.



You may also consider using the `vue-cli` (<https://github.com/vuejs/vue-cli>) for building your app. Beyond the scope of this book, as we only cover building a Vue app using the included JavaScript files, the `vue-cli` application allows you to develop your app in a more modular way and, once developed, deploy it in a similar fashion to how we have been developing the app.

Create an `index.html` and include your JavaScript files, ensuring Vue is loaded first and your app's JavaScript last. Add a container for your app to form the view of our shop:

```
<!DOCTYPE html>
<html>
<head>
  <title>Vue Shop</title>
</head>
<body>
  <div id="app"></div>

  <!-- Libraries -->
  <script type="text/javascript" src="js/libs/vue.js"></script>
  <script type="text/javascript" src="js/libs/vuex.js"></script>
  <script type="text/javascript" src="js/libs/router.js"></script>

  <!-- Components -->
  <script src="js/components/ListCategories.js"></script>
  <script src="js/components/ListProducts.js"></script>
  <script src="js/components/ListPurchases.js"></script>
  <script src="js/components/ProductFiltering.js"></script>

  <!-- Views -->
  <script src="js/views/PageNotFound.js"></script>
  <script src="js/views/CategoryPage.js"></script>
  <script src="js/views/HomePage.js"></script>
  <script src="js/views/OrderBasket.js"></script>
  <script src="js/views/OrderCheckout.js"></script>
  <script src="js/views/OrderConfirmation.js"></script>
  <script src="js/views/ProductPage.js"></script>

  <!-- App -->
  <script type="text/javascript" src="js/app.js"></script>
</body>
</html>
```



Ensure the `PageNotFound` component is loaded first, as we are going to be utilizing it within other components, as well as specifying it as the 404 page in our routes.

Within each file, initialize the type of component it's going to be by either declaring a variable or using `Vue.component`. For the views, add a `name` attribute too – to help with debugging later on.

For example, all of the files located in the `js/components/` folder should be initialized like the following. Make sure these components are lowercase and are hyphenated:

```
Vue.component('list-products', {  
});
```

Whereas the components for the routes and views, located in `js/views`, should look like the following:

```
const OrderConfirmation = {  
  name: 'OrderConfirmation'  
};
```

The last step is to initialize our Vuex store, Vue-router, and Vue application. Open `app.js` and initialize the libraries:

```
const store = new Vuex.Store({});  
  
const router = new VueRouter({});  
  
new Vue({  
  el: '#app',  
  
  store,  
  router  
});
```

With the Vue components and routes ready to go, our store, route, and app initialized, let's look at setting up a server (if required) and loading in data.

# Server setup

With our shop, we are going to be loading in a CSV of products on page load. This will simulate gathering stock and product data from a database or API from a point-of-sale system, something online shops with a physical shop might have to deal with.

In a similar way to our Dropbox app earlier in the book, we will be loading external data and saving it into the Vuex store. The issue we will face, however, is when loading a resource via JavaScript; the browsers demand the protocol for the file being requested is via HTTP, HTTPS, or is a CORS request.

This means that we are unable to load a *local* file using the `fetch()` technique we used with the Dropbox API as, when viewing our app in the browser, we are loading local assets over the `file://` protocol.

We can resolve this issue in a few different ways – which one you choose depends on your circumstance. We are going to be loading a CSV file and, using two plugins, converting it into a useable JSON object. The three options you have are:

1. Storing the file locally
2. Using a remote server or
3. Using a local server

Let's run through each option, with the advantages and disadvantages for each.

## Storing the file locally

The first option is to convert the CSV to JSON appropriately once, and then save the output in a file. You'll need to assign it to a variable in the file and load the JSON before your libraries. An example might be creating a `data.json` and updating it to be assigned to a variable:

```
const products = { ... }
```

You can then load the JSON file in your HTML:

```
<script type="text/javascript" src="data.json"></script>
```

You then have the `products` variable available to you in your `app.js`.

Advantages:

- Less load in your code
- No need to load the extra files required for processing the CSV
- No extra steps required

Disadvantages:

- Does not simulate the real world
- If you want to update the CSV data, you need to convert, save, and assign to a variable

## Using a remote server

Another option is to upload the files to a remote, existing server and develop your app there.

Advantages:

- Simulates real-world development of loading CSV
- Can be developed anywhere, with any machine

Disadvantages:

- Can be slow
- Needs to be connected to the internet
- Needs to either set up a deployment process or edit files on a live server

## Setting up local server

The last option is to set up a local server on your machine. There are several small, lightweight, zero configuration modules, and applications, or there are bigger, beefier applications too. If you have npm installed on your machine, the node HTTP server is recommended. If not, there are other options available.

The other option would be to use a more heavyweight application, which can provide you with an SQL database and the ability to run PHP applications. An example of this would be MAMP or XAMPP.

Advantages:

- Simulates real-world development of loading CSV
- Quick, instant updates
- Can be developed offline

Disadvantages:

- Requires installing software
- May require some configuration and/or command-line knowledge

The option we are going to choose is the last one, using an HTTP server. Let's load and process the CSV so we can start creating our shop.

## Loading CSV

To simulate gathering data from a shop database or point-of-sale, our app is going to load product data from a CSV. CSV, or Comma Separated Values, is a file format often used for sharing data in a database-style way. Think of how you would lay out a list of products in excel or numbers: that is how a CSV file is formatted.

This next step is going to require downloading and including a couple more JavaScript files. If you chose option 1 in the *Server setup* section – to have your files stored in a JSON file locally – you can skip this step.

The data we're going to be using is example shop data from Shopify. These CSVs have a wide selection of product types and different data, which will test our Vue skills. Shopify has made their example data available for download from a GitHub repository (<https://github.com/shopify/partners/shopify-product-csvs-and-images>). Download any CSV file that takes your interest and save it in a `data/` folder in your file system. For this app, I will be using the `bicycles.csv` file.

JavaScript cannot natively load and process CSV files without a significant amount of coding and processing of comma-separated and quote-encapsulated values. To save this book digressing into how to load, parse, and process CSV files, we are going to use a library to do the heavy lifting for us. There are two noteworthy libraries, CSV Parser (<https://github.com/okfn/csv.js>) and d3 (<https://d3js.org/>). CSV Parser simply does CSV parsing and nothing else, while d3 has the ability to generate charts and data visualizations.

It is worth considering which one suits you best; CSV Parser only adds just over 3 KB of weight to your app, whereas d3 is around 60 KB. Unless you anticipate adding visualizations later, it is recommended you go to the smaller library – especially as they execute the same function. However, we'll run through examples for both libraries.

We want to load our product data when the app loads, so our CSV will be loaded and parsed by the time our components require the data. Because of this, we will be loading our data in the `created()` method of Vue.

## Loading a CSV with d3

Both plugins load the data in a very similar way, but the data returned varies somewhat – however, we'll deal with that once we have loaded our data.

Load the d3 library – if you want to try it out, you can use the hosted version:

```
<script src="https://d3js.org/d3.v4.min.js"></script>
```

Using d3, we use a function on the `d3` object of `csv()`, which accepts one parameter – the path to the CSV file. Add the `created()` function to your Vue instance and initialize the CSV loader:

```
new Vue({
  el: '#app',

  store,
  router,
  created() {
    d3.csv('./data/csv-files/bicycles.csv', (error, data) => {
      console.log(data);
    });
  }
});
```



Remember the path to your file is relative to the HTML file which is including your JavaScript file – in this case, `index.html`.

Opening the file in your browser will not render any output. However, if you open the Javascript console and expand the object being output, you will see something similar to this:

This gives you a breakdown of all of the properties available on each product in a key: value format. This allows us to access each value in red, using a consistent key found on each product. For example, if we wanted 15mm-combo-wrench from the product above, we could use the `Handle` key. More on this will be covered later

## Loading a CSV with CSV Parser

CSV Parser works in a slightly different way, in that it can accept many different parameters and the library contains several different methods and functions. The data output is also in a different format, providing a table/CSV style structure in return, with a `headers` and `fields` object:

```
new Vue({
  el: '#app',
  store,
  router,
  created() {
    CSV.fetch({url: './data/csv-files/bicycles.csv'}).then(data => {
      console.log(data);
    });
  }
});
```

Viewing the output this time will reveal a much different structure and will require matching up the key of the fields, with the index of the `headers` object.

## Unifying Shopify CSV data

Before we can save and utilize the Shopify data, we need to unify the data and manipulate it into a more manageable state. If you inspect the data being output by either library, you will notice there is an entry for each variation or additional image of a product, with the handle being the linking factor between each entry. For example, there are around 12 entries with the handle of `pure-fix-bar-tape`, each one a different color. Ideally, we would like each variation grouped under the same item, also showing the images as a list of one product.

The other issue with the Shopify CSV data is that the punctuation and grammar of the field headings do not make great object keys. Ideally object keys would be like URL slugs, lowercase and contain no spaces. For example, Variant Inventory Qty should ideally be variant-inventory-qty.

To save manually processing the data ourselves and updating the keys, we can use a Vue plugin to process the output from either loading library and return an object of products formatted exactly how we want. The plugin is `vue-shopify-products` and is available from unpkg:

```
https://unpkg.com/vue-shopify-products
```

Download and include the library into your `index.html` file. The next step is to tell Vue to use this plugin – at the top of your `app.js` file, include the following line:

```
Vue.use(ShopifyProducts);
```

This now exposes a new method on the Vue instance of `$formatProducts()`, which allows us to pass in the output of our CSV loading library and get a more useful collection of objects:

```
Vue.use(ShopifyProducts);

const store = new Vuex.Store({});

const router = new VueRouter({});

new Vue({
  el: '#app',

  store,
  router,

  created() {
    CSV.fetch({url: './data/csv-files/bicycles.csv'}).then(data => {
      let products = this.$formatProducts(data);
      console.log(products);
    });
  }
});
```

Inspecting the output now reveals a collection grouped by handle, with variations and images as objects:

```
▼ {15mm-combo-wrench: {...}, 4mm-5mm-6mm-y-wrench: {...}, adjustable-stem: {...}, ass-savers: {...}
▶ 4mm-5mm-6mm-balldriver-y-wrench: {title: "4mm 5mm 6mm Balldriver Y-Wrench", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ 4mm-5mm-6mm-y-wrench: {title: "4mm 5mm 6mm Y-Wrench", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ 15mm-combo-wrench: {title: "15mm Combo Wrench", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▼ 650c-micro-wheelset:
  body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"
  handle: "650c-micro-wheelset"
▶ images: (4) [...], [...], [...], [...]
  tags: "650C, 650C Wheelsets, Black, Blue, Micro, Orange, Wheels, Wheelset, Wheelsets and Components"
  title: "650C 45mm Micro Wheelset"
  type: "Wheelsets"
▼ variations:
  ▶ items: Array(4)
    ▶ 0: {title: "Orange", barcode: "'741360638785", comaprePrice: null, grams: 13608, quantity: 1, unit: "Grams", unitPrice: 13608, weight: 13608}
    ▶ 1: {title: "Black", barcode: "'741360638761", comaprePrice: null, grams: 13608, quantity: 1, unit: "Grams", unitPrice: 13608, weight: 13608}
    ▶ 2: {title: "Blue", barcode: "'741360638792", comaprePrice: null, grams: 13608, quantity: 1, unit: "Grams", unitPrice: 13608, weight: 13608}
    ▶ 3: {title: "White", barcode: "'741360638778", comaprePrice: null, grams: 13608, quantity: 1, unit: "Grams", unitPrice: 13608, weight: 13608}
    ▶ length: 4
    ▶ __proto__: Array(0)
    title: "Color"
    ▶ __proto__: Object
    vendor: "Pure Fix Cycles"
    ▶ __proto__: Object
▶ 700c-aerospoke: {title: "700C Aerospoke - Lime Green Front", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ acs-crossfire-chain: {title: "ACS Crossfire Chain", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ acs-crossfire-freewheel: {title: "ACS Crossfire Freewheel", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ acs-crossfire-headset: {title: "ACS Crossfire Headset", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ acs-crossfire-pro-freewheel: {title: "ACS Crossfire Pro Freewheel", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ acs-crossfire-spanner: {title: "ACS Crossfire Spanner", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ acs-maindrive-freewheel: {title: "ACS MainDrive Freewheel", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ acs-maindrive-headset: {title: "ACS MainDrive Headset", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ adjustable-stem: {title: "Adjustable Stem", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
▶ airboy-mini-pump: {title: "Airboy Mini Pump", body: "<p><em>This is a demonstration store. You can purchase products like this from Pure Fix Cycles</em></p>"}
```

With our products grouped more effectively, we can proceed with storing and recalling as desired.

## Storing the products

Once we have retrieved and formatted the CSV data, we can cache the contents in the Vuex store. This will be done via a simple mutation that takes a payload and stores it without any modifications.

Create a state and mutations object in your store. Add a key of products as an object in the state, and create a function in the mutations object, also titled products. The mutation should accept two parameters – the state and a payload:

```
const store = new Vuex.Store({
  state: {
    products: {}
  },
  mutations: {
    products(state, payload) {
      }
    }
});
```

Update the state.products object to the contents of the payload:

```
const store = new Vuex.Store({
  state: {
    products: {}
  },
  mutations: {
    products(state, payload) {
      state.products = payload;
    }
  }
});
```

Replace the console.log in the main Vue instance with a commit function, calling the new mutation and passing in the formatted product data:

```
new Vue({
  el: '#app',
  store,
  router,
  created() {
    CSV.fetch({url: './data/csv-files/bicycles.csv'}).then(data => {
      let products = this.$formatProducts(data);
      this.store.commit('products', products);
    });
  }
});
```

This can be reduced somewhat, by passing the `$formatProducts` function directly into the store `commit()` function, rather than storing it as a variable:

```
new Vue({
  el: '#app',
  store,
  router,
  created() {
    CSV.fetch({url: './data/csv-files/bicycles.csv'}).then(data => {
      this.$store.commit('products', this.$formatProducts(data));
    });
  }
});
```

## Displaying a single product

With our data stored, we can now begin making our components and displaying content on the frontend. We're going to start by making a product view – displaying product details, variations, and images. We'll move on to creating the category listing page in [Chapter 10, Building an E-Commerce Store – Browsing Products](#).

The first step in making our product view is to create the route, to allow the component to be displayed via a URL. Referring back to our notes at the beginning of the chapter, the product component is to be loaded on the `/product/:slug` path.

Create a `routes` array in your Vue-router, with the path and component specified:

```
const router = new VueRouter({
  routes: [
    {
      path: '/product/:slug',
      component: ProductPage
    }
  ]
});
```

With the layout of the `products` object explained, we can start to understand how the route and products link. We will pass the handle of the product into the URL. This will select the product with that handle and display the data. This means we do not need to explicitly link `slug` with `products`.

## Page Not Found

With our first route created, we should also create our `PageNotFound` route, to catch any URLs that are non-existent. We can also redirect to this page when there is no product that matches.

We're going to create the `PageNotFound` component in a slightly different way than we did before. Rather than having the component on `*`, we're going to create a `/404` path as a named route. This allows us to alias and redirect several different routes as required.

Add a new object to the routes array, with `/404` as the path, the `PageNotFound` component as the specified component. Add a name to your route, so we can utilize if required, and lastly, add an `alias` attribute, which contains our global, catchall route.

Don't forget to put this *at the end* of the routes array – to catch any previously unspecified route. When adding new routes, always remember to put them before the `PageNotFound` route:

```
const router = new VueRouter({
  routes: [
    {
      path: '/product/:slug',
      component: ProductPage
    },
    {
      path: '/404',
      alias: '*',
      component: PageNotFound
    }
  ]
});
```

Add a template to your `PageNotFound` component. For now, give it some basic content – we can improve it later, once we have the rest of our app set out:

```
const PageNotFound = {
  name: 'PageNotFound',
  template: `<div>
    <h1>404 Page Not Found</h1>
    <p>Head back to the <router-link to="/">home page</router-link> and
    start again.</p>
  </div>`;
};
```

Note the use of the router link in the content. The last thing we need to do to get our app started is to add the `<router-view>` element inside our app. Head to the view, and include it in the app space:

```
<div id="app">
  <router-view></router-view>
</div>
```

Load up the app in your browser, not forgetting to start the HTTP server if required. You should be, at first, presented with your `PageNotFound` component contents. Navigating to the following product URL should result in a JavaScript error instead of the 404 page. This shows the route is correctly picking up the URL but the error is because our `ProductPage` component does not contain a template:

```
#/product/15mm-combo-wrench
```

If you are presented with the `PageNotFound` component, check your route's code, as it means the `ProductPage` route is not being picked up.

## Selecting the right product

With our initial routes set up, we can now proceed with loading the desired product and displaying the information from the store. Open `views/Product.js` and create a template key. To begin with, create a simple `<div>` container that displays the title of the product:

```
const ProductPage = {
  name: 'ProductPage',
  template: `<div>{{ product.title }}</div>`,
};
```

Viewing this in the browser will instantly throw a JavaScript error as Vue is expecting the `product` variable to be an object – but it is currently undefined as we have yet to declare it. Although the fix for this seems fairly simple at the moment, we need to consider the case where the product is not yet defined.

Our shop app loads the data CSV asynchronously. This means that the execution of the rest of the app does not stop while the products are being loaded. Overall, this increases the speed of our app at the moment we have the products, we can start manipulating and displaying the list, without waiting for the rest of the app to start.

Because of this, there is a distinct possibility that the user could visit the product details page, be it from a link that was shared or a search result, without the product list being loaded. To prevent the app trying to display the product data without being fully initialized, add a conditional attribute to the template to check if the product variable exists before trying to display any of its attributes.

When loading our product data, we can then ensure the product variable is set to `false`, until everything is fully loaded. Add the `v-if` attribute to the containing element in your template:

```
const ProductPage = {  
  name: 'ProductPage',  
  template: `<div v-if="product">{{ product.title }}</div>`  
};
```

We can now start loading the correct product from the store and assign it to a variable.

Create a `computed` object with a `product()` function inside. Within that, create a blank variable of the product, and return it afterward. This now defaults to returning `false`, which means our template will not generate the `<div>`:

```
const ProductPage = {  
  name: 'ProductPage',  
  template: `<div v-if="product">{{ product.title }}</div>`,  
  
  computed: {  
    product() {  
      let product;  
  
      return product;  
    }  
  }  
};
```

Selecting the product is now a fairly simple procedure, thanks to our helpfully-formatted product store and the `slug` variable, available to us within the `Product` component. The `products` object in the store is formatted with the handle as the key and the `product` `details` object as the value. With this in mind, we can select the desired product using the square bracket format. For example:

```
products[handle]
```

Using the router params object, load the desired product from the store and assign it to the product variable to be returned:

```
const ProductPage = {
  name: 'ProductPage',
  template: `<div v-if="product">{{ product.title }}</div>`,

  computed: {
    product() {
      let product;

      product = this.$store.state.products[this.$route.params.slug];

      return product;
    }
  }
};
```

The reason we don't assign the value of product straightaway is so we can add some conditional statements. To ensure we are only loading the product if the store has the data available, we can add an `if()` statement to make sure the product's object has keys available; in other words, has the data loaded?

Add an `if` statement checking the length of the store product keys. If they exist, assign the data from the store to the product variable to be returned:

```
const ProductPage = {
  name: 'ProductPage',
  template: `<div v-if="product">{{ product.title }}</div>`,

  computed: {
    product() {
      let product;

      if(Object.keys(this.$store.state.products).length) {
        product = this.$store.state.products[this.$route.params.slug];
      }

      return product;
    }
  }
};
```

Viewing the app in the browser now, you will be presented with the title of the product – once the data has loaded. This should only take a split second to load and should be gracefully handled by our `if` statement.

Before proceeding with displaying all our product data, we need to handle the situation where a product does not exist with the handle in the URL. Because our `ProductPage` route is picking up anything after `/product` in the URL, the `PageNotFound` wildcard path will not be able to be used – as it is our `ProductPage` component that is loading the data and determining whether the product exists.

## Catching products not found

In order to show the `PageNotFound` page when a product is not available, we are going to load the component with our `ProductPage` component and display it conditionally.

To do this, we need to register the component so we can use it in our template. We need to register it since our `PageNotFound` component currently lives as an object and not a Vue component (for example, when we use `Vue.component`).

Add a `components` object to your `ProductPage` component and include `PageNotFound`:

```
const ProductPage = {
  name: 'ProductPage',
  template: `<div v-if="product"><h1>{{ product.title }}</h1></div>`,
  components: {
    PageNotFound
  },
  computed: {
    product() {
      let product;
      if(Object.keys(this.$store.state.products).length) {
        product = this.$store.state.products[this.$route.params.slug];
      }
      return product;
    }
  }
};
```

This now gives us a new HTML element to use in the form of `<page-not-found>`. Add this element to your template after the existing `<div>`. As our templates need a single root element, wrap both of them in an extra container:

```
const ProductPage = {
  name: 'ProductPage',
  template: `<div>
    <div v-if="product"><h1>{{ product.title }}</h1></div>
    <page-not-found></page-not-found>
  </div>`,
  components: {
    PageNotFound
  },
  computed: {
    product() {
      let product;

      if(Object.keys(this.$store.state.products).length) {
        product = this.$store.state.products[this.$route.params.slug];
      }

      return product;
    }
  }
};
```

Viewing this in the browser will render the 404 page template and, once the data has loaded, the product title above that. We now need to update the component to only show the `PageNotFound` component when there is no data to show. We could use the existing `product` variable with a `v-if` attribute and, if false, show the error message like so:

```
<page-not-found v-if="!product"></page-not-found>
```

However, this would mean that if the user visited the product page without the product data loading yet, they would see a flash of the 404 information before being replaced with the product information. This isn't a very good user experience, so we should only show the error if we are sure the product data has loaded and that there isn't a matching item.

To combat this, we will create a new variable which will determine if the component displays. Create a data function in the `ProductPage` component that returns an object with a key of `productNotFound`, set to false. Add a `v-if` condition to the `<page-not-found>` element, checking against the new `productNotFound` variable:

```
const ProductPage = {
  name: 'ProductPage',
  template: `<div>
    <div v-if="product"><h1>{{ product.title }}</h1></div>
    <page-not-found v-if="productNotFound"></page-not-found>
  </div>`,
  components: {
    PageNotFound
  },
  data() {
    return {
      productNotFound: false
    }
  },
  computed: {
    product() {
      let product;

      if (Object.keys(this.$store.state.products).length) {
        product = this.$store.state.products[this.$route.params.slug];
      }

      return product;
    }
  }
};
```

The last step is to set the variable to `true` if a product doesn't exist. As we only want to do this once the data has loaded, add the code to the `$store.state.products` check. We are already assigning the data to the `product` variable, so we can add a check to see if this variable exists – if not, change the polarity of our `productNotFound` variable:

```
const ProductPage = {
  name: 'ProductPage',
  template: `<div>
    <div v-if="product"><h1>{{ product.title }}</h1></div>
    <page-not-found v-if="!product || productNotFound"></page-not-found>
  </div>`,
  computed: {
    product() {
      let product;

      if (Object.keys(this.$store.state.products).length) {
        product = this.$store.state.products[this.$route.params.slug];
      }

      return product;
    }
  }
};
```

```
components: {
  PageNotFound
},
data() {
  return {
    productNotFound: false
  }
},
computed: {
  product() {
    let product;

    if(Object.keys(this.$store.state.products).length) {
      product = this.$store.state.products[this.$route.params.slug];

      if(!product) {
        this.productNotFound = true;
      }
    }

    return product;
  }
}
};
```

Try entering an erroneous string at the end of the URL – you should be faced with our, now familiar, 404error page.

## Displaying product information

With our product loading, filtering, and error-catching in place, we can proceed with displaying the information we need for our product. Each product could contain one or many images, and one or many variations and any combination in-between – so we need to make sure we cater for each of these scenarios.

To see the data available to us, add a `console.log(product)` just before the `return`:

```
product() {
  let product;

  if(Object.keys(this.$store.state.products).length) {
    product = this.$store.state.products[this.$route.params.slug];
    if(!product) {
      this.productNotFound = true;
    }
  }
}
```

```
        }
    }

    console.log(product);
    return product;
}
```

Open up the JavaScript console and inspect the object that should now be there. Familiarize yourself with the keys and values available to you. Take note that the `images` key is an array and the `variations` an object, containing a string and a further array.

Before we tackle the variations and images – let's output the simple stuff. What we need to remember is that every field we output might not exist on every product – so it's best to wrap it in conditional tags where necessary.

Output the `body`, `type`, and `vendor.title` from the product details. Prepend both the `vendor.title` and `type` with a description of what they are, but make sure you only render that text if it exists in the product details:

```
template: `<div>
  <div v-if="product">
    <h1>{{ product.title }}</h1>
    <div class="meta">
      <span>
        Manufacturer: <strong>{{ product.vendor.title }}</strong>
      </span>
      <span v-if="product.type">
        Category: <strong>{{ product.type }}</strong>
      </span>
    </div>
    {{ product.body }}
  </div>
  <page-not-found v-if="productNotFound"></page-not-found>
</div>`,
```

Notice we've got the flexibility to prepend the type and vendor with more user-friendly names. Once we have our categories and filtering set up, we can link both the vendor and type to appropriate product listing.

Viewing this in the browser will reveal the body outputting all HTML tags as text – meaning we can see them on the page. If you cast your mind back to the beginning of the book where we were discussing output types, we need to use `v-html` to tell Vue to render the block as raw HTML:

```
template: `<div>
  <div v-if="product">
    <h1>{{ product.title }}</h1>
    <div class="meta">
      <span>
        Manufacturer: <strong>{{ product.vendor.title }}</strong>
      </span>
      <span v-if="product.type">
        Category: <strong>{{ product.type }}</strong>
      </span>
    </div>
    <div v-html="product.body"></div>
  </div>
  <page-not-found v-if="productNotFound"></page-not-found>
</div>,
```

## Product images

The next step is to output the images for our product. If you are using the bicycles CSV file, a good product to test with is `650c-micro-wheelset` – navigate to this product as it has four images. Don't forget to go back to your original product to check that it works with one image.

The `images` value will always be an array, whether there is one image or 100, so to display them, we will always need to do a `v-for`. Add a new container and loop through the images. Add a width to each image so it doesn't take over your page.

The `images` array contains an object for each image. This has an `alt` and `source` key that can be input directly into your HTML. There are some instances, however, where the `alt` value is missing – if it is, insert the product title instead:

```
template: `<div>
  <div v-if="product">

    <div class="images" v-if="product.images.length">
      <template v-for="img in product.images">
        
      </template>
</div>

<h1>{{ product.title }}</h1>

<div class="meta">
  <span>
    Manufacturer: <strong>{{ product.vendor.title }}</strong>
  </span>
  <span v-if="product.type">
    Category: <strong>{{ product.type }}</strong>
  </span>
</div>

<div v-html="product.body"></div>

</div>
<page-not-found v-if="productNotFound"></page-not-found>
</div>`,
```

With our images displaying, it would be a nice addition to create a gallery. Shops often show one big image, with a set of thumbnails underneath. Clicking each thumbnail then replaces the main image so the user can get a better look at the bigger image. Let's recreate that functionality. We also need to ensure we don't show the thumbnails if there is only one image.

We do this, by setting an image variable to the first image in the images array, this is the one that will form the big image. If there is more than one image in the array, we will show the thumbnails. We will then create a click method that updates the image variable with the selected image.

Create a new variable in your data object and update it with the first item from the images array when the product has loaded. It's good practice to ensure the `images` key is, in fact, an array of items before trying to assign a value:

```
const ProductPage = {
  name: 'ProductPage',

  template: `<div>
    <div v-if="product">
      <div class="images" v-if="product.images.length">
        <template v-for="img in product.images">
          
    
```

```
        </template>
</div>
<h1>{{ product.title }}</h1>
<div class="meta">
  <span>
    Manufacturer: <strong>{{ product.vendor.title }}</strong>
  </span>
  <span v-if="product.type">
    Category: <strong>{{ product.type }}</strong>
  </span>
</div>
<div v-html="product.body"></div>
</div>
<page-not-found v-if="productNotFound"></page-not-found>
</div>,

components: {
  PageNotFound
},
data() {
  return {
    productNotFound: false,
    image: false
  }
},
computed: {
  product() {
    let product;

    if(Object.keys(this.$store.state.products).length) {

      product = this.$store.state.products[this.$route.params.slug];
      this.image = (product.images.length) ? product.images[0] : false;

      if(!product) {
        this.productNotFound = true;
      }
    }

    console.log(product);
    return product;
  }
}
};
```

Next, update your existing images loop in your template to only display when there is more than one image in the array. Also, add the first image as the main image in your template – not forgetting to check whether it exists first:

```
template: `<div>
<div v-if="product">

  <div class="images" v-if="image">
    <div class="main">
      
    </div>

    <div class="thumbnails" v-if="product.images.length > 1">
      <template v-for="img in product.images">
        
      </template>
    </div>
  </div>

  <h1>{{ product.title }}</h1>

  <div class="meta">
    <span>
      Manufacturer: <strong>{{ product.vendor.title }}</strong>
    </span>
    <span v-if="product.type">
      Category: <strong>{{ product.type }}</strong>
    </span>
  </div>

  <div v-html="product.body"></div>

</div>
<page-not-found v-if="productNotFound"></page-not-found>
</div>`,
```

The last step is to add a click handler to each of the thumbnail images, to update the image variable when interacted with. As the images will not natively have the `cursor: pointer` CSS attribute, it might be worth considering adding this.

The click handler will be a method that accepts each image in the thumbnail loop as a parameter. On click, it will simply update the image variable with the object passed through:

```
const ProductPage = {
  name: 'ProductPage',

  template: `<div>
    <div v-if="product">
      <div class="images" v-if="image">
        <div class="main">
          
        </div>

        <div class="thumbnails" v-if="product.images.length > 1">
          <template v-for="img in product.images">
            
          </template>
        </div>
      </div>
    </div>

    <h1>{{ product.title }}</h1>

    <div class="meta">
      <span>
        Manufacturer: <strong>{{ product.vendor.title }}</strong>
      </span>
      <span v-if="product.type">
        Category: <strong>{{ product.type }}</strong>
      </span>
    </div>

    <div v-html="product.body"></div>
  </div>
  <page-not-found v-if="productNotFound"></page-not-found>
</div>`,

  components: {
    PageNotFound
  },
  data() {
    return {

```

```
        productNotFound: false,
        image: false
    },
),

computed: {
    product() {
        let product;

        if(Object.keys(this.$store.state.products).length) {

            product = this.$store.state.products[this.$route.params.slug];
            this.image = (product.images.length) ? product.images[0] : false;

            if(!product) {
                this.productNotFound = true;
            }
        }

        console.log(product);
        return product;
    }
},
methods: {
    updateImage(img) {
        this.image = img;
    }
}
};
```

Load the product up in your browser and try clicking on any of the thumbnails - you should be able to update the main image. Don't forget to validate your code on a product with one image or even zero images, to make sure the user isn't going to encounter any errors.



Don't be afraid of whitespace and adding new lines for readability. Being able to easily understand your code is better than the few bytes you would have saved on file load. When deploying to production, files should be minified, but during development white space takes precedence.

## Product variations

With this particular dataset, each of our products contains at least one variation but can contain several. This normally goes hand-in-hand with the number of images but does not always correlate. Variations can be things such as color or size.

On our `Product` object, we have two keys which are going to help us display the variations. These are `variationTypes`, which list the names of the variations such as size and color, and `variationProducts`, which contains all of the variations. Each product within the `variationProducts` object has a further object of `variant`, which lists all of the changeable properties. For example, if a jacket came in two colors and each color had three sizes, there would be six `variationProducts`, each with two `variant` properties.

Every product will contain at least one variation, although if there is only one variation, we may need to consider the UX of the product page. We are going to display our product variations in both a table and drop-down, so you can experience creating both elements.

## Variations display table

Create a new container in your product template that will display the variations. Within this container, we can create a table to display the different variations of the product. This will be achieved with a `v-for` declaration. However, now that you are more familiar with the functionality, we can introduce a new attribute.

## Using a key with loops

When using loops in Vue, it is advised you use an extra attribute to identify each item, `:key`. This helps Vue identify the elements of the array when re-ordering, sorting, or filtering. An example of `:key` use would be:

```
<div v-for="item in items" :key="item.id">
  {{ item.title }}
</div>
```

The `key` attribute should be a unique attribute of the item itself and not the index of the item in the array, to help Vue identify the specific object. More information about using a key with a loop is available in the [official Vue documentation](#).

We'll be utilizing the `key` attribute when displaying our variations, but using the `barcode` attribute.

## Displaying the variations in a table

Add a table element to your variations container and loop through the `items` array. For now, display the title, quantity and price. Add an additional cell that contains a button with the value of **Add to basket**. We'll configure that in Chapter 11, *Building an E-commerce Store – Adding a Checkout*. Don't forget to add a \$ currency symbol in front of your price, as it's currently just a "raw" number.

Watch out – when using the \$ sign within the template literals, JavaScript will try and interpret it, along with the curly brackets, as a JavaScript variable. To counteract this, prepend the currency with a backslash – this tells JavaScript that the next character is literal, and should not be interpreted in any other way:

```
template: `<div>
  <div v-if="product">
    <div class="images" v-if="image">
      <div class="main">
        
      </div>

      <div class="thumbnails" v-if="product.images.length > 1">
        <template v-for="img in product.images">
          
        </template>
      </div>
    </div>

    <h1>{{ product.title }}</h1>

    <div class="meta">
      <span>
        Manufacturer: <strong>{{ product.vendor.title }}</strong>
      </span>
      <span v-if="product.type">
        Category: <strong>{{ product.type }}</strong>
      </span>
    </div>

    <div class="variations">
      <table>
```

```
<tr v-for="variation in product.variationProducts"
:key="variation.barcode">
  <td>{{ variation.quantity }}</td>
  <td>\${{ variation.price }}</td>
  <td><button>Add to basket</button></td>
</tr>
</table>
</div>

<div v-html="product.body"></div>

</div>
<page-not-found v-if="productNotFound"></page-not-found>
</div>,
```

Although we're displaying the price and quantity, we aren't outputting the actual variant properties of the variation (such as color). To do this, we are going to need to do some processing on our variation with a method.

The variant object contains a child object for each variation type, with a name and a value for each type. They are also stored with a slug-converted key within the object. See the following screenshot for more details:

```
▼ product: Object
  body: "<p><em>This is a demonstration store. You can purchase products like this from
handle: "keirin-pro-track-frame"
▶ images: Array[9]
  tags: "Alloy, Black, Chrome, Framesets, Keirin, Parts, Pro, Racing, Track, Track Fram
  title: "Keirin Pro Track Frameset"
  type: "Framesets"
▼ variationProducts: Array[20]
  ▶ 0: Object
    barcode: "'712392689311"
    grams: 9072
    price: 325
    quantity: 0
    shipping: "true"
    sku: "Keirin Pro - Polished Raw - 49c"
    taxable: "true"
    ▼ variant: Object
      ▼ color: Object
        name: "Color"
        value: "Alloy"
      ▼ size: Object
        name: "Size"
        value: "49 cm"
```

Add a new cell at the beginning of the table that passes the variation to a method titled `variantTitle()`:

```
<div class="variations">
  <table>
    <tr v-for="variation in product.variationProducts"
      :key="variation.barcode">
      <td>{{ variantTitle(variation) }}</td>
      <td>{{ variation.quantity }}</td>
      <td>\${{ variation.price }}</td>
      <td><button>Add to basket</button></td>
    </tr>
  </table>
</div>
```

Create the new method within your `methods` object:

```
methods: {
  updateImage(img) {
    this.image = img;
  },
  variantTitle(variation) {
  }
}
```

We now need to construct a string with the title of the variant, displaying all available options. To do this, we are going to construct an array of each of the types and then join them into a string.

Store the variants as a variable and create an empty array. We can now loop through the keys available within the `variants` object and create a string to output. If you decide to add HTML into the string, as shown in the following example, we will need to update our template to output HTML instead of a raw string:

```
variantTitle(variation) {
  let variants = variation.variant,
  output = [];
  for(let a in variants) {
    output.push(`<b>\${variants[a].name}</b> \${variants[a].value}`);
  }
}
```

Our output array will have an item for each variant, formatted like the following:

```
[ "<b>Color:</b> Alloy", "<b>Size:</b> 49 cm" ]
```

We can now join each one together, which transforms the output from an array to a string. The character, string, or HTML you choose to join it with is up to you. For now, use a / with spaces on either side. Alternatively, you could use `</td><td>` tags to create a new table cell. Add the `join()` function and update the template to use `v-html`:

```
const ProductPage = {  
  name: 'ProductPage',  
  
  template: `<div>  
    <div v-if="product">  
      <div class="images" v-if="image">  
        <div class="main">  
            
        </div>  
  
        <div class="thumbnails" v-if="product.images.length > 1">  
          <template v-for="img in product.images">  
              
          </template>  
        </div>  
      </div>  
    </div>  
  
    <h1>{{ product.title }}</h1>  
  
    <div class="meta">  
      <span>  
        Manufacturer: <strong>{{ product.vendor.title }}</strong>  
      </span>  
      <span v-if="product.type">  
        Category: <strong>{{ product.type }}</strong>  
      </span>  
    </div>  
  
    <div class="variations">  
      <table>  
        <tr v-for="variation in product.variationProducts"  
        :key="variation.barcode">  
          <td v-html="variantTitle(variation)"></td>
```

```
<td>{{ variation.quantity }}</td>
<td>\${{ variation.price }}</td>
<td><button>Add to basket</button></td>
</tr>
</table>
</div>

<div v-html="product.body"></div>

</div>
<page-not-found v-if="productNotFound"></page-not-found>
</div>,

components: {
  PageNotFound
},
data() {
  return {
    productNotFound: false,
    image: false
  }
},
computed: {
  ...
},
methods: {
  updateImage(img) {
    this.image = img;
  },
  variantTitle(variation) {
    let variants = variation.variant,
      output = [];

    for(let a in variants) {
      output.push(`<b>\${variants[a].name}</b> \${variants[a].value}`);
    }

    return output.join(' / ');
  }
};
};
```

Attach a click event to the **Add to basket** button and create a new method on the component. This method will require the variation object to be passed in, so the correct one could be added to the basket. For now, add a JavaScript `alert()` to confirm you have the right one:

```
const ProductPage = {
  name: 'ProductPage',

  template: `<div>
    <div v-if="product">
      <div class="images" v-if="image">
        <div class="main">
          
        </div>

        <div class="thumbnails" v-if="product.images.length > 1">
          <template v-for="img in product.images">
            
          </template>
        </div>
      </div>
    </div>

    <h1>{{ product.title }}</h1>

    <div class="meta">
      <span>
        Manufacturer: <strong>{{ product.vendor.title }}</strong>
      </span>
      <span v-if="product.type">
        Category: <strong>{{ product.type }}</strong>
      </span>
    </div>

    <div class="variations">
      <table>
        <tr v-for="variation in product.variationProducts"
        :key="variation.barcode">
          <td v-html="variantTitle(variation)"></td>
          <td>{{ variation.quantity }}</td>
          <td>${{ variation.price }}</td>
          <td><button @click="addToBasket(variation)">Add to
```

```
basket</button></td>
      </tr>
    </table>
  </div>

  <div v-html="product.body"></div>

</div>
<page-not-found v-if="productNotFound"></page-not-found>
</div>,

components: {
  PageNotFound
},
data() {
  return {
    productNotFound: false,
    image: false
  }
},
computed: {
  product() {
    let product;

    if(Object.keys(this.$store.state.products).length) {

      product = this.$store.state.products[this.$route.params.slug];
      this.image = (product.images.length) ? product.images[0] : false;

      if(!product) {
        this.productNotFound = true;
      }
    }

    console.log(product);
    return product;
  }
},
methods: {
  updateImage(img) {
    this.image = img;
  },
  variantTitle(variation) {
    let variants = variation.variant,
      output = [];
  }
},
```

```
        for(let a in variants) {
            output.push(`<b>${variants[a].name}</b> ${variants[a].value}`);
        }

        return output.join(' / ');
    },

    addToBasket(variation) {
        alert(`Added to basket: ${this.product.title} - ${this.variantTitle(variation)}`);
    }
};

};
```

Note the template literals used within the alert box – this allows us to use Javascript variables without having to use string concatenation techniques. Clicking on the **Add to basket** button will now generate a popup listing of the name of the product and the variation clicked.

## Displaying variations in a select box

A more common interface pattern on product pages is to have a drop-down list, or select box, with your variations displayed and available for selecting.

When using a select box, we will have a variation which has either been selected by default or that the user has interacted with and chosen specifically. Because of this, we can change the image when the user changes the select box and display other pieces of information about the variant on the product page, including price and quantity.

We won't be relying on passing through the variant to the `addToBasket` method, as it will exist as an object on the product component.

Update your `<table>` element to be a `<select>`, and the `<tr>` to an `<option>`. Move the button *outside* of this element and remove the parameter from the `click` event. Remove any HTML from the `variantTitle()` method. Because it is now inside a select box it is not required:

```
<div class="variations">
<select>
    <option
        v-for="variation in product.variationProducts"
        :key="variation.barcode"
        v-html="variantTitle(variation)"
```

```
></option>
</select>

<button @click="addToBasket()">Add to basket</button>
</div>
```

The next step is to create a new variable available to use on the component. In a similar vein to the images, this will be completed with the first item of the `variationProducts` array and updated when the select box changes.

Create a new item in the data object, titled `variation`. Populate this variable when the data is loaded into the `product` computed variable:

```
const ProductPage = {
  name: 'ProductPage',
  template: `...`,
  components: {
    PageNotFound
  },
  data() {
    return {
      productNotFound: false,
      image: false,
      variation: false
    }
  },
  computed: {
    product() {
      let product;
      if (Object.keys(this.$store.state.products).length) {
        product = this.$store.state.products[this.$route.params.slug];
        this.image = (product.images.length) ? product.images[0] : false;
        this.variation = product.variationProducts[0];
        if (!product) {
          this.productNotFound = true;
        }
      }
      console.log(product);
      return product;
    }
  }
}
```

```
},  
  
methods: {  
  ...  
}  
};
```

Update the `addToBasket` method to use the `variation` variable of the `ProductPage` component and not rely on a parameter:

```
addToBasket() {  
  alert(`Added to basket: ${this.product.title} -  
  ${this.variantTitle(this.variation)} `);  
}
```

Try clicking the **Add to basket** button – it should add the first variation, regardless of what is selected in the dropdown. To update the variable on change, we can bind the `variations` variable to the select box – in the same way, that we did our textbox filtering at the beginning of this book.

Add a `v-model` attribute to the `select` element. We will also need to tell Vue what to bind to this variable when selecting. By default, it will do the contents of the `<option>`, which is currently our custom variant title. However, we want to bind the whole `variation` object. Add a `:value` property to the `<option>` element:

```
<div class="variations">  
  <select v-model="variation">  
    <option  
      v-for="variation in product.variationProducts"  
      :key="variation.barcode"  
      :value="variation"  
      v-html="variantTitle(variation)"  
    ></option>  
  </select>  
  
  <button @click="addToBasket()">Add to basket</button>  
</div>
```

Changing the select box and clicking the **Add to basket** button will now produce the correct variation. This method gives us much more flexibility over displaying the variations in a table.

It allows us to display variation data in other places on the product. Try adding the price next to the product title and the quantity within the `meta` container:

```
template: `<div>
  <div v-if="product">
    <div class="images" v-if="image">
      <div class="main">
        
      </div>

      <div class="thumbnails" v-if="product.images.length > 1">
        <template v-for="img in product.images">
          
        </template>
      </div>
    </div>
  </div>

  <h1>{{ product.title }} - \${{ variation.price }}</h1>

  <div class="meta">
    <span>
      Manufacturer: <strong>{{ product.vendor.title }}</strong>
    </span>
    <span v-if="product.type">
      Category: <strong>{{ product.type }}</strong>
    </span>
    <span>
      Quantity: <strong>{{ variation.quantity }}</strong>
    </span>
  </div>

  <div class="variations">
    <select v-model="variation">
      <option
        v-for="variation in product.variationProducts"
        :key="variation.barcode"
        :value="variation"
        v-html="variantTitle(variation)"></option>
    </select>
  <div>
```

```
</div>

<div v-html="product.body"></div>

</div>
<page-not-found v-if="productNotFound"></page-not-found>
</div>,
```

These two new attributes will update when changing the variation. We can also update the image to the selected variation if it has one. To do this, add a `watch` object to your component, which watches the variation variable. When updated, we can check if the variation has an image and, if so, update the image variable with this property:

```
const ProductPage = {
  name: 'ProductPage',
  template: `...`,
  components: {
    ...
  },
  data() {
    ...
  },
  computed: {
    ...
  },
  watch: {
    variation(v) {
      if(v.hasOwnProperty('image')) {
        this.updateImage(v.image);
      }
    }
  },
  methods: {
    ...
  }
};
```

When using `watch`, the function passes the new item as the first parameter. Rather than referring to the one on the component, we can use this to gather the image information.

Another enhancement we can make is to disable the **Add to basket** button and add a note in the dropdown if the variation is out of stock. This information is gathered from the `variation.quantity` key.

Check the quantity and, if less than one, display an **out of stock message** in the select box and disable the **Add to basket** button using the `disabled` HTML attribute. We can also update the value of the button:

```
template: `<div>
  <div v-if="product">
    <div class="images" v-if="image">
      <div class="main">
        
      </div>

      <div class="thumbnails" v-if="product.images.length > 1">
        <template v-for="img in product.images">
          
        </template>
      </div>
    </div>
  </div>

  <h1>{{ product.title }} - \${{ variation.price }}</h1>

  <div class="meta">
    <span>
      Manufacturer: <strong>{{ product.vendor.title }}</strong>
    </span>
    <span v-if="product.type">
      Category: <strong>{{ product.type }}</strong>
    </span>
    <span>
      Quantity: <strong>{{ variation.quantity }}</strong>
    </span>
  </div>

  <div class="variations">
    <select v-model="variation">
```

```
<option
    v-for="variation in product.variationProducts"
    :key="variation.barcode"
    :value="variation"
    v-html="variantTitle(variation) + (!variation.quantity) ? ' - out of stock' : ''">
</option>
</select>

<button @click="addToBasket()" :disabled="!variation.quantity">
    {{ variation.quantity }} ? 'Add to basket' : 'Out of stock' {}
</button>
</div>

<div v-html="product.body"></div>

</div>
<page-not-found v-if="productNotFound"></page-not-found>
</div>,
```

If using the bicycles.csv dataset, the Keirin Pro Track Frameset product (#/product/keirin-pro-track-frame) contains several variations, some without stock. This allows you to test the out of stock functionality along with the image changing.

Another thing we can do to the product page is only show the dropdown when there is more than one variation. An example of a product with only one is the **15 mm Combo Wrench** (#/product/15mm-combo-wrench). In this instance, it is not worth showing the <select> box. As we are setting the variation variable on the Product component on load, we are not relying on the selection to initially set the variable. Because of this, we can completely remove the select box with a v-if="" when there is only one alternate product.

Like we did with the images, check if the length of the array is more than one, this time the variationProducts array:

```
<div class="variations">
<select v-model="variation" v-if="product.variationProducts.length > 1">
<option
    v-for="variation in product.variationProducts"
    :key="variation.barcode"
    :value="variation"
    v-html="variantTitle(variation) + (!variation.quantity) ? ' - out of stock' : ''">
</option>
</select>
```

```
<button @click="addToBasket()" :disabled="!variation.quantity">
  {{ (variation.quantity) ? 'Add to basket' : 'Out of stock' }}
</button>
</div>
```

By removing elements when they are not needed, we now have a less cluttered interface.

## Updating the product details when switching URLs

While navigating through the different product URLs to check variations, you may have noticed that clicking back and forward doesn't update the product data on the page.

This is because `Vue-router` realizes the same component is being used between the pages, and so, rather than destroying and creating a new instance, it reuses the component. The downside to this is that the data does not get updated; we need to trigger a function to include the new product data. The upside is that the code is more efficient.

To tell Vue to retrieve the new data, we need to create a `watch` function; instead of watching a variable, we are going to watch the `$route` variable. When this gets updated, we can load new data.

Create a new variable in the data instance of `slug`, and set the default to be the route parameter. Update the `product` computed function to use this variable instead of the route:

```
const ProductPage = {
  name: 'ProductPage',
  template: `...`,
  components: {
    PageNotFound
  },
  data() {
    return {
      slug: this.$route.params.slug,
      productNotFound: false,
      image: false,
      variation: false
    }
  },
  computed: {
```

```
product() {
  let product;

  if(Object.keys(this.$store.state.products).length) {

    product = this.$store.state.products[this.slug];

    this.image = (product.images.length) ? product.images[0] : false;
    this.variation = product.variationProducts[0];

    if(!product) {
      this.productNotFound = true;
    }
  }

  console.log(product);
  return product;
},
watch: {
  ...
},
methods: {
  ...
},
};
```

We can now create a `watch` function, keeping an eye on the `$route` variable. When this changes, we can update the `slug` variable, which in turn will update the data being displayed.

When watching a route, the function has two parameters passed to it: `to` and `from`. The `to` variable contains everything about the route we are going to, including parameters and the component used. The `from` variable contains everything about the current route.

By updating the `slug` variable to the new parameter when the route changes, we are forcing the component to redraw with new data from the store:

```
const ProductPage = {
  name: 'ProductPage',

  template: `<div>
    <div v-if="product">
      <div class="images" v-if="image">
        <div class="main">
```

```
  
</div>  
  
<div class="thumbnails" v-if="product.images.length > 1">  
  <template v-for="img in product.images">  
      
  </template>  
  </div>  
</div>  
  
<h1>{{ product.title }} - \${{ variation.price }}</h1>  
  
<div class="meta">  
  <span>  
    Manufacturer: <strong>{{ product.vendor.title }}</strong>  
  </span>  
  <span v-if="product.type">  
    Category: <strong>{{ product.type }}</strong>  
  </span>  
  <span>  
    Quantity: <strong>{{ variation.quantity }}</strong>  
  </span>  
</div>  
  
<div class="variations">  
  <select v-model="variation" v-if="product.variationProducts.length  
> 1">  
    <option  
      v-for="variation in product.variationProducts"  
      :key="variation.barcode"  
      :value="variation"  
      v-html="variantTitle(variation) + (!variation.quantity) ? ' -  
out of stock' : ''"></option>  
  </select>  
  
  <button @click="addToBasket()" :disabled="!variation.quantity">  
    {{ (variation.quantity) ? 'Add to basket' : 'Out of stock' }}  
  </button>  
</div>  
  
<div v-html="product.body"></div>
```

```
</div>
<page-not-found v-if="productNotFound"></page-not-found>
</div>,

components: {
  PageNotFound
},
data() {
  return {
    slug: this.$route.params.slug,
    productNotFound: false,
    image: false,
    variation: false
  }
},
computed: {
  product() {
    let product;

    if(Object.keys(this.$store.state.products).length) {

      product = this.$store.state.products[this.slug];

      this.image = (product.images.length) ? product.images[0] : false;
      this.variation = product.variationProducts[0];

      if(!product) {
        this.productNotFound = true;
      }
    }

    return product;
  }
},
watch: {
  variation(v) {
    if(v.hasOwnProperty('image')) {
      this.updateImage(v.image);
    }
  },
  '$route'(to) {
    this.slug = to.params.slug;
  }
},
```

```
methods: {
  updateImage(img) {
    this.image = img;
  },
  variantTitle(variation) {
    let variants = variation.variant,
      output = [];
    for(let a in variants) {
      output.push(` ${variants[a].name}: ${variants[a].value}`);
    }
    return output.join(' / ');
  },
  addToBasket() {
    alert(`Added to basket: ${this.product.title} - ${this.variantTitle(this.variation)}`);
  }
};
```

With our product page completed, we can move on to creating a category listing for both the `type` and `vendor` variables. Remove any `console.log()` calls you have in your code, too, to keep it clean.

## Summary

This chapter has covered a lot. We loaded and stored a CSV file of products into our Vuex store. From there, we created a product detail page that used a dynamic variable in the URL to load a specific product. We have created a product detail view that allows the user to look through a gallery of images and choose a variation from a drop-down list. If the variation has an associated image, the main image updates.

In Chapter 10, *Building an E-Commerce Store – Browsing Products*, we will create a category page, creating filtering and ordering functions – helping the user to find the product they want.

# 10

## Building an E-Commerce Store - Browsing Products

In Chapter 9, *Using Vue-Router Dynamic Routes to Load Data*, we loaded our product data into the Vuex store and created a product detail page where a user could view the product and its variations. When viewing the product detail page, a user could change the variation from the drop-down and the price and other details would update.

In this chapter, we are going to:

- Create a home page listing page with specific products
- Create a category page with a reusable component
- Create an ordering mechanism
- Create filters dynamically and allow the user to filter the products

### **Listing the products**

Before we create any filtering, curated lists, ordering components, and functionality, we need to create a basic product list – showing all the products first, and then we can create a paginated component that we can then reuse throughout the app.

## Adding a new route

Let us add a new route to our `routes` array. For now, we'll work on the `HomePage` component, which will have the `/` route. Make sure you add it to the top of the `routes` array, so it doesn't get overridden by any of the other components:

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      name: 'Home',
      component: HomePage
    },
    {
      path: '/product/:slug',
      component: ProductPage
    },
    {
      path: '/404',
      alias: '*',
      component: PageNotFound
    }
  ]
});
```

Within the `HomePage` component, create a new `computed` property and gather all the products from the store. Ensure the products have loaded before displaying anything in the template. Populate the `HomePage` component with the following code:

```
const HomePage = {
  name: 'HomePage',

  template: `<div v-if="products"></div>`,

  computed: {
    products() {
      return this.$store.state.products;
    }
  }
};
```

## Looping through products

When looking at a category listing for any shop, the data displayed tends to have a recurring theme. It normally consists of an image, title, price, and manufacturer.

Add an ordered list to your template – as the products are going to have an order to them, it makes semantic sense to place them in an ordered list. Within the `<ol>`, add a `v-for` looping through the products and displaying a title for each one, as shown here. It's also good practice to ensure the `product` variable exists before proceeding with displaying it:

```
template: `<div v-if="products">
<ol>
  <li v-for="product in products" v-if="product">
    <h3>{{ product.title }}</h3>
  </li>
</ol>
</div>`,
```

When viewing the page in your browser, you may notice that the product list is very long. Loading images for every one of these products would be a huge load on the user's computer, along with overwhelming the user with that many products on display. Before we add more information, such as price and images, to our template, we'll look at paginating the products, allowing the data to be accessed in more manageable chunks.

## Creating pagination

Creating pagination, initially, seems quite simple – as you only need to return a fixed number of products. However, if we wish to make our pagination interactive and reactive to the product list – it needs to be a bit more advanced. We need to build our pagination to be able to handle different lengths of products – in the case where our product list has been filtered into fewer products.

## Calculating the values

The arithmetic behind creating a pagination component and displaying the correct products relies on four main variables:

- **Items per page:** This is usually set by the user; however, we'll use a fixed number of 12, to begin with
- **Total items:** This is the total number of products to display

- **Number of pages:** This can be calculated by dividing the number of products by the items per page
- **Current page number:** This, combined with the others, will allow us to return exactly which products we need

From these numbers, we can calculate everything needed for our pagination. This includes what products to display, whether to show next/previous links and, if desired, a component to skip to different links.

Before we proceed, we are going to convert our `products` object into an array. This allows us to use the `split` method on it, which will allow us to return a specific list of products. It also means we can easily count the total number of items.

Update your `products` computed function to return an array instead of an object. This is done by using the `map()` function – which is an ES2015 replacement for a simple `for` loop. This function now returns an array containing the product objects:

```
products() {  
  let products = this.$store.state.products;  
  return Object.keys(products).map(key => products[key]);  
},
```

Create a new function in the computed object titled `pagination`. This function will return an object with various figures about our pagination, for example, the total number of pages. This will allow us to create a product list and update the navigation components. We need to only return the object if our `products` variable has data. The function is shown in the following code snippet:

```
computed: {  
  products() {  
    let products = this.$store.state.products;  
    return Object.keys(products).map(key => products[key]);  
  },  
  
  pagination() {  
    if(this.products) {  
      return {  
        }  
    }  
  }  
},
```

We now need to keep track of two variables – items perPage and the currentPage. Create a data function on your HomePage component and store these two variables. We'll give the user the ability to update the perPage variable later on. The highlighted code portion shows our data function:

```
const HomePage = {  
  name: 'HomePage',  
  
  template: `...`,  
  
  data() {  
    return {  
      perPage: 12,  
      currentPage: 1  
    }  
  },  
  
  computed: {  
    ...  
  }  
};
```



You may be wondering when to use local data on a component and when to store the information in the Vuex store. This all depends on where you are going to be using the data and what is going to manipulating it. As a general rule, if only one component uses the data and manipulate it, then use the local data() function. However, if more than one component is going to be interacting with the variable, save it in the central store.

Back to the pagination() computed function, store a variable with the length of the products array. With this as a variable, we can now calculate the total pages. To do this, we are going to do the following equation:

$$\text{total number of products} / \text{items per page}$$

Once we have this result, we need to round it up to the nearest integer. This is because if there is any hangover, we need to create a new page for it.

For example, if you were showing 12 items per page and you had 14 products, that would yield a result of 1.1666 pages – which is not a valid page number. Rounding this up ensures we have two pages to display our products. To do this, use the `Math.ceil()` JavaScript function. We can also add the total number of products to our output. Check the following code for using the `Math.ceil()` function:

```
pagination() {
  if(this.products) {
    let totalProducts = this.products.length;
    return {
      totalProducts: totalProducts,
      totalPages: Math.ceil(totalProducts / this.perPage)
    }
  }
}
```

The next calculation we need to do is work out what the current range of products for the current page is. This is a little more complicated, as not only do we need to work out what we need from the page number, but the array slicing is based on the item index – which means the first item is 0.

To work out where to take our slice from, we can use the following calculation:

$$(current\ page\ number * items\ per\ page) - items\ per\ page$$

The final subtraction may seem odd, but it means on page 1, the result is 0. This allows us to work out at which index we need to slice the `products` array.

As another example, if we were on page three, the result would be 24, which is where the third page would start. The end of the slice is then this result *plus* the number of items per page. The advantage of this means we can update the items per page and all of our calculations will update.

Create an object inside the `pagination` result with these two results – this will allow us to access them later easily:

```
pagination() {
  if(this.products) {
    let totalProducts = this.products.length,
      pageFrom = (this.currentPage * this.perPage) - this.perPage;
    return {
      totalProducts: totalProducts,
      totalPages: Math.ceil(totalProducts / this.perPage),
      range: {
        from: pageFrom,
```

```
        to: pageFrom + this.perPage
    }
}
}
}
```

## Displaying a paginated list

With our pagination properties calculated, we are now able to manipulate our products array using the start and end points. Rather than use a hardcoded value, or use another computed function, we are going to use a method to truncate the product list. This has the advantage of being able to pass on any list of products while also meaning Vue does not cache the result.

Create a new method object inside your component with a new method of paginate. This should accept a parameter that will be the array of products for us to slice. Within the function, we can use the two variables we calculated previously to return the right number of products:

```
methods: {
  paginate(list) {
    return list.slice(
      this.pagination.range.from,
      this.pagination.range.to
    );
  }
}
```

Update the template to use this method when looping through the products:

```
template: `<div v-if="products">
  <ol>
    <li v-for="product in paginate(products)" v-if="product">
      <h3>{{ product.title }}</h3>
    </li>
  </ol>
</div>`,
```

We can now view this in our browser and note it returns the first 12 products from our object. Updating the currentPage variable within the data object to two or three will reveal different lists of products, depending on the number.

To continue our semantic approach to listing our products, we should update the start position of our ordered list when not on page one. This can be done using the HTML attribute of `start` – this allows you to specify with which number you should start an ordered list.

Use the `pagination.range.from` variable to set the starting point of our ordered list – remembering to add `1` as on the first page it will be `0`:

```
template: `<div v-if="products">
  <ol :start="pagination.range.from + 1">
    <li v-for="product in paginate(products)" v-if="product">
      <h3>{{ product.title }}</h3>
    </li>
  </ol>
</div>`
```

When incrementing the page numbers in the code now, you will notice the ordered list starts at the appropriate place for each page.

## Creating paginating buttons

Updating the page number via the code isn't user-friendly – so we should add some pages to increment and decrement the page number variable. To do this, we'll create a function that changes the `currentPage` variable to its value. This allows us to use it for both the **Next page** and **Previous page** buttons, plus a numbered page list if desired.

Begin by creating two buttons within your pagination container. We want to disable these buttons if we are at the extremities of the navigations – for example, you don't want to be able to go below `1` when going back, and past the maximum number of pages when going forward. We can do this by setting the `disabled` attribute on the button – like we did on the product detail page and comparing the current page against these limits.

Add a `disabled` attribute and, on the **Previous page**, the button checks if the current page is one. On the **Next page** button, compare it to the `totalPages` value of our `pagination` method. The code for implementing the previously mentioned attributes is shown here:

```
<button :disabled="currentPage == 1">Previous page</button>
<button :disabled="currentPage == pagination.totalPages">Next page</button>
```

Set the `currentPage` variable back to 1 and load the home page up in the browser. You should notice the Previous page button is disabled. If you change the `currentPage` variable, you will notice the buttons become active and inactive as desired.

We now need to create a click method for the buttons to update the `currentPage`. Create a new function titled `toPage()`. This should accept a single variable – this will directly update the `currentPage` variable:

```
methods: {
  toPage(page) {
    this.currentPage = page;
  },

  paginate(list) {
    return list.slice(this.pagination.range.from,
this.pagination.range.to);
  }
}
```

Add the click handlers to the buttons, passing through `currentPage + 1` for the **Next page** button, and `currentPage - 1` for the **Previous page button**:

```
template: `<div v-if="products">
  <button @click="toPage(currentPage - 1)" :disabled="currentPage ==
1">Previous page</button>
  <button @click="toPage(currentPage + 1)" :disabled="currentPage ==
pagination.totalPages">Next page</button>

  <ol :start="pagination.range.from + 1">
    <li v-for="product in paginate(products)" v-if="product">
      <h3>{{ product.title }}</h3>
    </li>
  </ol>
</div>`
```

We can now navigate back and forth through the products. As a nice addition to the user interface, we could give an indication of the page number and how many pages remain, using the variables available to us by using the code mentioned here:

```
template: `<div v-if="products">
  <p>
    Page {{ currentPage }} out of {{ pagination.totalPages }}
  </p>
  <button @click="toPage(currentPage - 1)" :disabled="currentPage ==
1">Previous page</button>
  <button @click="toPage(currentPage + 1)" :disabled="currentPage ==
pagination.totalPages">Next page</button>
```

```
<ol :start="pagination.range.from + 1">
  <li v-for="product in paginate(products)" v-if="product">
    <h3>{{ product.title }}</h3>
  </li>
</ol>
</div>`
```

## Updating the URL on navigation

Another improvement to the user experience would be to update the URL on page navigation – this would allow the user to share the URL, bookmark it, and return to it later. When paginating, the pages are a *temporary* state and should not be the main endpoint of a URL. Instead, we can take advantage of the query parameters with Vue router.

Update the `toPage` method to add the parameter to the URL on page change. This can be achieved using `$router.push`, however, we need to be careful not to remove any existing parameters that may be in use for filtering in the future. This can be achieved by combining the current query object from the route with a new one containing the `page` variable:

```
toPage(page) {
  this.$router.push({
    query: Object.assign({}, this.$route.query, {
      page
    })
  });

  this.currentPage = page;
},
```

While navigating from page to page, you will notice the URL obtaining a new parameter of `?page=` equal to the current page name. However, pressing refresh will not yield the correct page results but, instead, page one again. This is because we need to pass the `currentPage` query parameter to the `currentPage` variable on our `HomePage` component.

This can be done using the `created()` function – updating the variables – ensuring we've checked for its existence first. The `created` function is part of the Vue life cycle and was covered in Chapter 4, *Getting a List of Files Using the Dropbox API*:

```
created() {
  if(this.$route.query.page) {
    this.currentPage = parseInt(this.$route.query.page);
  }
}
```

We need to ensure the `currentPage` variable is an integer, to help us with any arithmetic we need to do later on as a `string` is not a fan of calculations.

## Creating pagination links

When viewing paginated products, it's often good practice to have a truncated list of page numbers, allowing the user to jump several pages. We already have the mechanism for navigating between pages – this can extend that.

As a simple entry point, we can create a link to every page by looping through until we reach the `totalPages` value. Vue allows us to do this without any JavaScript. Create a `nav` element at the bottom of the component with a list inside. Using a `v-for`, and create a variable of `page` for *every item* in the `totalPages` variable:

```
<nav>
  <ol>
    <li v-for="page in pagination.totalPages">
      <button @click="toPage(page)">{{ page }}</button>
    </li>
  </ol>
</nav>
```

This will create a button for every page – for example, if there are 24 pages in total, this will create 24 links. This is not the desired effect, as we want a few pages before and after the current page. An example of this would be, if the current page is 15, the page links should be 12, 13, 14, 15, 16, 17 and 18. This means there are fewer links and it is less overwhelming for the user.

To begin with, create a new variable in the `data` object, which will note how many pages to show either side of the selected page – a good value to start with is three:

```
data() {
  return {
    perPage: 12,
    currentPage: 1,
    pageLinksCount: 3
  }
},
```

Next, create a new computed function titled `pageLinks`. This function will need to take the current page and work out what page numbers are three less and three more than that. From there, we need to check that the lower range is not less than one, and the upper is not more than the total number of pages. Check that the `products` array has items before proceeding:

```
pageLinks() {
  if(this.products.length) {
    let negativePoint = parseInt(this.currentPage) - this.pageLinksCount,
        positivePoint = parseInt(this.currentPage) + this.pageLinksCount;

    if(negativePoint < 1) {
      negativePoint = 1;
    }

    if(positivePoint > this.pagination.totalPages) {
      positivePoint = this.pagination.totalPages;
    }

    return pages;
  }
}
```

The last step is to create an array and a `for` loop that loops from the lower range to the higher range. This will create an array containing, at most, seven numbers with the page range:

```
pageLinks() {
  if(this.products.length) {
    let negativePoint = parseInt(this.currentPage) - this.pageLinksCount,
        positivePoint = parseInt(this.currentPage) + this.pageLinksCount,
        pages = [];

    if(negativePoint < 1) {
```

```
        negativePoint = 1;
    }

    if(positivePoint > this.pagination.totalPages) {
        positivePoint = this.pagination.totalPages;
    }

    for (var i = negativePoint; i <= positivePoint; i++) {
        pages.push(i)
    }

    return pages;
}
}
```

We can now replace the `pagination.totalPages` variable in our navigation component with the new `pageLinks` variable and the correct number of links will be created, as shown here:

```
<nav>
  <ul>
    <li v-for="page in pageLinks">
      <button @click="toPage(page)">{{ page }}</button>
    </li>
  </ul>
</nav>
```

Viewing this in the browser, however, will render some odd behavior. Although the correct number of links will be generated, clicking on them or using the next/previous buttons will cause the buttons to remain the same – even if you navigate out of the range of the buttons. This is because the computed value is cached. We can combat this in two ways – either move the function into the `method` object or, alternatively, add a `watch` function to watch the route and update the current page.

Opting for the second option means we can ensure no other results and outputs get cached and are updated accordingly. Add a `watch` object to your component and update the `currentPage` variable to that of the `page` query variable. Ensure it exists, otherwise default to one. The `watch` method is as shown here:

```
watch: {
  '$route'(to) {
    this.currentPage = parseInt(to.query.page) || 1;
  }
}
```

This ensures all the computed variables update when a different page is navigated to. Open your `HomePage` component and ensure all your pagination components work accordingly and update the list.

## Updating the items per page

The last user interface addition we need to create is allowing the user to update the number of products per page. To initially set this up, we can create a `<select>` box with a `v-model` attribute that updates the value directly. This works as expected and updates the product list accordingly, as shown:

```
template: `<div v-if="products">
  <p>
    Page {{ currentPage }} out of {{ pagination.totalPages }}
  </p>
  Products per page:
  <select v-model="perPage">
    <option>12</option>
    <option>24</option>
    <option>48</option>
    <option>60</option>
  </select>

  <button @click="toPage(currentPage - 1)" :disabled="currentPage == 1">Previous page</button>
  <button @click="toPage(currentPage + 1)" :disabled="currentPage == pagination.totalPages">Next page</button>

  <ol :start="pagination.range.from + 1">
    <li v-for="product in paginate(products)" v-if="product">
      <h3>{{ product.title }}</h3>
    </li>
  </ol>

  <nav>
    <ul>
      <li v-for="page in pageLinks">
        <button @click="toPage(page)">{{ page }}</button>
      </li>
    </ul>
  </nav>
</div>
```

The issue with this is if the user is on a page higher than is possible once the value has changed. For example, if there are 30 products with 12 products per page, this would create three pages. If the user navigates to page three and then selects 24 products per page, there would only be two pages needed and page three would be empty.

This can be resolved, once again, with a watch function. When the `perPage` variable updates, we can check if the current page is higher than the `totalPages` variable. If it is, we can redirect it to the last page:

```
watch: {
  '$route'(to) {
    this.currentPage = parseInt(to.query.page);
  },
  perPage() {
    if(this.currentPage > this.pagination.totalPages) {
      this.$router.push({
        query: Object.assign({}, this.$route.query, {
          page: this.pagination.totalPages
        })
      })
    }
  }
}
```

## Creating the ListProducts component

Before we proceed with creating the filtering and ordering, we need to extract our product listing logic and template it into our component – allowing us to easily reuse it. This component should accept a prop of `products`, which it should be able to list and paginate.

Open up the `ListProducts.js` file and copy the code from the `HomePage.js` file into the component. Move the `data` object and copy the `pagination` and `pageLinks` computed functions. Move the `watch` and `methods` objects, as well as the `created()` function, from the `HomePage` to the `ListProducts` file.

Update the `HomePage` template to use the `<list-products>` components with a `products` prop, passing in the `products` computed value. In comparison, the `HomePage` component should now be significantly smaller:

```
const HomePage = {
  name: 'HomePage',
```

```
template: `<div>
  <list-products :products="products"></list-products>
</div>`,

computed: {
  products() {
    let products = this.$store.state.products;
    return Object.keys(products).map(key => products[key]);
  }
}
};
```

Within the `ListProducts` component, we need to add a `props` object, to let the component know what to expect. This component is now significant. There are a few more things we need to add to this component to make it more versatile. They include:

- Showing the next/previous links if there is more than one page
- Showing the "products per page" component if there are more than 12 products, and only showing each step if there are more products than in the preceding step
- Only showing the `pageLinks` component if it's more than our `pageLinksCount` variable

All of these additions have been added to the following component code as follows. We have also removed the unnecessary `products` `computed` value:

```
Vue.component('list-products', {
  template: `<div v-if="products">
  <p v-if="pagination.totalPages > 1">
    Page {{ currentPage }} out of {{ pagination.totalPages }}
  </p>

  <div v-if="pagination.totalProducts > 12">
    Products per page:
    <select v-model="perPage">
      <option>12</option>
      <option>24</option>
      <option v-if="pagination.totalProducts > 24">48</option>
      <option v-if="pagination.totalProducts > 48">60</option>
    </select>
  </div>

  <button
    @click="toPage(currentPage - 1)"
    :disabled="currentPage == 1"
    v-if="pagination.totalPages > 1"
  >
```

```
    Previous page
  </button>
  <button
    @click="toPage(currentPage + 1)"
    :disabled="currentPage == pagination.totalPages"
    v-if="pagination.totalPages > 1"
  >
    Next page
  </button>

  <ol :start="pagination.range.from + 1">
    <li v-for="product in paginate(products)" v-if="product">
      <h3>{{ product.title }}</h3>
    </li>
  </ol>

  <nav v-if="pagination.totalPages > pageLinksCount">
    <ul>
      <li v-for="page in pageLinks">
        <button @click="toPage(page)">{{ page }}</button>
      </li>
    </ul>
  </nav>
</div>`,

props: {
  products: Array
},
data() {
  return {
    perPage: 12,
    currentPage: 1,
    pageLinksCount: 3
  }
},
computed: {
  pagination() {
    if(this.products) {
      let totalProducts = this.products.length,
        pageFrom = (this.currentPage * this.perPage) - this.perPage,
        totalPages = Math.ceil(totalProducts / this.perPage);
      return {
        totalProducts: totalProducts,
        totalPages: Math.ceil(totalProducts / this.perPage),
        range: {
          from: pageFrom,
```

```
          to: pageFrom + this.perPage
        }
      }
    },
  },
  pageLinks() {
    if(this.products.length) {
      let negativePoint = this.currentPage - this.pageLinksCount,
        positivePoint = this.currentPage + this.pageLinksCount,
        pages = [];

      if(negativePoint < 1) {
        negativePoint = 1;
      }

      if(positivePoint > this.pagination.totalPages) {
        positivePoint = this.pagination.totalPages;
      }

      for (var i = negativePoint; i <= positivePoint; i++) {
        pages.push(i)
      }

      return pages;
    }
  },
  watch: {
    '$route'(to) {
      this.currentPage = parseInt(to.query.page);
    },
    perPage() {
      if(this.currentPage > this.pagination.totalPages) {
        this.$router.push({
          query: Object.assign({}, this.$route.query, {
            page: this.pagination.totalPages
          })
        })
      }
    }
  },
  created() {
    if(this.$route.query.page) {
      this.currentPage = parseInt(this.$route.query.page);
    }
  }
},
```

```
        },
    },

    methods: {
        toPage(page) {
            this.$router.push({
                query: Object.assign({}, this.$route.query, {
                    page
                })
            });
        }

        this.currentPage = page;
    },

    paginate(list) {
        return list.slice(this.pagination.range.from,
this.pagination.range.to)
    }
},
});
```

You can verify your conditional rendering tags are working by temporarily truncating the products array in the `HomePage` template – don't forget to remove it once you're done:

```
products() {
    let products = this.$store.state.products;
    return Object.keys(products).map(key => products[key]).slice(1, 10);
}
```

## Creating a curated list for the home page

With our product listing component in place, we can proceed with making a curated list of products for our home page, and add more information to the product listing.

In this example, we are going to hardcode an array of product handles on our home page component that we want to display. If this were in development, you would expect this list to be controlled via a content management system or similar.

Create a data function on your `HomePage` component, that which includes an array titled `selectedProducts`:

```
data() {
  return {
    selectedProducts: []
  }
},
```

Populate the array with several handles from the product list. Try and get about six, but if you go over 12, remember it will paginate with our component. Add your selected handles to the `selectedProducts` array:

```
data() {
  return {
    selectedProducts: [
      'adjustable-stem',
      'colorful-fixie-lima',
      'fizik-saddle-pak',
      'kenda-tube',
      'oury-grip-set',
      'pure-fix-pedals-with-cages'
    ]
  }
},
```

With our selected handles, we can now filter the product list to only include a list of products included in our `selectedProducts` array. The initial instinct might be to use the JavaScript `filter()` function on the `products` array combined with `includes()`:

```
products() {
  let products = this.$store.state.products;

  products = Object.keys(products).map(key => products[key]);
  products = products.filter(product =>
    this.selectedProducts.includes(product.handle));
  return products;
}
```

The issue with this is that, although it appears to work, it does not respect the ordering of the selected products. The `filter` function simply removes any items that do not match and leaves the remaining products in the order they are loaded.

Fortunately, our products are saved in a key/value pair with the handle as the key. Using this, we can utilize the `products` object and return an array using a `for` loop.

Create an empty array, `output`, within the computed function. Looping through the `selectedProducts` array, find each required product and add to the `output` array:

```
products() {
  let products = this.$store.state.products,
  output = [];

  if(Object.keys(products).length) {
    for(let featured of this.selectedProducts) {
      output.push(products[featured]);
    }
    return output;
  }
}
```

This creates the same product list but, this time, in the correct order. Try re-ordering, adding, and deleting items to ensure your list reacts accordingly.

## Showing more information

We can now work on showing more product information in our `ListProduct` component. As mentioned near the beginning of the chapter, we should display:

- Image
- Title
- Price
- Manufacturer

We're already displaying the title, and the image and manufacturer can easily be pulled out from the product information. Don't forget to always retrieve the first image from the `images` array. Open up the `ListProducts.js` file and update the product to display this information – making sure you check whether the image exists before displaying it.

The manufacturer title is listed under the `vendor` object in the product data:

```
<ol :start="pagination.range.from + 1">
  <li v-for="product in paginate(products)" v-if="product">
    
    <h3>{{ product.title }}</h3>
    <p>Made by: {{ product.vendor.title }}</p>
  </li>
</ol>
```

The price is going to be a little more complicated to work out. This is because each variation on the product can have a different price, however, these are often the same. If there are different prices we should display the cheapest one with a *from* prepended.

We need to create a function that loops through the variations and works out the cheapest price and, if there is a price range, add the word *from*. To achieve this, we are going to loop through the variations and build up an array of unique prices – if the price does not already exist in the array. Once complete, we can check the length – if there is more than one price, we can add the prefix, if not, it means all variations are the same price.

Create a new method on the `ListProducts` component called `productPrice`. This accepts one parameter, which will be the variations. Inside, create an empty array, `prices`:

```
productPrice(variations) {  
  let prices = [];  
}
```

Loop through the variations and append the price to the `prices` array if it does not exist already. Create a `for` loop that uses the `includes()` function to check if the price exists in the array:

```
productPrice(variations) {  
  let prices = [];  
  
  for(let variation of variations) {  
    if(!prices.includes(variation.price)) {  
      prices.push(variation.price);  
    }  
  }  
}
```

With our array of prices, we can now extract the lowest number and check whether there is more than one item.

To extract the lowest number from an array, we can use the JavaScript `Math.min()` function. Use the `.length` property to check the length of the array. Lastly, return the `price` variable:

```
productPrice(variations) {  
  let prices = [];  
  
  for(let variation of variations) {  
    if(!prices.includes(variation.price)) {  
      prices.push(variation.price);  
    }  
  }  
}
```

```
let price = '$' + Math.min(...prices);

if(prices.length > 1) {
    price = 'From: ' + price;
}

return price;
}
```

Add your `productPrice` method to your template, remembering to pass `product.variationProducts` into it. The last thing we need to add to our template is a link to the product:

```
<ol :start="pagination.range.from + 1">
  <li v-for="product in paginate(products)" v-if="product">
    <router-link :to="'/product/' + product.handle">
      
    </router-link>

    <h3>
      <router-link :to="'/product/' + product.handle">
        {{ product.title }}
      </router-link>
    </h3>

    <p>Made by: {{ product.vendor.title }}</p>
    <p>Price {{ productPrice(product.variationProducts) }}</p>
  </li>
</ol>
```

Ideally, the product links should use a named route and not a hardcoded link, in case the route changes. Add a name to the product route and update the `to` attribute to use the name instead:

```
{
  path: '/product/:slug',
  name: 'Product',
  component: ProductPage
}
```

Update the template to now use the route name, with the `params` object:

```
<ol :start="pagination.range.from + 1">
  <li v-for="product in paginate(products)" v-if="product">
    <router-link :to="{name: 'Product', params: {slug: product.handle}}">
      
    </router-link>
    <h3>
      <router-link :to="{name: 'Product', params: {slug: product.handle}}">
        {{ product.title }}
      </router-link>
    </h3>
    <p>Made by: {{ product.vendor.title }}</p>
    <p>Price {{ productPrice(product.variationProducts) }}</p>
  </li>
</ol>
```

## Creating categories

A shop is not really a usable shop if it does not have categories to navigate by. Fortunately, each of our products has a `type` key that indicates a category for it to be shown in. We can now create a category page that lists products from that particular category.

## Creating a category list

Before we can display the products in a particular category, we first need to generate a list of available categories. To help with the performance of our app, we will also store the handles of the products in each category. The categories structure will look like the following:

```
categories = {
  tools: {
    name: 'Tools',
    handle: 'tools',
    products: ['product-handle', 'product-handle'...]
  },
  freewheels: {
    name: 'Freewheels',
    handle: 'freewheels',
    products: ['another-product-handle', 'product'...]
  }
};
```

Creating the category list like this means we readily have available the list of products within the category while being able to loop through the categories and output the `title` and `handle` to create a list of links to categories. As we already have this information, we will create the category list once we've retrieved the product list.

Open up `app.js` and navigate to the `created()` method on the `Vue` instance. Rather than creating a second `$store.commit` underneath the `products` storing method, we are going to utilize a different functionality of Vuex – actions.

Actions allow you to create functions in the store itself. Actions are unable to mutate the state directly – that is still down to mutations, but it allows you to group several mutations together, which in this instance, suits us perfectly. Actions are also perfect if you want to run an asynchronous operation before mutating the state – for example with a `setTimeout` JavaScript function.

Navigate to your `Vuex.Store` instance and, after the mutations, add a new object of actions. Inside, create a new function titled `initializeShop`:

```
const store = new Vuex.Store({
  state: {
    products: {}
  },
  mutations: {
    products(state, payload) {
      state.products = payload;
    }
  },
  actions: {
    initializeShop() {
    }
  }
});
```

With action parameters, the first parameter is the store itself, which we need to use in order to utilize the mutations. There are two ways of doing this, the first is to use a single variable and access its properties within the function. For example:

```
actions: {
  initializeShop(store) {
    store.commit('products');
  }
}
```

However, with ES2015, we are able to use argument destructuring and utilize the properties we need. For this action, we only need the `commit` function, like so:

```
actions: {
  initializeShop({commit}) {
    commit('products');
  }
}
```

If we wanted the state from the store as well, we could add it to the curly brackets:

```
actions: {
  initializeShop({state, commit}) {
    commit('products');
    // state.products
  }
}
```

Using this "exploded" method of accessing the properties makes our code cleaner and less repetitive. Remove the `state` property and add a second parameter after the curly brackets labeled `products`. This will be our formatted product's data. Pass that variable directly to the product's `commit` function:

```
initializeShop({commit}, products) {
  commit('products', products);
}
```

Using actions is as simple as using mutations, except instead of using `$store.commit`, you use `$store.dispatch`. Update your created method – not forgetting to change the function name too, and check your app still works:

```
created() {
  CSV.fetch({url: './data/csv-files/bicycles.csv'}).then(data => {
    this.$store.dispatch('initializeShop', this.$formatProducts(data));
  });
}
```

The next step is to create a mutation for our categories. As we may want to update our categories independently of our products – we should create a second function within the mutations. It should also be this function that loops through the products and creates the list of categories.

First, make a new property in the state object titled `categories`. This should be an object by default:

```
state: {  
  products: {},  
  categories: {}  
}
```

Next, create a new mutation called `categories`. Along with the state, this should take a second parameter. To be consistent, title it `payload` – as this is what Vuex refers to it as:

```
mutations: {  
  products(state, payload) {  
    state.products = payload;  
  },  
  
  categories(state, payload) {  
  }  
},
```

Now for the functionality. This mutation needs to loop through the products. For every product, it needs to isolate the `type`. Once it has the title and slug, it needs to check if an entry exists with that slug; if it does, append the product handle to the `products` array, if not – it needs to create a new array and details.

Create an empty `categories` object and loop through the payload, setting a variable for both the product and type:

```
categories(state, payload) {  
  let categories = {};  
  
  Object.keys(payload).forEach(key => {  
    let product = payload[key],  
        type = product.type;  
  });  
}
```

We now need to check if an entry exists with the key of the current `type.handle`. If it does not, we need to create a new entry with it. The entry needs to have the title, handle, and an empty `products` array:

```
categories(state, payload) {  
  let categories = {};  
  
  Object.keys(payload).forEach(key => {  
    let product = payload[key],  
        type = product.type;
```

```
if(!categories.hasOwnProperty(type.handle)) {
  categories[type.handle] = {
    title: type.title,
    handle: type.handle,
    products: []
  }
}
});
```

Lastly, we need to append the current product handle onto the products array of the entry:

```
categories(state, payload) {
  let categories = {};

  Object.keys(payload).forEach(key => {
    let product = payload[key],
      type = product.type;

    if(!categories.hasOwnProperty(type.handle)) {
      categories[type.handle] = {
        title: type.title,
        handle: type.handle,
        products: []
      }
    }

    categories[type.handle].products.push(product.handle);
  });
}
```

You can view the `categories` output by adding `console.log` to the end of the function:

```
categories(state, payload) {
  let categories = {};

  Object.keys(payload).forEach(key => {
    ...
  });

  console.log(categories);
}
```

Add the mutation to the `initializeShop` action:

```
initializeShop({commit}, products) {
  commit('products', products);
  commit('categories', products);
}
```

Viewing the app in the browser, you will be faced with a JavaScript error. This is because some products do not contain a "type" for us to use to categorize them. Even with the JavaScript error resolved, there are still a lot of categories that get listed out.

To help with the number of categories, and to group the uncategorized products, we should make an "Miscellaneous" category. This will collate all the categories with two or fewer products and group the products into their own group.

## Creating a "miscellaneous" category

The first issue we need to negate is the nameless category. When looping through our products, if no type is found, we should insert a category, so everything is categorized.

Create a new object in the `categories` method that contains the title and handle for a new category. For the handle and variable call it `other`. Make the title a bit more user-friendly by calling it *Miscellaneous*.

```
let categories = {},
  other = {
    title: 'Miscellaneous',
    handle: 'other'
};
```

When looping through products, we can then check to see whether the `type` key exists, if not, create an `other` category and append to it:

```
Object.keys(payload).forEach(key => {
  let product = payload[key],
    type = product.hasOwnProperty('type') ? product.type : other;

  if(!categories.hasOwnProperty(type.handle)) {
    categories[type.handle] = {
      title: type.title,
      handle: type.handle,
      products: []
    }
}
```

```
    categories[type.handle].products.push(product.handle);
});
```

Viewing the app now will reveal all the categories in the JavaScript console – allowing you to see the magnitude of how many categories there are.

Let's combine any categories with two or fewer products into the "other" category – not forgetting to remove the category afterward. After the product loop, loop through the categories, checking the count of the products available. If fewer than three, add them to the "other" category:

```
Object.keys(categories).forEach(key => {
  let category = categories[key];

  if(category.products.length < 3) {
    categories.other.products =
    categories.other.products.concat(category.products);
  }
});
```

We can then delete the category we've just stolen the products from:

```
Object.keys(categories).forEach(key => {
  let category = categories[key];

  if(category.products.length < 3) {
    categories.other.products =
    categories.other.products.concat(category.products);
    delete categories[key];
  }
});
```

And with that, we have a much more manageable list of categories. One more improvement we can make is to ensure the categories are in alphabetical order. This helps users find their desired category much quicker. In JavaScript, arrays can be sorted a lot more easily than objects, so once again, we need to loop through an array of the object keys and sort them. Create a new object and add the categories as they are sorted to it. Afterward, store this on the `state` object so we have the categories available to us:

```
categories(state, payload) {
  let categories = {},
    other = {
      title: 'Miscellaneous',
      handle: 'other'
    };

  Object.keys(payload).forEach(key =>
```

```
let product = payload[key],  
    type = product.hasOwnProperty('type') ? product.type : other;  
  
if(!categories.hasOwnProperty(type.handle)) {  
    categories[type.handle] = {  
        title: type.title,  
        handle: type.handle,  
        products: []  
    }  
}  
  
categories[type.handle].products.push(product.handle);  
});  
  
Object.keys(categories).forEach(key => {  
    let category = categories[key];  
  
    if(category.products.length < 3) {  
        categories.other.products =  
        categories.other.products.concat(category.products);  
        delete categories[key];  
    }  
});  
  
let categoriesSorted = {}  
Object.keys(categories).sort().forEach(key => {  
    categoriesSorted[key] = categories[key]  
});  
state.categories = categoriesSorted;  
}
```

With that, we can now add a list of categories to our `HomePage` template. For this, we'll create named `router-view` components – allowing us to put things in the sidebar of the shop on selected pages.

## Displaying the categories

With our categories stored, we can now proceed with creating our `ListCategories` component. We want to display our category navigation in a sidebar on the home page, and also on a shop category page. As we want to show it in several places, we have a couple of options as to how we display it.

We can use the component in the template as we have with the `<list-products>` component. The issue with this is that if we want to display our list in a sidebar and our sidebar needs to be consistent across the site, we would have to copy and paste a lot of HTML between views.

A better approach would be to use named routes and set the template once in our `index.html`.

Update the app template to contain a `<main>` and an `<aside>` element. Within these, create a `router-view`, leaving the one inside `main` unnamed, while giving the one inside the `aside` element a name of `sidebar`:

```
<div id="app">
  <main>
    <router-view></router-view>
  </main>
  <aside>
    <router-view name="sidebar"></router-view>
  </aside>
</div>
```

Within our routes object, we can now add different components to different named views. On the Home route, change the `component` key to `components`, and add an object - specifying each component and its view:

```
{
  path: '/',
  name: 'Home',
  components: {
    default: HomePage,
    sidebar: ListCategories
  }
}
```

The `default` indicates that the component will go into the unnamed `router-view`. This allows us to still use the singular `component` key if required. For the component to be correctly loaded into the sidebar view, we need to alter how the `ListCategories` component is initialized. Instead of using `Vue.component`, initialize it as you would a `view component`:

```
const ListCategories = {
  name: 'ListCategories'
};
```

We can now proceed with making the template for the category list. As our categories are saved in the store, loading and displaying them should be familiar by now. It is advised you load the categories from the state into a computed function - for cleaner template code and easier adaptation should you need to manipulate it in any way.

Before we create the template, we need to create a route for the category. Referring back to our plan in [Chapter 9, Using Vue-Router Dynamic Routes to Load Data](#), we can see the route is going to be `/category/:slug` – add this route with a `name` and enable `props`, as we'll utilize them for the `slug`. Ensure you have made the `CategoryPage` file and initialized the component.

```
const router = new VueRouter({
  routes: [
    {
      path: '/',
      name: 'Home',
      components: {
        default: HomePage,
        sidebar: ListCategories
      }
    },
    {
      path: '/category/:slug',
      name: 'Category',
      component: CategoryPage,
      props: true
    },
    {
      path: '/product/:slug',
      name: 'Product',
      component: ProductPage
    },
    {
      path: '/404',
      alias: '*',
      component: PageNotFound
    }
  ]
});
```

Back to our `ListCategories` component; loop through the stored categories and create a link for each one. Show the product count in brackets after each name:

```
const ListCategories = {
  name: 'ListCategories',

  template: `<div v-if="categories">
    <ul>
      <li v-for="category in categories">
        <router-link :to="{name: 'Category', params: {slug:
          category.handle}}">
          {{ category.title }} ({{ category.products.length }})
        </router-link>
      </li>
    </ul>
  </div>`,

  computed: {
    categories() {
      return this.$store.state.categories;
    }
  }
};
```

With the links to our categories now showing on the home page, we can head on to make a category page.

## Displaying products in a category

Clicking one of the category links (that is, `/#/category/grips`) will navigate to a blank page – thanks to our route. We need to create a template and set up the category page to show the products. As a starting base, create the `CategoryPage` component in a similar vein to the product page.

Create a template with an empty container and the `PageNotFound` component inside. Create a data variable titled `categoryNotFound`, and ensure the `PageNotFound` component displays if this is set to `true`. Create a `props` object, which allows the `slug` property to be passed and, lastly, create a `category` computed function.

The `CategoryPage` component should look like the following:

```
const CategoryPage = {
  name: 'CategoryPage',
```

```
template: `<div>
  <div v-if="category"></div>
  <page-not-found v-if="categoryNotFound"></page-not-found>
</div>`,

components: {
  PageNotFound
},

props: {
  slug: String
},
data() {
  return {
    categoryNotFound: false,
  }
},
computed: {
  category() {
  }
}
};
```

Inside the `category` computed function, load the correct category from the store based on the slug. If it is not on the list, mark the `categoryNotFound` variable to true - similar to what we did in the `ProductPage` component:

```
computed: {
  category() {
    let category;

    if(Object.keys(this.$store.state.categories).length) {
      category = this.$store.state.categories[this.slug];

      if(!category) {
        this.categoryNotFound = true;
      }
    }

    return category;
  }
}
```

With our category loaded, we can output the title in the template:

```
template: `<div>
  <div v-if="category">
    <h1>{{ category.title }}</h1>
  </div>
  <page-not-found v-if="categoryNotFound"></page-not-found>
</div>`,
```

We can now proceed with displaying the products on our category page. To do this, we can use the code from the `HomePage` component as we have exactly the same scenario – an array of product handles.

Create a new computed function that takes the current category products and processes them as we did on the home page:

```
computed: {
  category() {
    ...
  },
  products() {
    if(this.category) {
      let products = this.$store.state.products,
        output = [];

      for(let featured of this.category.products) {
        output.push(products[featured]);
      }

      return output;
    }
  }
}
```

We don't need to check whether the products exist in this function as we are checking whether the category exists, and that would only return true if the data had been loaded. Add the component to the HTML and pass in the `products` variable:

```
template: `<div>
  <div v-if="category">
    <h1>{{ category.title }}</h1>
    <list-products :products="products"></list-products>
  </div>
  <page-not-found v-if="categoryNotFound"></page-not-found>
</div>`
```

With that, we have our category products listed out for each category.

## Code optimization

With our `CategoryPage` component complete, we can see a lot of similarities between that and the home page – the only difference being the home page has a fixed product array. To save repetition, we can combine these two components – meaning we only have to ever update one if we need to.

We can address the fixed array issue by displaying it when we identify that we are on the home page. The way of doing that is to check if the `slug` prop has a value. If not, we can assume we are on the home page.

First, update the `Home` route to point to the `CategoryPage` component and enable props. When using named views, you have to enable props for each of the views. Update the `props` value to be an object with each of the named views, enabling the props for each:

```
{  
  path: '/',  
  name: 'Home',  
  components: {  
    default: CategoryPage,  
    sidebar: ListCategories  
  },  
  props: {  
    default: true,  
    sidebar: true  
  }  
}
```

Next, create a new variable in the `data` function of the `CategoryPage`, titled `categoryHome`. This is going to be an object that follows the same structure as the category objects, containing a `products` array, title, and handle. Although the handle won't be used, it is good practice to follow conventions:

```
data() {  
  return {  
    categoryNotFound: false,  
    categoryHome: {  
      title: 'Welcome to the Shop',  
      handle: 'home',  
      products: [  
        'adjustable-stem',  
        'fizik-saddle-pak',  
        'fizik-saddle-pak',  
        'fizik-saddle-pak'  
      ]  
    }  
  }  
}
```

```
        'kenda-tube',
        'colorful-fixie-lima',
        'oury-grip-set',
        'pure-fix-pedals-with-cages'
    ]
}
}
}
```

The last thing we need to do is check whether the slug exists. If not, assign our new object to the category variable within the computed function:

```
category() {
  let category;

  if(Object.keys(this.$store.state.categories).length) {
    if(this.slug) {
      category = this.$store.state.categories[this.slug];
    } else {
      category = this.categoryHome;
    }

    if(!category) {
      this.categoryNotFound = true;
    }
  }

  return category;
}
```

Head to the home page and verify your new component is working. If it is, you can delete `HomePage.js` and remove it from `index.html`. Update the category route to also include the category list in the sidebar and use the `props` object:

```
{
  path: '/category/:slug',
  name: 'Category',
  components: {
    default: CategoryPage,
    sidebar: ListCategories
  },
  props: {
    default: true,
    sidebar: true
  }
},
```

## Ordering products in a category

With our category pages displaying the right products, it's time to add some ordering options within our `ListProducts` component. When viewing a shop online, you can normally order the products by the following:

- Title: Ascending (A - Z)
- Title: Descending (Z - A)
- Price: Ascending (\$1 - \$999)
- Price: Descending (\$999 - \$1)

However, once we have the mechanism in place, you can add any ordering criteria you want.

Start off by creating a select box in your `ListProducts` component with each of the preceding values. Add an extra first one of **Sort products by...**:

```
<div class="ordering">
  <select>
    <option>Order products</option>
    <option>Title - ascending (A - Z)</option>
    <option>Title - descending (Z - A)</option>
    <option>Price - ascending ($1 - $999)</option>
    <option>Price - descending ($999 - $1)</option>
  </select>
</div>
```

We now need to create a variable for the select box to update in the `data` function. Add a new key titled `ordering` and add a value to each option, so interpreting the value is easier. Construct the value by using the field and order, separated by a hyphen. For example, `Title - ascending (A - Z)` would become `title-asc`:

```
<div class="ordering">
  <select v-model="ordering">
    <option value="">Order products</option>
    <option value="title-asc">Title - ascending (A - Z)</option>
    <option value="title-desc">Title - descending (Z - A)</option>
    <option value="price-asc">Price - ascending ($1 - $999)</option>
    <option value="price-desc">Price - descending ($999 - $1)</option>
  </select>
</div>
```

And the updated `data` function becomes:

```
data() {
  return {
    perPage: 12,
    currentPage: 1,
    pageLinksCount: 3,
    ordering: ''
  }
}
```

To update the order of the products we now need to manipulate the product list. This needs to be done before the list gets split for pagination - as the user would expect the whole list to be sorted, not just the current page.

## Store the product price

Before we proceed, there is an issue we need to address. To sort by price, the price needs to ideally be available on the product itself, not calculated specifically for the template, which it currently is. To combat this, we are going to calculate the price before the products get added to the store. This means it will be available as a property on the product itself, rather than being dynamically created.

The details we need to know are the cheapest price and whether the product has many prices within its variations. The latter means we know whether we need to display the "From:" when listing the products out. We will create two new properties for each product: `price` and `hasManyPrices`.

Navigate to the `products` mutation in the store and create a new object and a loop of the products:

```
products(state, payload) {
  let products = {};

  Object.keys(payload).forEach(key => {
    let product = payload[key];

    products[key] = product;
  });
  state.products = payload;
}
```

Copy the code from the `productPrice` method on the `ListProducts` component and place it within the loop. Update the second `for` loop so it loops through `product.variationProducts`. Once this `for` loop has completed, we can add the new properties to the product. Lastly, update the state with the new products object:

```
products(state, payload) {
  let products = {};

  Object.keys(payload).forEach(key => {
    let product = payload[key];

    let prices = [];
    for(let variation of product.variationProducts) {
      if(!prices.includes(variation.price)) {
        prices.push(variation.price);
      }
    }

    product.price = Math.min(...prices);
    product.hasManyPrices = prices.length > 1;

    products[key] = product;
  });

  state.products = products;
}
```

We can now update the `productPrice` method on the `ListProducts` component. Update the function so it accepts the product, instead of variations. Remove the `for` loop from the function, and update the variables so they use the `price` and `hasManyPrices` properties of the product instead:

```
productPrice(product) {
  let price = '$' + product.price;

  if(product.hasManyPrices) {
    price = 'From: ' + price;
  }

  return price;
}
```

Update the template so the product is passed to the function:

```
<p>Price {{ productPrice(product) }}</p>
```

## Wiring up the ordering

With our price readily available, we can proceed with wiring up the ordering. Create a new computed function titled `orderProducts` that returns `this.products`. We want to ensure we are always sorting from the source and not ordering something that has previously been ordered. Call this new function from within the `paginate` function and remove the parameter from this method and from the template:

```
computed: {
  ...
  orderProducts() {
    return this.products;
  },
}

methods: {
  paginate() {
    return this.orderProducts.slice(
      this.pagination.range.from,
      this.pagination.range.to
    );
  },
}
```

To determine how we need to sort the products, we can use the `this.ordering` value. If it exists, we can split the string on the hyphen, meaning we have an array containing the field and order type. If it does not exist, we need to simply return the existing product array:

```
orderProducts() {
  let output;

  if(this.ordering.length) {
    let orders = this.ordering.split('-');
  } else {
    output = this.products;
  }
  return output;
}
```

Sort the `products` array based on the value of the first item of the ordering array. If it is a string, we will use `localCompare`, which ignores cases when comparing. Otherwise, we will simply subtract one value from the other – this is what the `sort` function expects:

```
orderProducts() {
  let output;
```

```
if(this.ordering.length) {
    let orders = this.ordering.split('-');
    output = this.products.sort(function(a, b) {
        if(typeof a[orders[0]] == 'string') {
            return a[orders[0]].localeCompare(b[orders[0]]);
        } else {
            return a[orders[0]] - b[orders[0]];
        }
   ));
}

} else {
    output = this.products;
}
return output;
}
```

Lastly, we need to check if the second item in the `orders` array is `asc` or `desc`. By default, the current sort function will return the items sorted in an ascending order, so if the value is `desc`, we can reverse the array:

```
orderProducts() {
    let output;

    if(this.ordering.length) {
        let orders = this.ordering.split('-');
        output = this.products.sort(function(a, b) {
            if(typeof a[orders[0]] == 'string') {
                return a[orders[0]].localeCompare(b[orders[0]]);
            } else {
                return a[orders[0]] - b[orders[0]];
            }
       ));
    }

    if(orders[1] == 'desc') {
        output.reverse();
    }
} else {
    output = this.products;
}
return output;
}
```

Head to your browser and check out the ordering of products!

## Creating Vuex getters

The last step to making our category page just like any other shop is the introduction of filtering. Filtering allows you to find products that have particular sizes, colors, tags, or manufacturers. Our filtering options are going to be built from the products on the page. For example, if none of the products have an XL size or a blue color, there is no point showing that as a filter.

To achieve this, we are going to need to pass the products of the current category to the filtering component as well. However, the products get processed on the `CategoryPage` component. Instead of repeating this processing, we can move the functionality to a Vuex store getter. Getters allow you to retrieve data from the store and manipulate it like you would in a function on a component. Because it is a central place, however, it means several components can benefit from the processing.

Getters are the Vuex equivalent of computed functions. They are declared as functions but called as variables. However, they can be manipulated to accept parameters by returning a function inside them.

We are going to move both the `category` and `products` functions from the `CategoryPage` component into the getter. The getter function will then return an object with the category and products.

Create a new object in your store titled `getters`. Inside, create a new function called `categoryProducts`:

```
getters: {  
  categoryProducts: () => {  
    }  
}
```

Getters themselves receive two parameters, the state as the first, and any other getters as the second. To pass a parameter to a getter, you have to return a function inside of the getter that receives the parameter. Fortunately, in ES2015, this can be achieved with the double arrow (`=>`) syntax. As we are not going to be using any other getters in this function, we do not need to call the second parameter.

As we are abstracting all of the logic out, pass in the `slug` variable as the parameter of the second function:

```
categoryProducts: (state) => (slug) => {  
}
```

As we are transferring the logic for selecting and retrieving the categories and products into the store, it makes sense to store the `HomePage` category content in the state itself:

```
state: {  
  products: {},  
  categories: {},  
  
  categoryHome: {  
    title: 'Welcome to the Shop',  
    handle: 'home',  
    products: [  
      'adjustable-stem',  
      'fizik-saddle-pak',  
      'kenda-tube',  
      'colorful-fixie-lima',  
      'oury-grip-set',  
      'pure-fix-pedals-with-cages'  
    ]  
  }  
}
```

Move category-selecting logic from the `category` computed function in the `CategoryPage` component into the getter. Update the `slug` and `categoryHome` variables to use the content from the relevant places:

```
categoryProducts: (state) => (slug) => {  
  if(Object.keys(state.categories).length) {  
    let category = false;  
    if(slug) {  
      category = this.$store.state.categories[this.slug];  
    } else {  
      category = state.categoryHome;  
    }  
  }  
}
```

With a category assigned, we can now load the products based on the handles stored in the category. Move the code from the `products` computed function into the getter. Combine the variable assignments together and remove the store product retrieval variable, as we have the state readily available. Ensure the code that checks to see whether the category exists is still in place:

```
categoryProducts: (state) => (slug) => {
  if(Object.keys(state.categories).length) {
    let category = false,
      products = [];

    if(slug) {
      category = this.$store.state.categories[this.slug];
    } else {
      category = state.categoryHome;
    }

    if(category) {
      for(let featured of category.products) {
        products.push(state.products[featured]);
      }
    }
  }
}
```

Lastly, we can add a new `productDetails` array on the `category` with the fleshed-out product data. Return the `category` at the end of the function. If the `slug` variable input exists as a category, we will get all of the data back. If not, it will return `false` – from which we can display our `PageNotFound` component:

```
categoryProducts: (state) => (slug) => {
  if(Object.keys(state.categories).length) {
    let category = false,
      products = [];

    if(slug) {
      category = state.categories[slug];
    } else {
      category = state.categoryHome;
    }

    if(category) {
      for(let featured of category.products) {
        products.push(state.products[featured]);
      }
    }

    category.productDetails = products;
  }
}
```

```
        }

        return category;
    }
}
```

In our `CategoryPage` component, we can remove the `products()` computed function and update the `category()` function. To call a getter function, you refer to `this.$store.getters`:

```
computed: {
  category() {
    if(Object.keys(this.$store.state.categories).length) {
      let category = this.$store.getters.categoryProducts(this.slug);

      if(!category) {
        this.categoryNotFound = true;
      }
      return category;
    }
  }
}
```

Unfortunately, we are still having to check whether the categories exist before proceeding. This is so we can tell that there is no category with the name, rather than an unloaded one.

To make this neater, we can extract this check into another getter and utilize it in both our other getter and the component.

Create a new getter titled `categoriesExist`, and return the contents of the `if` statement:

```
categoriesExist: (state) => {
  return Object.keys(state.categories).length;
},
```

Update the `categoryProducts` getter to accept getters in the arguments of the first function and to use this new getter to indicate its output:

```
categoryProducts: (state, getters) => (slug) => {
  if(getters.categoriesExist) {
    ...
  }
}
```

In our `CategoryPage` component, we can now call on the new getter with `this.$store.getters.categoriesExist()`. To save having `this.$store.getters` repeated twice in this function, we can map the getters to be locally accessed. This allows us to call `this.categoriesExist()` as a more readable function name.

At the beginning of the `computed` object, add a new function titled `...Vuex.mapGetters()`. This function accepts an array or an object as a parameter and the three dots at the beginning ensure the contents are expanded to be merged with the `computed` object.

Pass in an array containing the names of the two getters:

```
computed: {
  ...Vuex.mapGetters([
    'categoryProducts',
    'categoriesExist'
  ]),
  category() {
    ...
  }
}
```

This now means we have `this.categoriesExist` and `this.categoryProducts` at our disposal. Update the `category` function to use these new functions:

```
computed: {
  ...Vuex.mapGetters([
    'categoriesExist',
    'categoryProducts'
  ]),
  category() {
    if(this.categoriesExist) {
      let category = this.categoryProducts(this.slug);

      if(!category) {
        this.categoryNotFound = true;
      }
      return category;
    }
  }
}
```

Update the template to reflect the changes in the computed data:

```
template: `<div>
  <div v-if="category">
    <h1>{{ category.title }}</h1>
    <list-products :products="category.productDetails"></list-products>
  </div>
  <page-not-found v-if="categoryNotFound"></page-not-found>
</div>,
```

## Building the filtering component based on products

As mentioned, all our filters are going to be created from the products in the current category. This means if there are no products made by *IceToolz*, it won't appear as an available filter.

To begin with, open the `ProductFiltering.js` component file. Our product filtering is going to go in our sidebar, so change the component definition from `Vue.component` to an object. We still want our categories to display after the filtering, so add the `ListCategories` component as a declared component within `ProductFiltering`. Add a `template` key and include the `<list-categories>` component:

```
const ProductFiltering = {
  name: 'ProductFiltering',

  template: `<div>
    <list-categories />
  </div>`,

  components: {
    ListCategories
  }
}
```

Update the category route to include the `ProductFiltering` component in the sidebar instead of `ListCategories`:

```
{
  path: '/category/:slug',
  name: 'Category',
  components: {
    default: CategoryPage,
```

```
        sidebar: ProductFiltering
    },
    props: {
        default: true,
        sidebar: true
    }
}
```

You should now have the `Home` route, which includes the `CategoryPage` and `ListCategories` components, and the `Category` route, which includes the `ProductFiltering` component instead.

From the `CategoryPage` component, copy the props and computed objects - as we are going to be utilizing a lot of the existing code. Rename the `category` computed function to `filters`. Remove both the return and the `componentNotFound` if statement. Your component should now look like the following:

```
const ProductFiltering = {
    name: 'ProductFiltering',

    template: `<div>
        <list-categories />
    </div>`,

    components: {
        ListCategories
    },

    props: {
        slug: String
    },

    computed: {
        ...Vuex.mapGetters([
            'categoriesExist',
            'categoryProducts'
        ]),
        filters() {
            if(this.categoriesExist) {
                let category = this.categoryProducts(this.slug);

            }
        }
    }
}
```

We now need to construct our filters, based on the products in the category. We will be doing this by looping through the products, collecting information from preselected values, and displaying them.

Create a data object that contains a key of `topics`. This will be an object containing child objects with a, now familiar, pattern of '`handle`': `{}` for each of the properties we want to filter on.

Each child object will contain a `handle`, which is the value of the product of which to filter (for example, vendor), a `title`, which is the user-friendly version of the key, and an array of values, which will be populated.

We'll start off with two, `vendor` and `tags`; however, more will be dynamically added as we process the products:

```
data() {
  return [
    topics: {
      vendor: {
        title: 'Manufacturer',
        handle: 'vendor',
        values: {}
      },
      tags: {
        title: 'Tags',
        handle: 'tags',
        values: {}
      }
    }
  ],
}
```

We will now begin looping through the products. Along with the values, we are going to keep track of how many products have the same value, allowing us to indicate to the user how many products will be revealed.

Loop through the `products` on the category within the `filters` method and, to begin with, find the `vendor` of each product. For every one encountered, check whether it exists within the `values` array.

If it does not, add a new object with the name, handle, and a count, which is an array of product handles. We store an array of handles so that we can verify that the product has already been seen. If we were keeping a raw numerical count, we could encounter a scenario where the filters get triggered twice, doubling the count. By checking whether the product handle exists already, we can check it's only been seen once.

If a filter of that name does exist, add the handle to the array after checking it does not exist:

```
filters() {
  if(this.categoriesExist) {
    let category = this.categoryProducts(this.slug),
        vendors = this.topics.vendor;

    for(let product of category.productDetails) {

      if(product.hasOwnProperty('vendor')) {
        let vendor = product.vendor;

        if(vendor.handle) {
          if(!vendor.handle.count.includes(product.handle)) {
            category.values[item.handle].count.push(product.handle);
          }
        } else {
          vendors.values[vendor.handle] = {
            ...vendor,
            count: [product.handle]
          }
        }
      }
    }
  }
}
```

This utilizes the previously-used object-expanding ellipsis (...), which saves us from having to write:

```
vendors.values[product.vendor.handle] = {
  title: vendor.title,
  handle: vendor.handle,
  count: [product.handle]
}
```

Although, feel free to use this if you are more comfortable with it.

Duplicate the code to work with tags, however as tags are an array themselves, we need to loop through each tag and add accordingly:

```
for(let product of category.productDetails) {  
  
    if(product.hasOwnProperty('vendor')) {  
        let vendor = product.vendor;  
  
        if(vendor.handle) {  
            if(!vendor.handle.count.includes(product.handle)) {  
                category.values[item.handle].count.push(product.handle);  
            }  
        } else {  
            vendors.values[vendor.handle] = {  
                ...vendor,  
                count: [product.handle]  
            }  
        }  
    }  
  
    if(product.hasOwnProperty('tags')) {  
        for(let tag of product.tags) {  
            if(tag.handle) {  
                if(topicTags.values[tag.handle]) {  
                    if(!topicTags.values[tag.handle].count.includes(product.handle)) {  
                        topicTags.values[tag.handle].count.push(product.handle);  
                    }  
                } else {  
                    topicTags.values[tag.handle] = {  
                        ...tag,  
                        count: [product.handle]  
                    }  
                }  
            }  
        }  
    }  
}
```

Our code is already getting repetitive and complex, let's simplify it by creating a method to handle the repetitive code.

Create a `methods` object with a function of `addTopic`. This will take two parameters: the object to append to and the singular item. For example, its usage would be:

```
if(product.hasOwnProperty('vendor')) {  
    this.addTopic(this.topics.vendor, product.vendor, product.handle);  
}
```

Create the function and abstract out the logic from inside the `hasOwnProperty` if declaration. Name the two parameters `category` and `item`, and update the code accordingly:

```
methods: {  
    addTopic(category, item, handle) {  
        if(item.handle) {  
  
            if(category.values[item.handle]) {  
                if(!category.values[item.handle].count.includes(handle)) {  
                    category.values[item.handle].count.push(handle);  
                }  
  
            } else {  
  
                category.values[item.handle] = {  
                    ...item,  
                    count: [handle]  
                };  
            }  
        }  
    }  
}
```

Update the `filters` computed function to use the new `addTopic` method. Remove the variable declarations at the top of the function, as they are being passed directly into the method:

```
filters() {  
    if(this.categoriesExist) {  
  
        let category = this.categoryProducts(this.slug);  
  
        for(let product of category.productDetails) {  
  
            if(product.hasOwnProperty('vendor')) {  
                this.addTopic(this.topics.vendor, product.vendor, product.handle);  
            }  
  
            if(product.hasOwnProperty('tags')) {  
                this.addTopic(this.topics.tags, product.tags, product.handle);  
            }  
        }  
    }  
}
```

```
        for(let tag of product.tags) {
            this.addTopic(this.topics.tags, tag, product.handle);
        }
    }
}
```

At the end of this function, return `this.topics`. Although we could reference `topics` directly in the template, we need to ensure the `filters` computed property gets triggered:

```
filters() {
  if(this.categoriesExist) {
    ...
  }

  return this.topics;
}
```

Before we proceed to create our dynamic filters based on the various types, let's display the current filters.

Due to how the `topics` object is set up, we can loop through each of the child objects and then through the values of each one. We are going to make our filters out of checkboxes, with the value of the input being the handle of each of the filters:

```
template: `<div>
<div class="filters">
  <div class="filterGroup" v-for="filter in filters">
    <h3>{{ filter.title }}</h3>
    <label class="filter" v-for="value in filter.values">
      <input type="checkbox" :value="value.handle">
      {{ value.title }} ({{ value.count }})
    </label>
  </div>
</div>

<list-categories />
</div>`,
```

In order to keep track of what is checked, we can use a `v-model` attribute. If there are checkboxes with the same `v-model`, Vue creates an array with each item.

Add an array of `checked` to each of the `topic` objects in the data object:

```
data() {
  return {
    topics: {
      vendor: {
        title: 'Manufacturer',
        handle: 'vendor',
        checked: [],
        values: {}
      },
      tags: {
        title: 'Tags',
        handle: 'tags',
        checked: [],
        values: {}
      }
    }
  }
}
```

Next, add a `v-model` attribute to each checkbox, referencing this array on the `filter` object along with a click binder, referencing an `updateFilters` method:

```
<div class="filters">
  <div class="filterGroup" v-for="filter in filters">
    <h3>{{ filter.title }}</h3>

    <label class="filter" v-for="value in filter.values">
      <input type="checkbox" :value="value.handle" v-model="filter.checked"
        @click="updateFilters">
        {{ value.title }} ({{ value.count }})
      </label>
    </div>
  </div>
```

Create an empty method for now - we'll configure it later:

```
methods: {
  addTopic(category, item) {
    ...
  },

  updateFilters() {
  }
}
```

## Dynamically creating filters

With our fixed filters created and being watched, we can take the opportunity to create dynamic filters. These filters will observe the `variationTypes` on the products (for example, color, and size) and list out the options – again with the count of each one.

To achieve this, we need to first loop through the `variationTypes` on the products. Before adding anything, we need to check to see if that variation type exists on the `topics` object, if not – we need to add a skeleton object. This expands the variation (which contains the title and handle) and also includes empty `checked` and `value` properties:

```
filters() {
  if(this.categoriesExist) {

    let category = this.categoryProducts(this.slug);

    for(let product of category.productDetails) {

      if(product.hasOwnProperty('vendor')) {
        this.addTopic(this.topics.vendor, product.vendor);
      }

      if(product.hasOwnProperty('tags')) {
        for(let tag of product.tags) {
          this.addTopic(this.topics.tags, tag);
        }
      }

      Object.keys(product.variationTypes).forEach(vkey => {
        let variation = product.variationTypes[vkey];

        if(!this.topics.hasOwnProperty(variation.handle)) {
          this.topics[variation.handle] = {
            ...variation,
            checked: [],
            values: {}
          }
        }
      });
    }
  }

  return this.topics;
}
```

With our empty object created, we can now loop through the `variationProducts` on the product object. For each one, we can access the variant with the handle of the current variation. From there, we can use our `addTopic` method to include the value (for example, Blue or XL) within the filters:

```
Object.keys(product.variationTypes).forEach(vkey => {
  let variation = product.variationTypes[vkey];

  if(!this.topics.hasOwnProperty(variation.handle)) {
    this.topics[variation.handle] = {
      ...variation,
      checked: [],
      values: {}
    }
  }

Object.keys(product.variationProducts).forEach(pkey => {
  let variationProduct = product.variationProducts[pkey];

  this.addTopic(
    this.topics[variation.handle],
    variationProduct.variant[variation.handle],
    product.handle
  );
});

});
```

We do need to update our `addTopic` method, however. This is because the dynamic properties have a `value`, instead of a `title`.

Add an `if` statement to your `addTopic` method to check whether a `value` exists, if it does – set it to the `title`:

```
addTopic(category, item, handle) {
  if(item.handle) {

    if(category.values[item.handle]) {
      if(!category.values[item.handle].count.includes(handle)) {
        category.values[item.handle].count.push(handle);
      }
    } else {

      if(item.hasOwnProperty('value')) {
        item.title = item.value;
      }
    }
  }
}
```

```
        category.values[item.handle] = {
            ...item,
            count: [handle]
        }
    }
}
```

Viewing the app in the browser should reveal your dynamically-added filters, along with the original ones we had added.

## Resetting filters

When navigating between categories you will notice that, currently, the filters do not reset. This is because we are not clearing the filters between each navigation, and the arrays are persisting. This is not ideal, as it means they get longer as you navigate around and do not apply to the products listed.

To remedy this, we can create a method that returns our default topic object and, when the slug updates, call the method to reset the `topics` object. Move the `topics` object to a new method titled `defaultTopics`:

```
methods: {
  defaultTopics() {
    return {
      vendor: {
        title: 'Manufacturer',
        handle: 'vendor',
        checked: [],
        values: {}
      },
      tags: {
        title: 'Tags',
        handle: 'tags',
        checked: [],
        values: {}
      }
    },
    addTopic(category, item) {
      ...
    }
    updateFilters() {

```

```
    }  
}
```

Within the `data` function, change the value of `topics` to be `this.defaultTopics()` to call the method:

```
data() {  
  return {  
    topics: this.defaultTopics()  
  }  
},
```

Lastly, add a watch function to reset the `topics` key when the `slug` gets updated:

```
watch: {  
  slug() {  
    this.topics = this.defaultTopics();  
  }  
}
```

## Updating the URL on checkbox filter change

Our filtering component, when interacted with, is going to update the URL query parameters. This allows the user to see the filters in effect, bookmark them, and share the URL if needed. We already used query parameters for our pagination, and it makes sense to put the user back on page one when filtering – as there may only be one page.

To construct our query parameters of filters, we need to loop through each filter type and add a new parameter for each one that has items in the `checked` array. We can then call a `router.push()` to update the URL and, in turn, change the products displayed.

Create an empty object in your `updateFilters` method. Loop through the `topics` and populate the `filters` object with the items checked. Set the query parameters in the router to the `filters` object:

```
updateFilters() {  
  let filters = {};  
  
  Object.keys(this.topics).forEach(key => {  
    let topic = this.topics[key];  
    if(topic.checked.length) {  
      filters[key] = topic.checked;  
    }  
  });
```

```
this.$router.push({query: filters});  
}
```

Checking and unchecking the filters on the right should update the URL with the items checked.

## Preselecting filters on page load

When loading a category with filters already in the URL, we need to ensure the checkboxes are checked on the right-hand side. This can be done by looping through the existing query parameters and adding any matching keys and arrays to the topics parameter. As the query can either be an array or a string, we need to ensure the checked property is an array no matter what. We also need to ensure the query key is, indeed, a filter and not a page parameter:

```
filters() {  
    if(this.categoriesExist) {  
  
        let category = this.categoryProducts(this.slug);  
  
        for(let product of category.productDetails) {  
            ...  
        }  
  
        Object.keys(this.$route.query).forEach(key => {  
            if(Object.keys(this.topics).includes(key)) {  
                let query = this.$route.query[key];  
                this.topics[key].checked = Array.isArray(query) ? query : [query];  
            }  
        });  
    }  
  
    return this.topics;  
}
```

On page load, the filters in the URL will be checked.

## Filtering the products

Our filters are now being created and appended to dynamically, and activating a filter updates the query parameter in the URL. We can now proceed with showing and hiding products based on the URL parameters. We are going to be doing this by filtering the products before being passed into the `ListProducts` component. This ensures the pagination works correctly.

As we are filtering, open up `ListProducts.js` and add a `:key` attribute to each list item, with the value of the handle:

```
<ol :start="pagination.range.from + 1">
  <li v-for="product in paginate(products)" :key="product.handle">
    ...
  </li>
</ol>
```

Open up the `CategoryPage` view and create a method within the `methods` object titled `filtering()` and add a `return true` to begin with. The method should accept two parameters, a `product` and `query` object:

```
methods: {
  filtering(product, query) {
    return true;
  }
}
```

Next, within the `category` computed function, we need to filter the products if there is a query parameter. However, we need to be careful that we don't trigger the filters if the page number is present – as that is also a query.

Create a new variable called `filters`, which is a copy of the `query` object from the route. Next, if the `page` parameter is present, delete it from our new object. From there, we can check whether the `query` object has any other contents and if so, run the native JavaScript `filter()` function on our product array – passing in the `product` and `new query/filters` object to our method:

```
category() {
  if(this.categoriesExist) {
    let category = this.categoryProducts(this.slug),
      filters = Object.assign({}, this.$route.query);

    if(Object.keys(filters).length && filters.hasOwnProperty('page')) {
      delete filters.page;
```

```
        }
        if(Object.keys(filters).length) {
            category.productDetails = category.productDetails.filter(
                p => this.filtering(p, filters)
            );
        }
    }

    if(!category) {
        this.categoryNotFound = true;
    }
    return category;
}
}
```

Refresh your app to ensure the products still show.

To filter products, there is quite a complex process involved. We want to check whether an attribute is in the query parameters; if it is, we set a placeholder value of `false`. If the attribute on the product matches that of the query parameter, we set the placeholder to `true`. We then repeat this for each of the query parameters. Once complete, we then only show products that have all of the criteria.

The way we are going to construct this allows products to be `OR` within the categories, but `AND` with different sections. For example, if the user were to pick many colors (red and green) and one tag (accessories), it will show all products that are red or green accessories.

Our filtering is created with the tags, vendor, and then dynamic filters. As two of the properties are fixed, we will have to check these first. The dynamic filters will be verified by reconstructing the way they were built.

Create a `hasProperty` object, which will be our placeholder object for keeping track of the query parameters the product has. We'll begin with the `vendor` – as this is the simplest property.

We start by looping through the query attributes – in case there is more than one (for example, red and green). Next, we need to confirm that the `vendor` exists in the `query` – if it does, we then set a `vendor` attribute in the `hasProperty` object to `false`. We then check whether the `vendor` handle is the same as the `query` attribute. If this matches, we change our `hasProperty.vendor` property to `true`:

```
filtering(product, query) {
    let display = false,
        hasProperty = {};

    Object.keys(query).forEach(key => {
```

```
let filter = Array.isArray(query[key]) ? query[key] : [query[key]];

for(attribute of filter) {
    if(key == 'vendor') {

        hasProperty.vendor = false;
        if(product.vendor.handle == attribute) {
            hasProperty.vendor = true;
        }
    }
}

});

return display;
}
```

This will update the `hasProperty` object with whether the vendor matches the selected filter. We can now replicate the functionality with the `tags` – remembering that tags on a product are an object we need to filter.

The dynamic properties constructed by the filters will also need to be checked. This is done by checking the `variant` object on each `variationProduct`, and updating the `hasProperty` object if it matches:

```
filtering(product, query) {
    let display = false,
        hasProperty = {};

    Object.keys(query).forEach(key => {
        let filter = Array.isArray(query[key]) ? query[key] : [query[key]];

        for(attribute of filter) {
            if(key == 'vendor') {

                hasProperty.vendor = false;
                if(product.vendor.handle == attribute) {
                    hasProperty.vendor = true;
                }
            } else if(key == 'tags') {
                hasProperty.tags = false;

                product[key].map(key => {
                    if(key.handle == attribute) {
                        hasProperty.tags = true;
                    }
                })
            }
        }
    });

    return display;
}
```

```
        });

    } else {
        hasProperty[key] = false;

        let variant = product.variationProducts.map(v => {
            if(v.variant[key] && v.variant[key].handle == attribute) {
                hasProperty[key] = true;
            }
        });
    }
});

return display;
}
```

Lastly, we need to check each of the properties of the `hasProperty` object. If all the values are set to `true`, we can set the `display` of the product to `true` – meaning it will show. If one of them is `false`, the product will not show as it does not match all of the criteria:

```
filtering(product, query) {
    let display = false,
        hasProperty = {};

Object.keys(query).forEach(key => {
    let filter = Array.isArray(query[key]) ? query[key] : [query[key]];

    for(attribute of filter) {
        if(key == 'vendor') {

            hasProperty.vendor = false;
            if(product.vendor.handle == attribute) {
                hasProperty.vendor = true;
            }
        }

        } else if(key == 'tags') {
            hasProperty.tags = false;

            product[key].map(key => {
                if(key.handle == attribute) {
                    hasProperty.tags = true;
                }
            });
        }
    }

} else {
    hasProperty[key] = false;
```

```
let variant = product.variationProducts.map(v => {
  if(v.variant[key] && v.variant[key].handle == attribute) {
    hasProperty[key] = true;
  }
});
}

if(Object.keys(hasProperty).every(key => hasProperty[key])) {
  display = true;
}

});

return display;
}
```

We now have a successful filtering product list. View your app in the browser and update the filters – noting how products show and hide with each click. Note how even when you press refresh, only the filtered products display.

## Summary

In this chapter, we created a category listing page, allowing the user the view all the products in a category. This list is able to be paginated, along with the order changing. We also created a filtering component, allowing the user to narrow down the results.

With our products now browseable, filterable, and viewable, we can proceed on to making a Cart and Checkout page.

# 11

## Building an E-Commerce Store - Adding a Checkout

Over the last couple of chapters, we have been creating an e-commerce store. So far, we have created a product page that allows us to view the images and product variations, which may be size or style. We have also created a category page with filters and pagination—including a homepage category page that features specific, selected products.

Our users can browse and filter products and view more information about a specific product. We are now going to:

- Build the functionality to allow the user to add and remove products to their basket
- Allow a user to **Checkout**
- Add an **Order Confirmation** page

As a reminder—we won't be taking any billing details but we will make an Order Confirmation screen.

### Creating the basket array placeholder

To help us persist the products in the basket throughout the app, we are going to be storing the user's selected products in the Vuex store. This will be in the form of an array of objects. Each object will contain several key pieces of information that will allow us to display the products in the basket without having to query the Vuex store each time. It also allows us to store details about the current state of the product page—remembering the image updates when a variant is selected.

The details we're going to store for each product added to the basket are as follows:

- Product title
- Product handle, so we can link back to the product
- Selected variation title (as it appears in the select box)
- Currently selected image, so we can show an appropriate image in the Checkout
- Variation details, this contains price and weight along with other details
- Variation SKU, this will help us identify whether the product has already been added
- Quantity, how many items the user has added to their basket

As we will be storing all this information within an object, contained in an array, we need to create a placeholder array within the store. Add a new key to the `state` object within the store titled `basket` and make it a blank array:

```
const store = new Vuex.Store({
  state: {
    products: {},
    categories: {},
    categoryHome: {
      title: 'Welcome to the Shop',
      handle: 'home',
      products: [
        ...
      ],
    },
    basket: []
  },
  mutations: {
    ...
  },
  actions: {
    ...
  },
  getters: {
    ...
  }
});
```

## Adding product information to the store

With our basket array ready to receive data, we can now create a mutation to add the product object. Open the `ProductPage.js` file and update the `addToBasket` method to call a `$store commit` function, instead of the `alert` we put in place.

All of the information we require for products to be added to the basket is stored on the `ProductPage` component—so we can pass the component instance through to the `commit()` function using the `this` keyword. This will become clear when we build the mutation.

Add the function call to the `ProductPage` method:

```
methods: {  
  ...  
  
  addToBasket() {  
    this.$store.commit('addToBasket', this);  
  }  
}
```

## Creating the store mutation to add products to the basket

Navigate to the Vuex store and create a new mutation titled `addToBasket`. This will accept the `state` as the first parameter and the component instance as the second. Passing the instance through allows us to access the variables, methods, and computed values on the component:

```
mutations: {  
  products(state, payload) {  
    ...  
  },  
  
  categories(state, payload) {  
    ...  
  },  
  
  addToBasket(state, item) {  
    ...  
  }  
}
```

We can now proceed with adding the products to the `basket` array. The first step is to add the product object with the mentioned properties. As it's an array, we can use the `push()` function to add the object.

Next, add an object to the array, using the `item` and its properties to build the object. With access to the `ProductPage` component, we can construct the variant title as it appears in the select box, using the `variantTitle` method. Set the quantity to 1 by default:

```
addToBasket(state, item) {
  state.basket.push({
    sku: item.variation.sku,
    title: item.product.title,
    handle: item.slug,
    image: item.image,
    variationTitle: item.variantTitle(item.variation),
    variation: item.variation,
    quantity: 1
  });
}
```

This now adds the product to the `basket` array. An issue appears, however, when you add two of the same item to the basket. Rather than increasing the `quantity`, it simply adds a second product.

This can be remedied by checking if the `sku` exists within the array already. If it does, we can increment the `quantity` on that item, if not we can add a new item to the `basket` array. The `sku` is unique for each variation of each product. Alternatively, we could use the `barcode` property.

Using the native `find` JavaScript function, we can identify any products that have an SKU matching that of the one being passed in:

```
addToBasket(state, item) {
  let product = state.basket.find(p => {
    if(p.sku == item.variation.sku) {
    }
  });

  state.basket.push({
    sku: item.variation.sku,
    title: item.product.title,
    handle: item.slug,
    image: item.image,
```

```
        variationTitle: item.variantTitle(item.variation),
        variation: item.variation,
        quantity: 1
    });
}
```

If it matches, we can increment the quantity by one on that object, using the `++` notation in JavaScript. If not, we can add the new object to the `basket` array. When using the `find` function, we can return the product if it exists. If not, we can add a new item:

```
addToBasket(state, item) {
    let product = state.basket.find(p => {
        if(p.sku == item.variation.sku) {
            p.quantity++;

            return p;
        }
    });
}

if(!product) {
    state.basket.push({
        sku: item.variation.sku,
        title: item.product.title,
        handle: item.slug,
        image: item.image,
        variationTitle: item.variantTitle(item.variation),
        variation: item.variation,
        quantity: 1
    });
}
}
```

We now have a basket being populated as the item is added to the basket, and incrementing when it exists already.

To improve the usability of the app, we should give the user some feedback when they have added an item to the basket. This can be done by updating the **Add to Basket** button briefly and showing a product count with a link to the basket in the header of the site.

# Updating the Add to basket button when adding an item

As a usability improvement to our shop, we are going to update the **Add to basket** button when a user clicks it. This will change to **Added to your basket** and apply a class for a set period of time, for example, two seconds, before returning to its previous state. The CSS class will allow you to style the button differently—for example, changing the background to green or transforming it slightly.

This will be achieved by using a data property on the component—setting it to `true` and `false` as the item gets added. The CSS class and text will use this property to determine what to show and a `setTimeout` JavaScript function will change the state of the property.

Open the `ProductPage` component and add a new key to the data object titled `addedToBasket`. Set this to `false` by default:

```
data() {
  return {
    slug: this.$route.params.slug,
    productNotFound: false,
    image: false,
    variation: false,
    addedToBasket: false
  }
}
```

Update the button text to allow for this variation. As there is already a ternary `if`, within this, we are going to nest them with another one. This could be abstracted into a method if desired.

Replace the `Add to basket` condition in your button with an additional ternary operator, dependent on whether the `addedToBasket` variable is true. We can also add a conditional class based on this property:

```
<button
  @click="addToBasket()"
  :class="(addedToBasket) ? 'isAdded' : ''"
  :disabled="!variation.quantity"
>
  {{ (variation.quantity) ?
    ((addedToBasket) ? 'Added to your basket' : 'Add to basket') :
    'Out of stock' }}
```

```
    }  
  </button>
```

Refresh the app and navigate to a product to ensure the correct text is being shown. Update the `addedToBasket` variable to `true` to make sure everything is displaying as it should. Set it back to `false`.

Next, within the `addToBasket()` method, set the property to true. This should update the text when the item is added to the basket:

```
addToBasket() {  
  this.$store.commit('addToBasket', this);  
  
  this.addedToBasket = true;  
}
```

When you click the button, the text will now update, however it will never reset. Add a `setTimeout` JavaScript function afterward, which sets it back to `false` after a certain period of time:

```
addToBasket() {  
  this.$store.commit('addToBasket', this);  
  
  this.addedToBasket = true;  
  setTimeout(() => this.addedToBasket = false, 2000);  
}
```

The timing for `setTimeout` is in milliseconds, so 2000 is equal to two seconds. Feel free to tweak and play with this figure as much as you see fit.

One last addition would be to reset this value back to `false` if the variation is updated or the product is changed. Add the statement to both `watch` functions:

```
watch: {  
  variation(v) {  
    if(v.hasOwnProperty('image')) {  
      this.updateImage(v.image);  
    }  
    this.addedToBasket = false;  
  },  
  
  '$route'(to) {  
    this.slug = to.params.slug;  
    this.addedToBasket = false;  
  }  
}
```

# Showing the product count in the header of the app

It's common practice for a shop to show a link to the cart in the site's header—along with the number of items in the cart next to it. To achieve this, we'll use a Vuex getter to calculate and return the number of items in the basket.

Open the `index.html` file and add a `<header>` element to the app HTML and insert a placeholder, `span`—we'll convert this to a link once we've set up the routes. Within the `span`, output a `cartQuantity` variable:

```
<div id="app">
  <header>
    <span>Cart {{ cartQuantity }}</span>
  </header>
  <main>
    <router-view></router-view>
  </main>
  <aside>
    <router-view name="sidebar"></router-view>
  </aside>
</div>
```

Navigate to your Vue instance and create a computed object containing a `cartQuantity` function:

```
new Vue({
  el: '#app',

  store,
  router,

  computed: {
    cartQuantity() {
    }
  },
  created() {
    CSV.fetch({url: './data/csv-files/bicycles.csv'}).then(data => {
      this.$store.dispatch('initializeShop', this.$formatProducts(data));
    });
  }
});
```

If our header were to feature more items than our cart link, it would be advisable to abstract it out into a separate component to keep the methods, layout, and functions contained. However, as it is only going to feature this one link in our example app, adding the function to the `Vue` instance will suffice.

Create a new getter in the store titled `cartQuantity`. As a placeholder, return 1. The state will be required to calculate the quantity, so ensure that is passed into the function for now:

```
getters: {  
  ...  
  
  cartQuantity: (state) => {  
    return 1;  
  }  
}
```

Head back to your `Vue` instance and return the result of the getter. Ideally, we want to show the count of the basket in brackets, but we only want to show the brackets if there are items. Within the computed function, check the result of this getter and output the result with brackets if the result exists:

```
cartQuantity() {  
  const quantity = this.$store.getters.cartQuantity;  
  return quantity ? `(${quantity})` : '';  
}
```

Changing the result within the Vuex getter should reveal either the number in brackets or nothing at all.

## Calculating the basket quantity

With the display logic in place, we can now proceed with calculating how many items are in the basket. We could count the number of items in the `basket` array, however, this will only tell us how many different products are there now and not if the same product was added many times.

Instead, we need to loop through each product in the basket and add the quantities together. Create a variable called `quantity` and set it to 0. Loop through the basket items and add the `item.quantity` variable to the `quantity` variable. Lastly, return our variable with the right sum:

```
cartQuantity: (state) => {
  let quantity = 0;
  for(let item of state.basket) {
    quantity += item.quantity;
  }
  return quantity;
}
```

Navigate to the app and add some items to your basket to verify the basket count is being calculated correctly.

## Finalizing the Shop Vue-router URLs

We're now at a stage where we can finalize the URLs for our shop - including creating the redirects and Checkout links. Referring back to [Chapter 8, Introducing Vue-Router and Loading URL-Based Components](#), we can see which ones we are missing. These are:

- /category - redirect to /
- /product - redirect to /
- /basket - load OrderBasket component
- /checkout - load OrderCheckout component
- /complete - load OrderConfirmation component

Create the redirects in the appropriate places within the routes array. At the bottom of the routes array, create three new routes for the Order components:

```
routes: [
  {
    path: '/',
    name: 'Home',
    ...
  },
  {
    path: '/category',
    redirect: {name: 'Home'}
  },
  {
    path: '/category/:slug',
```

```
        name: 'Category',
        ...
    },
    {
        path: '/product',
        redirect: {name: 'Home'}
    },
    {
        path: '/product/:slug',
        name: 'Product',
        component: ProductPage
    },
    {
        path: '/basket',
        name: 'Basket',
        component: OrderBasket
    },
    {
        path: '/checkout',
        name: 'Checkout',
        component: OrderCheckout
    },
    {
        path: '/complete',
        name: 'Confirmation',
        component: OrderConfirmation
    },
    {
        path: '/404',
        alias: '*',
        component: PageNotFound
    }
]
```

We can now update the placeholder `<span>` in the header of our app with a `router-link`:

```
<header>
  <router-link :to="{name: 'Basket'}">Cart {{ cartQuantity }}</router-link>
</header>
```

# Building the Order process and ListProducts component

For the three steps of the Checkout, we are going to be utilizing the same component in all three: the `ListProducts` component. In the `OrderCheckout`, and `OrderConfirmation` components, it will be in a fixed, uneditable state, whereas when it is in the `OrderBasket` component, the user needs to be able to update quantities and remove items if desired.

As we're going to be working at the Checkout, we need products to exist in the `basket` array. To save us having to find products and add them to the basket every time we refresh the app, we can ensure there are some products in the `basket` array by hardcoding an array in the store.

To achieve this, navigate to a few products and add them to your basket. Ensure there is a good selection of products and quantities for testing. Next, open your JavaScript console in the browser and enter the following command:

```
console.log(JSON.stringify(store.state.basket));
```

This will output a string of your products array. Copy this and paste it into your store—replacing the `basket` array:

```
state: {
  products: {},
  categories: {},  
  
  categoryHome: {
    title: 'Welcome to the Shop',
    handle: 'home',
    products: [
      ...
    ],
  },
  
  basket: [{"sku":...}])
},
```

On page load, your `Cart` count in the header should update to be the correct number of items you added.

We can now proceed with building our Checkout process. The product display in the basket is more complicated than the **Checkout** and **Order Confirmation** screens so, unusually, we'll work backward. Starting with the **Order Confirmation** page and moving to the **Checkout** page, adding more complexity before we head to the basket, adding the ability to exit the products.

## Order Confirmation screen

The Order Confirmation screen is one that is shown once the order is complete. This confirms the items purchased and may include the expected delivery date.

Create a template within the `OrderConfirmation.js` file with a `<h1>` and some relevant content relating to the order being complete:

```
const OrderConfirmation = {  
  name: 'OrderConfirmation',  
  
  template: `<div>  
    <h1>Order Complete!</h1>  
    <p>Thanks for shopping with us - you can expect your products within 2  
    - 3 working days</p>  
  </div>`  
};
```

Open up the application in your browser, add a product to your basket and complete an order to confirm it's working. The next step is to include the `ListProducts` component. First, ensure the `ListProducts` component is correctly initialized and features an initial template:

```
const ListPurchases = {  
  name: 'ListPurchases',  
  
  template: `<table></table>`  
};
```

Add the `components` object to the `OrderConfirmation` component and include the `ListProducts` component. Next, include it in the template:

```
const OrderConfirmation = {  
  name: 'OrderConfirmation',  
  
  template: `<div>  
    <h1>Order Complete!</h1>  
    <p>Thanks for shopping with us - you can expect your products within 2  
    - 3 working days</p>  
  </div>`  
};
```

```
<list-purchases />
</div>`,

components: {
  ListPurchases
}
};
```

Open the `ListPurchases` component once more to start displaying the products. The default state of this component will be to list the products in the basket, along with the variation selected. The price for each product will be displayed, along with the price if the quantity is more than one. Lastly, a grand total will be shown.

The first step is to get the basket list into our component. Create a `computed` object with a `products` function. This should return the basket products:

```
const ListPurchases = {
  name: 'ListPurchases',

  template: `<table></table>`,

  computed: {
    products() {
      return this.$store.state.basket;
    }
  }
};
```

With the products in the basket now available to us, we can loop through them in the table displaying the information required. This includes a thumbnail image, the product and variation title, price, quantity, and the total price of the item. Add a header row to the table too, so the user knows what the column is:

```
template: `<table>
  <thead>
    <tr>
      <th></th>
      <th>Title</th>
      <th>Unit price</th>
      <th>Quantity</th>
      <th>Price</th>
    </tr>
  </thead>
  <tbody>
    <tr v-for="product in products">
      <td>
        
</td>
<td>
<router-link :to="{name: 'Product', params: {slug: product.handle}}">
    {{ product.title }}
</router-link><br>
{{ product.variationTitle }}
</td>
<td>{{ product.variation.price }}</td>
<td>{{ product.quantity }}</td>
<td>{{ product.variation.price * product.quantity }}</td>
</tr>
</tbody>
</table>,
```

Note that the price for each row is simply the unit price multiplied by the quantity. We now have a standard product list of the items the user has purchased.

## Using Vue filters to format the price

The price is currently an integer, as that it is in the data. On the product page, we just prepended a \$ sign to represent a price, however, this is now the perfect opportunity to utilize Vue filters. Filters allow you to manipulate the data in the template without using a method. Filters can be chained and are used to carry out, generally, a single modification—for example converting a string to lowercase or formatting a number to be a currency.

Filters are used with the pipe (|) operator. If, for example, we had a filter to lowercase text, it would be used like the following:

```
{{ product.title | lowercase }}
```

Filters are declared within a `filters` object on the component and accept a single parameter of the output preceding it.

Create a `filters` object within the `ListPurchases` component and create a function inside titled `currency()`. This function accepts a single parameter of `val` and should return the variable inside:

```
filters: {
  currency(val) {
    return val;
  }
},
```

We can now use this function to manipulate the price integers. Add the filter to both the unit and total price within the template:

```
<td>{{ product.variation.price | currency }}</td>
<td>{{ product.quantity }}</td>
<td>{{ product.variation.price * product.quantity | currency }}</td>
```

You won't notice anything in the browser, as we have yet to manipulate the value. Update the function to ensure the number is fixed to two decimal places and has a \$ preceding it:

```
filters: {
  currency(val) {
    return '$' + val.toFixed(2);
  }
},
```

Our prices are now nicely formatted and displaying correctly.

## Calculating a total price

The next addition to our purchase list is a total value of the basket. This will need to be calculated in a similar way to the basket count we did earlier.

Create a new computed function title: `totalPrice`. This function should loop through the products and add the price up, taking into consideration any multiple quantities:

```
totalPrice() {
  let total = 0;

  for(let p of this.products) {
    total += (p.variation.price * p.quantity);
  }

  return total;
}
```

We can now update our template to include the total price—ensuring we pass it through the currency filter:

```
template: `<table>
  <thead>
    <tr>
      <th></th>
      <th>Title</th>
      <th>Unit price</th>
      <th>Quantity</th>
      <th>Price</th>
    </tr>
  </thead>
  <tbody>
    <tr v-for="product in products">
      <td>
        
      </td>
      <td>
        <a href="#">
          {{ product.title }}
        </a>
        <br>
        {{ product.variationTitle }}
      </td>
      <td>{{ product.variation.price | currency }}</td>
      <td>{{ product.quantity }}</td>
      <td>{{ product.variation.price * product.quantity | currency }}</td>
    </tr>
  </tbody>
  <tfoot>
    <tr>
      <td colspan="4">
        <strong>Total:</strong>
      </td>
      <td>{{ totalPrice | currency }}</td>
    </tr>
  </tfoot>
</table>`,
```

# Creating an Order Checkout page

Our OrderCheckout page will have a similar makeup to the OrderConfirmation page - however, in a real shop, this would be the page before payment. This page would allow the user to fill in their billing and delivery details before navigating to the payment page. Copy the OrderConfirmation page and update the title and info text:

```
const OrderCheckout = {  
  name: 'OrderCheckout',  
  
  template: '<div>  
    <h1>Order Confirmation</h1>  
    <p>Please check the items below and fill in your details to complete  
    your order</p>  
    <list-purchases />  
  </div>',  
  
  components: {  
    ListPurchases  
  }  
};
```

Below the `<list-purchases />` component, create a form with several fields so we can collect the billing and delivery name and addresses. For this example, just collect the name, first line of the address, and ZIP code:

```
template: '<div>  
  <h1>Order Confirmation</h1>  
  <p>Please check the items below and fill in your details to complete your  
  order</p>  
  <list-purchases />  
  
<form>  
  <fieldset>  
    <h2>Billing Details</h2>  
    <label for="billingName">Name:</label>  
    <input type="text" id="billingName">  
    <label for="billingAddress">Address:</label>  
    <input type="text" id="billingAddress">  
    <label for="billingZipcode">Post code/Zip code:</label>  
    <input type="text" id="billingZipcode">  
  </fieldset>  
  <fieldset>  
    <h2>Delivery Details</h2>  
    <label for="deliveryName">Name:</label>  
    <input type="text" id="deliveryName">  
    <label for="deliveryAddress">Address:</label>
```

```
<input type="text" id="deliveryAddress">
<label for="deliveryZipcode">Post code/Zip code:</label>
<input type="text" id="deliveryZipcode">
</fieldset>
</form>
</div> ',
```

We now need to create a data object and bind each field to a key. To help group each set, create an object for both `delivery` and `billing` and create the fields inside with the correct names:

```
data() {
  return {
    billing: {
      name: '',
      address: '',
      zipcode: ''
    },
    delivery: {
      name: '',
      address: '',
      zipcode: ''
    }
  }
}
```

Add a `v-model` to each input, linking it to the appropriate data key:

```
<form>
<fieldset>
  <h2>Billing Details</h2>
  <label for="billingName">Name:</label>
  <input type="text" id="billingName" v-model="billing.name">
  <label for="billingAddress">Address:</label>
  <input type="text" id="billingAddress" v-model="billing.address">
  <label for="billingZipcode">Post code/Zip code:</label>
  <input type="text" id="billingZipcode" v-model="billing.zipcode">
</fieldset>
<fieldset>
  <h2>Delivery Details</h2>
  <label for="deliveryName">Name:</label>
  <input type="text" id="deliveryName" v-model="delivery.name">
  <label for="deliveryAddress">Address:</label>
  <input type="text" id="deliveryAddress" v-model="delivery.address">
  <label for="deliveryZipcode">Post code/Zip code:</label>
  <input type="text" id="deliveryZipcode" v-model="delivery.zipcode">
</fieldset>
</form>
```

The next step is to create a `submit` method and collate the data to be able to pass it on to the next screen. Create a new method titled `submitForm()`. As we are not handling payment in this example, we can route to the confirmation page in the method:

```
methods: {
  submitForm() {
    // this.billing = billing details
    // this.delivery = delivery details
    this.$router.push({name: 'Confirmation'});
  }
}
```

We can now bind a `submit` event to the form and add a submit button. Like the `v-bind:click` attribute (or `@click`), Vue allows you to bind a `submit` event to a method using a `@submit=""` attribute.

Add the declaration to the `<form>` element and create a submit button in your form:

```
<form @submit="submitForm()">
  <fieldset>
    ...
  </fieldset>

  <fieldset>
    ...
  </fieldset>

  <input type="submit" value="Purchase items">
</form>
```

On submitting your form, the app should redirect you to our Confirmation page.

## Copying details between addresses

One feature that several shops have is the ability to mark the delivery address to be the same as the billing address. There are several ways we could approach this, and how you choose to do it is up to you. The immediate options are:

- Have a "copy details" button—this copies the details from billing to delivery but does not keep them in sync

- Have a checkbox that keeps the two in sync—checking the box disables the delivery box fields but populates them with the billing details

For this example, we are going to code the second option.

Create a checkbox between the two fieldsets that is bound to a property in the data object via v-model called `sameAddress`:

```
<form @submit="submitForm()">
  <fieldset>
    ...
  </fieldset>
  <label for="sameAddress">
    <input type="checkbox" id="sameAddress" v-model ="sameAddress">
    Delivery address is the same as billing
  </label>
  <fieldset>
    ...
  </fieldset>

  <input type="submit" value="Purchase items">
</form>
```

Create a new key in the data object and set it to `false` by default:

```
data() {
  return {
    sameAddress: false,
    billing: {
      name: '',
      address: '',
      zipcode: ''
    },
    delivery: {
      name: '',
      address: '',
      zipcode: ''
    }
  },
},
```

The next step is to disable the delivery fields if the checkbox is checked. This can be done by activating the `disabled` HTML attribute based on the checkbox result. In a similar way to how we disabled the "Add to cart" button on the product page, bind the `disabled` attribute on the delivery fields to the `sameAddress` variable:

```
<fieldset>
  <h2>Delivery Details</h2>
  <label for="deliveryName">Name:</label>
  <input type="text" id="deliveryName" v-model="delivery.name"
:disabled="sameAddress">
  <label for="deliveryAddress">Address:</label>
  <input type="text" id="deliveryAddress" v-model="delivery.address"
:disabled="sameAddress">
  <label for="deliveryZipcode">Post code/Zip code:</label>
  <input type="text" id="deliveryZipcode" v-model="delivery.zipcode"
:disabled="sameAddress">
</fieldset>
```

Checking the box will now deactivate the fields - making the user unable to enter any data. The next step is to replicate the data across the two sections. As our data objects are the same structure, we can create a `watch` function to set the `delivery` object to the same as the `billing` object when the checkbox is checked.

Create a new `watch` object and function for the `sameAddress` variable. If it is `true`, set the `delivery` object to the same as the `billing` one:

```
watch: {
  sameAddress() {
    if(this.sameAddress) {
      this.delivery = this.billing;
    }
  }
}
```

With the `watch` function added, we can enter data into the billing address, check the box, and the delivery address gets populated. The best thing about this is that they now stay in sync, so if you update the billing address, the delivery address updates on the fly. The problem arises when you uncheck the box and edit the billing address—the delivery address still updates. This is because we have bound the objects together.

Add an `else` statement to make a *copy* of the billing address when the box is unchecked:

```
watch: {
  sameAddress() {
    if(this.sameAddress) {
      this.delivery = this.billing;
    } else {
      this.delivery = Object.assign({}, this.billing);
    }
  }
}
```

We now have a functioning Order Confirmation page, which collects billing and delivery details.

## Creating an editable basket

We now need to create our basket. This needs to show the products in a similar fashion to the Checkout and Confirmation, but it needs to give the user the ability to edit the basket contents—either to delete an item or update the quantity.

As a starting point, open `OrderBasket.js` and include the `list-purchases` component, as we did on the confirmation page:

```
const OrderBasket = {
  name: 'OrderBasket',

  template: `<div>
    <h1>Basket</h1>
    <list-purchases />
  </div>`,

  components: {
    ListPurchases
  }
};
```

The next thing we need to do is edit the `list-purchases` component. To ensure we can differentiate between the views, we are going to add an `editable` prop. This will be set to `false` by default and `true` in the basket. Add the prop to the component in the basket:

```
template: `<div>
  <h1>Basket</h1>
  <list-purchases :editable="true" />
</div>`,
```

We now need to tell the `ListPurchases` component to accept this parameter so we can do something with it within the component:

```
props: {
  editable: {
    type: Boolean,
    default: false
  }
},
```

## Creating editable fields

We now have a prop determining if our basket should be editable or not. This allows us to show the delete links and make the quantity an editable box.

Create a new table cell next to the quantity one in the `ListPurchases` component and make it visible only when the purchases are visible. Make the static quantity hidden in this state too. In the new cell, add an input box with the value set to the quantity. We are also going to bind a `blur` event to the box. The `blur` event is a native JavaScript event that triggers when the input is unfocused. On blur, trigger an `updateQuantity` method. This method should accept two arguments; the event, which will contain the new quantity, and the SKU for that particular product:

```
<tbody>
  <tr v-for="product in products">
    <td>
      
    </td>
    <td>
      <router-link :to="{name: 'Product', params: {slug: product.handle}}">
        {{ product.title }}
      </router-link><br>
    </td>
  </tr>
</tbody>
```

```
    {{ product.variationTitle }}
```

```
</td>
```

```
<td>{{ product.variation.price | currency }}</td>
```

```
<td v-if="!editable">{{ product.quantity }}</td>
```

```
<td v-if="editable">
```

```
    <input
```

```
        type="text"
```

```
        :value="product.quantity"
```

```
        @blur="updateQuantity($event, product.sku)"
```

```
    >
```

```
</td>
```

```
<td>{{ product.variation.price * product.quantity | currency }}</td>
```

```
</tr>
```

```
</tbody>
```

Create the new method on the component. This method should loop through the products, locating the one with a matching SKU and updating the quantity to an integer. We also need to update the store with the result - so that the quantity can be updated at the top of the page. We'll create a general mutation that accepts the full basket array back with new values to allow the same one to be used for the product deletion.

Create the mutation that updates the quantity and commits a mutation titled `updatePurchases`:

```
methods: {
```

```
    updateQuantity(e, sku) {
```

```
        let products = this.products.map(p => {
```

```
            if(p.sku == sku) {
```

```
                p.quantity = parseInt(e.target.value);
```

```
            }
```

```
            return p;
```

```
        });
```

```
        this.$store.commit('updatePurchases', products);
```

```
    }
```

```
}
```

In the store, create the mutation that sets the `state.basket` equal to the payload:

```
updatePurchases(state, payload) {
```

```
    state.basket = payload;
```

```
}
```

Updating the quantity should now update the total price of the item and the basket count at the top of the page.

## Removing items from your cart

The next step is to give the user the ability to remove items from their cart. Create a button in the `ListPurchases` component with a click binding. This button can go anywhere you want - our example shows it as an extra cell at the end of the row. Bind the click action to a method titled `removeItem`. This just needs to accept a single parameter of the SKU. Add the following to the `ListPurchases` component:

```
<tbody>
  <tr v-for="product in products">
    <td>
      
    </td>
    <td>
      <router-link :to="{name: 'Product', params: {slug: product.handle}}">
        {{ product.title }}
      </router-link><br>
      {{ product.variationTitle }}
    </td>
    <td>{{ product.variation.price | currency }}</td>
    <td v-if="!editable">{{ product.quantity }}</td>
    <td v-if="editable"><input
      type="text"
      :value="product.quantity"
      @blur="updateQuantity($event, product.sku)"
    ></td>
    <td>{{ product.variation.price * product.quantity | currency }}</td>
    <td v-if="editable">
      <button @click="removeItem(product.sku)">Remove item</button>
    </td>
  </tr>
</tbody>
```

Create the `removeItem` method. This method should filter the `basket` array, only returning the objects that *don't* match the SKU passed in. Once the result is filtered, pass the result to the same mutation we used in the `updateQuantity()` method:

```
removeItem(sku) {
  let products = this.products.filter(p => {
    if(p.sku != sku) {
      return p;
    }
  });
  this.$store.commit('updatePurchases', products);
}
```

One last enhancement we can make is to trigger the `removeItem` method if the quantity is set to 0. Within the `updateQuantity` method, check the value before looping through the products. If it is 0, or doesn't exist, run the `removeItem` method - passing the SKU through:

```
updateQuantity(e, sku) {
  if(!parseInt(e.target.value)) {
    this.removeItem(sku);
  } else {
    let products = this.products.map(p => {
      if(p.sku == sku) {
        p.quantity = parseInt(e.target.value);
      }
      return p;
    });
    this.$store.commit('updatePurchases', products);
  }
},
```

## Completing the shop SPA

The last step is to add a link from the `OrderBasket` component to the `OrderCheckout` page. This can be done by linking to the `Checkout` route. With that, your checkout is complete, along with your shop! Add the following link to the basket:

```
template: `<div>
  <h1>Basket</h1>
  <list-purchases :editable="true" />
  <router-link :to="{name: 'Checkout'}">Proceed to Checkout</router-link>
</div>`,
```

# Summary

Well done! You have created a full shop single-page application using `Vue.js`. You have learned how to list products and their variations, along with adding specific variations to the basket. You've learned how to create shop filters and category links, along with creating an editable shopping basket.

As with everything, there are always improvements to be made. Why don't you give some of these ideas a go?

- Persisting the basket using `localStorage`—so products added to the basket are retained between visits and the user pressing refresh
- Calculating shipping based on the `weight` attribute of the products in the basket—use a switch statement to create bands
- Allowing products without variations to be added to the basket from the category listing page
- Indicating which products have items out of stock when filtered on that variation on the category page
- Any ideas of your own!

# 12

## Using Vue Dev Tools and Testing Your SPA

Over the last 11 chapters, we've been developing several **Single-Page Applications (SPAs)** using `Vue.js`. Although development is a big chunk of creating an SPA, testing also forms a significant part of creating any JavaScript web app.

The Vue developer tools, available in Chrome and Firefox, provide great insights into the components being used within a certain view or the current state of the Vuex store – along with any events being emitted from the JavaScript. These tools allow you to check and validate the data within your app while developing to ensure everything is as it should be.

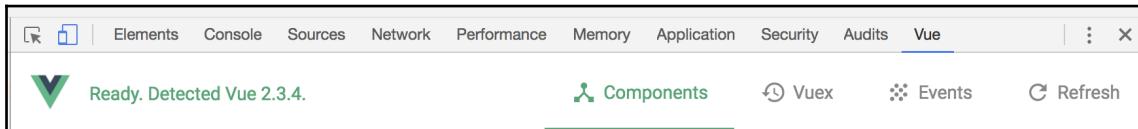
The other side of SPA testing is with automated tests. Conditions, rules, and routes you write to automate tasks within your app, allow you to then specify what the output should be and the test runs the conditions to verify whether the results match.

In this chapter, we will:

- Cover the usage of the Vue developer tools with the applications we've developed
- Have an overview of testing tools and applications

# Using the Vue.js developer tools

The Vue developer tools are available for Chrome and Firefox and can be downloaded from GitHub (<https://github.com/vuejs/vue-devtools>). Once installed, they become an extension of the browser developer tools. For example, in Chrome, they appear after the **Audits** tab.



The Vue developer tools will only work when you are using Vue in development mode. By default, the unminified version of Vue has the development mode enabled. However, if you are using the production version of the code, the development tools can be enabled by setting the `devtools` variable to `true` in your code:

```
Vue.config.devtools = true
```

Throughout the book, we've been using the development version of Vue, so the dev tools should work with all three of the SPAs we have developed. Open the Dropbox example and open the Vue developer tools.

## Inspecting Vue components data and computed values

The Vue developer tools give a great overview of the components in use on the page. You can also drill down into the components and preview the data in use on that particular instance. This is perfect for inspecting the properties of each component on the page at any given time.

For example, if we inspect the Dropbox app and navigate to the **Components** tab, we can see the `<Root>` Vue instance and we can see the `<DropboxViewer>` component. Clicking this will reveal all of the data properties of the component – along with any computed properties. This lets us validate whether the structure is constructed correctly, along with the computed path property:

The screenshot shows the Vue Dev Tools interface with the 'Components' tab selected. At the top, it says 'Ready. Detected Vue 2.3.3.' and has tabs for Components, Vuex, Events, and Refresh. Below is a search bar labeled 'Filter components' and a breadcrumb trail: '<Root> -> <DropboxViewer> == \$vm0'. The main panel displays the component structure:

```
<DropboxViewer>
  <Breadcrumb>
  <Folder>
  <Folder>
  <Folder>
  <Folder>
  <Folder>
  <Folder>
  <Folder>
  <File>
  <File>
```

On the right, the component's data and computed properties are shown:

```
data
  accessToken: null
  isLoading: false
  structure: Object
    files: Array[2]
      0: Object
      1: Object
    folders: Array[8]
      0: Object
      1: Object
      2: Object
      3: Object
      4: Object
      5: Object
      6: Object
      7: Object

computed
  path: ""
```

Drilling down into each component, we can access individual data objects and computed properties.

Using the Vue developer tools for inspecting your application is a much more efficient way of validating data while creating your app, as it saves having to place several `console.log()` statements.

## Viewing Vuex mutations and time-travel

Navigating to the next tab, **Vuex**, allows us to watch store mutations taking place in real time. Every time a mutation is fired, a new line is created in the left-hand panel. This element allows us to view what data is being sent, and what the Vuex store looked like before and after the data had been committed.

It also gives you several options to revert, commit, and time-travel to any point. Loading the Dropbox app, several structure mutations immediately populate within the left-hand panel, listing the mutation name and the time they occurred. This is the code pre-caching the folders in action. Clicking on each one will reveal the Vuex store state – along with a mutation containing the payload sent. The state display is *after* the payload has been sent and the mutation committed. To preview what the state looked like *before* that mutation, select the preceding option:

The screenshot shows the Vue Dev Tools interface with the 'Vuex' tab selected. At the top, there's a header with a 'Ready. Detected Vue 2.3.3.' message, followed by tabs for 'Components', 'Vuex' (which is active), 'Events', and 'Refresh'. Below the header are buttons for 'Filter mutations', 'Commit All', 'Revert All', and a red 'Recording' button. There are also 'Export' and 'Import' buttons.

The main area displays a list of mutations on the left and their corresponding state and getters on the right. The mutations listed are:

- Base State (timestamp: 18:54:39)
- structure (timestamp: 18:59:28)
- structure (timestamp: 18:59:29)
- structure (timestamp: 18:59:30)

On the right, for the last mutation (timestamp 18:59:30), the state and getters are expanded. The state object contains a path of "" and a structure object. The structure object has a breadcrumb array [1] with a single item (0) which is an object. The getters object is empty. Below this, the mutation object is shown with type "structure", payload (an object with data array [6] and path "applications"), and a timestamp of 18:59:30.

At the bottom of the mutations list, there are three icons: a download arrow, a circular arrow, and a clock. The bottom bar is green and shows the word 'inspected' in a purple button, 'active' in a teal button, and the timestamp '18:59:30'.

On each entry, next to the mutation name, you will notice three symbols that allow you to carry out several actions and directly mutate the store in your browser:

- **Commit this mutation:** This allows you to commit all the data up to that point. This will *remove* all of the mutations from the dev tools and update the **Base State** to this point. This is handy if there are several mutations occurring that you wish to keep track of.

- **Revert this mutation:** This will undo the mutation and all mutations after this point. This allows you to carry out the same actions again and again without pressing refresh or losing your current place. For example, when adding a product to the basket in our shop app, a mutation occurs. Using this would allow you to remove the product from the basket and undo any following mutations without navigating away from the product page.
- **Time-travel to this state:** This allows you to preview the app and state at that particular mutation, without reverting any mutations that occur after the selected point.

The mutations tab also allows you to commit or revert all mutations at the top of the left-hand panel. Within the right-hand panel, you can also import and export a JSON encoded version of the store's state. This is particularly handy when you want to re-test several circumstances and instances without having to reproduce several steps.

## Previewing event data

The **Events** tab of the Vue developer tools works in a similar way to the Vuex tab, allowing you to inspect any events emitted throughout your app. Our Dropbox app doesn't use events, so open up the people-filtering app we created in [Chapter 2, Displaying, Looping, Searching, and Filtering Data](#), and [Chapter 3, Optimizing our App and Using Components to Display Data](#), of this book.

Changing the filters in this app emits an event each time the filter type is updated, along with the filter query:

The screenshot shows the Vue Dev Tools interface with the 'Events' tab selected. At the top, there's a status message 'Ready. Detected Vue 2.3.4.' and navigation tabs for Components, Vuex, and Events. Below the tabs is a search bar labeled 'Filter events' and a 'Clear' button. A red dot indicates 'Recording'. The main area displays a list of events:

Event	Source	Time
changefilterfield \$emit by <Filtering>		19:12:53
changefilterquery \$emit by <Filtering>		19:12:55
changefilterquery \$emit by <Filtering>		19:13:05
changefilterfield \$emit by <Filtering>		19:13:08
changefilterquery \$emit by <Filtering>		19:13:08

To the right, the 'event info' pane shows details for the last event (the second 'changefilterquery' entry):

```
name: "changefilterquery"
type: "$emit"
source: "<Filtering>"
payload: Array[1]
  0: true
```

The left-hand panel again lists the name of the event and the time it occurred. The right panel contains information about the event, including its component origin and payload. This data allows you to ensure the event data is as you expected it to be and, if not, helps you locate where the event is being triggered.

The Vue dev tools are invaluable, especially as your JavaScript application gets bigger and more complex. Open the shop SPA we developed and inspect the various components and Vuex data to get an idea of how this tool can help you create applications that only commit mutations they need to and emit the events they have to.

## Testing your SPA

The majority of Vue testing suites revolve around having command-line knowledge and creating a Vue application using the **CLI (command-line interface)**. Along with creating applications in frontend-compatible JavaScript, Vue also has a CLI that allows you to create applications using component-based files. These are files with a `.vue` extension and contain the template HTML along with the JavaScript required for the component. They also allow you to create scoped CSS – styles that only apply to that component. If you chose to create your app using the CLI, all of the theory and a lot of the practical knowledge you have learned in this book can easily be ported across.

## Command-line unit testing

Along with component files, the Vue CLI allows you to integrate with command-line unit tests easier, such as Jest, Mocha, Chai, and TestCafe (<https://testcafe.devexpress.com/>). For example, TestCafe allows you to specify several different tests, including checking whether content exists, to clicking buttons to test functionality. An example of a TestCafe test checking to see if our filtering component in our first app contains the word *Filter* would be:

```
test('The filtering contains the word "filter"', async testController => {
  const filterSelector = await new Selector('body > #app > form >
label:nth-child(1)');

  await testController.expect(paragraphSelector.innerText).eql('Filter');
});
```

This test would then equate to `true` or `false`. Unit tests are generally written in conjunction with components themselves, allowing components to be reused and tested in isolation. This allows you to check that external factors have no bearing on the output of your tests.

Most command-line JavaScript testing libraries will integrate with Vue.js; there is a great list available in the awesome Vue GitHub repository (<https://github.com/vuejs/awesome-vue#test>).

## Browser automation

The alternative to using command-line unit testing is to automate your browser with a testing suite. This kind of testing is still triggered via the command line, but rather than integrating directly with your Vue application, it opens the page in the browser and interacts with it like a user would. A popular tool for doing this is `Nightwatch.js` (<http://nightwatchjs.org/>).

You may use this suite for opening your shop and interacting with the filtering component or product list ordering and comparing the result. The tests are written in very colloquial English and are not restricted to being on the same domain name or file network as the site to be tested. The library is also language agnostic – working for any website regardless of what it is built with.

The example `Nightwatch.js` gives on their website is for opening Google and ensuring the first result of a Google search for `rembrandt van rijn` is the Wikipedia entry:

```
module.exports = {
  'Demo test Google' : function (client) {
    client
      .url('http://www.google.com')
      .waitForElementVisible('body', 1000)
      .assert.title('Google')
      .assert.visible('input[type=text]')
      .setValue('input[type=text]', 'rembrandt van rijn')
      .waitForElementVisible('button[name=btnG]', 1000)
      .click('button[name=btnG]')
      .pause(1000)
      .assert.containsText('ol#rso li:first-child',
        'Rembrandt - Wikipedia')
      .end();
  }
};
```

An alternative to Nightwatch is Selenium (<http://www.seleniumhq.org/>). Selenium has the advantage of having a Firefox extension that allows you to visually create tests and commands.

Testing, especially for big applications, is paramount – especially when deploying your application to a development environment. Whether you choose unit testing or browser automation, there is a host of articles and books available on the subject.

## Summary

Till now, we created a mock shop. Using real data from Shopify CSV files, we created an application that allowed products to be viewed individually. We also created a category listing page that could be filtered and ordered, allowing the user to find specifically the products they wanted. To complete the experience, we built an editable **Basket**, **Checkout**, and **Order Confirmation** screen. In this chapter, we covered the use of the Vue dev tools, followed by how to build tests.

# 13

# Transitions and Animations

In this chapter, the following recipes will be covered:

- Integrating with third-party CSS animation libraries such as animate.css
- Adding your own transition classes
- Animating with JavaScript instead of CSS
- Transitioning on the initial render
- Transitioning between elements
- Letting an element leave before the enter phase in a transition
- Adding entering and leaving transitions for elements of a list
- Transitioning elements that move in a list
- Animating the state of your components
- Packaging reusable transitions into components
- Dynamic transitions

## Introduction

This chapter contains recipes related to transitions and animations. Vue has its own tags for dealing with transitions intended for when an element enters or leaves the scene: `<transition>` and `<transition-group>`. You will learn all about them and how to use them to give your customers a better user experience.

Vue transitions are pretty powerful in that they are completely customizable and can easily combine JavaScript and CSS styling while having very intuitive defaults that will let you write less code in case you don't want all the frills.

You can animate a great deal of what happens in your components even without transition tags since all you have to do is bind your state variables to some visible property.

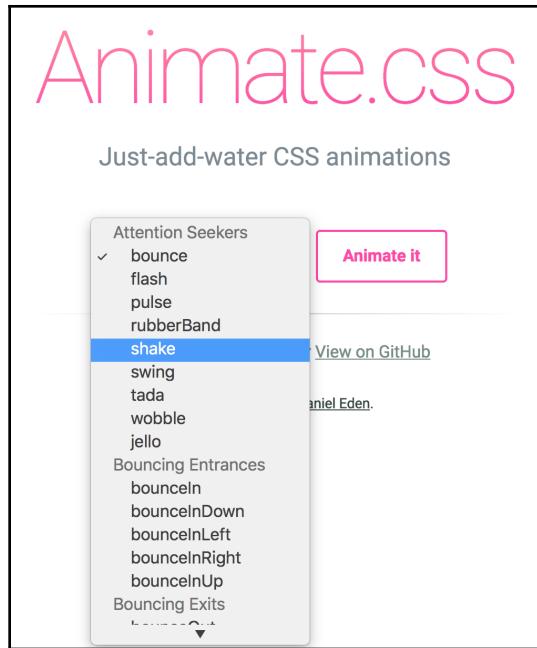
Finally, once you have mastered everything that there is to know about Vue transitions and animations, you can easily package these in layered components and reuse them throughout your application. This is what makes them not only powerful, but also easy to use and maintain.

## Integrating with third-party CSS animation libraries such as `animate.css`

Graphical interfaces not only need to be usable and easy to understand; they should also provide affordability and be pleasant to use. Having transitions can help a great deal by giving cues of how a website works in a fun way. In this recipe, we will examine how to use a CSS library with our application.

### Getting ready

Before starting, you can take a look at <https://daneden.github.io/animate.css/>, as shown, just to get an idea of the available animations, but you don't really need any special knowledge to proceed:



## How to do it...

Imagine that you are creating an app to book taxis. The interface we will create will be simple and fun.

First of all, add the `animate.css` library to the list of dependencies (refer to the *Choosing a development environment* recipe to learn how to do it).

To proceed, we need our usual wrapper:

```
<div id="app">  
</div>
```

Inside, we will put a button to call for a taxi:

```
<button @click="taxiCalled = true">  
  Call a cab  
</button>
```

You can already tell that we will use the `taxiCalled` variable to keep track of whether the button has been pressed or not

Let's add an emoji that will confirm to the user when the taxi is called:

```
<p v-if="taxiCalled">滴滴</p>
```

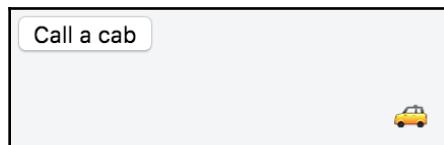
At this point, we can add some JavaScript:

```
new Vue({  
  el: '#app',  
  data: {  
    taxiCalled: false  
  }  
)
```

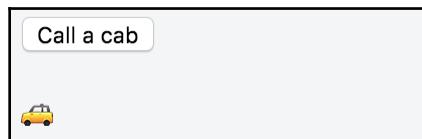
Run the application and you will see the taxi appear instantly when you press the button. We are a cool taxi company, so let's make the taxi drive to us with a transition:

```
<transition  
  enter-active-class="animated slideInRight">  
  <p v-if="taxiCalled">滴滴</p>  
</transition>
```

Now run your application; if you call the taxi, it will get to you by sliding from the right:



The taxi will slide from right to left, as shown:



## How does it work...

Every transition applies four classes. Two are applied when the element enters the *scene* and the other two are applied when it leaves:

Name	Applied when	Removed when
v-enter	Before the element is inserted	After one frame
v-enter-active	Before the element is inserted	When transition ends
v-enter-to	After one frame	When transition ends
v-leave	Transition starts	After one frame
v-leave-active	Transition starts	When transition ends
v-leave-to	After one frame	When transition ends

Here, the initial *v* stands for the name of your transition. If you don't specify a name, *v* will be used.



While the beginning of the transition is a well-defined instant, the end of the transition is a bit of work for the browser to figure out. For example, if a CSS animation loops, the duration of the animation will only be one iteration. Also, this may change in future releases, so keep this in mind.

In our case, we wanted to provide a third-party `v-enter-active` instead of writing our own. The problem is that our library already has a different name for the class of the animation we want to use (`slideInRight`). Since we can't change the name of the class, we tell Vue to use `slideInRight` instead of looking for a `v-enter-active` class.

To do this, we used the following code:

```
<transition enter-active-class="animated slideInRight">
```

This means that our `v-enter-active` is called `animated slideInRight` now. Vue will append those two classes before the element is inserted and drop them when the transition ends. Just note that `animated` is a kind of helper class that comes with `animate.css`.

# Adding your own transition classes

If your application is rich in animations and you would like to reuse your CSS classes in other projects by mixing and matching them, this is the recipe for you. You will also understand an important technique for performant animations, called **FLIP (First Last Invert Play)**. While the latter technique is normally triggered automatically by Vue, we will implement it manually to get a better understanding of how it works.

## Getting ready

To complete this recipe, you should understand how CSS animations and transitions work. This is out of the scope of this book, but you can find a good primer at <http://css3.bradshawenterprises.com/>. This website is also great because it will explain when you can use animations and transitions.

## How to do it...

We will build an interface for a taxi company (similar to the preceding recipe) that will enable users to call a taxi at the click of a button and will provide a nice animated feedback when the taxi is called.

To code the button, write the following HTML:

```
<div id="app">
  <button @click="taxiCalled = true">
    Call a cab
  </button>
  <p v-if="taxiCalled">滴滴</p>
</div>
```

Then, you initialize the `taxiCalled` variable to `false`, as shown in the following JavaScript:

```
new Vue({
  el: '#app',
  data: {
    taxiCalled: false
  }
})
```

At this point, we will create our own custom transition in CSS:

```
.slideInRight {  
    transform: translateX(200px);  
}  
  
.go {  
    transition: all 2s ease-out;  
}
```

Wrap your car emoji in a Vue transition:

```
<transition  
    enter-class="slideInRight"  
    enter-active-class="go">  
    <p v-if="taxiCalled">滴滴</p>  
</transition>
```

When you run your code and hit the **Call a cab** button, you will see a taxi stopping by.

## How it works...

When we click on the button, the `taxiCalled` variable turns `true` and Vue inserts the taxi into your page. Before actually doing this, it reads the classes you specified in `enter-class` (in this case, only `slideInRight`) and applies it to the wrapped element (the `<p>` element with the taxi emoji). It also applies the classes specified in `enter-class-active` (in this case, only `go`).

The classes in `enter-class` are removed after the first frame, and the classes in `enter-class-active` are also removed when the animation ends.

The animation created here follows the FLIP technique that is composed of four points:

- **First (F):** You take the property as it is in the first frame of your animation; in our case, we want the taxi to start somewhere from the right of the screen.
- **Last (L):** You take the property as it is in the last frame of your animation, which is the taxi at the left of the screen in our case.
- **Invert (I):** You invert the property change you registered between the first and last frame. Since our taxi moved to the left, at the final frame it will be at say -200 pixel offset. We invert that and set the `slideInRight` class to have `transform` as `translateX(200px)` so that the taxi will be at +200 pixel offset when it appears.

- **Play (P):** We create a transition for every property we have touched. In the taxi example, we use the transform property and so, we use `writetransition: all 2s ease-out` to tween the taxi smoothly.

This technique is used automatically by Vue under the cover to make transitions work inside the `<transition-group>` tag. More on that in the *Adding entering and leaving transition for elements of a list* recipe.

## Animating with JavaScript instead of CSS

It's a common misconception that animating with JavaScript is slower and that animations should be done in CSS. The reality is that if used correctly, animation in JavaScript can have similar or superior performance. In this recipe, we will create an animation with the help of the simple but powerful **Velocity.js** (<http://velocityjs.org/>) library:

The screenshot shows the Velocity.js website homepage. At the top, there's a navigation bar with links to Julian.com and Velocity.js, and a GitHub link. Below the header, the main title "Velocity.js | GitHub" is displayed, followed by the subtitle "Accelerated JavaScript animation." To the right, there's a sidebar with a vertical list of categories: Basics, Bugs, Dependencies, Arguments, Properties Map, Chaining, Option, Duration, Easing, Queue, Begin & Complete, Progress, mobileHA, Loop, Delay, Display & Visibility, Command, Fade & Slide, Scroll, Stop, Finish, Reverse, Feature, Transforms, Colors, SVG, Hook, Promises, Mock, Utility Function, and Advanced, Value Functions, Forcefeeding.

The main content area has several sections: "Overview" (explains Velocity is an animation engine with the same API as jQuery's `$.animate()`), "Download" (instructions to download and include the library), "Compatibility" (notes it works everywhere from IE8 to modern browsers), "Secret Sauce" (notes it uses JavaScript instead of CSS), and "Performance" (a section with a "Start" button and dropdowns for Velocity, duration, and easing). A sidebar on the right contains a summary from Julian Shapiro about summarizing the science of building muscle.

## Getting ready

This recipe, while it presupposes no knowledge of the Velocity library, assumes that you are quite familiar with animations either in CSS or with JavaScript libraries, such as jQuery. If you've never seen a CSS animation and you want a speedy introduction, just complete the two preceding recipes and you should be able to follow along.

## How to do it...

We're still looking for the perfect transition for a taxi company (the same as in the preceding recipe) that will entertain our clients while waiting for a taxi. We have a button to call a cab and a little taxi emoji that will appear when we make a reservation.

Before anything else, add the Velocity library as a dependency to your project--<https://cdnjs.cloudflare.com/ajax/libs/velocity/1.2.3/velocity.min.js>.

Here is the HTML to create the skeleton of our interface:

```
<div id="app">
  <button @click="taxiCalled = true">
    Call a cab
  </button>
  <p v-if="taxiCalled">🚕</p>
</div>
```

Our Vue model is very simple and consists only of the `taxiCalled` variable:

```
new Vue({
  el: '#app',
  data: {
    taxiCalled: false
  }
})
```

Create the animation by wrapping the little taxi in a Vue transition:

```
<transition
  @enter="enter"
  :css="false"
>
<p v-if="taxiCalled">🚕</p>
</transition>
```

The enter method will be called as soon as the taxi emoji is inserted at the press of a button.

The enter method, which you have to add to your Vue instance, looks like this:

```
methods: {
  enter (el) {
    Velocity(el,
      { opacity: [1, 0], translateX: ["0px", "200px"] },
      { duration: 2000, easing: "ease-out" })
  }
}
```

Run your code and press the button to book your taxi!

## How it works...

As you may have noted, there is no CSS in your code. The animation is purely driven by JavaScript. Let's dissect our Vue transition a little:

```
<transition
  @enter="enter"
  :css="false"
>
  <p v-if="taxiCalled">🚗</p>
</transition>
```

Although this is still a transition that could use CSS, we want to tell Vue to shut down the CSS and save precious CPU cycles by setting `:css="false"`. This will make Vue skip all the code related to CSS animation and will prevent CSS from interfering with our pure JavaScript animation.

The juicy part is in the `@enter="enter"` bit. We are binding the hook that triggers when the element is inserted in to the `enter` method. The method itself is as follows:

```
enter (el) {
  Velocity(el,
    { opacity: [1, 0], translateX: ["0px", "200px"] },
    { duration: 2000, easing: "ease-out" }
  )
}
```

Here, we are calling the Velocity library. The `el` parameter is passed for free by Vue, and it refers to the element that was inserted (in our case, the `<p>` element containing the emoji of the car).

The syntax of the Velocity function is as illustrated:

```
Velocity( elementToAnimate, propertiesToAnimate, [options] )
```

Other syntaxes are possible, but we will stick to this one.

In our call to this function, we passed our paragraph element as the first argument; we then said that the opacity should change from 0 to 1 and, at the same time, the element should move from a starting position of 200 pixels on the x axis toward its origin. As options, we specified that the animation should last for two seconds and that we want to ease the animation near the end.

I think everything is pretty clear maybe except how we are passing the opacity and `translateX` parameters.

This is what Velocity calls **forcefeeding**--we are telling Velocity that the opacity should start from 0 and go to 1. Likewise, we are telling Velocity that the `translateX` property should start at 200 pixels, ending at 0 pixels.

In general, we can avoid passing arrays to specify the initial value for the properties; Velocity will calculate how to transition.

For example, we could have had the following CSS class:

```
p {  
    opacity: 0;  
}
```

If we rewrite the Velocity call as follows:

```
Velocity(el,  
        { opacity: 1 }  
)
```

The car will slowly appear. Velocity queried the DOM for the initial value of the element and then transitioned it to 1. The problem with this approach is that since a query to the DOM is involved, some animations could be slower, especially when you have a lot of concurrent animations.

Another way we can obtain the same effect as force-feeding is by using the `begin` option, like so:

```
Velocity(el,  
        { opacity: 1 },  
        { begin: () => { el.style.opacity = 0 } }  
)
```

This will set the opacity to zero just before the animation begins (and hence, before the element is inserted). This will help in slower browsers in which forcefeeding will still display a flash of the car before bringing it all the way to the right and starting the animation.

The possible hooks for JavaScript animations are summarized in this table:

Attribute	Description
@before-enter	This function is called before the element is inserted.
@enter	This function is called when the element is inserted.
@after-enter	This function is called when the element is inserted and the animation is finished.
@enter-cancelled	This function is called when the animation is still in progress, but the element has to leave. If you use Velocity you can do something like <code>Velocity(el, "stop")</code> .
@before-leave	This function is called before the leave function is triggered.
@leave	This function is called when the element leaves.
@after-leave	This function is called when the element leaves the page.
@leave-cancelled	This is called in case the element has to be inserted before the leave call is finished. It works only with v-show.



Just be reminded that these hooks are valid for any library, not just Velocity.

## There's more...

We can try another take with this interface by implementing a cancel button. If the user booked a cab by mistake, hitting cancel will delete the reservation, and it will be apparent by the fact that the little taxi emoji disappears.

First, let's add a cancel button:

```
<button @click="taxiCalled = false">  
  Cancel  
</button>
```

That was easy enough; now we add our leave transition:

```
<transition
  @enter="enter"
  @leave="leave"
  :css="false"
>
  <p v-if="taxiCalled">滴滴</p>
</transition>
```

That brings us to our leave method:

```
leave (el) {
  Velocity(el,
    { opacity: [0, 1], 'font-size': ['0.1em', '1em'] },
    { duration: 200 })
}
```

What we are doing is making the emoji disappear while scaling it down.

If you try to run your code, you will encounter some problems.

When you click on the cancel button, what should happen is the leave animation should start and the taxi should become smaller and eventually disappear. Instead, nothing happens and the taxi disappears abruptly.

The reason the cancel animation doesn't play as planned is because since the animation is written in JavaScript instead of CSS, Vue has no way to tell when the animation is finished. In particular, what happens is that Vue thinks that the leave animation is finished before it even starts. That is what makes our car disappear.

The trick lies in the second argument. Every hook calls a function with two arguments. We have already seen the first, `el`, which is the subject of the animation. The second is a callback that when called, tells Vue that the animation is finished.

We will leverage the fact that Velocity has an option called `complete`, which expects a function to call when the animation (from the Velocity perspective) is complete.

Let's rewrite our code with this new information:

```
leave (el, done) {
  Velocity(el,
    { opacity: [0, 1], 'font-size': ['0.1em', '1em'] },
    { duration: 200 })
}
```

Adding the done arguments to our function lets Vue know that we want a callback to call when the animation is finished. We don't need to explicitly use the callback as Vue will figure it out by itself, but since it's always a bad idea to rely on default behaviors (they can change if they are not documented), let's call the done function when the animation is finished:

```
leave (el, done) {
  Velocity(el,
    { opacity: [0, 1], 'font-size': ['0.1em', '1em'] },
    { duration: 200, complete: done })
}
```

Run your code and press the **Cancel** button to cancel your taxi!

## Transitioning on the initial render

With the `appear` keyword, we are able to package transition for elements when they are first loaded. This helps the user experience in that it gives the impression that the page is more responsive and faster to load when you apply it to many elements.

## Getting ready

This recipe doesn't assume any particular knowledge, but if you have completed at least the *Adding some fun to your app with CSS transitions* recipe, it will be a piece of cake.

## How to do it...

We will build a page about the American actor Fill Murray; no, not Bill Murray. You can find more information about him at <http://www.fillmurray.com>. We will use images from this site to fill our page about him.

In our HTML, let's write a header as the title of our page:

```
<h1>
  The Fill Murray Page
</h1>
```

After the title, we will place our Vue application:

```
<div id="app">
  
```

```
<p>
  The internet was missing the ability to
  provide custom-sized placeholder images of Bill Murray.
  Now it can.
</p>
</div>
```

Which when rendered in a browser would appear like the following:



Our page is very plain right now. We want the Fill Murray picture to fade in. We have to wrap it inside a transition:

```
<transition appear>
  
</transition>
```

The following are the CSS classes:

```
img {
  float: left;
  padding: 5px
}
.v-enter {
  opacity: 0
}
.v-enter-active {
  transition: opacity 2s
}
```

Running our page now will make the image appear slowly, but it will also move the text. To fix it, we have to specify the image size in advance:

```
<transition appear>
  
</transition>
```

This way, our browser will set aside some space for the image that will appear slowly.

## How it works...

The `appear` directive in the `transition` tag will make the components appear for the first time with an associated transition (if it is found).

There are many possible ways to specify a transition on the first rendering of the component. In all cases, the `appear` directive must be specified.

The first things Vue will look for when this directive is present are JavaScript hooks or CSS classes specified in the tag:

```
<transition
  appear
  @before-appear="customBeforeAppearHook"
  @appear="customAppearHook"
  @after-appear="customAfterAppearHook"
  appear-class="custom-appear-class"
  appear-active-class="custom-appear-active-class"
>
  <p>My element</p>
</transition>
```

After that, if a name is specified, Vue will look for an entrance transition for that element:

```
<transition appear name="myTransition">
  <p>My element</p>
</transition>
```

The preceding code will look for classes named as follows:

```
.myTransition-enter {...}
.myTransition-enter-active {...}
```

Vue will look for the default CSS classes for the element insertion (`v-enter` and `v-enter-active`) if everything else fails. Incidentally, this is what we have done in our recipe.

Relying on these defaults is not a good practice; here, we have done it just as a demonstration. You should always give names to your transitions.



Maybe it's worth mentioning why we had to add the width and height to our image. The reason is that when we specify an image URL in our HTML, the browser doesn't know the size of the image in advance, so it doesn't reserve any space for it by default. Only by specifying the size of the image in advance, the browser is able to correctly compose the page even before an image is loaded.

## Transitioning between elements

Everything on a web page is an element. You can easily make them appear and disappear, thanks to Vue `v-if` and `v-show` directives. With transitions, you can easily control how they appear and even add magic effects. This recipe explains how to do it.

### Getting ready

For this recipe, you should have some familiarity with Vue transitions and how CSS works.

### How to do it...

Since we talked about magic, we will turn a frog into a princess. The transformation itself will be a transition.

We will instantiate a button that, when pressed, will represent a kiss to the frog:

```
<div id="app">
  <button @click="kisses++">👉Kiss!</button>
</div>
```

Every time the button is pressed, the variable `kisses` increases. The variable will be initialized to zero, as the following code shows:

```
new Vue({
  el: '#app',
  data: {
    kisses: 0
  }
})
```

Next, we need the frog and the princess that we will add immediately after the button:

```
<transition name="fade">
  <p v-if="kisses < 3" key="frog">🐸frog</p>
  <p v-if="kisses >= 3" key="princess">👸princess</p>
</transition>
```

The fade transition is the following CSS:

```
.fade-enter-active, .fade-leave-active {
  transition: opacity .5s
}
.fade-enter, .fade-leave-active {
  opacity: 0
}
```

To make it work properly, we need a last CSS selector to add:

```
p {
  margin: 0;
  position: absolute;
  font-size: 3em;
}
```

If you run the application and click enough times the kiss button, you should see your frog turn into a princess:



This transition will have a fade effect:



The frog emoji will turn into a princess emoji:



## How it works...

When we wrote the two elements, we used the `key` attribute specifying who is the frog and who is the princess. This is because, Vue optimization system will kick in otherwise. It will see that the content of the two elements can be swapped without swapping the elements themselves and no transition will ensue since the element was the same and only the content changed.

If we remove the `key` attribute, we can see for ourselves that the frog and the princess will change, but without any transition:

```
<transition name="fade">
  <p v-if="kisses < 3">🐸frog</p>
  <p v-if="kisses >= 3">👑princess</p>
</transition>
```

Consider that we use two different elements, as shown:

```
<p v-if="kisses < 3" >🐸frog</p>
<span v-if="kisses >= 3">👑princess</span>
```

Also, we modify our CSS selector for `<p>` accordingly:

```
p, span {
  margin: 0;
  position: absolute;
  font-size: 3em;
  display: block;
}
```

Now if we launch our application again, everything works without using any `key` attribute.



Using keys is generally recommended even when not necessary, like in the preceding case. This is especially true when items have a different semantic meaning. There are a couple of reasons for this. The main reason is that when multiple people work on the same line of code, modifying the `key` attribute will not break the application as easily as switching a `span` element back into a `p` element, which will ruin the transition as we just saw.

## There's more...

Here, we cover two subcases of the preceding recipe: switching between more than two elements and binding the `key` attribute.

## Transitioning between more than two elements

We can expand on the recipe we just completed in a straightforward manner.

Let's suppose that if we kiss the princess too many times, she will turn into Santa Claus, which may or may not be appealing, depending on your age I guess.

First, we add the third element:

```
<transition name="fade">
  <p v-if="kisses < 3" key="frog">🐸frog</p>
  <p v-else-if="kisses >= 3 && kisses <= 5" key="princess">👸princess</p>
  <p v-else key="santa">🎅santa</p>
</transition>
```

We can launch the application immediately and when we kiss the princess/frog more than five times, Santa will appear with the same fading transition:



Using this setup, we are limited in using the same transition we used between the first two elements.

There is a workaround for this explained in the *Dynamic transitions* recipe.

## Setting the key attribute dynamically

We don't have to write the key for all our elements if we already have some data available. Another way we could write the same app, but without repeating the element is as follows:

```
<transition name="fade">
  <p :key="transformation">{{emoji}}{{transformation}}</p>
</transition>
```

This, of course, means that we have to provide a sensible value for the transformation and `emoji` variables, depending on the number of kisses.

To do this, we will tie them to computed properties:

```
computed: {
  transformation () {
    if (this.kisses < 3) {
      return 'frog'
    }
    if (this.kisses >= 3 && this.kisses <= 5) {
      return 'princess'
    }
    if (this.kisses > 5) {
      return 'santa'
    }
  },
  emoji () {
    switch (this.transformation) {
      case 'frog': return '🐸'
      case 'princess': return '👸'
      case 'santa': return '🎅'
    }
  }
}
```

We traded off some complexity in the template for some more logic in our Vue instance. This can be good in the long run if we expect more complex logic in the future or if the number of transformation rises.

# Letting an element leave before the enter phase in a transition

In the *Transitioning between elements* recipe, we explored how to make the transition between two elements. The default behavior of Vue is to start the transition of the element that is entering at the same time that the first element is leaving; this is not always desirable.

You will learn about this important corner case and how to work around it in this recipe.

## Getting ready

This recipe builds on top of the transitioning between two elements and solves a specific problem. If you don't know what we are talking about, go back one recipe and you'll be on track in no time.

## How to do it...

First, you will see the problem if you have not encountered it yet. Next, we'll see what Vue offers us to solve it.

## The two elements problem

Let's create a carousel effect on our website. The user will view one product at a time and then he will swipe to the next product. To swipe to the next product the user will need to click a button.

First, we need our list of products in the Vue instance:

```
new Vue({  
  el: '#app',  
  data: {  
    product: 0,  
    products: ['☂️umbrella', '💻computer', '🏀ball', '📸camera']  
  }  
})
```

In our HTML, we will only need a button and the view of an element:

```
<div id="app">
  <button @click="product++>next</button>
  <transition name="slide">
    <p :key="products[product % 4]">{{products[product % 4]}}</p>
  </transition>
</div>
```

The modulo 4 (`product % 4`) is only because we want to start all over again when the list of products finishes.

To set up our sliding transition, we will need the following rules:

```
.slide-enter-active, .slide-leave-active {
  transition: transform .5s
}
.slide-enter {
  transform: translateX(300px)
}
.slide-leave-active {
  transform: translateX(-300px);
}
```

Also, to make everything look good, we finish up with the following:

```
p {
  position: absolute;
  margin: 0;
  font-size: 3em;
}
```

If you run the code now, you will see a nice carousel:



Now, let's try to remove the `position: absolute` from the last rule:

```
p {
  margin: 0;
  font-size: 3em;
}
```

If you try your code now, you will see a weird jumping from the products:



This is the problem we are trying to solve. The second transition starts before the first product has left. If the positioning is not absolute, we will see some weird effects.

## Transition modes

To fix this problem, we will change the transition mode. Let's modify the `<transition>` code:

```
<transition name="slide" mode="out-in">
  <p :key="products[product%4]">{products[product%4]}</p>
</transition>
```

Now run your program and you will see the products taking a little more time before sliding inside the screen. They are waiting for the previous item to go away before entering.

## How it works...

To recapitulate, you have two different ways to manage transitions between components in Vue. The default way is to start the *in* transition at the same time with the *out* transition. We can make that explicit with the following:

```
<transition mode="in-out">
  <!-- elements -->
</transition>
```

We can change this default behavior by waiting for the *out* part to be finished before starting the *in* animation. We achieved it with the following:

```
<transition mode="out-in">
  <!-- elements -->
</transition>
```

While the former is useful when elements have the absolute style position, the latter is more relevant when we really need to wait to have a clear way before putting more stuff on the page.

Absolute positioning won't care about having elements on top of each other because they don't follow the flow of the page. On the other hand, static positioning will append the second element after the first, making the transition awkward if both the elements are shown at the same time.

## Adding entering and leaving transitions for elements of a list

Here, we will try to add a visual way to suggest that an element is added or removed from the list. This can add a lot to UX since you have an opportunity to suggest to the user why an element was added or removed.

### Getting ready

Some familiarity with CSS and transition will help. If you feel like this is needed, just browse the other recipes in this chapter.

### How to do it...

We'll build a syllabus to study programming. When we are done with a topic, we'll feel relieved and we want to incorporate that feeling in our app by making the topic float away from the syllabus as we learn it.

The data of the list will be in our Vue instance:

```
new Vue({  
  el: '#app',  
  data: {  
    syllabus: [  
      'HTML',  
      'CSS',  
      'Scratch',  
      'JavaScript',  
      'Python'  
    ]  
  }  
})
```

```
 })
```

The list will be printed in our HTML with the following code:

```
<div id="app">
  <h3>Syllabus</h3>
  <ul>
    <li v-for="topic in syllabus">
      {{topic}}
    </li>
  </ul>
</div>
```

When we press a button, we want the topic to disappear from the list. For this to happen, we need to modify the code we have written.

First, let's add a **Done** button before each topic:

```
<li v-for="topic in syllabus">
  <button @click="completed(topic)">Done</button>{{topic}}
</li>
```

Here, the completed method will look like this:

```
methods: {
  completed (topic) {
    let index = this.syllabus.indexOf(topic)
    this.syllabus.splice(index, 1)
  }
}
```

Running the code now will reveal a simple application for checking off the topics we already studied. What we want though is an animation that will make us feel relieved.

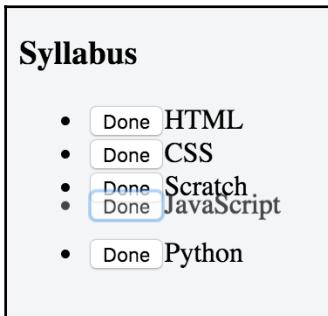
For that, we need to edit the container of our list. We remove the `<ul>` tag and, instead, tell the `<transition-group>` to compile to a `<ul>` tag:

```
<transition-group tag="ul">
  <li v-for="topic in syllabus" :key="topic">
    <button @click="completed(topic)">Done</button>{{topic}}
  </li>
</transition-group>
```

Note that we also added a key to each list element according to the topic. The last thing we need is adding the transition rules to our CSS:

```
.v-leave-active {  
  transition: all 1s;  
  opacity: 0;  
  transform: translateY(-30px);  
}
```

Now, the subjects will disappear with the transition on clicking the **Done** button, as shown:



## How it works...

The `<transition-group>` tag represents a container for a group of elements that will be displayed at the same time. By default, it represents the `<span>` tag, but by setting the `tag` attribute to `ul`, we made it represent an unordered list.

Every element in the list must have a unique key or the transitions won't work. Vue will take care of applying a transition to every element that enters or leaves.

## Transitioning elements that move in a list

In this recipe, you will build a list of elements that move according to how the list changes. This particular animation is useful when you want to tell your user that something has changed and the list is now updated accordingly. It will also help the user identify the point in which the element was inserted.

## Getting ready

This recipe is a little advanced; I would suggest you complete some of the recipes in this chapter if you are not very familiar with transitions in Vue. If you can complete the *Adding entering and leaving transitions for elements of a lists* recipe without much difficulty, you are good to go.

## How to do it...

You will build a little game--a bus station simulator!

Whenever a bus--represented by its emoji--leaves the station, all the other buses will drive a little ahead to take its place. Every bus is identified by a number, as you can see from the Vue instance data:

```
new Vue({
  el: '#app',
  data: {
    buses: [1,2,3,4,5],
    nextBus: 6
  }
})
```

Whenever a new bus arrives, it will have a progressive number assigned. We want a new bus to leave or go every two seconds. We can achieve this by hooking a timer when our component is mounted on screen. Immediately after data, write the following:

```
mounted () {
  setInterval(() => {
    const headOrTail = () => Math.random() > 0.5
    if (headOrTail()) {
      this.buses.push(this.nextBus)
      this.nextBus += 1
    } else {
      this.buses.splice(0, 1)
    }
  }, 2000)
}
```

The HTML of our app will look like this:

```
<div id="app">
  <h3>Bus station simulator</h3>
  <transition-group tag="p" name="station">
    <span v-for="bus in buses" :key="bus">bus</span>
```

```
</transition-group>  
</div>
```

To make the buses move around, we need to specify some CSS rules under the prefix `station`:

```
.station-leave-active, .station-enter-active {  
  transition: all 2s;  
  position: absolute;  
}  
  
.station-leave-to {  
  opacity: 0;  
  transform: translateX(-30px);  
}  
  
.station-enter {  
  opacity: 0;  
  transform: translateX(30px);  
}  
  
.station-move {  
  transition: 2s;  
}  
  
span {  
  display: inline-block;  
  margin: 3px;  
}
```

Launching the app now will result in an orderly queue of buses in which one leaves or arrives every two seconds:



## How it works...

The core of our app is the `<transition-group>` tag. It manages all the buses identified by their key:

```
<transition-group tag="p" name="station">
  <span v-for="bus in buses" :key="bus">❸</span>
</transition-group>
```

Whenever a bus enters or leaves the scenes, a FLIP animation (see the *Adding your own transition classes* recipe) will be automatically triggered by Vue.

To fix ideas, let's say we have buses [1, 2, 3] and bus 1 leaves the scene. What happens next is that the properties of the first bus's `<span>` element will be memorized before the animation actually starts. So we may retrieve the following object describing the properties:

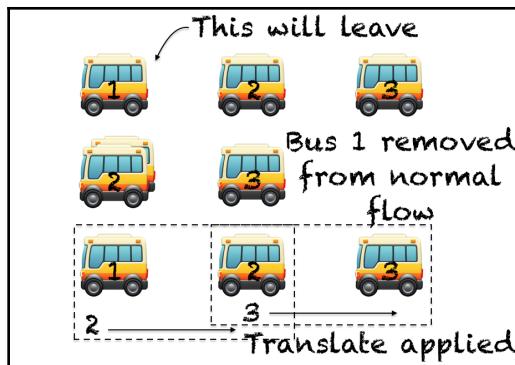
```
{
  bottom:110.4375
  height:26
  left:11
  right:27
  top:84.4375
  width:16
}
```

Vue does this for all the elements keyed inside the `<transition-group>` tag.

After this, the `station-leave-active` class will be applied to the first bus. Let's briefly review what the rules are:

```
.station-leave-active, .station-enter-active {
  transition: all 2s;
  position: absolute;
}
```

We note that the position becomes absolute. This means that the element is removed from the normal flow of the page. This in turn means that all the buses behind him will suddenly move to fill the space left blank. Vue records all the properties of the buses at this stage also and this is considered the final frame of the animation. This frame is not actually a real displayed frame; it is just used as an abstraction to calculate the final position of the elements:



Vue will calculate the difference between the final frame and the starting frame and will apply styles to make the buses appear in the initial frame even if they are not. The styles will be removed after one frame. The reason the buses slowly crawl to their final frame position instead of immediately moving in their new position is that they are `span` elements and we specified that any transform style (the one used by Vue to fake their position for one frame) must be transitioned for two seconds:

```
.station-move {
  transition: 2s;
}
```

In other words, at frame -1, the three buses are all in place and their position is recorded.

At frame 0, the first bus is removed from the flow of the page and the other buses are instantaneously moved behind it. In the very same frame, Vue records their new position and applies a transform that will move the buses back to where they were at frame -1 giving the appearance that nobody moved.

At frame 1, the transform is removed, but since we have a transition, the buses will slowly move to their final position.

## Animating the state of your components

In computers, everything is a number. In Vue, everything that is a number can be animated in one way or other. In this recipe, you will control a bouncy ball that will smoothly position itself with a tween animation.

## Getting ready

To complete this recipe, you will need at least some familiarity with JavaScript. The technicalities of JavaScript are out of the scope of this book, but I will break the code down for you in the *How it works...* section, so don't worry too much about it.

## How to do it...

In our HTML, we will add only two elements: an input box in which we will enter the desired position of our bouncy ball and the ball itself:

```
<div id="app">
  <input type="number">
    <div class="ball"></div>
</div>
```

To properly render the ball, write this CSS rule and it will appear on the screen:

```
.ball {
  width: 3em;
  height: 3em;
  background-color: red;
  border-radius: 50%;
  position: absolute;
  left: 10em;
}
```

We want to control the bar *Y* position. To do that, we will bind the `top` property of the ball:

```
<div id="app">
  <input type="number">
    <div class="ball" :style="'top: ' + height + 'em'"></div>
</div>
```

Height will be part of our Vue instance model:

```
new Vue({
  el: '#app',
  data: {
    height: 0
  }
})
```

Now, since we want the ball to animate in the new position whenever the `enteredHeight` changes, one idea would be to bind the `@change` event of the input element:

```
<div id="app">
  <input type="number" @input="move">
  <div class="ball" :style="`top: ${height}em`"></div>
</div>
```

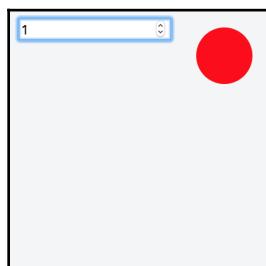
The move method will be the one responsible for taking the current height of the ball and slowly transitioning it to the specified value.

Before doing this, you will add the **Tween.js** library as a dependency. The official repository is at <https://github.com/tweenjs/tween.js>. You can add the CDN link specified in the **README.md** page if you are using JSFiddle.

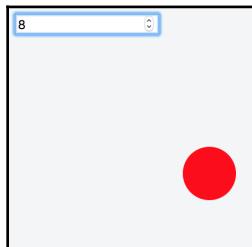
Add the move method after adding the library, like this:

```
methods: {
  move (event) {
    const newHeight = Number(event.target.value)
    const _this = this
    const animate = (time) => {
      requestAnimationFrame(animate)
      TWEEN.update(time)
    }
    new TWEEN.Tween({ H: this.height })
      .easing(TWEEN.Easing.Bounce.Out)
      .to({ H: newHeight }, 1000)
      .onUpdate(function () {
        _this.height = this.H
      })
      .start()
      animate()
  }
}
```

Try to launch the app and see the ball bounce while you edit its height:



When we change the height, the position of the ball also changes:



## How it works...

The general principle here is that you have a state for an element or component. When the state is numeric in nature, you can "tween" (from between) from one value to the other following a specific curve or acceleration.

Let's break down the code, shall we?

The first thing we do is to take the specified new height for the ball and save it to the `newHeight` variable:

```
const newHeight = Number(event.target.value)
```

In the next line, we are also saving our Vue instance in a `_this` helper variable:

```
const _this = this
```

The reason we do so will be clear in a minute:

```
const animate = (time) => {
  requestAnimationFrame(animate)
  TWEEN.update(time)
}
```

In the preceding code, we are wrapping all of our animation in a function. This is idiomatic to the Tween.js library and identifies the main loop we will use to animate. If we have other tweens, this is the place to trigger them:

```
new TWEEN.Tween({ H: this.height })
  .easing(TWEEN.Easing.Bounce.Out)
  .to({ H: newHeight }, 1000)
  .onUpdate(function () {
    _this.height = this.H
  })
.start()
```

This is the API call to our library. First, we are creating an object that will hold a copy of the height value in lieu of our component. Normally, here you put the object that represents the state itself. Due to Vue limitations (or Tween.js limitations), we are using a different strategy; we are animating a copy of the state and we are syncing the true state for every frame:

```
Tween({ H: this.height })
```

The first line initializes this copy to be equal to the current actual height of the ball:

```
easing(TWEEN.Easing.Bounce.Out)
```

We choose the easing to resemble a bouncy ball:

```
.to({ H: newHeight }, 1000)
```

This line sets the target height and the number of milliseconds the animation should last for:

```
onUpdate(function () {
  _this.height = this.H
})
```

Here, we are copying the height of the animation back to the real thing. As this function binds this to the copied state, we are forced to use ES5 syntax to have access to it. This is why we had a variable ready to reference the Vue instance. Had we used the ES6 syntax, we would not have any way to get the value of H directly.

## Packaging reusable transitions into components

We may have a significant transition in our website that we want to reuse throughout the user funnel. Packaging transition into components can be a good strategy if you are trying to keep your code organized. In this recipe, you will build a simple transition component.

## Getting ready

Following this recipe makes sense if you have already worked your way through the transition with Vue. Also, since we are working with components, you should at least have an idea of what they are. Skim through the next chapter for a primer on components. In particular, we will create a functional component, the anatomy of which is detailed in the *Creating a functional component* recipe.

## How to do it...

We will build a signature transition for a news portal. Actually, we will use a premade transition in the excellent magic library (<https://github.com/minIMAC/magic>), so you should add it to your project as a dependency. You can find the CDN link at <https://cdnjs.com/libraries/magic> (go to the page to find the link, don't copy it as a link).

First, you will build the website page, then you will build the transition itself. Lastly, you will just add the transition to different elements.

## Building the basic web page

Our web page will consist of two buttons each that will display a card: one is a recipe and the other is the last breaking news:

```
<div id="app">
  <button @click="showRecipe = !showRecipe">
    Recipe
  </button>
  <button @click="showNews= !showNews">
    Breaking News
  </button>
  <article v-if="showRecipe" class="card">
    <h3>
      Apple Pie Recipe
    </h3>
    <p>
      Ingredients: apple pie. Procedure: serve hot.
    </p>
  </article>
  <article v-if="showNews" class="card">
    <h3>
      Breaking news
    </h3>
```

```
<p>
    Donald Duck is the new president of the USA.
</p>
</article>
</div>
```

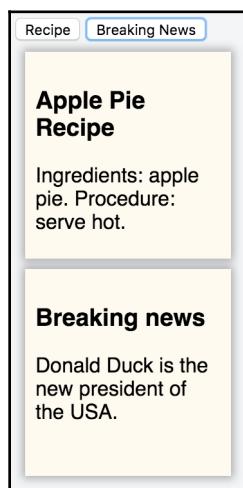
The cards will have their unique touch, thanks to the following CSS rule:

```
.card {
    position: relative;
    background-color: FloralWhite;
    width: 9em;
    height: 9em;
    margin: 0.5em;
    padding: 0.5em;
    font-family: sans-serif;
    box-shadow: 0px 0px 10px 2px rgba(0,0,0,0.3);
}
```

The JavaScript part will be a very simple Vue instance:

```
new Vue({
  el: '#app',
  data: {
    showRecipe: false,
    showNews: false
  }
})
```

Running this code will already display your web page:



## Building the reusable transition

We decided that our website will feature a transition whenever a card is displayed. Since we intend to reuse the animation with everything in our website, we'd better package it in a component.

Before the Vue instance, we declare the following component:

```
Vue.component('puff', {
  functional: true,
  render: function (createElement, context) {
    var data = {
      props: {
        'enter-active-class': 'magictime puffIn',
        'leave-active-class': 'magictime puffOut'
      }
    }
    return createElement('transition', data, context.children)
  }
})
```

The `puffIn` and `puffOut` animations are defined in `magic.css`.

## Using our transition with the elements in our page

Now, we will just edit our web page to add the `<puff>` component to our cards:

```
<div id="app">
  <button @click="showRecipe = !showRecipe">
    Recipe
  </button>
  <button @click="showNews = !showNews">
    Breaking News
  </button>
  <puff>
    <article v-if="showRecipe" class="card">
      <h3>
        Apple Pie Recipe
      </h3>
      <p>
        Ingredients: apple pie. Procedure: serve hot.
      </p>
    </article>
  </puff>
  <puff>
    <article v-if="showNews" class="card">
```

```
<h3>
  Breaking news
</h3>
<p>
  Donald Duck is the new president of the USA.
</p>
</article>
</puff>
</div>
```

The cards will now appear and disappear when pressing the button with a "puff" effect.

## How it works...

The only tricky part in our code is building the `<puff>` component. Once we have that in place, whatever we put inside will appear and disappear according to our transition. In our example, we used an already made transition. In the real world, we may craft a seriously complex animation that can be difficult to apply every time in the same manner. Having it packaged in a component is much easier and maintainable.

Two things make the `<puff>` component work as a reusable transition:

```
props: {
  'enter-active-class': 'magictime puffIn',
  'leave-active-class': 'magictime puffOut'
}
```

Here, we specify the classes the component must adopt when entering and leaving; there is nothing too special here, we have already done it in the *Integrating with third-party CSS animation libraries such as animate.css* recipe.

At the end we return the actual element:

```
return createElement('transition', data, context.children)
```

This line creates the root of our element that is a `<transition>` tag with only one child--`context.children`. This means that the child is unspecified; the component will put as child whatever actual child is passed in the template. In our examples, we passed some cards that were promptly displayed.

# Dynamic transitions

In Vue, a constant theme is reactivity and, of course, transitions can be dynamic because of that. Not only the transition themselves, but all their properties can be bound to reactive variables. This gives us a lot of control over which transition to use at any given moment.

## Getting ready

This recipe builds on top of the *Transitioning between elements* recipe. You don't need to go back if you already know about transitions, but if you feel like you're missing something, it might be a good idea to complete that first.

## How to do it...

We will transform a frog into a princess with some kisses, but if we kiss too much the princess will turn into Santa. Of course, we are talking about emojis.

Our HTML setup is very simple:

```
<div id="app">
  <button @click="kisses++">👉Kiss!</button>
  <transition :name="kindOfTransformation" :mode="transformationMode">
    <p :key="transformation">{{emoji}} {{transformation}}</p>
  </transition>
</div>
```

Just note that most of the attributes here are bound to variables. Here is how the JavaScript unfolds.

First, we will create a simple Vue instance with all of our data:

```
new Vue({
  el: '#app',
  data: {
    kisses: 0,
    kindOfTransformation: 'fade',
    transformationMode: 'in-out'
  }
})
```

The fade transformation we are referring to is the following CSS:

```
.fade-enter-active, .fade-leave-active {  
  transition: opacity .5s  
}  
.fade-enter, .fade-leave-active {  
  opacity: 0  
}
```

The variables transformation and emoji are defined by two computed properties:

```
computed: {  
  transformation () {  
    if (this.kisses < 3) {  
      return 'frog'  
    }  
    if (this.kisses >= 3 && this.kisses <= 5) {  
      return 'princess'  
    }  
    if (this.kisses > 5) {  
      return 'santa'  
    }  
  },  
  emoji () {  
    switch (this.transformation) {  
      case 'frog': return '🐸'  
      case 'princess': return '👸'  
      case 'santa': return '🎅'  
    }  
  }  
}
```

While we are using the fade transition between the frog and the princess, we want something else between the princess and the frog. We will use the following transition classes:

```
.zoom-leave-active, .zoom-enter-active {  
  transition: transform .5s;  
}  
  
.zoom-leave-active, .zoom-enter {  
  transform: scale(0)  
}
```

Now, since we bound the name of the transition to a variable, we can easily switch that programmatically. We can do that by adding the following highlighted lines to the computed property:

```
transformation () {
  if (this.kisses < 3) {
    return 'frog'
  }
  if (this.kisses >= 3 && this.kisses <= 5) {
    this.transformationMode = 'out-in'
    return 'princess'
  }
  if (this.kisses > 5) {
    this.kindOfTransformation = 'zoom'
    return 'santa'
  }
}
```

The first added line is to avoid having an overlap while the zoom transition starts (more on that in the *Letting an element leave before the enter phase in a transition recipe*).

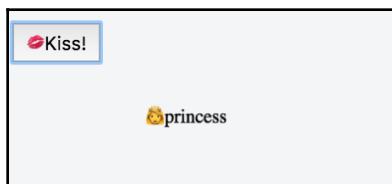
The second added line switches the animation to "zoom".

To make everything appear the right way, we need one more CSS rule:

```
p {
  margin: 0;
  position: absolute;
  font-size: 3em;
}
```

This is much nicer.

Now run the app and see how the two different transitions are used dynamically:



As the number of kisses increase, the princess zooms out:



With this, the Santa zooms in:



## How it works...

If you understand how reactivity works in Vue, there is not much to add. We bound the name of the transition to the `kindOfTransformation` variable and switched from fade to zoom in our code. We also demonstrated that the other attributes of the `<transition>` tag can be changed on the fly as well.

# 14

# Vue Communicates with the Internet

In this chapter, the following recipes will be covered:

- Sending basic AJAX request with Axios
- Validating user data before sending it
- Creating a form and sending data to your server
- Recovering from an error during a request
- Creating a REST client (and server!)
- Implementing infinite scrolling
- Processing a request before sending it out
- Preventing XSS attacks to your app

## Introduction

Web applications rarely work all by themselves. What makes them interesting is actually the fact that they enable us to communicate with the world in innovative ways that didn't exist just a few years ago.

Vue, by itself, doesn't contain any mechanism or library to make AJAX requests or open web sockets. In this chapter, we will, therefore, explore how Vue interacts with built-in mechanisms and external libraries to connect to external services.

You will start by making basic AJAX requests with the help of an external library. Then, you'll explore some common patterns with sending and getting data in forms. Finally, there are some recipes with real-world applications and how to build a RESTful client.

# Sending basic AJAX requests with Axios

**Axios** is the recommended library for Vue for making HTTP requests. It's a very simple library, but it has some built-in features that help you in carrying out common operations. It implements a REST pattern for making requests with HTTP verbs and can also deal with concurrency (spawning multiple requests at the same time) in a function call. You can find more information at <https://github.com/mzabriskie/axios>.

## Getting ready

For this recipe, you don't need any particular knowledge of Vue. We will use Axios, which itself uses **JavaScript promises**. If you have never heard of promises, you can have a primer at <https://developers.google.com/web/fundamentals/getting-started/primers/promises>.

## How to do it...

You will build a simple application that gives you a wise piece of advice every time you visit the web page.

The first thing you will need is to install Axios in your application. If you are using npm, you can just issue the following command:

```
npm install axios
```

If you are working on a single page, you can import the following file from CDN, at <https://unpkg.com/axios/dist/axios.js>.



Unfortunately, the advise slip service we will use will not work with JSFiddle because while the service runs on HTTP, JSFiddle is on HTTPS and your browser will most likely complain. You can run this recipe on a local HTML file.

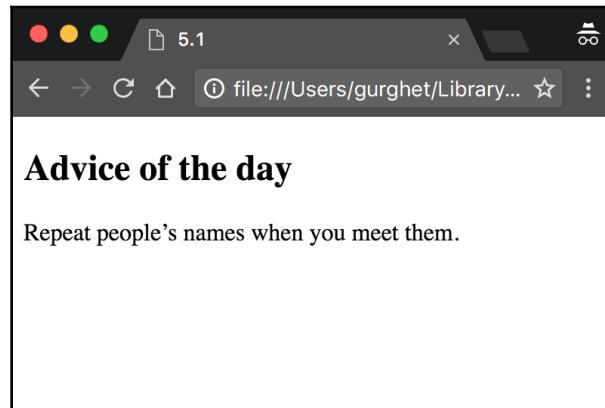
Our HTML looks like this:

```
<div id="app">
  <h2>Advice of the day</h2>
  <p>{{advice}}</p>
</div>
```

Our Vue instance is as follows:

```
new Vue({  
  el: '#app',  
  data: {  
    advice: 'loading...'  
  },  
  created () {  
    axios.get('http://api.adviceslip.com/advice')  
      .then(response => {  
        this.advice = response.data.slip.advice  
      })  
      .catch(error => {  
        this.advice = 'There was an error: ' + error.message  
      })  
  }  
)
```

Open your app to have a refreshingly wise slip of advice:



## How it works...

When our application starts up, the created hook is engaged and will run the code with Axios. The first line performs a GET request to the API endpoint:

```
axios.get('http://api.adviceslip.com/advice')
```

This will return a promise. We can use the `then` method on any promise to act on the result if the promise resolves successfully:

```
.then(response => {
  this.advice = response.data.slip.advice
})
```

The response object will contain some data about the result of our request. A possible response object is the following:

```
{
  "data": {
    "slip": {
      "advice": "Repeat people's name when you meet them.",
      "slip_id": "132"
    }
  },
  "status": 200,
  "statusText": "OK",
  "headers": {
    "content-type": "text/html; charset=UTF-8",
    "cache-control": "max-age=0, no-cache"
  },
  "config": {
    "transformRequest": {},
    "transformResponse": {},
    "timeout": 0,
    "xsrfCookieName": "XSRF-TOKEN",
    "xsrfHeaderName": "X-XSRF-TOKEN",
    "maxContentLength": -1,
    "headers": {
      "Accept": "application/json, text/plain, */*"
    },
    "method": "get",
    "url": "http://api.adviceslip.com/advice"
  },
  "request": {}
}
```

We navigate to the property we want to interact with; in our case, we want `response.data.slip.advice`, which is the string. We copied the string in the variable `advice` in the instance state.

The last part is when something wrong happens to our request or to our code inside the first branch:

```
.catch(error => {
  this.advice = 'There was an error: ' + error.message
})
```

We will explore error handling more in depth in the *Recovering from an error during a request* recipe. For now, let's trigger an error by hand, just to see what happens.

The cheapest way to trigger an error is to run the app on JSFiddle. Since the browser detects JSFiddle on a secure connection and our API is on HTTP (which is not secure), modern browsers will complain and will block the connection. You should see the following text:

```
There was an error: Network Error
```

This is just one of the many possible errors you can experiment with. Consider that you edit the GET endpoint to some non-existent page:

```
axios.get('http://api.adviceslip.com/non-existent-page')
```

In this case, you will get a 404 error:

```
There was an error: Request failed with status code 404
```

Interestingly, you will end up in the error branch even if the request goes well but there is an error in the first branch.

Change the then branch to this:

```
.then(response => {
  this.advice = undefined.hello
})
```

As everybody knows, JavaScript cannot read "hello" property of an undefined object:

```
There was an error: Cannot read property 'hello' of undefined
```

It's just as I told you.

# Validating user data before sending it

Generally, users hate forms. While we can't do much to change that, we can make it less frustrating for them by providing relevant instructions on how to fill them in. In this recipe, we will create a form, and we will leverage HTML standards to provide the user with a nice guidance on how to complete it.

## Getting ready

This recipe does not need previous knowledge to be completed. While we will build a form (the *Sending basic AJAX requests with Axios* recipe), we will fake the AJAX call and concentrate on the validation.

## How to do it...

We will build a very simple form: one field for the username and one for the user e-mail, plus one button to submit the information.

Type in this HTML:

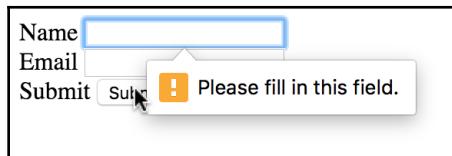
```
<div id="app">
  <form @submit.prevent="vueSubmit">
    <div>
      <label>Name</label>
      <input type="text" required>
    </div>
    <div>
      <label>Email</label>
      <input type="email" required>
    </div>
    <div>
      <label>Submit</label>
      <button type="submit">Submit</button>
    </div>
  </form>
</div>
```

The Vue instance is trivial, as shown:

```
new Vue({
  el: '#app',
  methods: {
    vueSubmit() {
```

```
        console.info('fake AJAX request')
    }
})
})
```

Run this app and try to submit the form with an empty field or wrong e-mail. You should see help from the browser itself:



Then, if you try to enter an invalid e-mail address, you will see the following:



## How it works...

We are using a native HTML5 validation API, which internally uses pattern matching to check whether what we are typing is conformant to certain rules.

Consider the attribute required in the following line:

```
<input type="text" required>
```

This ensures that when we submit the form, the field is actually populated while having `type="email"` in the other input element ensures that the content resembles an e-mail format.

This API is very rich and you can read more at

[https://developer.mozilla.org/en-US/docs/Web/Guide/HTML/Forms/Data\\_form\\_validation](https://developer.mozilla.org/en-US/docs/Web/Guide/HTML/Forms/Data_form_validation).

Many a time, the problem is that to leverage this API, we need to trigger the native validation mechanism. This means that we are not allowed to prevent the default behavior of the **Submit** button:

```
<button type="submit" @click.prevent="vueSubmit">Submit</button>
```

This will not trigger the native validation and the form will always be submitted. On the other hand, if we do the following:

```
<button type="submit" @click="vueSubmit">Submit</button>
```

The form will get validated but, since we are not preventing the default behavior of the submit button, the form will be sent to another page, which will destroy the one-page application experience.

The trick is to intercept the submit at form level:

```
<form @submit.prevent="vueSubmit">
```

This way, we can have form native validation and all the modern browsing experience we really like.

## Creating a form and sending data to your server

HTML forms are a standard way to interact with your user. You can gather their data to register within the site, make them log in, or even carry out more advanced interactions. In this recipe, you will build your first form with Vue.

### Getting ready

This recipe is very easy, but it assumes that you already know about AJAX and you want to apply your knowledge on Vue.

### How to do it...

Let's pretend that we have a blog, and we want to write a new post. For that, we need a form. Here is how you lay out the HTML:

```
<div id="app">
```

```
<h3>Write a new post</h3>
<form>
  <div>
    <label>Title of your post:</label>
    <input type="text" v-model="title">
  </div>
  <div>
    <label>Write your thoughts for the day</label>
    <textarea v-model="body"></textarea>
  </div>
  <div>
    <button @click.prevent="submit">Submit</button>
  </div>
</form>
</div>
```

We have a box for the title, one for the body of our new post, and a button to send our post.

In our Vue instance, those three things along with a user ID will be part of the state of the app:

```
new Vue({
  el: '#app',
  data: {
    userId: 1,
    title: '',
    body: ''
  }
})
```

At this point, we just need to add a method to send the data to our server when we click on the **Submit** button. Since we don't have a server, we will use a very useful service by **Typicode**. It's basically a fake REST server. We will send a request and the server will respond in a realistic manner, even if nothing will really happen.

Here's our method:

```
methods: {
  submit () {
    const xhr = new XMLHttpRequest()
    xhr.open('post', 'https://jsonplaceholder.typicode.com/posts')
    xhr.setRequestHeader('Content-Type',
      'application/json; charset=UTF-8')
    xhr.onreadystatechange = () => {
      const DONE = 4
      const CREATED = 201
      if (xhr.readyState === DONE) {
        if (xhr.status === CREATED) {
```

```
        this.response = xhr.response
    } else {
        this.response = 'Error: ' + xhr.status
    }
}
xhr.send(JSON.stringify({
    title: this.title,
    body: this.body,
    userId: this.userId
}))
}
}
```

To see the actual response of the server, we will add the response variable to our status:

```
data: {
    userId: 1,
    title: '',
    body: '',
    response: '...'
}
```

After the form in our HTML, add the following:

```
<h3>Response from the server</h3>
<pre>{{response}}</pre>
```

When you launch your page, you should be able to interact with your server. When you write a post, the server will echo the post and answer with the post ID:

### Write a new post

Title of your post:

Write your thoughts for the day

### Response from the server

```
{
    "title": "First Post",
    "body": "This is my first post! Yey!",
    "userId": 1,
    "id": 101
}
```

## How it works...

Most of the magic happens in the `submit` method. In the first line, we are creating an `XMLHttpRequest` object, which is a native JavaScript mechanism to make AJAX requests:

```
const xhr = new XMLHttpRequest()
```

We then use the `open` and `setRequestHeader` methods to configure a new connection; we want to send a POST request, and we will send some JSON along with it:

```
xhr.open('post', 'http://jsonplaceholder.typicode.com/posts')
xhr.setRequestHeader('Content-Type', 'application/json; charset=UTF-8')
```

Since we are interacting with a RESTful interface, the POST method means that we expect our request to modify data on the server (in particular, create a new post), and that issuing the same request more than one time will get different results every time (namely we will create a new, different post ID each time).

This is different from the more common GET request that will not modify data on the server (except logs maybe) and this will always yield the same results (provided that data on the server does not change between requests).

For more details about REST, take a look at the *Creating a REST client (and server!)* recipe.

The following lines are all about the response:

```
xhr.onreadystatechange = () => {
  const DONE = 4
  const CREATED = 201
  if (xhr.readyState === DONE) {
    if (xhr.status === CREATED) {
      this.response = xhr.response
    } else {
      this.response = 'Error: ' + xhr.status
    }
  }
}
```

This will install a handler whenever we get some kind of change in our object. If the `readyState` is changed to `DONE` it means, that we have our response from the server. Next, we check the status code, which should be `201` to signal that a new resource (our new post) has been created. If that is the case, we set the variable we put in the mustaches to get a quick feedback. Otherwise, we put the error message we received in the same variable.

The last thing we need to do, after setting up the event handlers, is to actually send the request along with the data of our new post:

```
xhr.send(JSON.stringify({  
  title: this.title,  
  body: this.body,  
  userId: this.userId  
}))
```

## There's more...

Another way to approach the same problem is to use Axios for sending the AJAX request. If you need to brush up on what Axios is, take a look at the *Sending basic AJAX requests with Axios* recipe.

The code for the `submit` method will become as follows (remember to add Axios as a dependency):

```
submit () {  
  axios.post('http://jsonplaceholder.typicode.com/posts', {  
    title: this.title,  
    body: this.body,  
    userId: this.userId  
  }).then(response => {  
    this.response = JSON.stringify(response, null, '  ')  
  }).catch(error => {  
    this.response = 'Error: ' + error.response.status  
  })  
}
```

This code is perfectly equivalent, but it's much more expressive and concise than using native browser objects.

## Recovering from an error during a request

Requests to an external service take ages from the perspective of a computer. In human terms, it would be like sending a satellite to Jupiter and waiting for it to come back to Earth. You can't be 100% sure that the travel will ever be complete and how much time will the travel actually take. Networks are notoriously flaky and it's better to come prepared in case our request does not complete successfully.

## Getting ready

This recipe is a little complex, but, does not use advanced concepts. You are expected, nonetheless, to be familiar with using Vue.

We will be using Axios for this recipe. You can complete the *Sending basic AJAX requests with Axios* recipe if you are unsure of what it exactly entails.

## How to do it...

You will build a website for ordering pizzas on Mt. Everest. The area has a notoriously poor Internet connection, so we may want to retry a couple of times before giving up on our pizza.

This is what our HTML looks like:

```
<div id="app">
  <h3>Everest pizza delivery</h3>
  <button @click="order"
    :disabled="inProgress">Order pizza!</button>
  <span class="spinner" v-show="inProgress"></span>
  <h4>Pizza wanted</h4>
  <p>{{requests}}</p>
  <h4>Pizzas ordered</h4>
  <span v-for="pizza in responses">
    {{pizza.id}}:{{pizza.req}}
  </span>
</div>
```

We have a button to place orders that will be disabled while an order is in progress--a list of orders in progress (that will contain only one order for the moment) and a list of pizzas already ordered.

We can add a spinner to make the waiting a bit more pleasant. Add this CSS to make the little pizza spin:

```
@keyframes spin {
  100% {transform:rotate(360deg); }
}
.spinner {
  width: 1em;
  height: 1em;
  padding-bottom: 12px;
  display: inline-block;
  animation: spin 2s linear infinite;
```

```
}
```

Our Vue instance will keep track of a few things; write this code to start building the instance:

```
new Vue({
  el: '#app',
  data: {
    inProgress: false,
    requests: new Object(null),
    responses: new Object(null),
    counter: 0,
    impatientAxios: undefined
  }
})
```

I would like to use JavaScript sets for the requests and responses; unfortunately, sets are not reactive in Vue; the closest thing we can use is an object, which is empty for now, that is, we are initializing requests and responses to an empty object.

The `impatientAxios` variable will be filled upon creation. Normally, Axios waits as long as the browser will wait for a response. Since we are impatient, we will create an Axios that will drop the connection after 3 seconds:

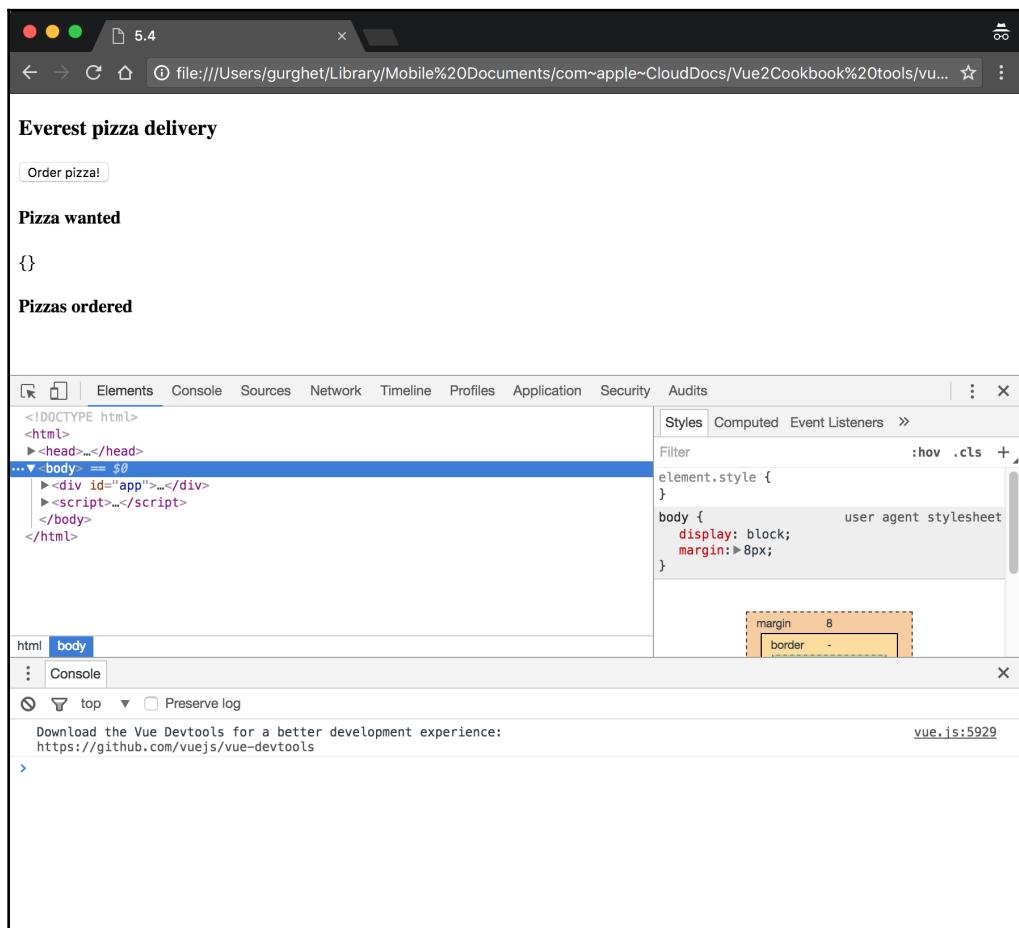
```
created () {
  this.impatientAxios = axios.create({
    timeout: 3000
  })
}
```

The last thing we need to build is the order method. Since we don't have a web server to make actual requests to, we will use the `http://httpstat.us/200` endpoint that simply answers **200 OK** to all our requests:

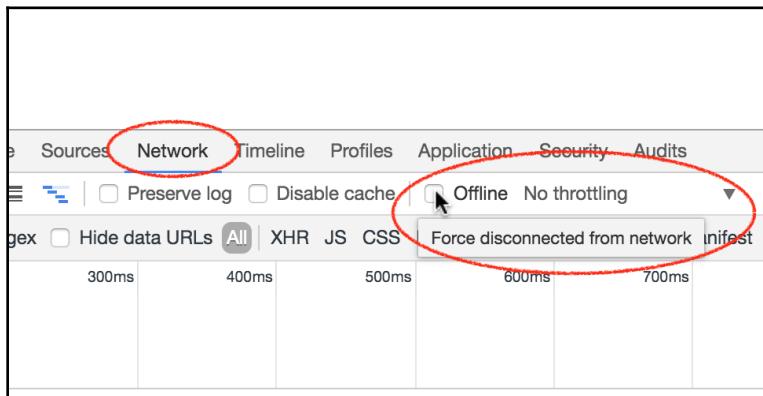
```
methods: {
  order (event, oldRequest) {
    let request = undefined
    if (oldRequest) {
      request = oldRequest
    } else {
      request = { req: '🍕', id: this.counter++ }
    }
    this.inProgress = true
    this.requests[request.id] = request
    this.impatientAxios.get('http://httpstat.us/200')
      .then(response => {
        this.inProgress = false
      })
  }
}
```

```
        this.responses[request.id] = this.requests[request.id]
        delete this.requests[request.id]
    })
    .catch(e => {
        this.inProgress = false
        console.error(e.message)
        console.error(this.requests.s)
        setTimeout(this.order(event, request), 1000)
    })
}
```

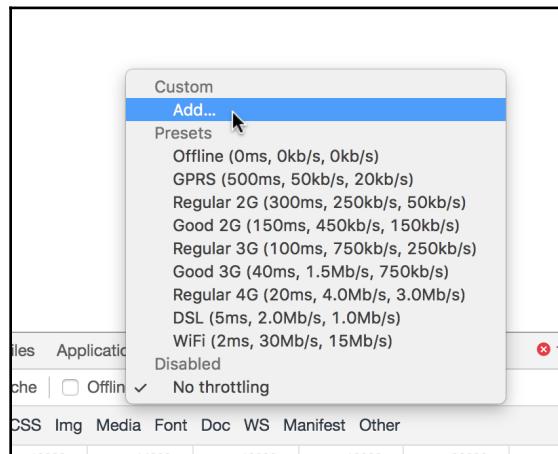
To run this program as intended, open it in Chrome and open the **Developer Tools** with **Cmd + Opt + I** (**F12** on Windows):



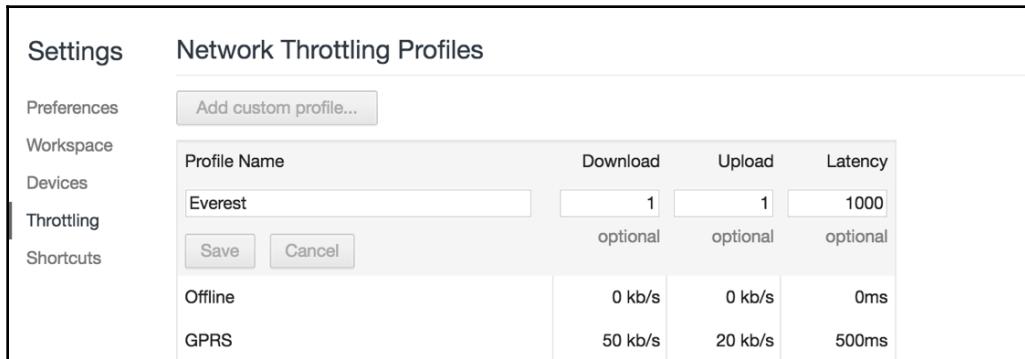
Switch the tab to **Network** and open the dropdown where you see **No Throttling**:



Click on it to display the drop-down menu:



Add a new custom throttling called `Everest` with 1kb/s for download and upload and a latency of 1,000 milliseconds, as in the following screenshot:



You can then select that type of throttling and try to order some pizzas. If you are lucky, you should eventually be able to order some, thanks to the persistency of Axios.

If you are not getting success or if all your pizzas are ordered correctly, try to adjust the parameters; much of this process is actually random and highly dependent on the machine.

## How it works...

There are many ways to deal with flaky connections and there are many libraries out there that integrate with Axios and have more advanced retry and reattempt strategies. Here, we have seen only one basic strategy, but libraries such as **Patience JS** have more advanced ones and they are not difficult to use.

## Creating a REST client (and server!)

In this recipe, we will learn about REST and how to build a REST client. To build a REST client, we will need a server that exposes a REST interface; we will build that also. Wait a minute! A whole REST server is a side note in a recipe in a book about Vue? Just follow along and you won't be disappointed.

## Getting ready

This recipe is fairly advanced in the sense that you will need to be comfortable with the architecture of client and server and at least have heard or read about REST interfaces. You will also need to be familiar with the command line and have npm installed. You can read all about it in the *Choosing a development environment* recipe.

Axios will also need to be installed; read more about this in the first recipe of this chapter.

## How to do it...

I remember when some years ago, building a REST server could take days or weeks. You can use `Feathers.js`, and it will be quick and (hopefully painless). Open a command line and install it through npm with the following command:

```
npm install -g feathers-cli
```

After that, create a directory where you will run the server, go inside it, and launch Feathers:

```
mkdir my-server
cd my-server
feathers generate app
```

Answer all the questions with default values. When the process finishes, type in the following command to create a new resource:

```
feathers generate service
```

One of the questions is the name of the resource; call it `messages`, but other than that, use the default for all the other questions.

Exit from the `feathers-cli` with the `exit` command and start your new server with the following command:

```
npm start
```

After some seconds, your REST server should be started and should be listening on port 3030. Can you honestly say it was difficult?



The preceding sequence of commands works with Feathers version 2.0.0. It's totally possible that you may be using another version but it should still be easy to get the same result with a later version; check the online install guide at <https://feathersjs.com/>.

Next, you'll build a Vue app that communicates with the server seamlessly. Now, since the server is running in your local environment through HTTP, you will not be able to use JSFiddle because it works on HTTPS and considers HTTP insecure. You can either use other methods described earlier or use services on HTTP, such as `codepen.io` or others.

You will code an app that manages sticky messages. We want to be able to view, add, edit, and delete them.

Type the following in this HTML:

```
<div id="app">
  <h3>Sticky messages</h3>
  <ol>
    <li v-for="message in messages">
      <button @click="deleteItem(message._id)">Delete</button>
      <button @click="edit(message._id, message.text)">
        edit
      </button>
      <input v-model="message.text">
    </li>
  </ol>
  <input v-model="toAdd">
  <button @click="add">add</button>
</div>
```

Our Vue instance state will consist of a list of recorded messages, plus a temporary message to be added to the list:

```
new Vue({
  el: '#app',
  data: {
    messages: [],
    toAdd: ''
  },
})
```

The first thing that we want to do is ask the server for a list of messages. Write the created hook for this:

```
created () {
  axios.get('http://localhost:3030/messages/')
    .then(response => {
      this.messages = response.data.data
    })
},
```

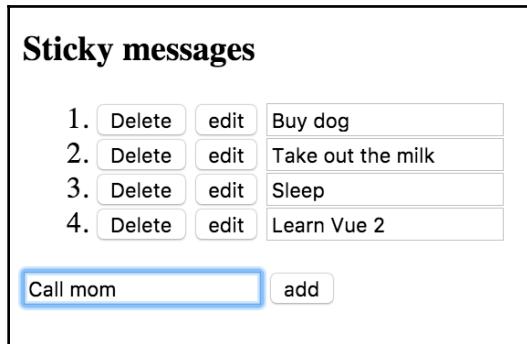
For creating a new message, write a method that binds to the click of the add button and send what's written in the input box to the server:

```
methods: {
  add () {
    axios.post('http://localhost:3030/messages/' , {
      text: this.toAdd
    })
    .then(response => {
      if (response.status === 201) {
        this.messages.push(response.data)
        this.toAdd = ''
      }
    })
  }
}
```

Similarly, write a method for deleting a message and for editing a message:

```
deleteItem (id) {
  console.log('delete')
  axios.delete('http://localhost:3030/messages/' + id)
  .then(response => {
    if (response.status < 400) {
      this.messages.splice(
        this.messages.findIndex(e => e.id === id), 1
      )
    }
  })
},
edit (id, text) {
  axios.put('http://localhost:3030/messages/' + id, {
    text
  })
  .then(response => {
    if (response.status < 400) {
      console.info(response.status)
    }
  })
}
```

Launch your application and you will be able to manage your board of sticky messages:



To prove to yourself that you are really communicating with the server, you can refresh the page or close and reopen the browser and your notes will still be there.

## How it works...

REST means REpresentational State Transfer, as in you will transfer a representation of the state of some resource. In practice, we are using a set of **verbs** to transfer the representation of the state of our messages.

Using the HTTP protocol, we have at our disposal the following verbs:

Verb	Properties	Description
GET	Idempotent, safe	Used to retrieve the representation of a resource
POST		Used to upload a new resource
PUT	Idempotent	Used to upload an existing resource (to modify it)
DELETE	Idempotent	Used to delete a resource

Idempotent means that if we use the same verb twice, nothing will happen to the resource, and safe means that nothing will happen at all.

In our application, we use the GET verb only at the beginning during creation. When we see the list changing as a result of the other actions, it is only because we are mirroring the actions on the server on the frontend.

The POST verb is used to add a new message to the list. Note how it's not idempotent, as even with the same text in the sticky message, we nonetheless create a new message that differs in ID when pressing the **add** button.

Pressing the **edit** button triggers a PUT and the **Delete** button, well, you can imagine that it uses the DELETE verb.

Axios makes this very clear by naming the methods of its API with the verbs themselves.

## Implementing infinite scrolling

Infinite scrolling is a fine example of what you can do with Vue and AJAX. It is also quite popular and can improve interaction for some kind of content. You will build a random word generator that works with infinite scrolling.

### Getting ready

We will use Axios. Take a look at the *Sending basic AJAX requests with Axios* recipe to know how to install it and its basic functionality. Other than that, you don't need to know much to follow along.

### How to do it...

To make our app work, we will ask random words from the `http://www.setgetgo.com/randomword/get.php` endpoint. Every time you point the browser at this address, you will get a random word.

The whole page will consist solely of an infinite list of words. Write the following HTML:

```
<div id="app">
  <p v-for="word in words">{{word}}</p>
</div>
```

The list of words needs to grow as we scroll down. So we need two things: understanding when the user reaches the bottom of the page, and getting new words.

To know when the user has reached the bottom of the page, we add a method in our Vue instance:

```
new Vue({
  el: '#app',
  methods: {
    bottomVisible () {
      const visibleHeight = document.documentElement.clientHeight
      const pageHeight = document.documentElement.scrollHeight
      const scrolled = window.scrollY
      const reachedBottom = visibleHeight + scrolled >= pageHeight
      return reachedBottom || pageHeight < visibleHeight
    }
  }
})
```

This will return `true` if either the page is scrolled until the bottom of the page itself is smaller than the browser.

Next, we need to add a mechanism to bind the result of this function to a state variable `bottom` and update it every time the user scrolls the page. We can do that in the created hook:

```
created () {
  window.addEventListener('scroll', () => {
    this.bottom = this.bottomVisible()
  })
}
```

The state will be composed of the `bottom` variable and the list of random words:

```
data: {
  bottom: false,
  words: []
}
```

We now need a method to add words to the array. Add the following method to the existing method:

```
addWord () {
  axios.get('http://www.setgetgo.com/randomword/get.php')
    .then(response => {
      this.words.push(response.data)
      if (this.bottomVisible()) {
        this.addWord()
      }
    })
}
```

The method will recursively call itself until the page has enough words to fill the whole browser view.

Since this method needs to be called every time we reach the bottom, we will watch for the bottom variable and fire the method if it's `true`. Add the following option to the Vue instance just after the `data`:

```
watch: {  
  bottom (bottom) {  
    if (bottom) {  
      this.addWord()  
    }  
  }  
}
```

We also need to call the `addWord` method in the `created` hook to kick-start the page:

```
created () {  
  window.addEventListener('scroll', () => {  
    this.bottom = this.bottomVisible()  
  })  
  this.addWord()  
}
```

If you launch the page now, you will have an infinite stream of random words, which is useful when you need to create a new password!

## How it works...

In this recipe, we used an option called `watch`, which uses the following syntax:

```
watch: {  
  'name of state variable' (newValue, oldValue) {  
    ...  
  }  
}
```

This is the counterpart of computed properties when we are not interested in a result after some reactive variable changes. As a matter of fact, we used it to just fire another method. Had we been interested in the result of some calculations, we would have used a computed property.

# Processing a request before sending it out

This recipe teaches you how to use interceptors to edit your request before it goes out to the Internet. This can be useful in some cases, such as when you need to supply an authorization token along with all the requests to your server or when you need a single point to edit how your API calls are performed.

## Getting ready

This recipe uses Axios (the *Sending basic AJAX requests with Axios* recipe); apart from that, it will be useful to have completed the *How to validate user data before sending it* recipe since we will build a small form for demonstration.

## How to do it...

In this recipe, you will build a filter for curse words for a hypothetical comment system. Suppose there's an article on our website that can potentially start a flame war:

```
<div id="app">
  <h3>Who's better: Socrates or Plato?</h3>
  <p>Technically, without Plato we wouldn't have<br>
  much to go on when it comes to information about<br>
  Socrates. Plato ftw!</p>
```

After that article, we place a comment box:

```
<form>
  <label>Write your comment:</label>
  <textarea v-model="message"></textarea>
  <button @click.prevent="submit">Send!</button>
</form>
<p>Server got: {{response}}</p>
</div>
```

We also added a line after the form to debug the response that we will get from the server.

In our Vue instance, we write all the support code to send the comment to our server, which, in this case, will be `http://jsonplaceholder.typicode.com/comments`, a fake REST interface that will behave like a real server.

Here's the submit method that is triggered by the press of the **Submit** button:

```
methods: {
  submit () {
    axios.post('http://jsonplaceholder.typicode.com/comments',
    {
      body: this.message
    }).then(response => {
      this.response = response.data
    })
  }
}
```

The state of the Vue instance will only be two variables:

```
data: {
  message: '',
  response: '...'
}
```

As usual, we want to mount it to the `<div>` app:

```
new Vue({
  el: '#app',
  ...
})
```

As soon as the instance is mounted, we want to install the word filter in Axios; for this, we tap into the `mounted` hook of Vue:

```
mounted () {
  axios.interceptors.request.use(config => {
    const body = config.data.body.replace(/punk/i, '****')
    config.data.body = body
    return config
  })
}
```

We can launch our application now and try to write our salty comment:

The screenshot shows a Vue.js application with a title "Who's better: Socrates or Plato?". Below the title is a text area containing: "Technically, without Plato we wouldn't have much to go on when it comes to information about Socrates. Plato ftw!". Below this is a comment input field with the placeholder "Write your comment:" and a "Send!" button. To the right of the input field is a message: "Plato was just a punk!!!". At the bottom, there is a log message: "Server got: { \"body\": \"Plato was just a \*\*\*!!!\", \"id\": 501 }".

## How it works...

In the mounted hook, we are installing a so-called `interceptor`. In particular, it is a request interceptor, which means it will take our request and manipulate it before sending it out to the Internet:

```
axios.interceptors.request.use(config => {
  const body = config.data.body.replace(/punk/i, '***')
  config.data.body = body
  return config
})
```

The `config` object contains a lot of things we can edit. It contains the headers and URL parameters. It also contains Axios configuration variables. You can check out the Axios documentation for an up-to-date list.

We are taking what's inside the data part that got sent along with the POST request and sniffing if the `punk` word is found. If that is the case, it will get substituted with asterisks. The returned object will be the new config for the current request.

# Preventing XSS attacks to your app

Writing applications without thinking about security will inevitably lead to vulnerabilities, especially if it has to run on a web server. **Cross site scripting (XSS)** is among the most popular security issues nowadays; even if you are not a security expert, you should be aware of how it works and how to prevent it in a Vue application.

## Getting ready

This recipe does not need any previous knowledge except for Axios. You can find more on Axios and how to install it in the *Sending basic AJAX requests with Axios* recipe.

## How to do it...

The first thing you should do is to discover how your backend is giving you the CSRF token (more on this in the next paragraph). We will suppose that the server will place a cookie in your browser with the name, XSRF-TOKEN.



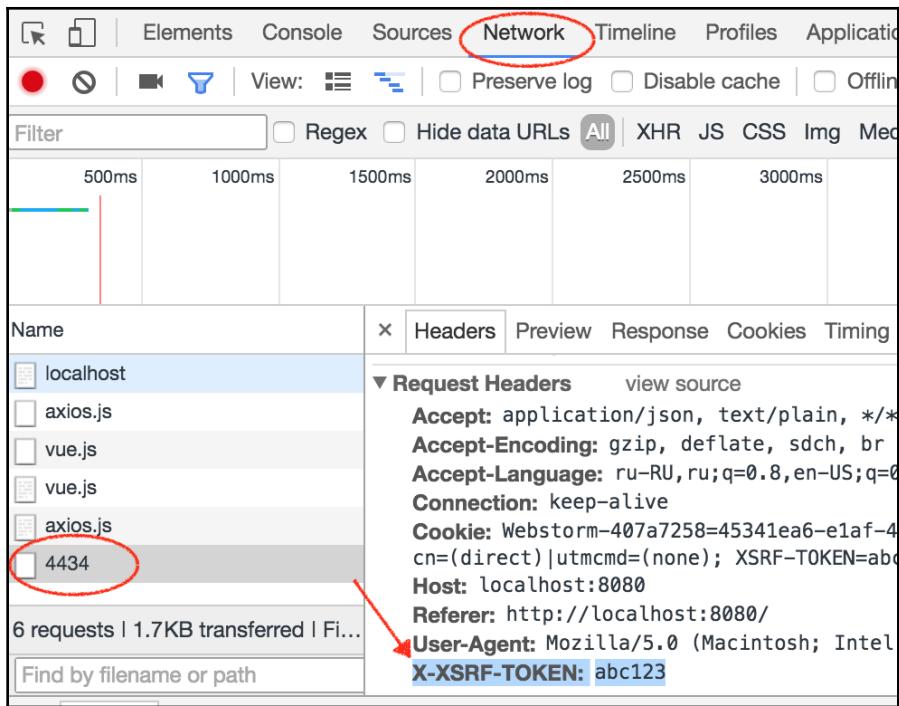
You can simulate your server, setting a cookie with the `document.cookie = 'XSRF-TOKEN=abc123'` command issued in the browser console (in the developer tools).

Axios automatically reads such a cookie and transmits it in the next request.

Consider that we call an Axios `get` request in our code, as follows:

```
methods: {
  sendAllMoney () {
    axios.get('/sendTo/' + this.accountNo)
  }
}
```

Axios will pick up that cookie and add a new header to the request called **X-XSRF-TOKEN**. You can see such headers in the **Network** tab of the **Developer Tools** in Chrome by clicking on the name of the request:



## How it works...

To prevent XSS attacks, you must ensure that no user input can appear as code in your app. This means you must be very careful about using the `v-html` attribute (the *Output raw HTML* recipe).

Unfortunately, you can't control what happens outside your page. If one of your users receives a fake e-mail that contains a link that corresponds to an action in your application, clicking on the link in the e-mail will trigger the action.

Let's make a concrete example; you developed a bank app, *VueBank*, and a user of your app receives the following fake e-mail:

```
Hello user!  
Click here to read the latest news.
```

As you can see, the mail is not even about our application and the `here` hyperlink is hidden in the HTML of the mail itself. In reality, it points to the `http://vuebank.com?give_all_my_money_to_account=754839534` address.

If we are logged in to VueBank, the link may work right away. It does not look good for our finances.

To prevent these kinds of attacks, we should have our backend generate a **CSRF (Cross Site Request Forgery)** token for us. We will take the token and send it along the request to prove that the request originated from the user. The preceding link will become

`http://vuebank.com?give_all_my_money_to_account=754839534&csrf=s83Rnj.`

Since the token is generated randomly every time, the link in the mail cannot be forged correctly because the attacker does not know the token that the server gave to the web page.

In Vue, we use Axios to send the token. Usually, we won't send it as part of the link, but in a header of the request; in fact, Axios does this for us and puts in the token in the next request automatically.

You can change the name of the cookie that Axios will pick up by setting the `axios.defaults.xsrfCookieName` variable, and you can edit the name of the header that will return the token acting on the `axios.defaults.xsrfHeaderName` variable.

# 15

# Single Page Applications

In this chapter, the following recipes will be covered:

- Creating an SPA with vue-router
- Fetching data before switching route
- Using named dynamic routes
- Having more than one router-view in your page
- Composing your routes hierarchically
- Using route aliases
- Adding transitions between your routes
- Managing errors for your routes
- Adding a progress bar to load pages
- How to redirect to another route
- Saving scrolling position when hitting back

## Introduction

Many modern applications are based on the **SPA** or **Single Page Application** model. From the users perspective, this means that the whole website looks similar to an application in a single page.

This is good because, if done correctly, it enhances the user experience, mainly reducing waiting times, because there are no new pages to load--the whole website is on a single page. This is how Facebook, Medium, Google, and many other websites work.

URLs don't point to HTML pages anymore, but to particular states of your application (that most often look like different pages). In practice, on a server, assuming that your application is inside the `index.html` page, this is implemented by redirecting the user that is requesting, say, `about me` to `index.html`.

The latter page will take the suffix of the URL and will interpret it as a **route**, which in turn will create a page-like component with biographical information.

## Creating an SPA with vue-router

Vue.js implements the SPA pattern through its core plugin, `vue-router`. To `vue-router`, every route URL corresponds to a component. This means that we will tell `vue-router` how to behave when the user goes to a particular URL in terms of its component. In other words, every component in this new system is a page in the old system.

## Getting ready

For this recipe, you will only need to install `vue-router` and have some knowledge about Vue components.

To install `vue-router`, follow the instructions at <https://router.vuejs.org/en/installation.html>.

If you are using JSFiddle to follow along, you can add a link similar to <https://unpkg.com/vue-router/dist/vue-router.js>.

## How to do it...

We are preparing a modern website for a restaurant and we will use the SPA pattern.

The website will consist of three pages: a home page, the restaurant menu, and the bar menu.

The whole HTML code will be like this:

```
<div id="app">
  <h1>Choppy's Restaurant</h1>
  <ul>
    <li>Home</li>
    <li>Menu</li>
```

```
<li>Bar</li>
</ul>
<router-view></router-view>
</div>
```

The `<router-view>` component is the entry point for vue-router. It's where the components are displayed as pages.

The list elements will become the link. For now, they are only list elements; to turn them into links, we can use two different syntaxes. Wrap the first link as in the following line:

```
<li><router-link to="/">Home</router-link></li>
```

Another example is as follows:

```
<li><router-link to="/menu">Menu</router-link></li>
```

Another syntax we can use is the following (for the **Bar** link):

```
<li>
  <router-link
    tag="li" to="/bar"
    :event="['mousedown', 'touchstart']"
  >
    <a>Bar</a>
  </router-link>
</li>
```

This, more verbose but more explicit, syntax can be used to bind a custom event to a particular routing.

To instruct Vue that we want to use the vue-router plugin, write the following in the JavaScript:

```
Vue.use(VueRouter)
```

The part of three pages we listed at the beginning will be played by these three dummy components (add them to the JavaScript):

```
const Home = { template: '<div>Welcome to Choppy's</div>' }
const Menu = { template: '<div>Today we have cookies</div>' }
const Bar = { template: '<div>We serve cocktails</div>' }
```

Now, you can finally create the router. The code for it is as follows:

```
const router = new VueRouter({})
```

This router doesn't do much; we have to add routes (which correspond to URLs) and their associated components:

```
const router = new VueRouter({
  routes: [
    { path: '/', component: Home },
    { path: '/menu', component: Menu },
    { path: '/bar', component: Bar }
  ]
})
```

Now our application is almost complete; we only need to declare a simple Vue instance:

```
new Vue({
  router,
  el: '#app'
})
```

Our application will now work; before launching it, add this CSS rule to have slightly better feedback:

```
a.router-link-active, li.router-link-active>a {
  background-color: gainsboro;
}
```

When you open your app and click on the **Bar** link, you should see something similar to the following screenshot:



## How it works...

The first thing your program does is to register vue-router as a plugin. The vue-router, in turn, registers the routes (which are parts of URLs) and connects components to each of them.

When we visit the application for the first time, the URL on the browser (you won't be able to see it changing inside JSFiddle because it is inside an iframe) will end with `index.html/#/`. Everything after the hash symbol is a route for the vue-router. In this case, it is only a slash (/) and so it matches the first home route.

When we click on the links, the content of the `<router-view>` changes according to the component we associated with that route.

## There's more...

The astute reader will certainly find what can be interpreted as a bug--we added a couple of CSS styles before running the application. The `.router-link-active` class is automatically injected in the `<router-link>` component whenever the page corresponds to the link actually pointed to.

When we click on **Menu** and **Bar**, the background color changes but it seems that it remains stuck to be selected for the **Home** link. This is because the matching performed by the `<router-link>` component is not **exact**. In other words, `/bar` and `/menu` contain the `/` string and, for this reason, `/` is always matched.

A quick fix for this is to add the attribute exactly the same as the first `<router-link>`:

```
<li><router-link to="/" exact>Home</router-link></li>
```

Now, the `Home` link is highlighted only when the route exactly matches the home page link.

Another thing to note is the rule itself:

```
a.router-link-active, li.router-link-active>a {  
    background-color: gainsboro;  
}
```

Why do we match two different things? It depends on how you wrote the router link.

```
<li><router-link to="/" exact>Home</router-link></li>
```

The preceding code will be translated in the following DOM portion:

```
<li><a href="/" class="router-link-active">Home</a></li>
```

While:

```
<router-link tag="li" to="/" exact>Home</router-link>
```

Becomes:

```
<li class="router-link-active">Home</li>
```

Note how in the first case, the class is applied to the child anchor element; in the second case, it is applied to the parent element.

## Fetching data before switching route

In the previous version of Vue, we had a dedicated method to fetch data from the Internet before changing the route. With Vue 2, we have a more general method that will take care of this and possibly other things before switching route.

## Getting ready

To complete this recipe, you are expected to already know the basics of vue-router and how to make AJAX requests (more on this in the last chapter).

## How to do it...

We will write a simple web portfolio composed of two pages: a home page and an about me page.

For this recipe, we will need to add Axios as a dependency.

The basic layout is clear from the following HTML code:

```
<div id="app">
  <h1>My Portfolio</h1>
  <ul>
```

```
<li><router-link to="/" exact>Home</router-link></li>
<li><router-link to="/aboutme">About Me</router-link></li>
</ul>
<router-view></router-view>
</div>
```

In the JavaScript, you can start building your `AboutMe` component:

```
const AboutMe = {
  template: `<div>Name: {{name}}<br>Phone: {{phone}}</div>`
}
```

It will display only a name and a telephone number. Let's declare the two variables in the `data` option of the component, as follows:

```
data () {
  return {
    name: undefined,
    phone: undefined
  }
}
```

The vue-router, before actually loading the component onto the scene, will look for an option in our object, called `beforeRouteEnter`; we will use this to load the name and phone from a server. The server we are using will provide fake data just for the purpose of displaying something, which is as follows:

```
beforeRouteEnter (to, from, next) {
  axios.post('https://schematic-ipsum.herokuapp.com/', {
    "type": "object",
    "properties": {
      "name": {
        "type": "string",
        "ipsum": "name"
      },
      "phone": {
        "type": "string",
        "format": "phone"
      }
    }
  }).then(response => {
    next(vm => {
      vm.name = response.data.name
      vm.phone = response.data.phone
    })
  })
}
```

For the other component, the home page, we will just write a small component as a placeholder:

```
const Home = { template: '<div>This is my home page</div>' }
```

Next thing is that you have to register the router and its paths:

```
Vue.use(VueRouter)
const router = new VueRouter({
  routes: [
    { path: '/', component: Home },
    { path: '/aboutme', component: AboutMe },
  ]
})
```

Also, of course, you have to register a Vue root instance, which is as follows:

```
new Vue({
  router,
  el: '#app'
})
```

When you launch your application and click on the **About Me** link, you should see something similar to this:



You will note that there is no page reload when you click on the link, but it still takes quite some time to display the bio. This is because it is fetching the data from the Internet.

## How it works...

The `beforeRouteEnter` hook takes three parameters:

- `to`: This is a `Route` object that represents the route requested by the user.
- `from`: This is also a `Route` object that represents the current route. This is the route the user will be kept at in case of errors.

- `next`: This is a function we can use when we are ready to go on with the switching of the route. Calling this function with `false` will prevent the route from being changed, and it is useful in case of errors.

When the preceding functions are called, we made a call with Axios to a web service that provided a string for a name and a string for a phone number.

When we are inside this hook, it's important to remember that we don't have access to this. It's because this hook runs before the component is actually instantiated, so there is no `this` to refer to.

When the server responds, we are inside the `then` function and want to assign the name and phone returned from the server but, as said, we don't have access to this. The `next` function receives a reference to our component as an argument. We use this to set the variables to the received value:

```
...
}).then(response => {
  next(vm => {
    vm.name = response.data.name
    vm.phone = response.data.phone
  })
})
```

## Using named dynamic routes

Registering all the routes by hand can be time consuming and, when the routes are not known in advance, it is impossible. vue-router lets you register routes with an argument so that you can have links for all the objects in a database and cover other use-cases where the user chooses a route, following some pattern that will result in too many routes to be registered by hand.

## Getting ready

Except for the basics on vue-router (refer to the *Creating an SPA with vue-router* recipe), you won't need any additional information to complete this recipe.

## How to do it...

We will open an online restaurant with ten different dishes. We will create a route for every dish.

The HTML layout of our website is the following:

```
<div id="app">
  <h1>Online Restaurant</h1>
  <ul>
    <li>
      <router-link :to="{ name: 'home' }" exact>
        Home
      </router-link>
    </li>
    <li v-for="i in 10">
      <router-link :to="{ name: 'menu', params: { id: i } }">
        Menu {{i}}
      </router-link>
    </li>
  </ul>
  <router-view class="view"></router-view>
</div>
```

This will create 11 links, one for the home page and ten for the dishes.

After registering the `VueRouter` in the JavaScript part, the code is as follows:

```
Vue.use(VueRouter)
```

Create two components; one will be a placeholder for the home page:

```
const Home = { template: `<div>Welcome to Online Restaurant</div>` }
```

The other routes will be connected to a `Menu` component:

```
const Menu = { template: `<div>You just ordered<br/></div>` }
```

In the preceding component, we refer to the global router object with `$route`, and we take the `id` parameter from the URL. [Lorempixel.com](http://Lorempixel.com) is a website that provides sample images. We are connecting a different image for every `id`.

Finally, create the router itself using the following code:

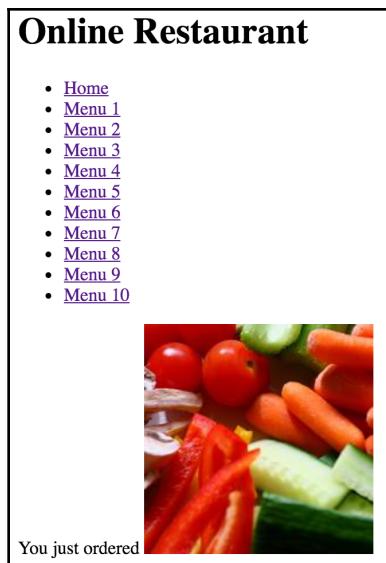
```
const router = new VueRouter({
  routes: [
    { path: '/', name:'home', component: Home },
    { path: '/menu/:id', name: 'menu', component: Menu },
  ]
})
```

You can see that the path for the menu contains `/:id`, which is a placeholder for the `id` parameter that will appear in the URL.

At last, write a root Vue instance:

```
new Vue({
  router,
  el: '#app'
})
```

You can launch the application now and should be able to see all the menu items. Clicking on any one of them should order a different dish:



## How it works...

There are two main parts of the code that contribute to creating the routes for the different dishes.

First, we registered a generic route using the colon syntax and assigned a name to it, which is as follows code:

```
{ path: '/menu/:id', name: 'menu', component: Menu }
```

This means that we can have a URL that ends in /menu/82, and the `Menu` component will be displayed with the `$route.params.id` variable set to 82. So, the following line should be changed as per the following:

```

```

The preceding line will be replaced by the following line in the rendered DOM:

```

```

Never mind the fact that there is no such image in real life.

Note that we also gave a name to this route. This is not strictly necessary, but it enabled us to write the second main part of the code, as shown:

```
<router-link :to="{ name: 'menu', params: { id: i } }">
  Menu {{i}}
</router-link>
```

Instead of writing a string, we can pass an object to the `to` prop and specify the `params`. In our case, the `param` is given by the `v-for` wrapping. This means that, for example, at the fourth cycle of the `v-for`:

```
<router-link :to="{ name: 'menu', params: { id: 4 } }">
  Menu 4
</router-link>
```

This will result in the DOM as follows:

```
<a href="#/menu/4" class="">Menu 4</a>
```

# Having more than one router-view in your page

Having multiple `<router-view>` enables you to have pages that can be organized with more complex layouts. For example, you can have a sidebar and the main view. This recipe is all about that.

## Getting ready

This recipe doesn't use any advanced concept. You are advised to familiarize yourself with the vue-router and learn how to install it, though. Go to the first recipe in the chapter to find out more.

## How to do it...

This recipe will use a lot of code to drive the point home. Don't be discouraged though, the mechanism is really simple.

We will build a second-hand hardware store. We will have a main view and a sidebar; these will be our router-views. The sidebar will contain our shopping list so that we always know what we are shopping for and will have no distractions.

The whole HTML code is quite short because it only contains a title and the two router-view components:

```
<div id="app">
  <h1>Second-Hand Hardware</h1>
  <router-view name="list"></router-view>
  <router-view></router-view>
</div>
```

In this case, the list is named `router-view`. The second one does not have a name; thus, it gets named as `Vue` by default.

Register the `vue-router` in the JavaScript:

```
Vue.use(VueRouter)
```

After that, register the routes:

```
const router = new VueRouter({
  routes: [
    { path: '/',
      components: {
        default: Parts,
        list: List
      }
    },
    { path: '/computer',
      components: {
        default: ComputerDetail,
        list: List
      }
    }
  ]
})
```

Components is not a single object anymore; it's become an object with two components inside it: one for the `list` and the other for the `default router-view`.

Write the `list` component, as illustrated, before the router code:

```
const List = { template: ` 
<div>
  <h2>Shopping List</h2>
  <ul>
    <li>Computer</li>
  </ul>
</div>
` }
```

This will display just the computer as an item we ought to remember to buy.

The parts component is the following; write it before the `router` code:

```
const Parts = { template: ` 
<div>
  <h2>Computer Parts</h2>
  <ul>
    <li><router-link to="/computer">Computer</router-link></li>
    <li>CD-ROM</li>
  </ul>
</div>
` }
```

This contains a link to see more about the computer on sale; the next component is bound to that page, so write it before the router code:

```
const ComputerDetail = { template: `<div><h2>Computer Detail</h2><p>Pentium 120Mhz, CDs sold separately</p></div>` }
```

Of course, don't forget to add the Vue instance:

```
new Vue({  
  router,  
  el: '#app'  
})
```

When you launch the app, you should see the two router views one above the other. If you want them side by side, you can add some CSS styles:



## How it works...

When adding the `<router-view>` components to the page, you just have to remember to add a name to refer to it later during route registration:

```
<router-view name="view1"></router-view>  
<router-view name="view2"></router-view>  
<router-view></router-view>
```

If you don't specify a name, the route will be referred to as default:

```
routes: [
  { path: '/',
    components: {
      default: DefaultComponent,
      view1: Component1,
      view2: Component2
    }
  }
]
```

This way, the components will be displayed in their respective `router-view` elements.



If you don't specify one or more components for a named view, the `router-view` associated with that name will be empty.

## Compose your routes hierarchically

In many cases, the organization tree of your website may be complex. In some cases, there is a clear hierarchical organization that you can follow and with nested routes, vue-routes helps you keep everything orderly. The best situation is if there is an exact correspondence with how URLs are organized and how components are nested.

## Getting ready

In this recipe, you will use components and other basic features of Vue. You will also use dynamic routes. Go to the *Using named dynamic routes* recipe to find out more about them.

## How to do it...

In this recipe, you will build an online accounting website for an imaginary world. We will have two users--Stark and Lannister--and we will be able to see how much gold and how many soldier these two have.

The HTML layout of our website is as follows:

```
<div id="app">
  <h1>Kindoms Encyclopedia</h1>
  <router-link to="/user/Stark/">Stark</router-link>
  <router-link to="/user/Lannister/">Lannister</router-link>
  <router-view></router-view>
</div>
```

We have a title and two links--one for Stark and one for Lannister--and, finally, the router-view element.

We add the VueRouter to the plugins:

```
Vue.use(VueRouter)
```

Then, we register the routes:

```
const router = new VueRouter({
  routes: [
    { path: '/user/:id', component: User,
      children: [
        {
          path: 'soldiers',
          component: Soldiers
        },
        {
          path: 'gold',
          component: Gold
        }
      ]
    }
  ]
})
```

What we've said is to register a dynamic route, /user/:id, and inside the User component, there will be another router-view that will have the nested paths for gold and soldiers.

The three components just mentioned are written as shown; add them before the routing code:

```
const User = { template: `
  <div class="user">
    <h1>Kindoms Encyclopedia</h1>
    User {{$route.params.id}}
    <router-link to="gold">Gold</router-link>
  </div>
`}
```

```
<router-link to="soldiers">Soldiers</router-link>
  <router-view></router-view>
</div>
` }
```

As anticipated, there is another router-view entry point inside the `User` component that will contain the nested routes components.

Then, write the `Soldiers` and `Gold` components, always before the routing code:

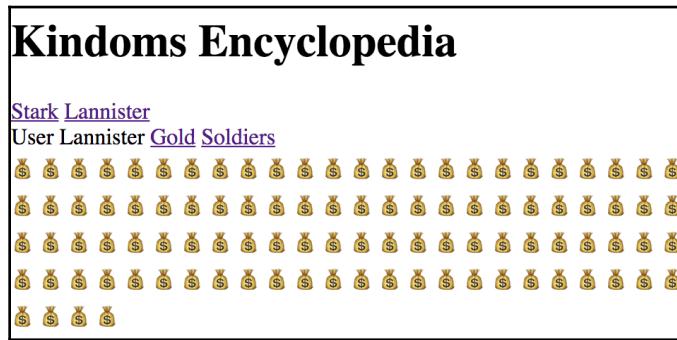
```
const Soldiers = { template: ` 
  <div class="soldiers">
    <span v-for="soldier in $root[$route.params.id].soldiers">
      
    </span>
  </div>
` }
const Gold = { template: ` 
  <div class="gold">
    <span v-for="coin in $root[$route.params.id].gold">
      
    </span>
  </div>
` }
```

These components will just display as many emojis as the `soldiers` or `gold` variable inside the Vue root instance data option.

This is what the Vue root instance looks like:

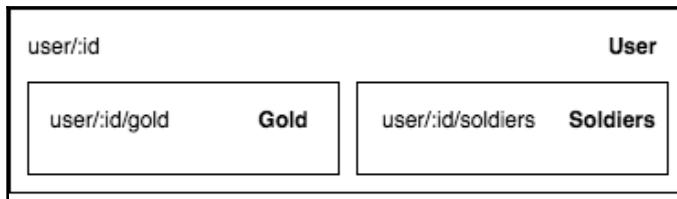
```
new Vue({
  router,
  el: '#app',
  data: {
    Stark: {
      soldiers: 100,
      gold: 50
    },
    Lannister: {
      soldiers: 50,
      gold: 100
    }
  }
})
```

Launching the application will enable you to have a visual representation of the gold and the number of soldiers of the two users:



## How it works...

To understand how nested routes work better, it's useful to take a look at the following diagram:



There are only two levels in our recipe. The first level, which is the top level, is represented by the the big wrapping rectangle that corresponds to the `/user/:id` route, meaning that every potential matching ID will be on the same level.

The inner rectangle instead is a nested route and a nested component. It corresponds to the route `gold` and to the `Gold` component.

When nested routes correspond to nested components, this is the right choice. There are two other cases to consider.

When we have nested components but don't have nested routes, we can just prefix the nested route with a slash, `/`. This will make it behave like a top-level route.

For example, consider that we change our code to the following:

```
const router = new VueRouter({
  routes: [
    { path: '/user/:id', component: User,
      children: [
        {
          path: 'soldiers',
          component: Soldiers
        },
        {
          path: '/gold',
          component: Gold
        }
      ]
    }
  ]
})
```

Prefixing the `/gold` route will make the `Gold` component appear when we point the browser to the `/gold` URL instead of `/user/Lannister/gold` (which will result in an error and an empty page in this case because the user is not specified).

The other, opposite, case is when having nested `routes` but no components on the same level. In this case, just use the regular syntax to register routes.

## Using route aliases

Sometimes it's necessary to have multiple URLs that point to the same page. This may be because the page has changed name or because the page is referred to differently in different parts of the site.

In particular, when a page changes its name, it is very important to also leave the former name in many settings. Links may break and the page may become unreachable from some parts of the website. In this recipe, you will prevent exactly that.

## Getting ready

For this recipe, you are only required to have some knowledge of the `vue-router` component (how to install it and basic operations). More information about `vue-router` will start from the *Creating a SPA with vue-router* recipe.

## How to do it...

Let's imagine that we have a fashion website and Lisa, the employee responsible for giving titles to dresses, creates two new links for two pieces of clothing:

```
<router-link to="/green-dress-01">Valentino</router-link>
<router-link to="/green-purse-A2">Prada</router-link>
```

The developers create the corresponding routes in the vue-router:

```
const router = new VueRouter({
  routes: [
    {
      path: '/green-dress-01',
      component: Valentino01
    },
    {
      path: '/green-purse-A2',
      component: PradaA2
    }
  ]
})
```

Later, it is discovered that the two items are not green but red. Lisa is not to blame since she is color-blind.

You are now in charge of changing all the links to reflect the true color of the listing. The first thing you do is change the links themselves. Here's what the HTML layout looks like after you edit it:

```
<div id="app">
  <h1>Clothes Shop</h1>
  <router-link to="/red-dress-01">Valentino</router-link>
  <router-link to="/red-purse-A2">Prada</router-link>
  <router-view></router-view>
</div>
```

You add the `VueRouter` plugin to Vue:

```
Vue.use(VueRouter)
```

Then, register the new routes as well as aliases for the old ones:

```
const router = new VueRouter({
  routes: [
    {
      path: '/red-dress-01',
      component: Valentino01,
```

```
        alias: '/green-dress-01'  
    },  
    {  
        path: '/red-purse-A2',  
        component: PradaA2,  
        alias: '/green-purse-A2'  
    }  
]  
))
```

Here's what the mentioned components look like:

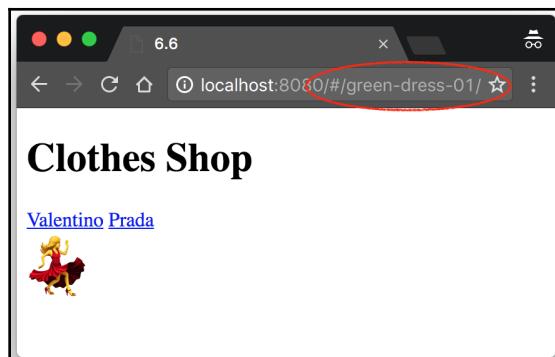
```
const Valentino01 = { template: '<div class="emoji">👗</div>' }  
const PradaA2 = { template: '<div class="emoji">👜</div>' }
```

Before launching the app, remember to instantiate a `Vue` instance:

```
new Vue({  
    router,  
    el: '#app'  
})
```

You can add a CSS rule to make the emojis look like images, as shown in the following screenshot:

```
.emoji {  
    font-size: 3em;  
}
```



## How it works...

Even if we changed all of our links, we cannot control how other entities are linked to our page. For search engines, such as Google, there is no way to tell them to remove their link to the old page and use the new one. This means that if we weren't to use aliases, we may have a lot of bad publicity in the form of broken links and 404 pages; in some cases, even from advertisers, we are paying to link to a non-existent page.

## Adding transitions between your routes

We explored transitions in detail in *Transitions and Animations*. Here, we will use them when changing routes instead of changing elements or components. The same observations apply here as well.

## Getting ready

Before trying this recipe, I highly suggest that you complete some recipes in *Transitions and Animations*, as well as this one. This recipe is a mixture of concepts learned up to now.

## How to do it...

In this recipe, we will build a website for a restaurant for ghosts. It won't be much different from the website of a regular restaurant, except for the requirements that the pages must fade instead of appearing instantly.

Let's put down some HTML layout, shall we:

```
<div id="app">
  <h1>Ghost's Restaurant</h1>
  <ul>
    <li><router-link to="/">Home</router-link></li>
    <li><router-link to="/menu">Menu</router-link></li>
  </ul>
  <transition mode="out-in">
    <router-view></router-view>
  </transition>
</div>
```

Note how we wrapped the main router display port with a `transition` tag. The mode `out-in` is set because we want the animation for the disappearing component to finish before the other component appears. If we hadn't we set that, the two fading components would be stacked for a brief time. For a more detailed discussion, you can refer to the [Letting an element leave before the enter phase in a transition](#) recipe.

Let's create the two pages/components:

```
const Home = { template: '<div>Welcome to Ghost's</div>' }
const Menu = { template: '<div>Today: invisible cookies</div>' }
```

Now, let's register routes:

```
Vue.use(VueRouter)
const router = new VueRouter({
  routes: [
    { path: '/', component: Home },
    { path: '/menu', component: Menu }
  ]
})
```

Before launching the application, instantiate a `Vue` object:

```
new Vue({
  router,
  el: '#app'
})
```

For the transition to work, you have to add a few CSS rules:

```
.v-enter-active, .v-leave-active {
  transition: opacity .5s;
}
.v-enter, .v-leave-active {
  opacity: 0
}
```

Launch your application now. You successfully added a fade transition between page changes.

## How it works...

Wrapping the whole `<router-view>` inside a transition tag will perform the same transition for all the components.

If we want a different transition for every component, we have an alternate option: we have to wrap the individual components inside transitions themselves.

Let's say, for example, that we have two transitions: `spooky` and `delicious`. We want to apply the first when the `Home` component appears, and the second when the `Menu` component appears.

We need to modify our components, as follows:

```
const Home = { template: `<transition name="spooky">
  <div>Welcome to Ghost's</div>
</transition>
` }
const Menu = { template: `<transition name="delicious">
  <div>Today: insisble cookies!</div>
</transition>
` }
```

## Managing errors for your routes

It does not make much sense to go to a link if the page we go to is not found or is not working. Traditionally, we are presented with an error page when this happens. In an SPA, we are more powerful and we can prevent the user from going there altogether, displaying a little courtesy message stating that the page is not available. This greatly enhances the UX since the user can immediately take another action without the need to go back.

## Getting ready

In order to follow along, you should complete the *Fetching data before switching route* recipe.

This recipe will build up on top of it and I'll assume that you already have all the relevant code in place.

## How to do it...

As said, we will edit the resulting code from the *Fetching data before switching route* recipe to manage errors. Just so you remember, when going to the `/aboutme` page, we were loading information from the Internet. We want to avoid going to that page in case the information is not available.

For this recipe, add Axios as a dependency, as done in the previous recipes.

First, enrich the HTML layout with the highlighted code:

```
<div id="app">
  <h1>My Portfolio</h1>
  <ul>
    <li><router-link to="/" exact>Home</router-link></li>
    <li><router-link to="/aboutme">About Me</router-link></li>
  </ul>
  <router-view></router-view>
  <div class="toast" v-show="showError">
    There was an error
  </div>
</div>
```

This is a toast message that will appear on the screen whenever there is an error. Add some style to it with this CSS rule:

```
div.toast {
  width: 15em;
  height: 1em;
  position: fixed;
  bottom: 1em;
  background-color: red;
  color: white;
  padding: 1em;
  text-align: center;
}
```

The next thing you want to do is have a global mechanism to set `showError` to `true`. At the top of the JavaScript code, declare the `vm` variable:

```
let vm
```

Then, assign our Vue root instance to it:

```
vm = new Vue({  
  router,  
  el: '#app',  
  data: {  
    showError: false  
  }  
})
```

We also added the `showError` variable to the data option.

The last thing to do is actually manage the error on the retrieval of our data, before displaying the bio information.

Add the highlighted code to the `beforeRouteEnter` hook:

```
beforeRouteEnter (to, from, next) {  
  axios.post('http://example.com/', {  
    "type": "object",  
    "properties": {  
      "name": {  
        "type": "string",  
        "ipsum": "name"  
      },  
      "phone": {  
        "type": "string",  
        "format": "phone"  
      }  
    }  
  }).then(response => {  
    next(vm => {  
      vm.name = response.data.name  
      vm.phone = response.data.phone  
    })  
  }).catch(error => {  
    vm.showError = true  
    next(false)  
  })  
}
```

The next (false) command will make the user stay where they are, and we also edited the endpoint to `example.com`, which will return an error code on a `POST` request:



## How it works...

Axios will receive an error from `example.com` and this will trigger a rejection of the promise created when we called `post`. The rejection of a promise will, in turn, trigger the function passed inside the `catch`.

It's worth noting that at this point in the code, `vm` is referring to the root `Vue` instance; this is because the code is always executed after the `Vue` instance is initialized and assigned to `vm`.

## Adding a progress bar to load pages

It's true that with an SPA the user does not have to wait for a new page to load, but he still has to wait for the data to load. In the *Fetching data before switching route* recipe, we had to wait a while longer after we clicked on the button to the `/aboutme` page. There was nothing to suggest that the data was loading, and then suddenly the page appeared. Wouldn't it be great if the user had at least some feedback that the page is loading?

## Getting ready

In order to follow along, you should complete the *Fetching data before switching route* recipe. This recipe will build up on top of it and I'll assume that you have all the relevant code in place already.

## How to do it...

As stated earlier, I will assume that you have all the code resulting from the *Fetching data before switching route* recipe in place and working.

For this recipe, we will use an additional dependency--NProgress, a small utility to display a loading bar on top of the screen.

Add the following two lines inside the head of your page or the list of dependencies in JSFiddle (there is also a package for npm):

```
<link rel="stylesheet"
      href="https://cdn.bootcss.com/nprogress/X/nprogress.css">
<script src="https://cdn.bootcss.com/nprogress/X/nprogress.js"></script>
```

Here, X is the version of NProgress. At writing time it was 0.2.0, but you can look it up online.

After we've done this, the next step is to define the behavior we want from the progress bar.

First, we'd like the progress bar to appear as soon as we click on the link. For this, we can add an event listener to the click event, but it will be a poor design if we had, say, a hundred links. A much more sustainable and clean way to do it is by creating a new hook for the router and connecting the appearance of the progress bar with the switching of the route. This will also have the advantage of offering a consistent experience throughout the application:

```
router.beforeEach((to, from, next) => {
  NProgress.start()
  next()
})
```

In a similar fashion, we want the bar to disappear when loading is completed successfully. This means that we want to do it inside the callback:

```
beforeRouteEnter (to, from, next) {
  axios.post('http://schematic-ipsum.herokuapp.com/', {
    "type": "object",
    "properties": {
      "name": {
        "type": "string",
        "ipsum": "name"
      },
      "phone": {
        "type": "string",
        "format": "phone"
      }
    }
  })
  .then(response => {
    next();
  })
  .catch(error => {
    next(error);
  })
}
```

```
        }
    }
}) .then(response => {
  NProgress.done()
  next(vm => {
    vm.name = response.data.name
    vm.phone = response.data.phone
  })
})
}
```

You can now launch the application and your progress bar should already work:



## How it works...

This recipe also demonstrates that it is not at all difficult to leverage external libraries, provided they are easy to install.

Since the `NProgress` component is so simple and useful, I report its API as a reference here:

- `NProgress.start()`: Shows the progress bar
- `NProgress.set(0.4)`: Sets a percentage of the progress bar
- `NProgress.inc()`: Increments the progress bar by a little
- `NProgress.done()`: Completes the progress

We have used two of the preceding functions.

As a precaution, I would also suggest not relying on the `done()` function being called by the individual components. We are calling it in the `then` function, but what if the next developer forgets? After all, we are starting the progress bar before *any* switch in route.

It would be better to add a new hook to the router:

```
router.afterEach((to, from) => {
  NProgress.done()
})
```

Since the `done` function is idempotent, we can call it as many times as we want. This will, therefore, not modify the behavior of our application and will ensure that even if future developers forget to close the progress bar, it will disappear by itself once the route has changed.

## How to redirect to another route

There are infinite reasons you may wish to redirect the user. You may want the user to log in before accessing a page, or maybe a page has moved and you want your user to take note of the new link. In this recipe, you will redirect the user to a new home page as a way to quickly modify the website.

### Getting ready

This recipe will only use basic knowledge about vue-router. If you have completed the *Creating a SPA with vue-router* recipe, you are good to go.

### How to do it...

Suppose that we have an online clothing shop.

This will be the HTML layout of the site:

```
<div id="app">
  <h1>Clothes for Humans</h1>
  <ul>
    <li><router-link to="/">Home</router-link></li>
    <li><router-link to="/clothes">Clothes</router-link></li>
  </ul>
  <router-view></router-view>
</div>
```

It's just a page with a link to a clothes listing.

Let's register the `VueRouter`:

```
Vue.use(VueRouter)
```

We have three pages in our website, represented by the following components:

```
const Home = { template: '<div>Welcome to Clothes for Humans</div>' }
const Clothes = { template: '<div>Today we have shoes</div>' }
const Sales = { template: '<div>Up to 50% discounts! Buy!</div>' }
```

They represent the home page, the clothes listing, and a page we used last year with some discounts.

Let's register some routes:

```
const router = new VueRouter({
  routes: [
    { path: '/', component: Home },
    { path: '/clothes', component: Clothes },
    { path: '/last-year-sales', component: Sales }
  ]
})
```

Finally, we add a root `Vue` instance:

```
new Vue({
  router,
  el: '#app'
})
```

You can launch the application, and it should work without any problems.

Black Friday is tomorrow and we forgot that it's the biggest event in fashion around the world. We don't have time to rewrite the home page, but there's that page from last year's sales that can do the trick. What we will do is redirect users who visit our home page to that page.

To implement this, we need to modify how we registered our routes:

```
const router = new VueRouter({
  routes: [
    { path: '/', component: Home, redirect: '/last-year-sales' },
    { path: '/clothes', component: Clothes },
    { path: '/last-year-sales', component: Sales }
  ]
})
```

Only by adding that redirect we did save the day. Now, you will be presented with the sales page whenever you visit the home page.

## How it works...

When the root route is matched, the `Home` component won't be loaded. The path of `/last-year-sales` will be matched instead. We can also omit the component altogether since it will never be loaded:

```
{ path: '/', redirect: '/last-year-sales' }
```

## There's more...

Redirecting in vue-router is more powerful than what we just saw. Here, I will try to enrich the application we just created with more functionality from redirecting.

## Redirecting to 404s

Redirecting not found pages is done by adding a catch-all as the last route. It will match everything that is not matched by the other routes:

```
...
{ path: '/404', component: NotFound },
{ path: '*', redirect: '/404' }
```

## Named redirecting

Redirection can be combined with named routes (refer to the *Using named dynamic routes* recipe). We can specify the destination by name:

```
...
{ path: '/clothes', name: 'listing', component: Clothes },
{ path: '/shoes', redirect: { name: 'listing' } }
```

## Redirecting with parameters

You can also retain the parameters while redirecting:

```
...
{ path: '/de/Schuh/:size', redirect: '/en/shoe/:size' },
{ path: '/en/shoe/:size', component: Shoe }
```

## Dynamic redirecting

This is the ultimate redirect. You can access the route the user is trying to access and decide where you want to redirect him (you can't cancel the redirection though):

```
...
{ path: '/air', component: Air },
{ path: '/bags', name: 'bags', component: Bags },
{ path: '/super-shirt/:size', component: SuperShirt },
{ path: '/shirt/:size?', component: Shirt},
{ path: '/shirts/:size?',
  redirect: to => {
    const { hash, params, query } = to
    if (query.colour === 'transparent') {
      return { path: '/air', query: null }
    }
    if (hash === '#prada') {
      return { name: 'bags', hash: '' }
    }
    if (params.size > 10) {
      return '/super-shirt/:size'
    } else {
      return '/shirt/:size?'
    }
  }
}
```

## Saving scrolling position when hitting back

In vue-router, there are two modes of navigation: `hash` and `history`. The default mode and the one used in the previous recipes is `hash`. Traditionally, when you visit a website, scroll down a bit and click on a link to another page; the new page displays from the top. When you click on the browser's back button, the page displays from the previous scrolled height and the link you just clicked on is visible.

This is not true when you are in an SPA, or at least is not automatic. The vue-router history mode lets you simulate this or, even better, have fine-grained control of what happens to your scrolling.

## Getting ready

To complete this recipe, we will need to switch to history mode. History mode only works when the app is running on a properly configured server. How to configure a server for SPA is out of the scope of this book (but the principle is that every route gets redirected from the server side to `index.html`).

We will use an npm program to launch a small server; you are expected to have npm installed .

## How to do it...

First, you'll install a compact server for SPAs so that history mode will work.

In your favorite command line, go inside the directory that will contain your application. Then, type the following commands:

```
npm install -g history-server  
history-server .
```

After the server is run, you will have to point your browser to `http://localhost:8080` and if you have a file called `index.html` in your directory, it will be shown; otherwise, you won't see much.

Create a file called `index.html` and fill in some boilerplate, like in the *Choosing a development environment* recipe. We want an empty page with only `Vue` and `vue-router` as dependencies. Our empty canvas should look like this:

```
<!DOCTYPE html>  
<html>  
<head>  
  <script src="https://unpkg.com/vue/dist/vue.js"></script>  
  <script src="https://unpkg.com/vue-router/dist/vue-router.js"></script>  
</head>  
<body>  
  <div id="app">  
  </div>  
  <script>  
    new Vue({
```

```
        router,
        el: '#app'
    })
</script>
</body>
</html>
```

As HTML layout, put this in the body:

```
<div id="app">
  <h1>News Portal</h1>
  <ul>
    <li><router-link to="/">Home</router-link></li>
    <li><router-link to="/sports">Sports</router-link></li>
    <li><router-link to="/fashion">Fashion</router-link></li>
  </ul>
  <router-view></router-view>
</div>
```

We have a heading with three links and a router-view entry point. We will create two long pages for the sports and fashion pages:

```
const Sports = { template: `

<div>
  <p v-for="i in 30">
    Sample text about sports {{i}}.
  </p>
  <router-link to="/fashion">Go to Fashion</router-link>
  <p v-for="i in 30">
    Sample text about sports {{i + 30}}.
  </p>
</div>
` }

const Fashion = { template: `

<div>
  <p v-for="i in 30">
    Sample text about fashion {{i}}.
  </p>
  <router-link to="/sports">Go to Sports</router-link>
  <p v-for="i in 30">
    Sample text about fashion {{i + 30}}.
  </p>
</div>
` }
```

We only need a stub for the home page component:

```
const Home = { template: '<div>Welcome to BBCCN</div>' }
```

Write a reasonable router for this news website:

```
Vue.use(VueRouter)
const router = new VueRouter({
  routes: [
    { path: '/', component: Home },
    { path: '/sports', component: Sports },
    { path: '/fashion', component: Fashion }
  ]
})
```

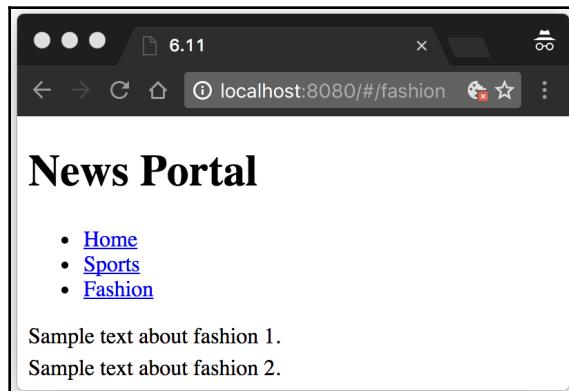
If you go with your browser now to the address specified earlier, you should see the site live.

Go to the sports page, scroll down until you see the link, and click on it.

Note how the page you are visiting is not displayed from the beginning. This will not happen with a traditional website and is not desirable.

Click on the back button and note how we are where we last left the page; we want to retain this behavior.

Lastly, note how the URL of the page does not look natural but has the hash symbol inside; we would like the URL to look better:



To accomplish this, let's modify our router code to the following:

```
const router = new VueRouter({
  mode: 'history',
  routes: [
    { path: '/', component: Home },
    { path: '/sports', component: Sports },
    { path: '/fashion', component: Fashion }
  ],
  scrollBehavior (to, from, savedPosition) {
    if (savedPosition) {
      return savedPosition
    } else {
      return { x: 0, y: 0 }
    }
  }
})
```

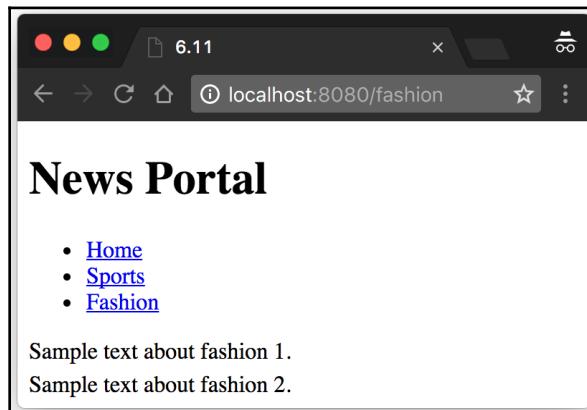
We added a line that specifies the new mode to be history (no hash in the link) and we defined the `scrollBehavior` function to go back to the last position if present; if it's a new page, it should scroll to the top-left corner.

You can try this by refreshing the browser and going back to the home page.

Open the sports page and click on the link in the middle of the page. The new page now displays from the beginning.

Click on back and the `savedPosition` gets restored.

Note how the URL looks much nicer now:



## How it works...

When you use a URL that contains the hash symbol in the browser, the browser will send a request for the URL without the suffix after the hash, that is, when you have an event inside a page that goes to the same page but with a different hash suffix:

```
http://example.com#/page1 on http://example.com#/page2
```

The browser will not reload the page; this is why vue-router can modify the content of the page when the user clicks on a link that only modifies the hash, without the page being reloaded.

When you change the mode from hash to history, vue-router will drop the hash notation and will leverage the `history.pushState()` function.

This function adds another virtual page and changes the URL to something else:

```
http://example.com/page1 =pushState=> http://example.com/page2
```

The browser will not send a GET request to look for `page2` though; in fact, it won't do anything.

When you press the back button, the browser reverts the URL and vue-router receives an event. It will then read the URL (which is now `page1`) and match the associated route.

The role of our compact history server is to redirect every GET request to the `index.html` page. This is why when we try to go to `http://localhost:8080/fashion` directly, we don't get a `404` error.

# 16

## Organize + Automate + Deploy = Webpack

In this chapter, we will talk about the following topics:

- Extracting logic from your components to keep the code tidy
- Bundling your component with Webpack
- Organizing your dependencies with Webpack
- Using external components in your Webpack project
- Developing with continuous feedback with hot reloading
- Using Babel to compile from ES6
- Running a code linter while developing
- Using only one command to build both a minified and a development .js file
- Releasing your components to the public

## Introduction

Webpack coupled with npm is a very powerful tool. In essence, it's just a bundler that takes some files along with their dependencies and bundles everything into one or more consumable files. It's now in its second version and represents much more than before, especially for Vue developers.

Webpack will enable you to write components conveniently isolated in single files and shippable on command. It will enable you to use different JavaScript standards, such as ES6, but also other languages altogether, all thanks to **loaders**, a concept that will recur in the following recipes.

# Extracting logic from your components to keep the code tidy

Vue components can become very complex sometimes. In these cases, it's better to split them up and try to hide some complexity with abstraction. The best place to put such complexity is external JavaScript files. This way you have the added benefit that, if necessary, it's easier to share the extracted logic with additional components.

## Getting ready

This recipe is of intermediate level. Before coming here, you know how to set up a project with npm.

Also, ensure that you have the `vue-cli` package installed globally with the following command:

```
npm install -g vue-cli
```

## How to do it...

We will build a calculator for compound interest; you will discover how much money you will have after an initial investment.

## Creating a clean Webpack project

Create a new directory and a new Vue project inside it with the following command:

```
vue init webpack
```

You can choose the default values for the questions asked.

Run `npm install` to install all the required dependencies.

Then, navigate to `src/App.vue` in the directory structure and delete pretty much everything inside the file.

The final result should be as follows:

```
<template>
  <div id="app">
  </div>
</template>

<script>
export default {
  name: 'app'
}
</script>

<style>
</style>
```



I've already done this for you, and, you can use another template with the following command instead:

```
vue init gurghet/webpack
```

## Building the compound interest calculator

To build the compound interest calculator, you need three fields: the initial capital or principal, the yearly interest rate, and the investment length. You will then add an output field to display the final result. Here's the corresponding HTML code:

```
<div id="app">
  <div>
    <label>principal capital</label>
    <input v-model.number="principal">
  </div>
  <div>
    <label>Yearly interestRate</label>
    <input v-model.number="interestRate">
  </div>
  <div>
    <label>Investment length (timeYears)</label>
    <input v-model.number="timeYears">
  </div>
  <div>
    You will gain:
    <output>{{final}}</output>
  </div>
</div>
```

```
</div>
</div>
```

We put the `.number` modifier, or otherwise the numbers we put inside will be converted to strings by JavaScript.

In the JavaScript part, declare the three model variables by writing the following code:

```
export default {
  name: 'app',
  data () {
    return {
      principal: 0,
      interestRate: 0,
      timeYears: 0
    }
  }
}
```

To calculate the compound interest, we take the math formula for it:

$$\text{FinalCapital} = (1 + \text{YearlyInterestRate})^{\text{Years}}$$

In JavaScript, it can be written as follows:

```
P * Math.pow((1 + r), t)
```

You have to add this to the Vue component as a computed property, as shown:

```
computed: {
  final () {
    const P = this.principal
    const r = this.interestRate
    const t = this.timeYears
    return P * Math.pow((1 + r), t)
  }
}
```

You can run your application with the following command (launched from your directory):

```
npm run dev
```

Now that our application works, you can see how much we will gain by putting 0.93 dollars into a bank account with 2.25 percent interest and hibernating for 1,000 years (4.3 billion dollars!):

principal capital	0.93
Yearly interestRate	0.0225
Investment length (timeYears)	1000
You will gain:	4283508449.711061

The formula inside the code is not much of a bother right now. Still, what if we had another component that also does the same calculation? We would also like to make it more explicit that we are computing the compound interest and we don't actually care what the formula does in this scope.

Create a new file, named `compoundInterest.js`, inside the `src` folder; write the following code inside it:

```
export default function (Principal, yearlyRate, years) {  
  const P = Principal  
  const r = yearlyRate  
  const t = years  
  return P * Math.pow((1 + r), t)  
}
```

We then modify the code in `App.vue` accordingly:

```
computed: {  
  final () {  
    return compoundInterest(  
      this.principal,  
      this.interestRate,  
      this.timeYears  
    )  
  }  
}
```

Also, remember to import the file we just created at the top of the JavaScript part:

```
<script>  
  import compoundInterest from './compoundInterest'  
  export default {  
    ...
```

## How it works...

When working in a component or when programming in general, it's much better to reduce the scope of the code to only one layer of abstraction. When we write a computed function that returns the final capital value, we should only worry about calling the right function--the one that does the right calculation for our purpose. The internals of the formula are on a lower layer of abstraction and we don't want to deal with that.

What we have done is that we brought all the nitty gritty of the calculations in a separate file. We then exported the function from the file with the following line:

```
export default function (Principal, yearlyRate, years) {  
  ...
```

This makes the function available by default when we import the file from our Vue component:

```
import compoundInterest from './compoundInterest'  
...
```

So, now `compoundInterest` is the function we defined in the other file. Furthermore, this separation of concerns allow us to use this function to compute compound interest everywhere in our code, even in other files (potentially other projects too).

## Bundling your component with Webpack

Webpack lets you package your project in minified JavaScript files. You can then distribute these files or use them yourself. When you use the inbuilt templates that come with `vue-cli`, Webpack is configured to build an entire working application with it. Sometimes we want to build a library to publish or use in another project. In this recipe, you will tweak the default configuration of the Webpack template to release a component instead.

## Getting ready

This recipe will make sense to you only after you have installed npm and got familiar with `vue-cli` and the Webpack template.

## How to do it...

For this recipe, you will build a reusable component that shakes whatever you put into it; for this, we will use the excellent CSSShake library.

Create a new clean project based on the Webpack template. You can take a look at the previous recipe to see how to do that, or you can use the prebuilt template I made. You can use my template by creating a new directory and running this command:

```
vue init gurghet/webpack
```

Choose the default answers if you don't know what they mean. Remember to run `npm install` to bring in the dependencies.

Let's first rename a couple of things: rename the `App.vue` file to `Shaker.vue`.

Inside it, write the following as the HTML template:

```
<template>
  <span id="shaker" class="shake">
    <link rel="stylesheet" type="text/css"
      href="https://cssshake.surge.sh/cssshake.min.css">
    <slot></slot>
  </span>
</template>
```

Note how we changed the `<div>` into a `<span>` with respect to the original template. That's because we want our shaker to be an inline component.

The component is complete as it is; we just need a minor cosmetic edit in the JavaScript part:

```
<script>
  export default {
    name: 'shaker'
  }
</script>
```

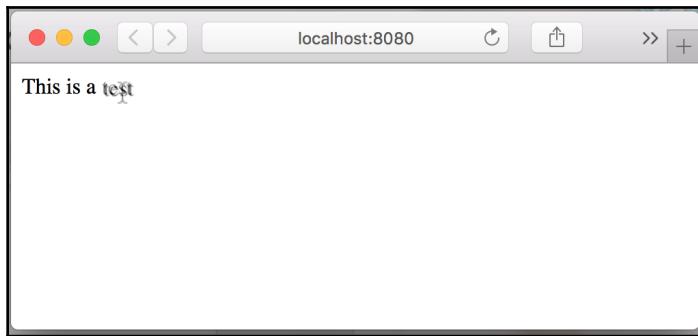
To manually test our application, we can modify the `main.js` file in the following way (the highlighted text is the modified code):

```
// The Vue build version to load with the `import` command
// (runtime-only or standalone) has been set in webpack.base.conf with an
// alias.
import Vue from 'vue'
import Shaker from './Shaker'
```

```
/* eslint-disable no-new */
new Vue({
  el: '#app',
  template: `
    <div>
      This is a <Shaker>test</Shaker>
    </div>
  `,
  components: { Shaker }
})
```

This will create a sample page as shown in the following screenshot, in which we can prototype our component with hot-reloading. Launch it by running the following command:

```
npm run dev
```



Placing the cursor over the word `test` should make it shake.

Now, we would like to package this component in a single JavaScript file that can be reused in the future.

There is no configuration present for this in the default template, but it's easy enough to add one.

First of all, you have to do some hammering in the `webpack.prod.js` file inside the `build` folder.

Let's get rid of some plugins that we don't need for releasing a library; find the `plugins` array inside the file. It's an array containing plugins in the form of the following code:

```
plugins: [
  new Plugin1(...),
  new Plugin2(...),
  ...
  new PluginN(...)
]
```

We only need the following plugins:

- `webpack.DefinePlugin`
- `webpack.optimize.UglifyJsPlugin`
- `webpack.optimize.OccurrenceOrderPlugin`

Get rid of all the other plugins as we don't need them; the final array should look like this:

```
plugins: [
  new webpack.DefinePlugin({
    'process.env': env
  }),
  new webpack.optimize.UglifyJsPlugin({
    compress: {
      warnings: false
    }
  }),
  new webpack.optimize.OccurrenceOrderPlugin()
]
```

The first one allows you to add some more configuration, the second plugin minifies the file, and the third one will optimize the size of the resulting file.

Another property we need to edit is `output`, as we want to simplify the output path.

The original property looks like this:

```
output: {
  path: config.build.assetsRoot,
  filename: utils.assetsPath('js/[name].[chunkhash].js'),
  chunkFilename: utils.assetsPath('js/[id].[chunkhash].js')
}
```

What it does originally is, it creates a series of output files inside a `js` directory. There are variables in square parentheses; we won't need them because you only have one self-contained module for our application, which we'll call *shaker*. We need to obtain the following code:

```
output: {
  path: config.build.assetsRoot,
  filename: utils.assetsPath('shaker.js')
}
```

Since, as just said, you want the component to be self-contained, we need some more modifications, which will also depend on your needs.

If you want the component to have any CSS styling built-in (we have none in our case as we are using an external CSS library), you should disable the `ExtractTextPlugin`; we already deleted the plugin from the list but some other files are still using it. Find the `extract` option inside the `vue-loader.conf.js` file (the `vue` section of the same file in some versions) and replace it with the following code:

```
...
loaders: utils.cssLoaders({
  ...
  extract: false
})
}
```

Our component will normally contain the Vue library inside; if you want to use the component in a Vue project, you don't need this, as it would be duplicated code. You can tell Webpack to just search for dependencies externally and not include them. Add the following property in the `webpack.prod.js` file you just modified before `plugins`:

```
externals: {
  'vue': 'Vue'
}
```

This will tell Webpack not to write the Vue library into the bundle but to just take a global, named `Vue`, and use it wherever the `vue` dependency is imported in our code. The Webpack configuration is almost done; we just need to add another property before the `module` property:

```
var webpackConfig = merge(baseWebpackConfig, {
  entry: {
    app: './src/dist.js'
  },
  module: {
    ...
  }
})
```

This will start the compilation reading code from the `dist.js` file. Wait a minute, this file doesn't exist yet. Let's create it and add the following code inside:

```
import Vue from 'vue'  
import Shaker from './Shaker'  
Vue.component('shaker', Shaker)
```

In the final JavaScript minified file, the Vue dependency will be taken externally, and then we register the component globally.

As the last change, I would suggest modifying the folder in which the minified file gets saved. In the `config/index.js` file, edit the following line:

```
assetsSubDirectory: 'static',
```

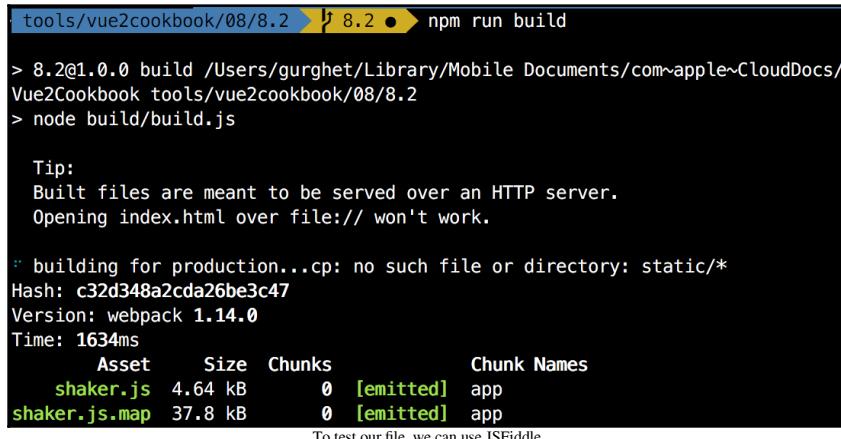
Swap the preceding line with the following code:

```
assetsSubDirectory: '.',
```

Now run the command to build the minified file with npm:

```
npm run build
```

You will see an output that looks like this:



A terminal window showing the output of the `npm run build` command. The output shows the build process for a Vue application, including the creation of a `dist` directory and the contents of the `dist` directory.

```
tools/vue2cookbook/08/8.2 ➜ 8.2 ➜ npm run build  
> 8.2@1.0.0 build /Users/gurghet/Library/Mobile Documents/com~apple~CloudDocs/Vue2Cookbook/tools/vue2cookbook/08/8.2  
> node build/build.js  
  
Tip:  
Built files are meant to be served over an HTTP server.  
Opening index.html over file:// won't work.  
  
Building for production...cp: no such file or directory: static/*  
Hash: c32d348a2cda26be3c47  
Version: webpack 1.14.0  
Time: 1634ms  


| Asset         | Size    | Chunks | Chunk Names   |
|---------------|---------|--------|---------------|
| shaker.js     | 4.64 kB | 0      | [emitted] app |
| shaker.js.map | 37.8 kB | 0      | [emitted] app |

To test our file, we can use JSFiddle
```

Copy the content of the file you created inside `dist/shaker.js`, then go to <https://gist.github.com/> (you may need to register) and paste the content of the file inside the text area. Name it `shaker.js`:

The screenshot shows a code editor interface for creating a gist. The file is named `shaker.js`. The code content is:

```
1 !function(e,t){"object"==typeof exports&&"object"==typeof module?module.exports=t(require("Vue")):"function"==typeof define&&define(2 /*#__PURE__*/function(t){"use strict";function e(e){return new Promise((n,r)=>{e(n,r)});}function n(e){return new Promise((n,r)=>{e(r,n)});}function r(e){return new Promise((n,r)=>{e(n,r)});}function o(e){return new Promise((n,r)=>{e(r,n)});}})(this,Vue);2 //# sourceMappingURL=shaker.js.map
```

At the bottom right, there are buttons for **Create secret gist** and **Create public gist**.

Since the text is a single line, you will not see much with the **No wrap** option on. Click on **Create public gist** and when you are presented with the next page, click on **Raw**, as shown in the following screenshot:

The screenshot shows the public gist view for `shaker.js`. The raw code is displayed:

```
1 !function(e,t){"object"==typeof exports&&"object"==typeof module?module.exports=t(require("Vue")):"function"==typeof define&&define(2 /*#__PURE__*/function(t){"use strict";function e(e){return new Promise((n,r)=>{e(n,r)});}function n(e){return new Promise((n,r)=>{e(r,n)});}function r(e){return new Promise((n,r)=>{e(n,r)});}function o(e){return new Promise((n,r)=>{e(r,n)});}})(this,Vue);2 //# sourceMappingURL=shaker.js.map
```

A red circle highlights the **Raw** link at the top right of the code block.

Copy the URL in the address bar and go to <http://rawgit.com/>, where you can paste the link:

**RawGit**

RawGit serves raw files directly from GitHub with proper **Content-Type** headers.

<https://gist.githubusercontent.com/gurghet/f42627c8382e52ad40eb5c00dfd534de/raw/8>

**Use this URL in production**

<https://cdn.rawgit.com/gurghet/f42627c8382e52ad40eb5c00dfd534de/raw/8>

- No traffic limits or throttling. Files are served via [StackPath](#)'s super fast global CDN.
- Use a specific tag or commit hash in the URL (not a branch). Files are cached permanently based on the URL. Query strings are ignored.
- The catch: this is a free service, so there are

**Use this URL for development**

<https://rawgit.com/gurghet/f42627c8382e52ad40eb5c00dfd534de/raw/8>

- New changes you push to GitHub will be reflected within minutes.
- Excessive traffic will be throttled and blacklisted.
- If excessive traffic continues, RawGit will display a prominent error message on your

Click and copy the link you get on the right. Congratulations, you just published your component on the Web!

Now head to JSFiddle and pick **Vue** as a library. You can now add the link you copied in the left and you have your component available to use:

The screenshot shows the JSFiddle interface. On the left, there's a sidebar with a cloud icon and a red notification badge (4). It includes sections for 'Fiddle Meta', 'External Resources', and 'JavaScript/CSS URI'. Under 'External Resources', there's a link to 'shaker.js'. Below the sidebar is a large preview area. In the preview area, the HTML tab shows the following code:

```
<div id="app">
  This is a
  <shaker>test</shaker>
</div>
```

The JavaScript tab shows:

```
new Vue({
  el: '#app'
})
```

The output on the right shows the rendered result: "This is a test".

## How it works...

Webpack configuration in the official templates is quite involved. On the other hand, don't try to understand everything straight away, or you will get stuck and not learn much anyway.

We created a **UMD (Universal Module Definition)** module that will try and see whether there is a Vue dependency available and install itself as a component.

You can even add CSS and styling to your component and, the way we configured Webpack, the styles will still ship with your component.

## There's more...

In the *Releasing your components to the public* recipe in this chapter, you will learn how to publish your component in the npm publish registry. We'll use a different approach than this, but you'll find there the missing steps to publish it to the registry.

# Organizing your dependencies with Webpack

Webpack is a tool for organizing your code and dependencies. Furthermore, it gives you a way to develop and build with JavaScript files that embed all the dependencies and modules that we pass to them. We'll use this in this recipe to build a small Vue application and bundle everything in a single file.

## Getting ready

This recipe doesn't require any particular skill except the use of npm and some knowledge of the command line. You can find out more in the *Organizing your dependencies with Webpack* recipe in this chapter.

## How to do it...

Create a new folder for your recipe and create a `package.json` file with the following content inside it:

```
{  
  "name": "recipe",  
  "version": "1.0.0"  
}
```

This defines an npm project in our folder. You can, of course, use `npm init` or `yarn init` if you know what you're doing.

We will install Webpack 2 for this recipe. To add it to your project dependencies, run the following command:

```
npm install --save-dev webpack@2
```

The `--save-dev` option means that we will not ship the code for Webpack in our final product, but we will use it only for development purposes.

Create a new `app` directory and an `App.vue` file inside it.

This file will be a simple Vue component; it can be as simple as the following:

```
<template>
  <div>
    {{msg}}
  </div>
</template>
<script>
export default {
  name: 'app',
  data () {
    return {
      msg: 'Hello world'
    }
  }
}
</script>
<style>
</style>
```

We need to tell Webpack how to turn .vue files into .js files. To do that, we create a configuration file in the root folder, named webpack.config.js; this file will be automatically picked up by Webpack. Inside this file, write as follows:

```
module.exports = {
  module: {
    rules: [
      {test: /\.vue$/, use: 'vue-loader'}
    ]
  }
}
```

The line inside rules says the following:

*Hey Webpack, when you see a file that ends in .vue, use the vue-loader to turn it into a JavaScript file.*

We need to install such a loader with npm using the following command:

```
npm install --save-dev vue-loader
```

This loader internally uses other dependencies that will not be installed automatically; we need to do it manually by running the following command:

```
npm install --save-dev vue-template-compiler css-loader
```

Let's also take this opportunity to install Vue itself:

```
npm install --save vue
```

Now our Vue component is ready. We need to write a page in which to place it and try it. Create a file called `index.js` inside the `app` folder. We will instantiate the component in a Vue instance. Inside `index.js`, write the following:

```
import Vue from 'vue'
import App from './App.vue'
new Vue({
  el: '#app',
  render: h => h(App)
})
```

This will mount the Vue instance inside an element with `id="app"`, and it will contain a single component--our `App.vue`.

We need one more file--an HTML file. In the root directory, create `index.html` with this code:

```
<!DOCTYPE html>
<html>
  <head>
    <title>Webpack 2 demo</title>
  </head>
  <body>
    <div id="app"></div>
    <script src="dist/bundle.js"></script>
  </body>
</html>
```

We don't want to refer to `app/index.js` directly here; this is because `index.js` itself doesn't contain much. It has an `import` statement that won't be recognized by the browser. Webpack can instead easily create `dist/bundle.js` with `index.js` inside, along with all its dependencies. To do it, run this command:

```
./node_modules/webpack/bin/webpack.js app/index.js dist/bundle.js
```

This should generate an output similar to this:

```
▶ 8.3 ➔ ./node_modules/webpack/bin/webpack.js app/index.js dist/bundle.js
Hash: 50e77638cffa51b001f1
Version: webpack 2.2.0
Time: 105ms
 Asset   Size  Chunks      Chunk Names
bundle.js 183 kB       0 [emitted]  main
 [0] ./app/App.vue 1.79 kB {0} [built]
 [1] ./~/.vue/dist/vue.runtime.common.js 162 kB {0} [built]
 [2] ./~/.css-loader!./~/.vue-loader/lib/style-rewriter.js?id=data-v-7057c7d3!./~/.vue-loader/lib/selector
.js?type=styles&index=0!./app/App.vue 192 bytes {0} [built]
 [3] ./~/.css-loader/lib/css-base.js 1.51 kB {0} [built]
 [4] ./~/.process/browser.js 5.3 kB {0} [built]
 [5] ./~/.vue-loader/lib/selector.js?type=script&index=0!./app/App.vue 113 bytes {0} [built]
 [6] ./~/.vue-loader/lib/template-compiler.js?id=data-v-7057c7d3!./~/.vue-loader/lib/selector.js?type=tem
plate&index=0!./app/App.vue 376 bytes {0} [built]
 [7] ./~/.vue-style-loader/addStyles.js 6.24 kB {0} [built]
 [8] ./~/.vue-style-loader!./~/.css-loader!./~/.vue-loader/lib/style-rewriter.js?id=data-v-7057c7d3!./~/.vu
e-loader/lib/selector.js?type=styles&index=0!./app/App.vue 1.31 kB {0} [built]
 [9] (webpack)/buildin/global.js 509 bytes {0} [built]
[10] ./app/index.js 99 bytes {0} [built]
```

You can now open `index.html` and you'll see the component working.

However, it's not so much fun to launch this long command every time. Webpack and npm can do better.

In `webpack.config.js`, add the following properties:

```
module.exports = {
  entry: './app/index.js',
  output: {
    filename: 'bundle.js',
    path: __dirname + '/dist'
  },
  module: {
    ...
  }
}
```

This will specify the entry point of Webpack and where the resulting file should be saved.

We can also add a script to `package.json`:

```
"scripts": {
  "build": "webpack"
}
```

Now, launching `npm run build` will have the same effect as the long command we used.

## How it works...

In this recipe, we basically created a JavaScript file (`bundle.js`) that simultaneously contains Vue and the component we wrote. In the `index.html`, there is no trace of Vue because it's embedded in `bundle.js`.

This way of working is much better when we have a lot of dependencies. We don't need to add a lot of tags in the head or the body of the page anymore. Also, we don't have to be afraid to load a dependency that we don't need.

As an added bonus, Webpack has the power and flexibility to minify our final file and other advanced optimizations that are simply not possible by loading the dependencies manually.

# Using external components in your Webpack project

Using external Vue components in your own project is usually straightforward. Sometimes though, things aren't so simple. In particular, there are some configurations in the official templates with Webpack that (weirdly) actually prevent you from using some external components. In this recipe, we will install a modal dialog component from the Bulma project.

## Getting ready

In this recipe, we will tweak the Webpack configuration. It is suggested to have completed the *Organizing your dependencies with Webpack* recipe before taking up this task.

## How to do it...

We will start with a fresh Webpack project. You can create a new one using the `vue-cli` and the official Webpack template. My suggestion, however, is, to begin with my Webpack template, which is a clean slate. To do it, run the following command in a new directory:

```
vue init gurghet/webpack
```

We will install `vue-bulma-modal`, which is a component written in Vue with the Bulma CSS framework:

```
npm install --save vue-bulma-modal bulma
```

In the preceding command, we installed `bulma` too, which contains the actual CSS styles.

To actually make the styles work, we need to turn them into JavaScript for Webpack; this means we need to install a couple of loaders:

```
npm install --save-dev node-sass sass-loader
```

The SASS loader is already configured, so there is no need to touch anything. What we will touch though, is the Webpack configuration related to the Babel loader (learn more about it in the *Developing with continuous feedback with hot reloading* recipe).

In the official template (but this may change, watch out), there is a line that prevents Webpack from compiling dependencies. Go to `build/webpack.base.conf.js` and find this block:

```
{
  test: /\.js$/,
  loader: 'babel-loader',
  include: [
    path.join(projectRoot, 'src')
  ],
  exclude: /node_modules/
},
```



Depending on the version of Webpack you are using, you may need to slightly tweak the loader syntax. In older versions of Webpack, for example, you would write `babel` instead of `babel-loader`.

You have to remove the highlighted line and, instead, write the following:

```
{
  test: /\.js$/,
  loader: 'babel-loader',
  include: [
    path.join(projectRoot, 'src'),
    path.join(projectRoot, 'node_modules/vue-bulma-modal')
  ]
},
```

This is telling Webpack to compile the component we just installed with `babel-loader`.

Now, write the following HTML layout in App.vue:

```
<template>
  <div id="app">
    <card-modal
      @ok="accept"
      ok-text="Accept"
      :visible="popup"
      @cancel="cancel"
    >
      <div class="content">
        <h1>Contract</h1>
        <p>
          I hereby declare I have learned how to
          install third party components in my
          own Vue project.
        </p>
      </div>
    </card-modal>
    <p v-if="signed">It appears you signed!</p>
  </div>
</template>
```

Then, you can write the logic, as shown, in the JavaScript:

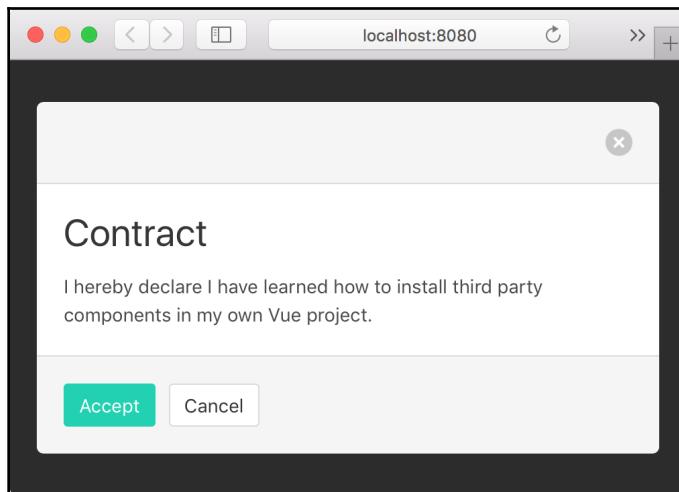
```
<script>
import { CardModal } from 'vue-bulma-modal'
export default {
  name: 'app',
  components: { CardModal },
  data () {
    return {
      signed: false,
      popup: true
    }
  },
  methods: {
    accept () {
      this.popup = false
      this.signed = true
    },
    cancel () {
      this.popup = false
    }
  }
}
</script>
```

To actually use the Bulma styles, we need to kick in the SASS loader and import the `bulma` file. Add the following lines:

```
<style lang="sass">
  @import '~bulma';
</style>
```

Note how we are specifying the language of our styles in the first line (we are writing SCSS, but in this case we write it as it is).

If you now try to run your app with the `npm run dev` command, you will see the Bulma modal dialog in all its splendor:



## How it works...

The official Webpack template contains the configuration rule to never compile files inside the `node_modules` directory. This means that authors of web components are encouraged to distribute an already compiled file because otherwise, users will import raw JavaScript files (since Webpack won't compile them) in their projects, causing all sorts of errors in browsers. Personally, I don't think this is good engineering. One problem with this setup is that since the files you are importing in your project are compiled against one version of Vue, the component might not work (this actually happened in the past) if you use a newer version of Vue.

A better approach is to import the raw files and components and let Webpack compile them in a single file. Unfortunately, the majority of components available in the wild are distributed already compiled, so while it's very quick to import them given the official template, you're more likely to encounter compatibility problems.

When importing external components, the first thing to do is to examine their package.json file. Let's see what the vue-bulma-modal package contains in this file:

```
{  
  "name": "vue-bulma-modal",  
  "version": "1.0.1",  
  "description": "Modal component for Vue Bulma",  
  "main": "src/index.js",  
  "peerDependencies": {  
    "bulma": ">=0.2",  
    "vue": ">=2"  
  },  
  ...  
  "author": "Fangdun Cai <cfddream@gmail.com>",  
  "license": "MIT"  
}
```

The file referred to by the main property is the file we are importing when we write the following line in JavaScript:

```
import { CardModal } from 'vue-bulma-modal'
```

The src/index.js file, in turn, contains the following code:

```
import Modal from './Modal'  
import BaseModal from './BaseModal'  
import CardModal from './CardModal'  
import ImageModal from './ImageModal'  
  
export {  
  Modal,  
  BaseModal,  
  CardModal,  
  ImageModal  
}
```

This is not a compiled file; it's raw ES6 and we know it because `import` is not defined in regular JavaScript. That's why we need Webpack to compile this for us.

On the other hand, consider that we write the following:

```
<style lang="sass">
  @import '~bulma';
</style>
```

With the tilde sign (~), we tell Webpack to resolve the style like it was a module and so, what we are really importing is the file referred to by the `main` in the `package.json` of the `bulma` package, which, if we check, looks as follows:

```
{
  "name": "bulma",
  "version": "0.3.1",
  ...
  "main": "bulma.sass",
  ...
}
```

Since we are importing a SASS with the SASS syntax, we need to specify in the Vue component that we are using `lang="sass"`.

## Developing with continuous feedback with hot reloading

Hot reloading is a really useful technology that lets you develop while looking at the results in the browser, without even refreshing the page. It's a very tight loop and can really speed up your development process. In the official Webpack template, hot reloading is installed by default. In this recipe, you will learn how to install it yourself.

### Getting ready

Before attempting this recipe, you should have at least a vague idea of how Webpack works; the *Organizing your dependencies with Webpack* recipe in this chapter will have you covered.

## How to do it...

Create a new npm project in a new directory, either with `npm init -y` or `yarn init -y`. I personally prefer the second one because the resulting `package.json` is much more compact.



To install Yarn, you can use the `npm install -g yarn` command. The main benefit of Yarn is that you will be able to lock your dependencies to a known version. This prevents bugs when working in teams and the application gets cloned from Git with slightly different versions that introduce incompatibilities.

You will create a digital swear jar. For every swear word you pronounce, you donate an amount of money to a swear jar for a long-term objective.

Create a new file, named `SwearJar.vue`, and add the following code inside it:

```
<template>
  <div>
    Swears: {{counter}} $$
    <button @click="addSwear">+</button>
  </div>
</template>
<script>
export default {
  name: 'swear-jar',
  data () {
    return {
      counter: 0
    }
  },
  methods: {
    addSwear () {
      this.counter++
    }
  }
}
</script>
```

You will insert this component on a web page.

Create a file named `index.html` in the same directory and write the following code:

```
<!DOCTYPE html>
<html>
  <head>
    <title>Swear Jar Page</title>
  </head>
  <body>
    <div id="app"></div>
    <script src="bundle.js"></script>
  </body>
</html>
```

The `bundle.js` file will be created (in memory) by Webpack for us.

The last app file you need is a JavaScript file that will contain our Vue root instance. Create it in the same directory and name it `index.js`; put the following content in it:

```
import Vue from 'vue'
import SwearJar from './SwearJar.vue'
new Vue({
  el: '#app',
  render: h => h(SwearJar)
})
```

Now you need to create a file, `webpack.config.js`, to tell Webpack a couple of things. The first thing is the entry point of our application (`index.js`) and where we would like to place the compiled files:

```
module.exports = {
  entry: './index.js',
  output: {
    path: 'dist',
    filename: 'bundle.js'
  }
}
```

Next, we will tell Webpack to turn `.vue` files into JavaScript with `vue-loader`:

```
module.exports = {
  entry: './index.js',
  output: {
    path: 'dist',
    filename: 'bundle.js'
  },
  module: {
    rules: [
      {
        test: /\.vue$/,
        loader: 'vue-loader'
      }
    ]
  }
}
```

```
        test: /\.vue$/,
        use: 'vue-loader'
    }
}
}
```

To make everything work, we still need to install the dependencies we implied in our code. We can install them with the following two commands:

```
npm install --save vue
npm install --save-dev vue-loader vue-template-compiler webpack webpack-
dev-server
```

The last one in particular--webpack-dev-server--is a development server that will help us develop with hot reloading.

Run the following command to start the server:

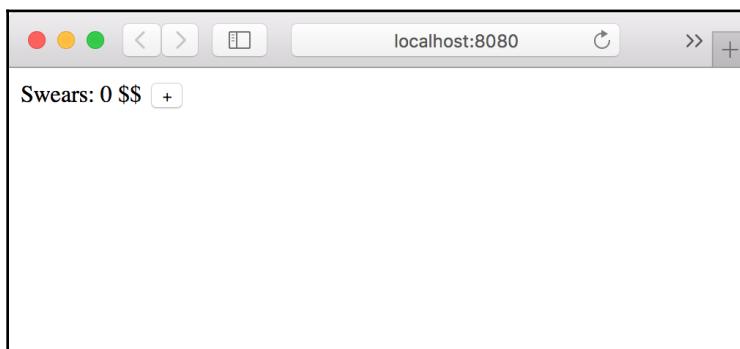
```
./node_modules/webpack-dev-server/bin/webpack-dev-server.js --output-path /
--inline --hot --open
```

Actually, let's put this command in an npm script.

Open package.json and add the following lines:

```
"scripts": {
  "dev": "webpack-dev-server --output-path / --inline --hot --open"
}
```

We can now run `npm run dev` and we'll get the same result--a browser will pop up--as illustrated in the following screenshot:



Clicking on the plus button will make the counter go up, but what about the style of this application? Let's make it more attractive.

Open your code editor and the window side by side and make the following modifications to `SwearJar.vue`:

```
<template>
<div>
  <p>Swears: {{counter}} $$</p>
  <button @click="addSwear">Add Swear</button>
</div>
</template>
```

Save the file, and you will see the page updating itself. Even better, the state will be retained if the counter was already set above zero, and this means that if you have a complex component you don't have to bring it manually into the same state again after each modification. Try to set the swear count to some number and edit the template. Most of the time, the counter will not get reset to zero.

## How it works...

The Webpack dev server is very helpful software that lets you develop with a very tight feedback loop. We used plenty of arguments to make it run:

```
webpack-dev-server --output-path / --inline --hot --open
```

All these parameters are the same inside the `webpack.config.js`. Instead, we are putting these parameters in the command line for convenience. The `--output-path` is where the Webpack server will serve `bundle.js`; in our case, we said that we want it served at the root path, so it will effectively bind the `/bundle.js` path to the actual `bundle.js` file.

The second parameter, `--inline`, will inject some JavaScript code in our browser so that our app can communicate with the Webpack dev server.

The `--hot` parameter will activate the Hot Module Replacement plugin, which will communicate with the `vue-loader` (actually with the `vue-hot-reload-api`, which is inside it) and will either restart or rerender (preserving the state) each Vue model inside the page.

Finally, `--open` just opens the default browser for us.

# Using Babel to compile from ES6

ES6 has a lot of useful features, and in this recipe, you will learn how you can use it in your projects. It's worth noting that ES6 currently has very good browser support. You won't have compatibility issues with 80% of the browsers in the wild, but you may need to even reach people who're still using Internet Explorer 11, depending on your audience, or you may just want to maximize your audience. Moreover, some tools for development and Node.js still don't fully support ES6, deeming Babel necessary even for development.

## Getting ready

In this recipe, we will use npm and the command line.

## How to do it...

Create a new directory with an empty npm project. You can use the `npm init -y` command or, if you have Yarn installed, you can use `yarn init -y` inside the directory. This command will create a new `package.json` inside the directory. (Refer to the note in the *Developing with continuous feedback with hot reloading* recipe on Yarn.)

For this npm project, we will need a couple of dependencies other than Vue: Webpack, and Babel in the form of a loader for Webpack. Oh yes, we will need the `vue-loader` as well for Webpack. To install them, launch the following two commands:

```
npm install --save vue
npm install --save-dev webpack babel-core babel-loader babel-preset-es2015
vue-loader vue-template-compiler
```

In the same directory, let's write a component that uses ES6 syntax; let's call it `myComp.vue`:

```
<template>
  <div>Hello</div>
</template>
<script>
var double = n => n * 2
export default {
  beforeCreate () {
    console.log([1,2,3].map(double))
  }
}
</script>
```

This component doesn't do much except print the `[2, 4, 6]` array to the console, but it does it with arrow syntax at the following line:

```
var double = n => n * 2
```

This is not understood by some browsers and tools; we need to compile this component with Webpack, but we need to do it with the Babel loader.

Create a new `webpack.config.js` file and write the following inside it:

```
module.exports = {
  entry: 'babel-loader!vue-loader!./myComp.vue',
  output: {
    filename: 'bundle.js',
    path: 'dist'
  }
}
```

This will tell Webpack to start compiling from our `myComp.vue` file, but before that, it will be processed by the `vue-loader` to turn it into a `.js` file and then by the `babel-loader` to turn the arrow function into something simpler and more compatible.

We can achieve the same thing with a different and more standard configuration:

```
module.exports = {
  entry: './myComp.vue',
  output: {
    filename: 'bundle.js'
  },
  module: {
    rules: [
      {
        test: /\.vue$/,
        use: 'vue-loader'
      },
      {
        test: /\.js$/,
        use: 'babel-loader'
      }
    ]
  }
}
```

This is a more general configuration and it says that whenever we encounter a file that ends with `.vue`, it should be parsed and processed with the `vue-loader` and `.js` files with the `babel-loader`.

To configure the Babel loader, there are a couple of options; we'll follow the recommended way. Create a file called `.babelrc` inside your project folder (note the initial point) and to specify that we want the `es2015` preset applied, we write the following code:

```
{  
  "presets": ["es2015"]  
}
```

Lastly, I always like to add a new script to the `package.json` file to make launching commands easier. Add the following line at the end of the file (but before the last curly brace):

```
"scripts": {  
  "build": "webpack"  
}
```

Then run `npm run build`. This creates a file inside the `dist` directory, named `bundle.js`; open it and search for a line that contains, for example, `double`. You should find something like this:

```
...  
var double = function double(n) {  
  return n * 2;  
};  
...
```

This was our `var double = n => n * 2`, transformed from ES6 to *regular* JavaScript.

## How it works...

The `es2015` Babel preset is a collection of Babel plugins that aims to transform ECMAScript2015 (ES6) syntax into simpler JavaScript. For example, it contains the `babel-plugin-transform-es2015-arrow-functions` plugin, which as you may have guessed, transforms arrow functions:

```
var addOne = n => n + 1
```

Transform the arrow functions into simpler JavaScript as follows:

```
var addOne = function addOne(n) {  
    return n + 1  
}
```

To select the files and their respective loaders, we filled the test field inside `webpack.config.js` and to match the `.vue` files, we wrote the following:

```
test: /\.vue$/
```

This syntax is a regular expression and it always starts with a forward slash and ends with another forward slash. The first character it matches is the point, which is expressed as `\.` because the `.` character is already taken for other purposes. The point has to be followed by the `vue` string and the end of string character is expressed as a dollar sign. If you put them all together, it will match all the strings that end with `.vue`. A similar thing is followed for the `.js` files.

## Running a code linter while developing

Linting your code drastically reduces small bugs and inefficiencies that accumulate during development, it guarantees that the coding style is consistent across a team or organization, and it makes your code more readable. Instead of running the linter once in a while, it's useful to have it constantly running. This recipe teaches you how to do it with Webpack.

### Getting ready

In this recipe, we will play with Webpack once again. You will build a tight loop with `webpack-dev-server`, which is covered in the *Developing with continuous feedback with hot reloading* recipe.

### How to do it...

In a new folder, create a new npm project (you can use `npm init -y` or `yarn init -y`).

Inside the folder, create a new directory named `src` and put a file inside it, called `MyComp.vue`. Let the file contain the following code:

```
<template>  
  <div>
```

```
    Hello {{name}}!
  </div>
</template>
<script>
export default {
  data () {
    return {
      name: 'John',
      name: 'Jane'
    }
  }
}
</script>
```

We can already spot a problem--the `John` name property will be overwritten by the later property, `Jane`, with the same key. Let's pretend that we didn't notice this and put the component inside a web page. For this, we need another file, named `index.js`, in the `src` directory. Write the following code inside it:

```
import Vue from 'vue'
import MyComp from './MyComp.vue'
new Vue({
  el: '#app',
  render: h => h(MyComp)
})
```

In the root directory, place an `index.html` file with the following code:

```
<!DOCTYPE html>
<html>
  <head>
    <title>Hello</title>
  </head>
  <body>
    <div id="app"></div>
    <script src="bundle.js"></script>
  </body>
</html>
```

We now need a `webpack.config.js` file to tell Webpack how to compile our files; write the following inside it:

```
module.exports = {
  entry: './src/index.js',
  module: {
    rules: [
      {
        test: /\.vue$/,
        loader: 'vue-loader'
```

```
        use: 'vue-loader'  
    }  
]  
}  
}
```

This just tells Webpack to start compiling from the `index.js` file and, whenever it finds a `.vue` file, to turn it into JavaScript with the `vue-loader`. Beyond this, we want to scan all our files with a linter to ensure that we didn't make silly mistakes in our code.

Add the following loader to the `rules` array:

```
{  
  test: /\.(vue|js)$/,  
  use: 'eslint-loader',  
  enforce: 'pre'  
}
```

The `enforce: 'pre'` property will run this loader before the others, so it will apply to the code you wrote and not a transformation of it.

The last thing we need is to configure ESLint. Create a new file in the root directory named `.eslintrc.js`, and add the following inside it:

```
module.exports = {  
  "extends": "eslint:recommended",  
  "parser": "babel-eslint",  
  "plugins": [  
    "html"  
  ]  
}
```

We are saying a couple of things here. First is the set of rules we want to apply to our code; in other words, our set of rules (which is empty now) is extending the recommended set of rules. Second, we are using the `babel-eslint` parser instead of the default one. Finally, we are using the HTML ESLint plugin, which will help us to deal with the `.vue` files and will extract the JavaScript code in them.

We are now ready to launch our development machinery, but first, we need to install the dependencies using the following command:

```
npm install --save vue  
npm install --save-dev babel-eslint eslint eslint-loader eslint-plugin-html  
vue-loader vue-template-compiler webpack webpack-dev-server
```

We can launch the Webpack dev server directly, but I highly suggest adding the following code to the `package.json` file:

```
"scripts": {  
  "dev": "webpack-dev-server --entry ./src/index.js --inline --hot --open"  
}
```

Now, if we launch `npm run dev`, a browser should open with the component incorrectly displaying the following:

*Hello Jane!*

You should also be able to see the problem in the console:

```
11:7  error  Duplicate key 'name'  no-dupe-keys
```

This means that we have two keys with the same *name*. Correct the error by removing the property:

```
data () {  
  return {  
    name: 'John'  
  }  
}
```

In the console, after you save the Vue component, you should note that Webpack already performed the compilation again, this time with no errors.

## How it works...

Basically, what happens here is that the linter loader processes the files before other compilation steps and writes the errors in the console. This way, you will be able to see imperfections in your code while you develop continuously.

ESLint and Webpack are available in the Vue official template. You now know that if for some reason, you want to modify the ESLint rules, you can do it from the `.eslintrc.js` file and that if you want to use another linter altogether, you can use another loader in the Webpack configuration file.

# Using only one command to build both a minified and a development .js file

While working on the release of your components, you may need a reliable process to issue your built files. A common operation is to release two versions of a library/component: one for development purposes and one to be consumed in production code, usually minified. In this recipe, you will tweak the official template to release both a minified and a development JavaScript file at the same time.

## Getting ready

This recipe makes sense if you are already building and distributing your own components. If you want to learn more, I suggest you refer to the *Bundling your component with Webpack* recipe.

## How to do it...

We'll start with a project with the official Webpack template. You can use your own, or you can spin up a new project with `vue init webpack` and install the dependencies with `npm install`.

Go inside the `build` directory. When you launch the `npm run build` command, you are effectively launching the `build.js` file in this directory.

If you examine the file, you will find something like this near the end:

```
webpack(webpackConfig, function (err, stats) {  
  ...  
})
```

This is equivalent to launching Webpack from the command line using the same configuration specified in the first argument, `webpackConfig`. To have a minified and non-minified file, we have to bring the `webpackConfig` to a common denominator, then we will specify only the differences between the development and production versions of the files.

To do this, go inside `webpack.prod.conf.js` in the same directory. Here, you can see the configuration we are passing; in particular, you will find `UglifyJsPlugin`, which is responsible for minifying the file if you look at the plugin array. Remove the plugin since it represents the main difference between the two distributions.

Now, write the following in `build.js` before the Webpack command:

```
const configs = [
  {
    plugins: [
      new webpack.optimize.UglifyJsPlugin({
        compress: {
          warnings: false
        },
        sourceMap: true
      })
    ]
  },
  {
    plugins: []
  }
]
```

You now have an array with two different configurations, one with the plugin required to minify the file and one without it. If you merge each of them with the configuration inside the `webpack.prod.conf.js`, you will obtain a different result.

To merge the two configurations, we will use the `webpack-merge` package. Add the following line to the top of the file:

```
var merge = require('webpack-merge')
```

Then, modify the first line of the Webpack command to the following:

```
configs.map(c => webpack(merge(webpackConfig, c)), function (err, stats) {
  ...
})
```

This will launch as many different merged configurations as we specify in the `configs` array.

You can launch the `npm run build` command now, but the problem is that the files will have the same name. Cut the `output` property from the `webpack.prod.conf.js` and paste it in the `config` array, which should now look like this:

```
const configs = [
  {
    output: {
      path: <whatever is your path>,
      filename: 'myFilename.min.js'),
      <other options you may have>
    },
    plugins: [
      ...
    ]
}
```

```
new webpack.optimize.UglifyJsPlugin({
  compress: {
    warnings: false
  }
})
]
},
{
  output: {
    path: <whatever is your path>,
    filename: 'myFilename.js'),
    <other options you may have>
  },
  plugins: []
}
]
```

If you build your project now, you will have both a minified and a development file. You can, of course, personalize your configurations to grow very different. For example, you can add source maps in one and leave the other as is.

## How it works...

We first created an array of objects that represent differences in the Webpack configuration. We then mapped each piece of configuration into a larger, common configuration with the help of `webpack-merge`. When we now call the `npm run build` command, both the configurations run one after the other.

It's a common convention to postfix the name of the file with `min` to signal that the file is minified and ready to be used in production.

## Releasing your components to the public

At a certain point, there comes a moment when you want to give back to the community. Maybe you built a "fart button" or maybe you built an automates stock options trader; whatever it is that you've built, the JavaScript and Vue community will be happy to welcome you. There is a big chunk of things to be done on the side of marketing and licensing, but in this recipe you will concentrate on the more technical aspects.

## Getting ready

This recipe is directed at those who want to share their work in Vue with the rest of the community. In the *Bundling your component with Webpack* recipe, you will find how to tweak the official Webpack template to bundle your component correctly; this recipe can be thought of as a second part. We will not use the official template though.

## How to do it...

The approach I will take for this recipe is to use the excellent `vue-share-components` template by *Guillaume Chau*. We'll build a joke button from that starting point.

In your command line, create a new directory and type the following command inside it:

```
vue init Akryum/vue-share-components
```

It will ask you some questions; you can copy the responses from the following image. The only thing to note is that you (sadly) cannot use the `joke-button` name for your project because I have already registered it while writing this recipe. However, you can come up with a similar sounding name (you may want to check whether the name is available in the npm registry before moving ahead):

```
▶ vue init Akryum/vue-share-components

? Generate project in current directory? Yes
? Plugin name joke-button
? Library name for browser usage JokeButton
? Plugin description A button to display jokes
? Initial version 0.0.1
? Author Andrea Passaglia <gurghet@gmail.com>
? GitHub Account gurghet
? Pick a css language css

vue-cli · Generated "8.9".

To get started:

  cd 8.9
  npm install
  npm run dev
```

Once the project is created, you can install the dependencies with `npm install`, just as in the console output.

Inside the project, let's create the joke button component. Inside the `components` folder, you will find a `Test.vue` component; rename it to `JokeButton.vue` and make it look like the following code:

```
<template>
<div class="test">
  <button @click="newJoke">New Joke</button>
  <p>{{joke}}</p>
</div>
</template>
<script>
const jokes = [
  'Chuck Norris/'s keyboard has the Any key.',
  'Chuck Norris can win at solitaire with only 18 cards.',
  'Chuck Norris/' first job was as a paperboy. There were no survivors.',
  'When Chuck Norris break the build, you can't fix it.',
]
export default {
  name: 'joke-button',
  data () {
    return {
      joke: '...',
    }
  },
  methods: {
    newJoke () {
      this.joke = jokes[Math.floor(Math.random() * jokes.length)]
    },
  },
}
</script>
```

Obviously, you can create the component you prefer; this is just an example.

In the `index.js` file, you will see the `Test` component imported and installed; you will need to install the `JokeButton` instead. The lines you need to change are highlighted:

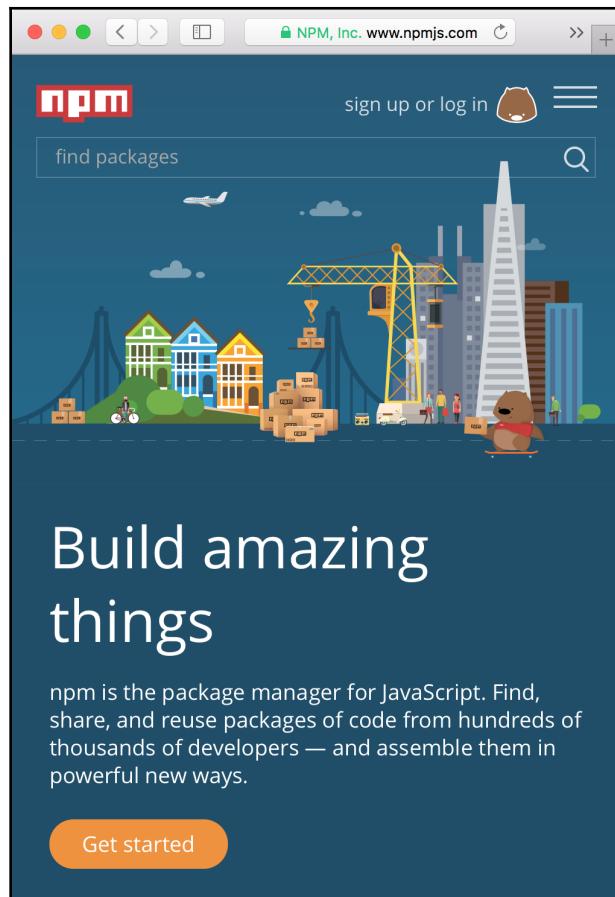
```
import JokeButton from './components/JokeButton.vue'
// Install the components
export function install (Vue) {
  Vue.component('jokeButton', JokeButton)
  /* -- Add more components here -- */
}
// Expose the components
```

```
export {  
  JokeButton,  
  /* -- Add more components here -- */  
}  
...
```

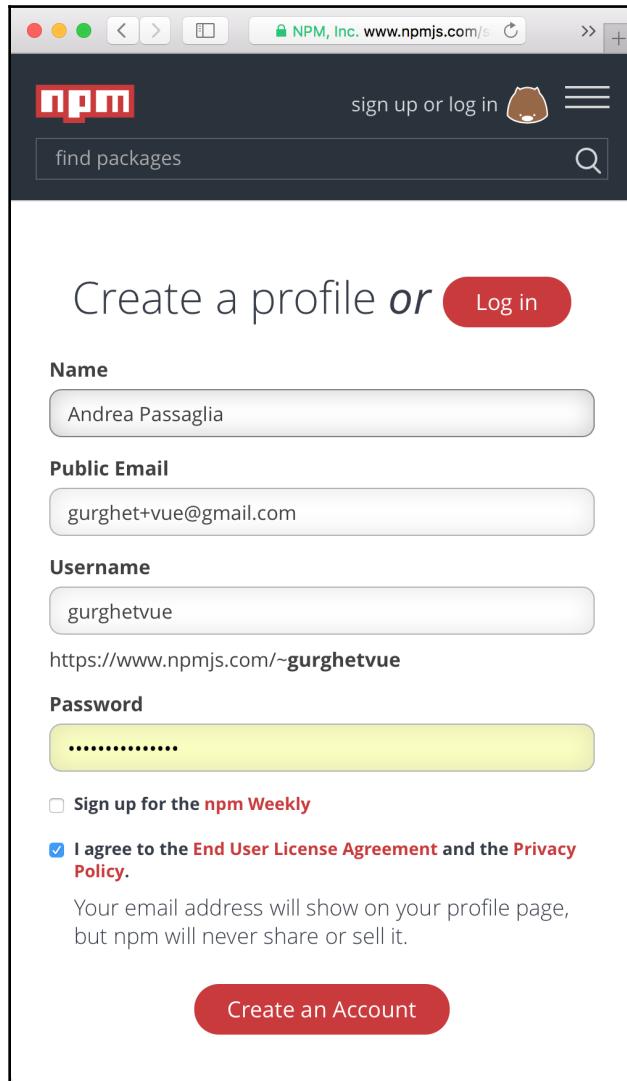
Our component is ready!

Now you have to go to the npm website to register for an account (if you don't have one already).

Go to [npmjs.com](https://www.npmjs.com):



Click on **sign up** and enter your details, like I did here:



Of course, you can subscribe to the npm weekly newsletter if you like.

Once registered, you're done and can come back to the command line. You must log in to the npm registry from the terminal with the following command:

```
npm adduser
```

You will see something like this:

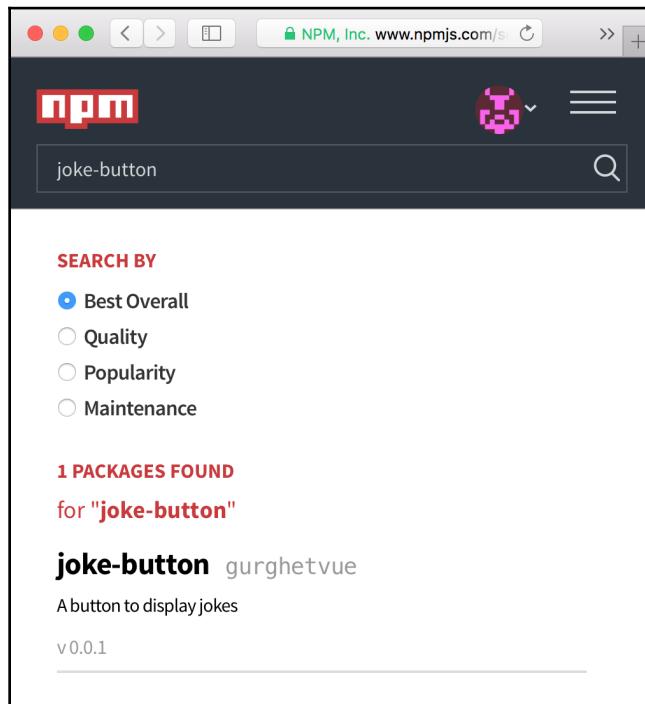
```
▶ npm adduser
Username: gurghetvue
Password:
Email: (this IS public) gurghet+vue@gmail.com
Logged in as gurghetvue on https://registry.npmjs.org/.
```

You will have to enter the password you just entered for the npm website.

The next command will publish your library in the public repository:

```
npm publish
```

Now you can even look up your package and, sure enough, you will find it as shown in the following screenshot:



To try it, you can find the instructions in your own README, how cool is that?

## How it works...

The vue-share-components is simpler than the official template, so it's a good way to learn by examining it.

The first thing we can take a look at is the package.json file. The following lines are relevant:

```
...
"main": "dist/joke-button.common.js",
"unpkg": "dist/joke-button.browser.js",
"module": "index.js",
"scripts": {
  "dev": "cross-env NODE_ENV=development webpack --config config/webpack.config.dev.js --progress --watch",
  "build": "npm run build:browser && npm run build:common",
  "build:browser": "cross-env NODE_ENV=production webpack --config config/webpack.config.browser.js --progress --hide-modules",
  "build:common": "cross-env NODE_ENV=production webpack --config config/webpack.config.common.js --progress --hide-modules",
  "prepublish": "npm run build"
},
...
```

The main property is what we actually get when we write the following command in our programs:

```
import JokeButton from 'JokeButton'
```

Alternatively, we get it when we add the following code:

```
var JokeButton = require("JokeButton")
```

So, the JokeButton variable will actually contain what is exported in our joke-button.common.js.

You can edit the main property of `package.json` to point directly to a `.vue` component. This way, you give the user the responsibility to compile the component. While this is more work for the user, it also helps when one wants the freedom to compile against the most recent version of Vue.



In the latter case, if you have some logic of your component exported in `external.js` files (like in the first recipe of this chapter), always remember to add the directory in the Webpack rules, like so:

```
{  
  test: /\.js$/,
  loader: 'babel-loader',
  include: [resolve('src'), resolve('test'),
  resolve('node_modules/myComponent')]  
},
```

The `unpkg` is particular of `unpkg.com`, which is a CDN. This is very nice because as soon as we publish our project, we will have our script published at `https://unpkg.com/joke-button`, and it will point to the `joke-button.browser.js` file that is suited for the browser.

The `prepublish` script is a special script that will be called before publishing the project to npm with the `npm publish` command. This eliminates the possibility that you forget to build the files before publishing your component (it happened to me many times, so I was forced to increase the version of the software artificially, build the files manually, and publish again).

Another interesting fact to note is the difference between `webpack.config.common.js`, which outputs the `joke-button.common.js` file, and `webpack.config.browser.js`, which outputs the `joke-button.browser.js` file.

The first file has the output set to the following:

```
output: {  
  path: './dist',  
  filename: outputFile + '.common.js',  
  libraryTarget: 'commonjs2',  
},  
target: 'node',
```

So, it will output a library that will expose a commonJS interface; this is tailored for non-browser environments, and you will have to require or import this library to use it. On the other hand, the second file for the browser has the following output:

```
output: {
  path: './dist',
  filename: outputFile + '.browser.js',
  library: globalName,
  libraryTarget: 'umd',
},
```

A UMD will expose itself in a global scope, no need to import anything, so it's perfect for the browser because we can include the file in a Vue webpage and use the component freely. This is also possible, thanks to the `index.js` auto-install feature:

```
/* -- Plugin definition & Auto-install -- */
/* You shouldn't have to modify the code below */
// Plugin
const plugin = {
  /* eslint-disable no-undef */
  version: VERSION,
  install,
}
export default plugin
// Auto-install
let GlobalVue = null
if (typeof window !== 'undefined') {
  GlobalVue = window.Vue
} else if (typeof global !== 'undefined') {
  GlobalVue = global.Vue
}
if (GlobalVue) {
  GlobalVue.use(plugin)
}
```

What this code is doing is packaging the `install` function (which registers the component(s) with Vue) inside the `plugin` constant and exporting it in the meantime. Then, it checks whether there is either `window` or `global` defined, in that case, it gets hold of the `Vue` variable that represents the Vue library and uses the plugin API to install the component(s).

# 17

# Advanced Vue.js - Directives, Plugins, and Render Functions

In this chapter, we will talk about the following topics:

- Creating a new directive
- Using WebSockets in Vue
- Writing a plugin for Vue
- Rendering a simple component manually
- Rendering a component with children
- Using JSX to render a component
- Creating a functional component
- Building a responsive table with higher-order components

## Introduction

Directives and plugins are ways to package functionality in a reusable way and also make it easily shareable across apps and teams; you will build a few of them in this chapter. Render functions are how Vue really works under the hood to turn templates into the Vue language and then into HTML and JavaScript again; they become useful if you need to optimize the performance of your apps and work in some corner cases.

In general, you should avoid using these advanced functions when possible as they have been a little overused in the past. Usually, many problems can be solved by simply writing a good component and distributing the component itself; you should look at advanced features only when this is not true.

This chapter is for the slightly more experienced, and you probably won't find the level of step-by-step detail found in other recipes, but I have strived to make them complete nonetheless.

## Creating a new directive

Directives are like mini functions that you can use to quickly drop into your code, mainly to improve the user experience, and to add new low-level features to your graphic interface.

### Getting ready

This recipe, although found in the advanced chapter, is really easy to complete. The main reason directives are *advanced* is because you should usually prefer composition to add functionality and style to your apps. When components won't cut it, use directives.

### How to do it...

We will build a v-pony directive that will turn any element into a pony element. A pony element is created with a pink background and changes color when you click on it.

The HTML code for the pony element is as follows:

```
<div id="app">
  <p v-pony>I'm a pony paragraph!</p>
  <code v-pony>Pony code</code>
  <blockquote>Normal quote</blockquote>
  <blockquote v-pony>I'm a pony quote</blockquote>
</div>
```

Just to show the difference, I've included a normal `blockquote` element. In our JavaScript section, write the following:

```
Vue.directive('pony', {
  bind (el) {
    el.style.backgroundColor = 'hotpink'
  }
})
```

This is how you declare a new directive. The `bind` hook is called when the directive is bound to the element. The only thing we are doing now is setting the background color. We also want to make it change color after each click. To do this, you have to add this code:

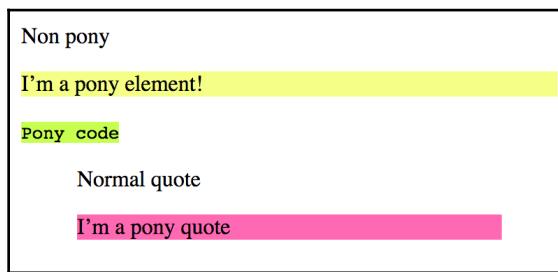
```
Vue.directive('pony', {
  bind (el) {
    el.style.backgroundColor = 'hotpink'
    el.onclick = () => {
      const colGen = () =>
        Math.round(Math.random()*255 + 25)
      const cols =
        [colGen() + 100, colGen(), colGen()]
      const randRGB =
        `rgb(${cols[0]}, ${cols[1]}, ${cols[2]})`
      el.style.backgroundColor = randRGB
    }
  }
})
```

Here, we are creating an `onclick` listener that will generate a random color with a bias toward red and assign it as a new background color.

At the end of our JavaScript, remember to create a `Vue` instance:

```
new Vue({
  el: '#app'
})
```

You can launch your application to see your directive in action:



Don't forget to click on the text to change the background color!

## How it works...

The syntax to declare a new directive is as illustrated:

```
Vue.directive(<name: String>, {  
  // hooks  
})
```

This will register a new global directive. Inside the hooks object, you can define two important functions: `bind`, which you used in this recipe, and `update`, which is triggered every time a component contained in it is updated.

Every hook function is called with at least three arguments:

- `el`: The HTML element
- `binding`: Directives can receive an argument; `binding` is an object that will contain the value of the argument
- `vnode`: the Vue internal representation of this element

We used the `el` parameter to edit the appearance of our element, manipulating it directly.

## Using WebSockets in Vue

WebSockets is a new technology that enables two-way communication between the user and the server where the app is hosted. Before this technology, only the browser could initiate a request and, thus, a connection. If some update on the page was expected, the browser had to continuously poll the server. With WebSockets, this is no longer necessary; after the connection is established, the server can send updates only when there is a need.

## Getting ready

You don't need any preparation for this recipe, just the basics of Vue. If you don't know what WebSockets are, you don't really need to, just think about them as a channel of continuous two-way communication between a server and browser.

## How to do it...

For this recipe, we need a server and a browser that will act a client. We will not build a server; instead, we'll use an already existing server that just echoes whatever you send to it via WebSockets. So, if we were to send the `Hello` message, the server would respond with `Hello`.

You will build a chat app that will talk to this server. Write the following HTML code:

```
<div id="app">
  <h1>Welcome</h1>
  <pre>{{chat}}</pre>
  <input v-model="message" @keyup.enter="send">
</div>
```

The `<pre>` tag will help us render a chat. As we don't need the `<br/>` element to break a line, we can just use the `n` special character that means a new line.

For our chat to work, we first have to declare our WebSocket in the JavaScript:

```
const ws = new WebSocket('ws://echo.websocket.org')
```

After that, we declare our Vue instance that will contain a `chat` string (to contain the chat so far) and a `message` string (to contain the message we are currently writing):

```
new Vue({
  el: '#app',
  data: {
    chat: '',
    message: ''
  }
})
```

We still need to define the `send` method, which is called upon pressing `Enter` in the textbox:

```
new Vue({
  el: '#app',
  data: {
    chat: '',
    message: ''
  },
  methods: {
    send () {
      this.appendToChat(this.message)
      ws.send(this.message)
      this.message = ''
    }
},
```

```
    appendToChat (text) {
      this.chat += text + '\n'
    }
  }
}
```

We factored out the `appendToChat` method because we will use it to append all the messages we'll receive. To do this, we must wait for the component to be instantiated. The created hook is a safe place for that:

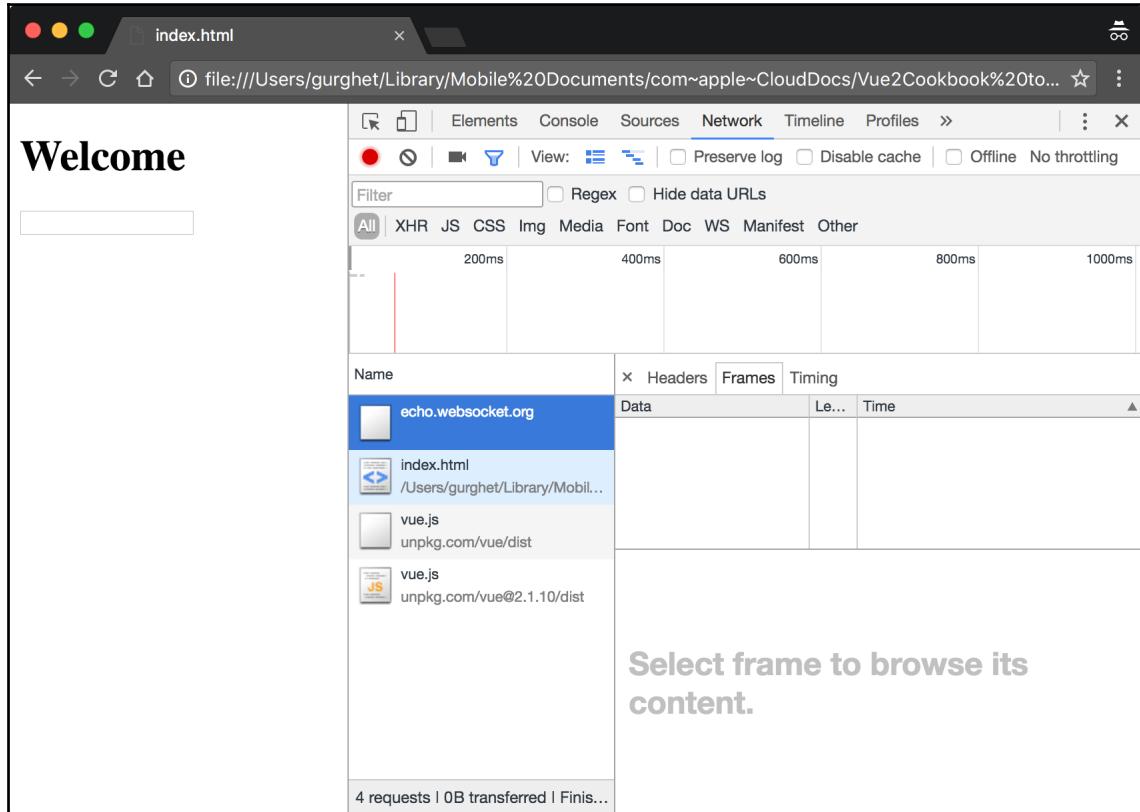
```
...
created () {
  ws.onmessage = event => {
    this.appendToChat(event.data)
  }
}
...
```

Now launch the application to chat with your personal echo chamber:

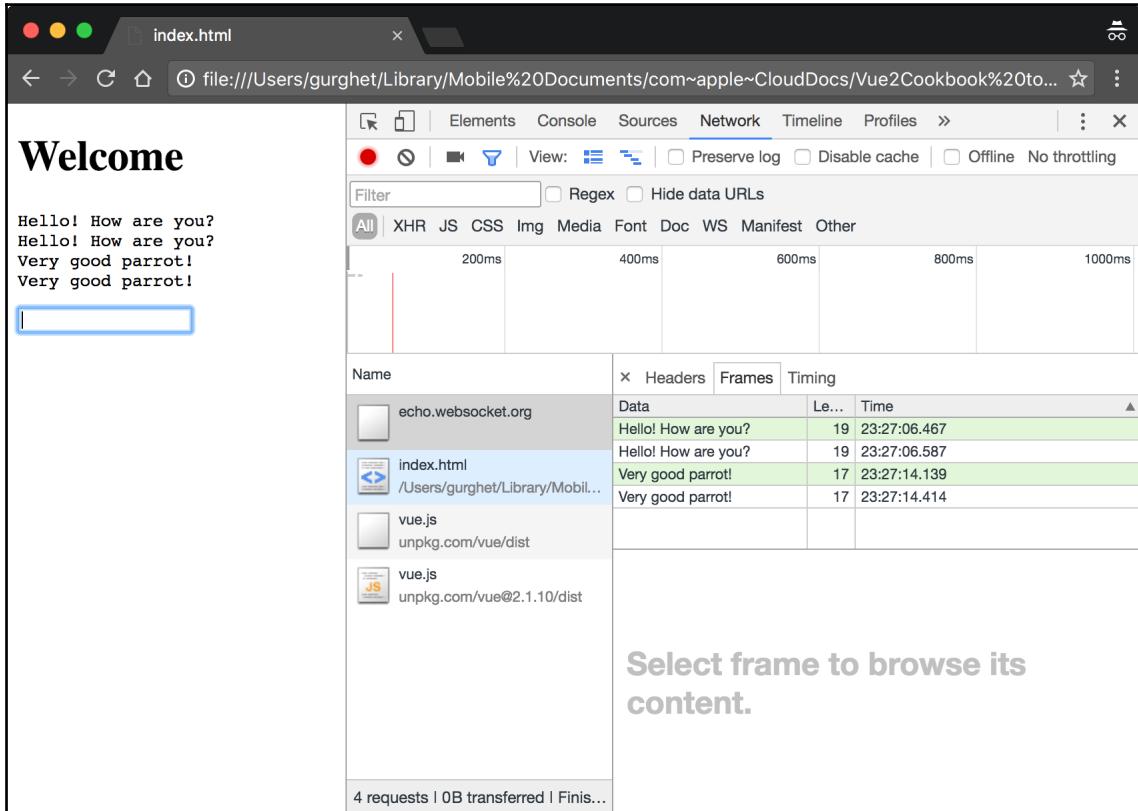


## How it works...

To see the internals of what you have built, open the Chrome developer tools (⋮ | More tools | Developer tools or *Opt + Cmd + I*):



Go to the **Network** tab and reload the page; you should see the `echo.websocket.org` WebSocket, as seen in the screenshot. Write something and messages will appear in the frame tab, like so:



The green messages are sent from you while the white messages are the ones you receive. You can also examine the message length (in bytes) and the exact time they were sent or received.

# Writing a plugin for Vue

A plugin is a collection of utilities or a global new behavior that we want in our application. Vuex and vue-router are two famous examples of Vue plugins. A plugin can really be anything, since writing one means acting at a very low level. There are different kinds of plugins you can write. For this recipe, we will concentrate on building a directive with global properties.

## Getting ready

This recipe will be based on *Creating a new directive*, except that we will add some features for global coordination.

## How to do it...

For this recipe, we will build a website for a kangaroo appreciation club. The layout of the home page HTML looks like this:

```
<div id="app">
  <h1>Welcome to the Kangaroo club</h1>
  
  
  
  <p>We love kangaroos</p>
</div>
```

You can change the link to the images of kangaroos with the one you prefer.

In the JavaScript part, we instantiate an empty `Vue` instance for now:

```
new Vue({
  el: '#app'
})
```

If we open the page now, we get this:



Now we want to add a fun note to our website. We want the elements of the page, except the title, to jump at random intervals.

To do this, the strategy you will implement is to register all the elements that will need to jump in an array, and then, periodically take a random element and make it jump.

The first thing we need to define is the jump animation in CSS:

```
@keyframes generateJump {
  20%{transform: translateY(0);}
  40%{transform: translateY(-30px);}
  50%{transform: translateY(0);}
  60%{transform: translateY(-15px);}
  80%{transform: translateY(0);}
}
.kangaroo {
  animation: generateJump 1.5s ease 0s 2 normal;
}
```

What this does is create a class named `kangaroo` that, when applied to an element, makes it jump twice by translating it along the y axis.

Next, write a function that adds this class to a specified element in the JavaScript:

```
const jump = el => {
  el.classList.add('kangaroo')
  el.addEventListener('animationend', () => {
    el.classList.remove('kangaroo')
  })
}
```

The `jump` function adds the `kangaroo` class and then removes it when the animation is finished.

We want to perform this action on a random element picked from the ones registered:

```
const doOnRandomElement = (action, collection) => {
  if (collection.length === 0) {
    return
  }
  const el =
    collection[Math.floor(Math.random() * collection.length)]
  action(el)
}
```

The `doOnRandomElement` function takes an action and a collection and applies the action to a drawn element. We then need to schedule it at random intervals:

```
const atRandomIntervals = action => {
  setTimeout(() => {
    action()
    atRandomIntervals(action)
  }, Math.round(Math.random() * 6000))
}
```

The `atRandomIntervals` function takes the specified function and calls it at random intervals shorter than 6 seconds.

We now have all the functions we need to actually build a plugin that will make our element jump:

```
const Kangaroo = {
  install (vueInstance) {
    vueInstance.kangaroos = []
    vueInstance.directive('kangaroo', {
      bind (el) {
        vueInstance.kangaroos.push(el)
      }
    })
    atRandomIntervals(() =>
      doOnRandomElement(jump, vueInstance.kangaroos))
  }
}
```

The Kangaroo plugin, when installed, creates an empty array; it declares a new directive, `kangaroo` which will register all the elements with it inside the array.

Then at random intervals, one random element is drawn from the array and the `jump` function is called on it.

To activate the plugin, we need one line before declaring the `Vue` instance (but after declaring `Kangaroo`):

```
Vue.use(Kangaroo)
new Vue({
  el: '#app'
})
```

We have to choose the elements that jump, that is, everything except the title:

```
<div id="app">
  <h1>Welcome to the Kangaroo club</h1>
  
  
  
  <p v-kangaroo>We love kangaroos</p>
</div>
```

If you run your app now, you will see that an image or the text jumps just like a kangaroo every few seconds.

## How it works...

In its essence, a Vue plugin is just a way to group some functionalities. There are not many restrictions and all you have to do to create a plugin is to declare an `install` function. The general syntax to do that is as follows:

```
MyPlugin.install = (vueInstance, option) => {
  // ...
}
```

To use the plugin you just made, write the following:

```
Vue.use(MyPlugin, { /* any option you need */ })
```

Here, the second parameter is the optional object that gets passed to the `install` function.

Since plugins are global entities, you should use them sparsely and only for features that you foresee will affect your app throughout.

## Rendering a simple component manually

Vue turns your HTML templates into render functions. Usually, you should stick to templates because they are much simpler. There are a couple of cases in which render functions become handy. Here, we show a simple example in which render functions are useful.

## Getting ready

This is the first recipe on render functions. If you already understand the basics of Vue, you will understand everything.

## How to do it...

The first use case for render functions is whenever you just want a `Vue` instance that displays another component.

Write an empty HTML layout, as follows:

```
<div id="app"></div>
```

We have a `Greeter` component somewhere that we want to show as the main `Vue` instance. In the JavaScript part, add the following code:

```
const Greeter = {
  template: '<p>Hello World</p>'
}
```

Here, we have to imagine that we are taking the `Greeter` component from somewhere else and, since the component is nicely packaged, we don't want to modify it. Instead, we will pass it to the `Vue` main instance:

```
const Greeter = {
  template: '<p>Hello World</p>'
}
new Vue({
  el: '#app',
  render: h => h(Greeter)
})
```

If we launch the application now, we will only see the `Greeter` component. The main `Vue` instance will only act as a wrapper.

## How it works...

The render function replaces the template in the `Vue` instance. When render is called, the passed argument is the so-called `createElement` function. We named it `h` for brevity. This function accepts three arguments, but for now, just note how the first argument we are passing (the only one we are passing) is the `Greeter` component.



In theory, you can write the component inline, inside the `h` function. In a real project, this is not always possible depending on the presence of the Vue template compiler at runtime. When you use the official Webpack template, one of the questions you are asked is whether you want to include the Vue template compiler when distributing your software.

The arguments for the `createElement` function are listed here:

1. As the first argument, the only required one, you have the option to pass three different things:
  - The options of a Vue component, like in our recipe
  - A string representing an HTML tag (such as `div`, `h1`, and `p`)
  - A function that returns an options object for a Vue component or a string representing an HTML tag
2. The second argument must be an object called **Data Object**. This object is explained in the next recipe.
3. The third argument is an array or a string:
  - The array represents a list of elements, text, or components to put inside the component
  - You can write a string that will be rendered to text

## Rendering a component with children

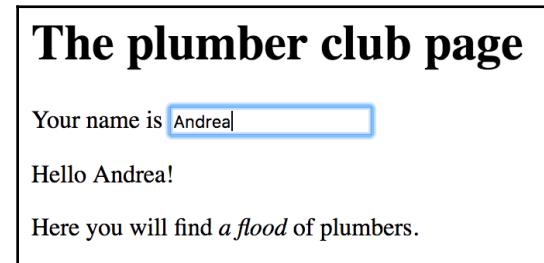
In this recipe, you will build a simple web page with a few elements and components completely using render functions. This will give you a close-up view of how Vue compiles your templates and components. It may be useful if you want to build an advanced component and you want a full example to kick start.

## Getting ready

This is a complete recipe on how to build components through render functions. Usually, you don't need to do this in practice; it's recommended only for advanced readers.

## How to do it...

You will build a page for a plumber club. The page will look like this:



Whenever we write a name inside the name textbox, it will be written in the greeting exactly like the `v-model` directive.

For this recipe, we are starting from the end instead of the beginning because usually when you have to resort to the `render` function, you have a pretty clear idea of what you are trying to get.

In the HTML side of our app, let's start with an empty tag:

```
<div id="app"></div>
```

In the JavaScript, write an empty `<div>` element in the `render` function:

```
new Vue({  
  el: '#app',  
  render: h => h('div')  
})
```

The first thing we'll put inside is the title, like so:

```
new Vue({  
  el: '#app',  
  render: h => h(  
    'div',  
    [  
      h('h1', 'The plumber club page')  
    ]  
  )  
})
```

All the other elements and components will fit inside the array we have just created for the title.

We need an `<input>` element that will take the value and display a greeting. For this, we can build a Vue component.

In the following code, we are using a regular JavaScript function instead of an arrow function; this is because we want a reference to the component itself. Arrow functions don't allow you to modify the scope of `this`, while `this` depends on how the function is called and can be optionally bound to any variable in regular functions. In our case, it will be bound to the instance component.

After the title of the page, we add the following component in the same array:

```
h(
  {
    render: function (h) {
      const self = this
      return h('div', [
        'Your name is ',
        h('input', {
          domProps: {
            value: self.name
          },
          on: {
            input (event) {
              self.name = event.target.value
            }
          }
        }),
        h(
          'p',
          'Hello ' + self.name +
          (self.exclamation ? '!' : ''))
      ])
    },
    data () { return { name: '' } },
    props: ['exclamation']
  },
  {
    props: {
      exclamation: true
    }
  }
)
```

The component has three options: the `render`, `data`, and `props` functions.

The second parameter of the `createElement` function is to actually assign values to our `props`:

```
{  
  props: {  
    exclamation: true  
  }  
}
```

This will be equivalent to writing `:exclamation="true"` when declaring the component.

You can easily understand the `data` and `props` options of the component. Let's examine what we wrote in the `render` function.

In the first line of the function, we set `self = this` as a convenient way to refer to the component where we add any nested functions. Then, we return the result of a `createElement` function (`h`) that, inside a `div` tag, places three things in the DOM. The first is the raw text `Your name is` and then two elements: an input and a paragraph.

We don't have a direct equivalent of the `v-model` directive when working with render functions. Instead, we implement it manually. We bind the value to the `name`, and then we add a listener to the `input` event that will set the value of the state variable, `name`, to whatever is inside the textbox.

We then insert a paragraph element that will compose the greeting phrase, adding an exclamation point based on the value of the `exclamation` prop.

After the component, we can add the following, as illustrated, in the same array:

```
'Here you will find ', h('i', 'a flood'), 'of plumbers.'
```

If you have done things right, you should be able to run the application and see the whole page.

## How it works...

In this example, we've seen a glimpse of what happens behind the curtains when Vue compiles our templates; again, you are not advised to do this with regular components. Most of the time, the result will be just more verbose with little or no gain. On the other hand, there are a couple of cases in which writing the render function may actually result in better or more robust code and cover some functionality that is difficult to express with templates.

# Using JSX to render a component

JSX is very popular in the React community. In Vue, you don't have to use JSX to build templates for your components; you can use the much more familiar HTML. JSX, however, is the next best thing you can do if you are forced to write a lot of render functions.

## Getting ready

Before venturing into this recipe, you better play a little with the render function. The previous recipes provide some exercises.

## How to do it...

JSX needs a Babel plugin to work. For this recipe, I will assume that you are working within the webpack template.

To install the babel plugin, you can run the following command:

```
npm install
  babel-plugin-syntax-jsx
  babel-plugin-transform-vue-jsx
  babel-helper-vue-jsx-merge-props
  --save-dev
```

Inside the `.babelrc` file, add the following in the `plugins` array:

```
"plugins": [
  ...
  "transform-vue-jsx"
]
```

Run `npm install`, as usual, to actually install all the dependencies.

Now, open the `main.js` and delete everything inside. Replace it with the following code:

```
import Vue from 'vue'

/* eslint-disable no-new */
new Vue({
  el: '#app',
  render (h) {
    return <div>{this.msg}</div>
  },
  data: {
```

```
        msg: 'Hello World'  
    }  
})
```

The highlighted line is the weird bit if you have never seen JSX. Just note that we didn't use the arrow function in the `render` option in the preceding code. That's because we are using `this` inside and we want it to be bound to the component.

You can already see your page working using the `npm run dev` command.

## How it works...

The babel plugin will turn the JSX code into a JavaScript `render` function.

I wouldn't recommend using JSX with Vue. The only time I can see it being useful is whenever you need to intermix `render` functions with JavaScript and you need a quick and readable way of defining templates. Other than that, there are not many advantages to using JSX.

## There's more...

Let's complicate the code a little bit to at least have a flavor of how JSX plays with props.

Define a new component before the main `Vue` instance:

```
const myComp = {  
  render (h) {  
    return <p>{this.myProp}</p>  
  },  
  props: ['myProp']  
}
```

Let's use this component in our `Vue` instance and pass the `msg` variable via props:

```
new Vue({  
  el: '#app',  
  render (h) {  
    return <div>  
      <myComp myProp={this.msg}/>  
    </div>  
  },  
  data: {  
    msg: 'Hello World'  
  },
```

```
components: {  
    myComp  
}  
})
```

The syntax is slightly different from an HTML template. In particular, note how props are passed and how we can use camelCase and self-closing tags.

## Creating a functional component

A lighter version of a component is a functional component. The functional component doesn't have instance variables (so no `this`) and has no state. In this recipe, we will write a simple functional component that takes some instructions via HTML and turns them into a drawing.

### Getting ready

Before attempting this recipe, you should at least become familiar with the render function in Vue. You can use the previous recipes to do that.

### How to do it...

When you are writing an `<svg>` element, you usually have to put data in the attributes of elements inside it to actually draw shapes. For example, if you want to draw a triangle, you have to write the following:

```
<svg>  
  <path d="M 100 30 L 200 30 L 150 120 z"/>  
</svg>
```

The text inside the `d` attribute is a series of instructions that make a virtual cursor move to draw: `M` moves the cursor to the (100, 30) coordinate inside the `<svg>`, then `L` traces a line up until (200, 30) and then again to the (150, 120) coordinate. Finally, `z` closes the path we are drawing, and the result is always a triangle.

We would like to write a triangle with a component, but we don't like attributes and we want to write in our own language, so we would write the following to get the same result:

```
<orange-line>
  moveTo 100 30 traceLine 200 30 traceLine 150 120 closePath
</orange-line>
```

This is a perfect job for a functional component because there is no state to manage, only a translation from one component to one element.

Your HTML layout will simply look like this:

```
<div id="app">
  <orange-line>
    moveTo 100 30 traceLine 200 30 traceLine 150 120 closePath
  </orange-line>
</div>
```

Then, lay out your functional component in your JavaScript:

```
const OrangeLine = {
  functional: true,
  render (h, context) {
    return h('svg',
      []
    )
  }
}
```

You have to specify that the component will be functional with `functional: true`; then the render function is slightly different than usual. The first argument is still the `createElement` function, but the second passed is the context of our component.

We can access the text written inside the HTML of our component (the commands to draw) through `context.children`.

You can see that I already added an empty `<svg>` element. Inside this, there is an empty array of children; we will put only the `<path>` element there, which is as follows:

```
render (h, context) {
  return h('svg',
    [
      h('path', {
        attrs: {
          d: context.children.map(c => {
            return c.text
              .replace(/moveTo/g, 'M')
        })
      })
    ]
  )
}
```

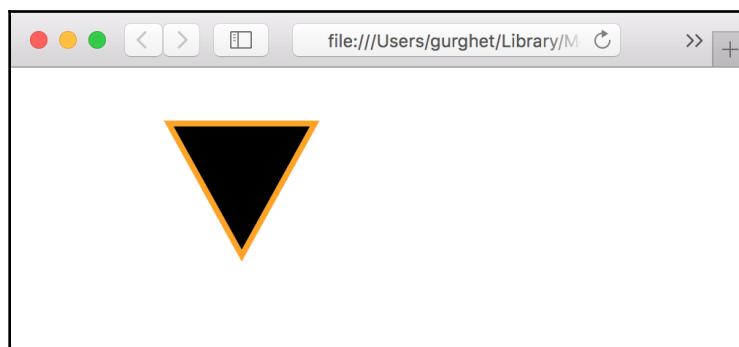
```
        .replace(/traceLine/g, 'L')
        .replace(/closePath/g, 'z')
    }).join(' ').trim(),
    fill: 'black',
    stroke: 'orange',
    'stroke-width': '4'
}
})
]
)
}
```

The highlighted code creates a path element and then sets some attributes, such as `fill` and `stroke`. The `d` attribute takes the text from inside the component, makes some substitutions, and then returns it.

We just need to create the Vue instance in the JavaScript:

```
new Vue({
  el: '#app',
  components: {
    OrangeLine
  }
})
```

Now, loading the app, we should see a triangle, which is shown in the following screenshot:



## How it works...

Vue lets you create components that are very lightweight as they don't have any internal state. With this come some limitations, for example, the only place where we can put some logic to process user input (in the form of children of the element or props) is in the render function.

The context we passed contains the following properties:

- `props`: This is passed by the user.
- `children`: This is really an array of virtual nodes, children of our component in the template. We don't have the actual HTML element here but only a representation of it by Vue.
- `slots`: This is a function returning the slots (can be used instead of children in some cases).
- `data`: This is the entire data object passed to the component.
- `parent`: This is a reference to the parent component.

In our code, we extracted the text inside the component by doing the following:

```
context.children.map(c => {
  return c.text
  .replace(/moveTo/g, 'M')
  .replace(/traceLine/g, 'L')
  .replace(/closePath/g, 'z')
}).join(' ').trim()
```

We are taking the array of virtual nodes contained in `children` and mapping each node to its text. Since we put only some text in our HTML, the array of nodes will be a singleton, with only one node: the text we entered. Therefore, in this particular case, doing `var a = children.map(c => someFunction(c))` is then equivalent of doing `var a = [someFunction(children[0])]`.

We are not only extracting the text though, but we are also replacing some terms I invented to describe `svg` commands, with the real commands. The `join` function will sew together all the strings in the array (just one in our case) and `trim` will remove all the white spaces and line breaks.

# Building a responsive table with higher-order components

Functional components are very good wrappers when we have to decide which component to actually wrap. In this recipe, you'll write a responsive table that will display different columns depending on the browser width.

## Getting ready

This recipe is about functional components. If you want to warm up, you can try and complete the previous recipe.

## How to do it...

For this recipe, we will use the excellent semantic UI CSS framework. To use it, you have to include the CSS library as a dependency or as a `<link>` tag. For example, you can put the following code in the `<head>` of your HTML:

```
<link rel="stylesheet"
  href="https://cdnjs.cloudflare.com/ajax/libs/semantic-ui/2.2.7/semantic.css"
  />
```

If you are using JSFiddle, the link inside should be sufficient.

Another tag you have to add to your page for it to look good on mobile is this:

```
<meta name="viewport" content="width=device-width">
```

This tells the mobile browser that the width of the page is equal to the width of the device. If you don't put this, the mobile may assume that the page is much larger than the phone and, trying to display all of it, show a miniaturized version of your app.

We will design a table of cat breeds. You can see all the data in the Vue instance status. Write it in your JavaScript:

```
new Vue({
  el: '#app',
  data: {
    width: document.body.clientWidth,
    breeds: [
      { name: 'Persian', colour: 'orange', affection: 3, shedding: 5 },
      { name: 'Siberian', colour: 'blue', affection: 5, shedding: 4 },
```

```
        { name: 'Bombay', colour: 'black', affection: 4, shedding: 2 }
    ],
},
created() {
    window.onresize = event => {
        this.width = document.body.clientWidth
    }
},
components: {
    BreedTable
}
})
})
```

We are declaring the `width` variable to change the layout of the page and since the `width` of the page is not reactive by nature, we're also installing a listener on `window.onresize`. For a real project, you'll probably want something a bit more sophisticated, but for this recipe, this will suffice.

Also, note how we are using the `BreedTable` component, which we write like this:

```
const BreedTable = {
    functional: true,
    render(h, context) {
        if (context.parent.width > 400) {
            return h(DesktopTable, context.data, context.children)
        } else {
            return h(MobileTable, context.data, context.children)
        }
    }
}
```

What our component is doing is just passing all the `context.data` and `context.children` to another component, which will be `DesktopTable` or `MobileTable`, depending on the resolution.

Our HTML layout is the following:

```
<div id="app">
    <h1>Breeds</h1>
    <breed-table :breeds="breeds"></breed-table>
</div>
```

The `breeds` props will be passed on to the selected component in the `context.data`.

Our desktop table will look pretty regular for a table:

```
const DesktopTable = {
  template: `
    <table class="ui celled table unstackable">
      <thead>
        <tr>
          <th>Breed</th>
          <th>Coat Colour</th>
          <th>Level of Affection</th>
          <th>Level of Shedding</th>
        </tr>
      </thead>
      <tbody>
        <tr v-for="breed in breeds">
          <td>{{breed.name}}</td>
          <td>{{breed.colour}}</td>
          <td>{{breed.affection}}</td>
          <td>{{breed.shedding}}</td>
        </tr>
      </tbody>
    </table>
  `,
  props: ['breeds']
}
```

The classes at the top are part of semantic UI and they will make our table look much better. The `unstackable` class, in particular, disables the automatic stacking performed by CSS. We will cover more on this in the next section.

For the mobile table, we'd like to edit not only the styling, but we'd also like to group the columns themselves. The breed will go along with the color and the affection with the shedding. Also, we want to express them in a compact style. The table head will look like this:

```
const MobileTable = {
  template: `
    <table class="ui celled table unstackable">
      <thead>
        <tr>
          <th>Breed</th>
          <th>Affection & Shedding</th>
        </tr>
      </thead>
    ...
```

Instead of just spelling the coat color, we draw a little circle of that color:

```
...
<tbody>
  <tr v-for="breed in breeds">
    <td>{{breed.name}}
      <div
        class="ui mini circular image"
        :style="'height:35px;background-color:'+breed.colour"
      ></div>
    </td>
  ...

```

Also, instead of using numbers like in the desktop table for the affection and shedding level, we put a heart and star rating:

```
...
<td>
  <div class="ui heart rating">
    <i
      v-for="n in 5"
      class="icon"
      :class="{ active: n <= breed.affection }"
    ></i>
  </div>
  <div class="ui star rating">
    <i
      v-for="n in 5"
      class="icon"
      :class="{ active: n <= breed.shedding }"
    ></i>
  </div>
</td>
</tr>
</tbody>
</table>
```

Also, don't forget to declare the `breeds` prop like in the `DesktopTable` component.

Now launch your application in a browser. You can see how the table groups the column when squished enough:

Breed	Coat Colour	Level of Affection	Level of Shedding
Persian	orange	3	5
Siberian	blue	5	4
Bombay	black	4	2

The following screenshot shows that numbers are replaced by hearts and star rating:

Breed	Affection & Shedding
Persian	● ● ● ● ● ★ ★ ★ ★
Siberian	● ● ● ● ● ★ ★ ★ ★
Bombay	● ● ● ● ● ★ ★ ★ ★

## How it works...

A responsive page changes its layout according to the width of the browser and this is very important when the user is using a tablet or smartphone to browse the website.

Most of the components have to be developed only once for a responsive page, and only the styling is done multiple times according to different sizes. This can save a lot of development time if compared to having a separate site optimized for mobile.

Normally, in a responsive page table, go from columnar to stacked, as shown in the following illustration:



The diagram illustrates a transformation in table layout. On the left, a columnar table is shown with four rows. Each row contains an employee's name, their department, and their score. On the right, a stacked table is shown, where the columns are collapsed, and the data is stacked vertically. A large grey arrow points from the columnar table to the stacked table.

Employee	Correct Guesses
Lena Human Resources	22
Matthew Fabric Design	15
Lindsay Entertainment	12
Mark Executive	11

Employee	Correct Guesses
Lena Human Resources	22
Matthew Fabric Design	15
Lindsay Entertainment	12
Mark Executive	11

I never liked this approach, but the objective disadvantage is that if you make your table look good on one side, it will look not so good on the other. This is because you have to style the cells in the same way and what the responsiveness does is that it stacks them up.

What our `BreedTable` component does is to dynamically switch between the two components instead of simply relying on the CSS. Since it's a functional component, it has the advantage of being very lightweight compared to a full-fledged component.

In a real application, using the `onresize` event is questionable, mainly because of the performance hit. In a production system, the solutions for responsiveness via JavaScript need to be more structured. For example, consider using a timer or using `matchMedia`.

As a last thing, note how the Vue instance never registers the two subcomponents; this is because they never appear in a template but are referenced directly in the code as objects.

# 18

# Large Application Patterns with Vuex

In this chapter, we'll cover the following recipes:

- Dynamically loading pages in your vue-router
- Building a simple storage for the application state
- Understanding Vuex mutations
- Listing your actions in Vuex
- Separating concerns with modules
- Building getters to help retrieve your data
- Testing your store

## Introduction

In this chapter, you will learn how Vuex works and how to use it to support a scalable application. Vuex implements a pattern that is popular in frontend frameworks and consists of dividing the different concerns to manage a big global application state. The mutations are the only things that can change the state, so you have only one place to look for that. Much of the logic, along with all the asynchronous logic, is contained in the actions; finally, getters and modules further help to spread the cognitive load when it comes to computing the derived state and splitting your code into different files.

Along with recipes, you will find grains of wisdom that I found useful when developing real large applications; some have to do with naming conventions and others with little tricks to avoid bugs.

If you complete all the recipes, you will be ready to develop big frontend applications with fewer bugs and seamless collaboration.

# Dynamically loading pages in your vue-router

Soon, you will build huge Vue websites with loads of components. Loading a lot of JavaScript may generate wasteful and useless upfront delay.

## Getting ready

This recipe requires knowledge of vue-router.

## How to do it...

Create a new project with `vue-cli` by making a new directory and running the following command:

```
vue init webpack
```

You can answer the question as you prefer, as long as you add the `vue-router` to the template when asked.

We will create two components: one will be our home page and it will be small and light, the other component will be very big and very slow to load. What we want to achieve is to load the home page immediately, without having to wait for the huge component to be downloaded by the browser.

Open the `Hello.vue` file in the `components` folder. Delete everything and only leave the following:

```
<template>
<div>
  Lightweight hello
</div>
</template>
```

In the same folder, create another file named `Massive.vue` and write the following inside it:

```
<template>
<div>
  Massive hello
</div>
</template>
```

```
<script>
/* eslint-disable no-unused-vars */
const a = `
```

Leave an open back tick at the last line because we have to bloat the file with a lot of useless data. Save and close `Massive.vue`.

In a console, go to the same directory where the file is stored and use the following file to put a lot of garbage into it:

```
yes "XXX" | head -n $((10**6)) >> Massive.vue
```

What this command does is append the `XXX` line to the file repeatedly  $10^6$  times; this will add 4 million bytes to the file, making it too huge for a fast browsing experience.

Now we need to close the back tick we opened. Don't try to open the file now, as your text editor may not be capable of opening such a big file; instead, use the following command:

```
echo ``</script>' >> Massive.vue
```

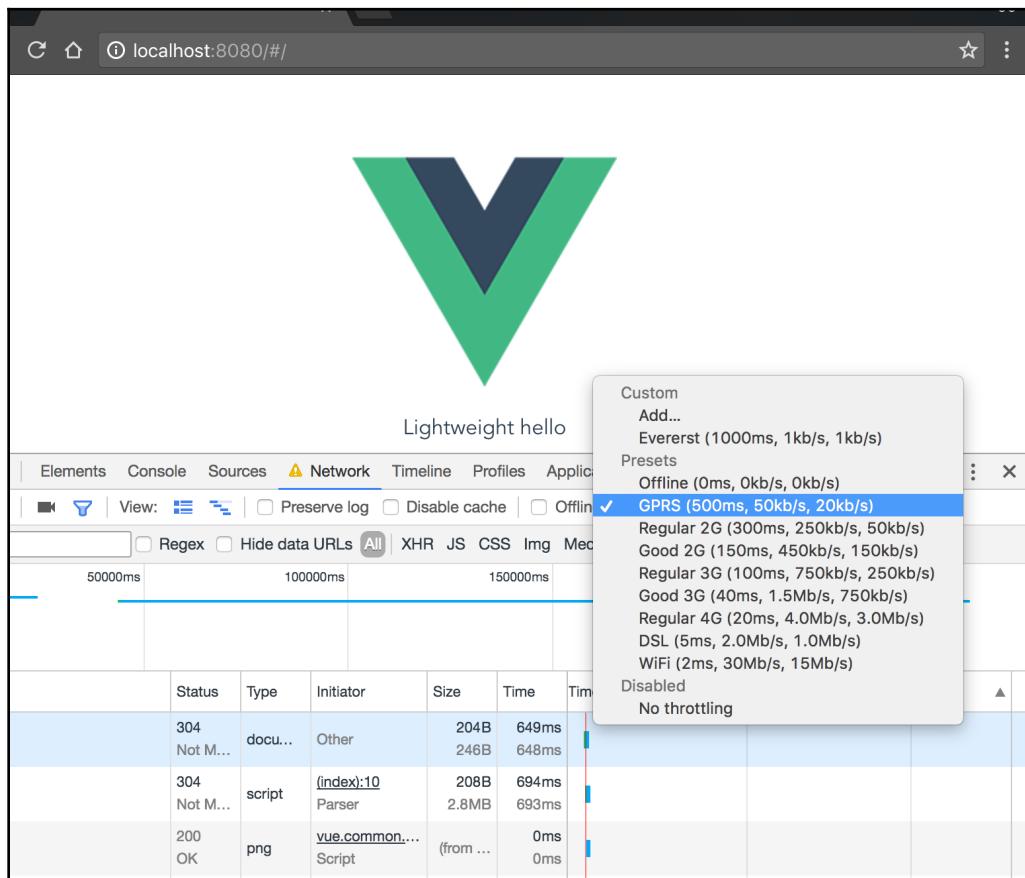
Our `Massive` component is now complete.

Open the `index.js` inside the `router` folder and add the component and its route:

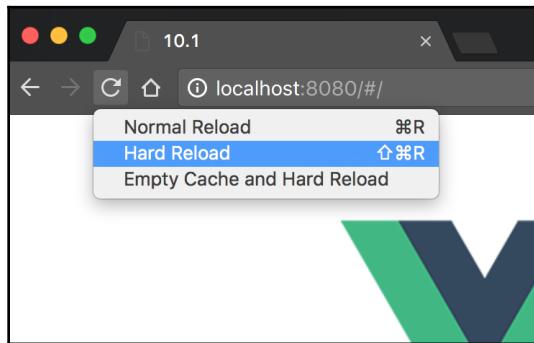
```
import Massive from '@/components/Massive'
...
export default new Router({
  routes: [
    {
      path: '/',
      name: 'Hello',
      component: Hello
    },
    {
      path: '/massive',
      name: 'Massive',
      component: Massive
    }
  ]
})
```

After installing all the dependencies with `npm install`, we are now ready to launch our very large app with the `npm run dev` command.

The app will load quite fast, but that's because it's loading directly from your local storage; to simulate a more realistic scenario, open the developer tools at the **Network** tab and select network throttling. Pick something slow, such as GPRS or maybe good 3G, which most of us may have:



Now right-click on the refresh button and select **Hard Reload** to bypass the cache (or press *Shift + Cmd + R*):



You will notice that the page doesn't load for a few minutes. You can stop the loading of the page by clicking on the refresh button again when it becomes an X.

To fix this, go back to the `index.js` file in the `router` folder. Delete the following line, where you import the `Massive` component:

```
import Massive from '@/components/Massive'
```

The preceding line is telling Webpack to include all the code contained in the `Massive` component in a single js bundle. Instead, we want to tell Webpack to keep the `Massive` component as a separate bundle and to load it only when necessary.

Instead of directly importing the component, declare `Massive` with the following code:

```
const Massive = resolve =>
  require(['../components/Massive.vue'], resolve)
```

Webpack will turn this special syntax into a separate file that will be loaded lazily. Save and do another hard refresh with the throttling still set to slow speed (like GPRS to good 3G). After a few seconds, you should be able to see the hello page. If you want to load the `Massive` component, just add `massive` to the URL, but you'll be in for some waiting.

## How it works...

Now you obviously won't have such a big component in a real application, but you can easily see that if the `Massive` component represents all the other components of your app, they can quickly amount to such a big size.

The trick here is to load them asynchronously; Webpack will help you separate them into smaller bundles so that they will be loaded only if and when required.

## There's more...

There is an alternative syntax to import components lazily. It may become an ECMA standard in the future, so you should be aware of it. Open `index.js` inside the `router` directory and completely remove the import of the `Massive` component or the `Massive` constant line we added in this recipe.

Inside the routes, try the following when specifying the component for the `/massive` route:

```
routes: [
  {
    path: '/',
    name: 'Hello',
    component: Hello
  },
  {
    path: '/massive',
    name: 'Massive',
    component: import('@/components/Massive')
  }
]
```

This will be equivalent to what we have done before because Webpack will take the line and instead of directly importing the code of the `Massive` component, it will create a different `js` file, loaded lazily.

## Building a simple storage for the application state

In this recipe, you will understand the fundamentals of Vuex when building a big application. This recipe is a little unorthodox because to understand how Vuex's store work, we will manipulate it directly; you should never do that in a real application.

## Getting ready

Before trying this recipe, you should know how to make components talk with Vuex.

## How to do it...

Create a new project based on the Webpack template with the following command run in a new directory:

```
vue init webpack
```

How you answer the question is not relevant. Run `npm install` and install Vuex with `npm install vuex --save` or `yarn add vuex` if you use yarn.

Open the `main.js` file inside the `src` folder and add the following highlighted lines to finish installing Vuex:

```
import Vue from 'vue'  
import App from './App'  
import router from './router'  
import store from './store'  
  
/* eslint-disable no-new */  
new Vue({  
  el: '#app',  
  router,  
  store,  
  template: '<App/>',  
  components: { App }  
})
```

Of course, there is no `store` module right now, so you need to create one. To do this, create a folder just under the `src` folder and call it `store`. Inside it, create a file named `index.js`. In the `main.js` file, we didn't specify to use the `index.js` file, but that's the default behavior when no file is specified but only the folder.

What we will implement is a simplified stock market. We have three assets: stars (STAR), lamps (LAMP), and diamonds (DIAM). We will define two routes: one for the STAR/LAMP market and another for the LAMP/DIAM market.

Inside the `index.js` file in the `store` folder, write the following:

```
import Vue from 'vue'  
import Vuex from 'vuex'  
Vue.use(Vuex)  
const store = new Vuex.Store({  
  state: {  
    STAR: 100,  
    LAMP: 100,  
    DIAM: 100,
```

```

        rate: {
          STAR: {
            LAMP: 2
          },
          LAMP: {
            DIAM: 0.5
          }
        }
      })
    }
  )
}

export default store

```

We are creating a new Vuex store that will hold our balance. Initially, we have 100 of each asset; in the store, the exchange rate between stars and lamps and between lamps and diamonds is also fixed.

Create a new component under the `components` directory, named `Market.vue`. It will have the following template:

```

<template>
  <div class="market">
    <h2>{{symbol1}}/{{symbol2}} Stock Exchange</h2>
    <div class="buy-sell">
      <input v-model.number="amount">{{symbol1}}
      <button @click="buy">
        Buy for {{rate*amount}} {{symbol2}}
      </button>
      <button @click="sell">
        Sell for {{rate*amount}} {{symbol2}}
      </button>
    </div>
  </div>
</template>

```

`symbol1` and `symbol2` represent the two assets traded. In the JavaScript of this component, where we define the `sell` and `buy` methods, we operate directly on the global Vuex store:

```

<script>
export default {
  name: 'market',
  data () {
    return {
      amount: 0
    }
  },
  computed: {
    rate () {

```

```
        return this.$store.state.rate[this.symbol1][this.symbol2]
    }
},
props: ['symbol1', 'symbol2'],
methods: {
    buy () {
        this.$store.state[this.symbol1] += this.amount
        this.$store.state[this.symbol2] -= this.amount * this.rate
    },
    sell () {
        this.$store.state[this.symbol1] -= this.amount
        this.$store.state[this.symbol2] += this.amount * this.rate
    }
}
</script>
```



You should never touch the state directly like I've done here. You should always use mutations. Here, we are skipping the middleman to keep the recipe minimalistic. There's more on mutations in the next recipe.

You have to use this component in `index.js`, inside the `router` folder, in the following way:

```
import Vue from 'vue'
import Router from 'vue-router'
import Market from '@/components/Market'
Vue.use(Router)
export default new Router({
  routes: [
    {
      path: '/',
      redirect: '/STAR/LAMP'
    },
    {
      path: '/:symbol1/:symbol2',
      component: Market,
      props: true
    }
  ]
})
```

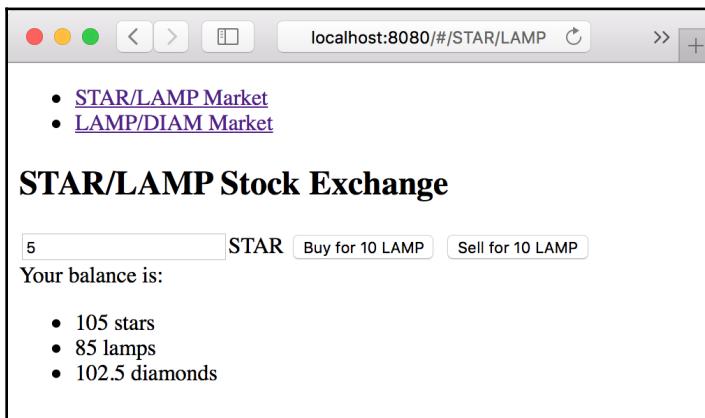
In the preceding code, we are using the `Market` component for any route that contains a couple of trade symbols. As a home page, we are using the STAR/LAMP market.

To display some navigation links to a different market and our current balance, we can edit the `App.vue` component with the following template:

```
<template>
  <div id="app">
    <nav>
      <ul>
        <li>
          <router-link to="/STAR/LAMP">STAR/LAMP Market</router-link>
        </li><li>
          <router-link to="/LAMP/DIAM">LAMP/DIAM Market</router-link>
        </li>
      </ul>
    </nav>
    <router-view></router-view>
    <div class="balance">
      Your balance is:
      <ul>
        <li>{$store.state.STAR} stars</li>
        <li>{$store.state.LAMP} lamps</li>
        <li>{$store.state.DIAM} diamonds</li>
      </ul>
    </div>
  </div>
</template>
```

We don't need any JavaScript for this component, so you can delete the `<script>` tag.

Our app is now ready; launch it and start trading with it. The following image is our completed app without the styles contained in `App.vue`:



## How it works...

The balance in the bottom is like a summary of the global state. With Vuex, we were able to affect other components by accessing the `$store` variable that gets injected into every component by the Vuex plugin. You can easily imagine how to use this strategy in a big application when you want to basically expand the scope of a variable beyond the component itself.

Some of the states may be local, for example, if you need some animations or you need some variables to show modal dialogs for the component; it's perfectly okay to not put these values in the store. Otherwise, having a structured centralized state in one place helps a lot. In the subsequent recipes, you'll use more advanced techniques to exploit the power of Vuex better.

## Understanding Vuex mutations

The proper way to mutate the state in a Vuex application is with the help of mutations. Mutations are a very useful abstraction to decompose state changes in the atomic unit. In this recipe, we will explore just that.

### Getting ready

This recipe can be completed without knowing too much about Vuex, but completing the previous recipe first is suggested.

### How to do it...

Add Vuex as a dependency to your project (the CDN address is <https://unpkg.com/vuex>). I will assume that you are using JSFiddle to follow along; otherwise, just remember to put `Vue.use(Vuex)` before the store code.

The sample application we will build is to broadcast notifications to the users of the website.

The HTML layout looks as shown:

```
<div id="app">
  <div v-for="(message, index) in messages">
    <p style="cursor:pointer">{{message}}
      <span @click="close(index)">[x]</span>
    </p>
  </div>
  <input v-model="newMessage" @keyup.enter="broadcast">
  <button @click="broadcast">Broadcast</button>
</div>
```

The idea is to have a textbox to write messages and the broadcasted messages will be displayed on the top with the most recent appearing first. The messages can be dismissed by clicking on the little x.

First, let's build a store that will hold the list of broadcasted messages and enumerate the possible mutations we can make to said list:

```
const store = new Vuex.Store({
  state: {
    messages: []
  },
  mutations: {
    pushMessage (state, message) {
      state.messages.push(message)
    },
    removeMessage (state, index) {
      state.messages.splice(index, 1)
    }
  }
})
```

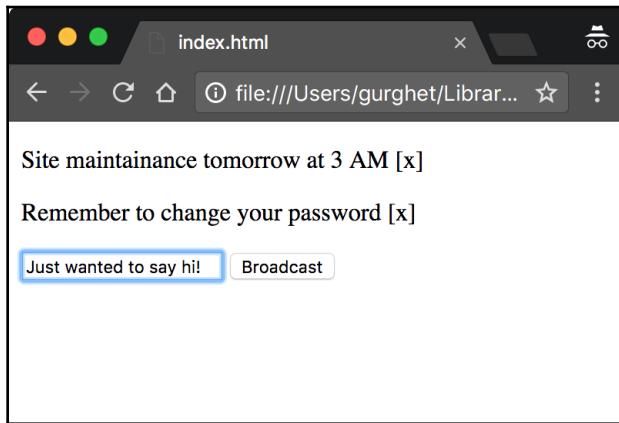
So, we have a list of messages; we can push one to the top of the list or we can remove a message by knowing its index.

Next, we need to write the logic of the application itself:

```
new Vue({
  store,
  el: '#app',
  data: {
    newMessage: ''
  },
  computed: Vuex.mapState(['messages']),
  methods: {
    broadcast () {
      store.commit('pushMessage', this.newMessage)
```

```
        this.newMessage = ''  
    },  
    close (index) {  
        store.commit('removeMessage', index)  
    }  
})  
})
```

You can now launch the app and start broadcasting messages to our imaginary users:



## How it works...

I think it's important to note the names of the mutations; they are called `pushMessage` and `removeMessage`, but what they really do in this application is show the message in a stack on the screen and (fictionally) broadcast messages to users. Would it be better to call them `showMessage`, or `broadcastMessage` and `hideMessage`? No, that's because there has to be a clear separation of intent between the mutation itself and the particular effects of that mutation. The problem becomes clear when, for example, we decide to give users the ability to ignore these notifications or we introduce a delay before actually broadcasting the notifications. Then we will have a `showMessage` mutation that does not actually show a message.

The computed syntax we have used is as illustrated:

```
computed: Vuex.mapState(['messages'])
```



You don't have to explicitly use Vuex in your expression when you are importing Vuex as an ES6 module. You just need to write `import { mapState } from 'Vuex'`. Then, the `mapState` function will be available.

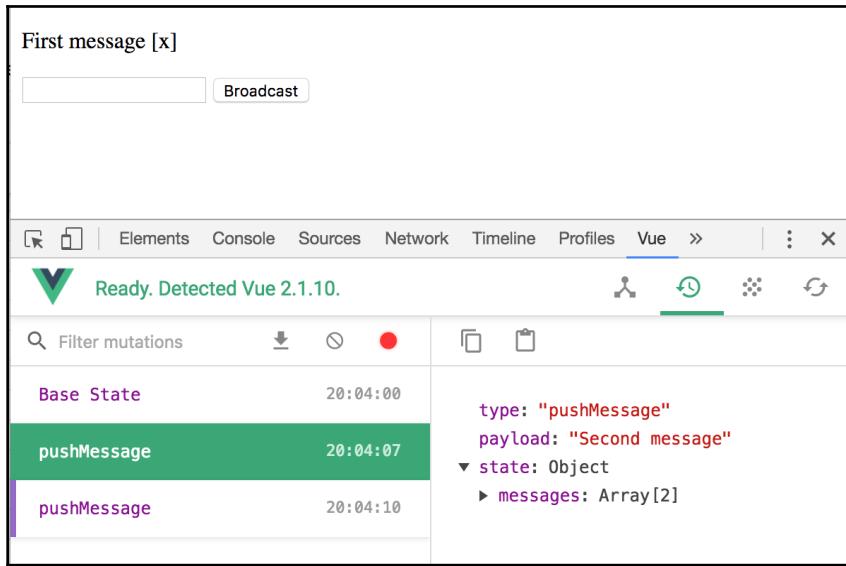
The `mapState` method takes an array of strings as a parameter, looks for a `state` variable in the store with the same name as the string, and creates a computed property with the same name. You can do this with as many variables as you want.

## There's more...

If you followed along on a local npm project, open the Vue developer tools (unfortunately Vue developer tools is not available when using JSFiddle) and you will see that a new mutation is issued with each message. Consider that you click on the little clock:

The screenshot shows the Vue DevTools interface. At the top, there are two input fields: "First message [x]" and "Second message [x]", with a "Broadcast" button. Below this is a toolbar with icons for Elements, Console, Sources, Network, Timeline, Profiles, and Vue. The Vue tab is selected. The main area is the Timeline tab, which displays a list of mutations. A mutation named "pushMessage" is highlighted with a green background. The mutation details show it was triggered at 20:04:07 and has the following payload:  
type: "pushMessage"  
payload: "Second message"  
state: Object  
The "Time Travel to This State" button is visible next to the mutation details.

You can actually undo the mutation with that, as shown in the following illustration:



Note how the state didn't change when clicking the time travel option; that's because the purple ribbon is still at the last state. To examine a different state, just click on the name of the mutation itself.

This debug mechanism is possible because mutations are always synchronous; this means that it's possible to take a snapshot of the state before and after the mutation and navigate through time. In the next recipe, you will learn how to use Vuex to perform asynchronous actions.

## Listing your actions in Vuex

All your mutations must be synchronous, so how do you do things such as waiting for a timeout or using Axios for an AJAX request? Actions are the next level of abstraction that will help you with this. Inside an action, you can commit multiple mutations and make asynchronous operations.

## Getting ready

Mutations are the building blocks of actions, so it's highly suggested you complete the preceding recipe before trying this.

We will be using the setup from the *Building a simple storage for the application state* recipe; you can use your own as well, but in any case, this recipe is based on a slight modification of the official Webpack template.

## How to do it...

You will build a clone of the popular Xkcd website. Actually, it will be a wrapper more than a real clone, since we will reuse the panels from the website.

Create a Vue project based on the Webpack template with `vue init webpack`. The first thing we will do is wire up the API to the Xkcd website in the `index.js` inside the `config` folder. Put the following lines inside the `proxyTable` object:

```
module.exports = {
  ...
  dev: {
    proxyTable: {
      '/comic': {
        target: 'https://xkcd.com',
        changeOrigin: true,
        pathRewrite: (path, req) => {
          const num = path.split('/')[2]
          return `/ ${num}/info/0.json`
        }
      }
    },
  ...
}
```

This will redirect all the requests we make to `/comic` to the Xkcd website.

Inside `src`, make a new `store` directory and an `index.js` inside it; here, start building the application store:

```
import Vue from 'vue'
import Vuex from 'vuex'

Vue.use(Vuex)

const store = new Vuex.Store({
  state: {
```

```
        currentPanel: undefined,
        currentImg: undefined,
        errorStack: []
    },
    actions: {},
    mutations: {}
}

export default store
```

You should import this inside `main.js` like in previous recipes. We want to trace the current panel number, the link to the panel image, and the possible errors. The only way to modify the state is through mutations, while actions can perform asynchronous work.

When the app is loaded, we plan to display the latest comic. For this, we create an action:

```
actions: {
    goToLastPanel ({ commit }) {
        axios.get(endpoint)
            .then(({ data }) => {
                commit('setPanel', data.num)
                commit('setImg', data.img)
            })
            .catch(error => {
                commit('pushError', error)
            })
    }
}
...
```

For this code to work, we need to declare the endpoint and install Axios:

```
...
import axios from 'axios'
...
const endpoint = '/comic/'
```

It should be easy for you to write the corresponding mutations:

```
mutations: {
    setPanel (state, num) {
        state.currentPanel = num
    },
    setImg (state, img) {
        state.currentImg = img
    },
    pushError (state, error) {
        state.errorStack.push(error)
    }
}
```

We'll recycle the `Hello.vue` component and put the following template inside it:

```
<template>
<div class="hello">
  <h1>XKCD</h1>
  
</div>
</template>
```

To make the last panel appear on loading you can use the following JavaScript in the component:

```
<script>
import { mapState } from 'vuex'
export default {
  name: 'hello',
  computed: mapState(['currentImg']),
  created () {
    this.$store.dispatch('goToLastPanel')
  }
}
</script>
```

Also, you can delete most of the `App.vue` template and leave only the following:

```
<template>
<div id="app">
  <router-view></router-view>
</div>
</template>
```

## How it works...

The `proxyTable` object will configure the `http-proxy-middleware`. This is useful every time we are developing the UI of a bigger web application and we launch our developer server on `localhost`, but our API responds to another web server. This is especially relevant when we want to use CORS and we don't allow other websites to use our API. The `Xkcd` API doesn't allow `localhost` to consume the web service. This is why, even if we try to use the `Xkcd` API directly, our browser won't let us. The `changeOrigin` option will send the request with `Xkcd` as host, making CORS unnecessary.

To call an action from a component, we used the `dispatch` function. It's also possible to pass the second argument, the first being the name of the action itself. The second argument is then passed when you define the action as the second parameter.

A last note on the naming--it being implicit that actions are asynchronous while mutations are synchronous, there is no need, in my opinion, to make the asynchronicity in the name of the actions explicit.

## Separating concerns with modules

When building big applications, the Vuex store can become crowded. Luckily, it's possible to divide the different concerns of the applications into separate compartments with modules.

### Getting ready

This recipe can be a reference if you want to use modules. You are expected to already know enough about Vuex.

For this recipe, you will have to be a little familiar with Webpack.

### How to do it...

In this recipe, we will model a fully functional human body in a slightly simplified manner. Every organ will have a separate module.

Create a new Webpack template with `vue init webpack` and `npm install vuex`.

Create a new directory with the `src/store/index.js` file in it. Inside, write the following:

```
import Vue from 'vue'  
import Vuex from 'vuex'  
  
Vue.use(Vuex)  
  
const store = new Vuex.Store({  
  modules: {  
    brain,  
    heart  
  }  
})  
  
export default store
```

The heart module is like this; put it before the store declaration:

```
const heart = {
  state: { loves: undefined },
  mutations: {
    love (state, target) {
      state.loves = target
    },
    unlove (state) {
      state.loves = undefined
    }
  }
}
```

Note how the state passed inside the mutations is not the root state, but the local state of the module.

Then comes the brain, which is divided into the left and right lobes; write the following before the store:

```
const brain = {
  modules: {
    left: leftLobe,
    right: rightLobe
  }
}
```

You can implement them as simple Boolean states (write them before the brain on which they depend):

```
const leftLobe = {
  namespaced: true,
  state: { reason: true },
  mutations: {
    toggle (state) { state.reason = !state.reason }
  }
}
const rightLobe = {
  namespaced: true,
  state: { fantasy: true },
  mutations: {
    toggle (state) { state.fantasy = !state.fantasy }
  }
}
```

Setting `namespaced` to true modifies the way you can call the mutator. Since they are both called `toggle`, now you can specify which lobe, for example, for the left lobe the mutation string becomes `left/toggle`, where `left` says it is the key used in the brain to refer to the left lobe.

To see your store in action, you can create a component that uses all the mutations. For the brain, we can have two pictures of the lobes, like so:

```

```

This will create two drawings of brain lobes in red pencil; note the use of the name of the modules in a nested way. The following `off` CSS rule grays the lobes out:

```
.off {  
  filter: grayscale(100%);  
}
```

To call the mutations, we use the aforementioned strings in the right methods:

```
methods: {  
  left () {  
    this.$store.commit('left/toggle')  
  },  
  right () {  
    this.$store.commit('right/toggle')  
  }  
}
```

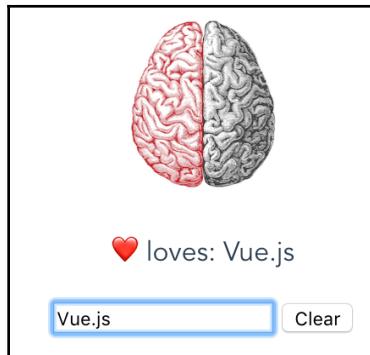
You can also create an input textbox and call the other two mutations, as follows:

```
...  
love () {  
  this.$store.commit('love', this.partner)  
},  
clear () {  
  this.$store.commit('unlove')  
  this.partner = undefined  
}  
...
```

This was very easy, but how do you retrieve the loved name? You can put these mustachios in your template:

```
<p>❤ loves: {{$store.state.heart.loves}}</p>
<input v-model="partner" @input="love">
<button @click="clear">Clear</button>
```

You obviously have to declare the partner variable on your Vue instance:



## How it works...

We have seen how to use modules to split your application concerns into different units. This ability may become important as the project grows in size.

The common pattern is that while inside a mutation, you have direct access to the local state:

```
const leftLobe = {
  namespaced: true,
  state: { reason: true },
  mutations: {
    toggle (state) {
      // here state is the left lobe state
      state.reason = !state.reason
    }
  }
}
```

In a mutation, it makes sense to have access only to the local state. The brain, for example, cannot change the heart and vice versa, but what about actions? If we declare an action inside a module, we are passed an object called context that looks like this:

```
{  
  "getters":{},  
  "state":{  
    "reason":true  
  },  
  "rootGetters":{},  
  "rootState":{  
    "brain":{  
      "left":{  
        "reason":true  
      },  
      "right":{  
        "fantasy":false  
      }  
    },  
    "heart":{  
      "loves": "Johnny Toast"  
    }  
  }  
}
```

So, if we want to declare an action in the left lobe and we want to affect the heart, we have to do something like the following:

```
actions: {  
  beNerd ({ rootState }) {  
    rootState.heart.loves = 'Math & Physics'  
  }  
}
```

## Building getters to help retrieve your data

You don't want to keep too much data in your state. It can be especially dangerous to keep duplicate or derivative data because it can be brought out of sync very easily. Getters help you with this without shifting the burden onto the components by keeping all the logic in one place.

## Getting ready

This recipe is for you if you already have some Vuex knowledge and want to expand your horizons.

## How to do it...

Imagine that you are building a Bitcoin wallet. You want to give your users an overview of their balance, and you want them to see how many Euros it corresponds to.

Create a new Webpack template with `vue init webpack` and `npm install vuex`.

Create a new `src/store/index.js` file and write the following inside it:

```
import Vue from 'vue'
import Vuex from 'vuex'

Vue.use(Vuex)

const store = new Vuex.Store({
  state: {
    bitcoin: 600,
    rate: 1000,
    euro: 600000
  }
})

export default store
```

This code is prone to errors. The first error can be a miscalculation of the Euro amount if we don't get the multiplication right. The second kind of error can be that we tell the user the `bitcoin` and `euro` balance during a transaction, resulting in a stale and wrong amount for one of the two.

To tackle these issues, we use getters:

```
const store = new Vuex.Store({
  state: {
    bitcoin: 600,
    rate: 1000
  },
  getters: {
    euro: state => state.bitcoin * state.rate
  }
})
```

This way the `euro` amount is never in the state but always computed. Moreover, it is centralized in the store, so we don't need to add anything to our components.

Now, it's easy to retrieve the two amounts from a template:

```
<template>
  <div>
    <h1>Balance</h1>
    <ul>
      <li>{$store.state.bitcoin}฿</li>
      <li>{$store.getters.euro}€</li>
    </ul>
  </div>
</template>
```

Here, `฿` is the HTML entity for the Bitcoin symbol.

## How it works...

Having a `getter` for derived data is always a good idea if we are not talking about input data. A notable feature of getters we have not yet discussed is their ability to interact with other getters and take an argument.

## Accessing other getters

The second argument passed to a getter when called is the object that contains the other getters:

```
getters: {
  ...
  getCatPictures: state => state.pictures.filter(pic => isCat(pic))
  getKittens: (state, getters) => {
    return getters.getCatPictures().filter(cat => !isAdult(cat))
  }
}
```

In our recipe, we could call the `euro` getter to have some more derived data, like roughly how many houses we can buy with our Bitcoin given an average price of 150,000 euros:

```
const store = new Vuex.Store({
  state: {
    bitcoin: 600,
    rate: 1000
  },
  getters: {
    euro: state => state.bitcoin * state.rate / 150000
  }
})
```

```
getters: {
  euro: state => state.bitcoin * state.rate,
  houses: (state, getters) => getters.euro() / 150000
})
```

## Passing an argument

If a getter returns a function with an argument, that argument will be the argument of the getter:

```
getters: {
  ...
  getWorldWonder: state => nth => state.worldWonders[nth]
}
```

In our recipe, a practical example could specify the average cost of a house in the getter from the previous paragraph:

```
const store = new Vuex.Store({
  state: {
    bitcoin: 600,
    rate: 1000
  },
  getters: {
    euro: state => state.bitcoin * state.rate,
    houses: (state, getters) => averageHousePrice => {
      return getters.euro() / averageHousePrice
    }
})
```

## Testing your store

In this recipe, you will write tests for a Vuex store.

## Getting ready

This recipe requires knowledge of Unit testing and End-To-End testing and little familiarity with Vuex.

## How to do it...

First, I'll define some features that our store must implement; then you will write tests that prove that the features are present and working.

## Software requirements

Our store consists of items in a to-do list, like the following:

```
state: {
  todo: [
    { id: 43, text: 'Buy iPhone', done: false },
    ...
  ],
  archived: [
    { id: 2, text: 'Buy gramophone', done: true },
    ...
  ]
}
```

We have two requirements:

- We must have an `MARK_ITEM_AS_DONE` mutation that changes the `done` field from `false` to `true`
- We must have a `downloadNew` action that downloads the latest items from our server and adds them to the list

## Testing mutations

To be able to test your mutations, you have to make them available for your test files. To do this, you have to extract the mutation object from your store. Consider something like this:

```
import Vuex from 'vuex'
import Vue from 'vue'

Vue.use(Vuex)

const store = new Vuex.Store({
  ...
  mutations: {
    ...
    MARK_ITEM_AS_DONE (state, itemId) {
      state.todo.filter(item => {
        return item.id === itemId
      })
    }
  }
})
```

```
        }) .forEach(item => {
          item.done = true
        })
      state.archived.filter(item => {
        return item.id === itemId
      }).forEach(item => {
        item.done = true
      })
    }
  }
}

export default store
```

You have to extract it to something similar to this:

```
export const mutations = { ... }

const store = new Vuex.Store({ ... })

export default store
```

This way, you can import the mutations in your test files with the following line:

```
import { mutations } from '@/store'
```

The test for requirement number 1 can be written as follows:

```
describe('mutations', () => {
  it(`MARK_ITEM_AS_DONE mutation must change the
     done field from false to true for a todo`, () => {
    const state = {
      todo: [
        { id: 43, text: 'Buy iPhone', done: false }
      ],
      archived: [
        { id: 40, text: 'Buy cat', done: false }
      ]
    }
    mutations.MARK_ITEM_AS_DONE(state, 43)
    expect(state.todo[0].done).toBe(true)
  })
})
```



If you are using the official Webpack template, you can run your tests with `npm run unit`. This uses PhantomJS by default, which doesn't implement some features. You can either use Babel polyfills or simply go into `karma.conf.js` and write `Chrome` instead of `PhantomJS` in the `browsers` array. Remember to install the Chrome launcher with `npm install karma-chrome-launcher --save-dev`.

## Testing actions

**Testing actions** means testing that the action commits the expected mutations. We are not interested in the mutations themselves (not in unit tests at least) because they are already tested separately. We might, though, need to mock some dependencies.

To avoid any dependencies from Vue or Vuex (since we don't need them and they may pollute the tests), we create a new `actions.js` file inside the `store` directory. Install Axios with `npm install axios`. The `actions.js` file can look like the following:

```
import axios from 'axios'

export const actions = {
  downloadNew ({ commit }) {
    axios.get('/myNewPosts')
      .then(({ data }) => {
        commit('ADD_ITEMS', data)
      })
  }
}
```

To test for requirement number 2, we start by mocking the call to the server that should download the new to-do items:

```
describe('actions', () => {
  const actionsInjector =
    require('inject-loader!@/store/actions')
  const buyHouseTodo = {
    id: 84,
    text: 'Buy house',
    done: true
  }
  const actions = actionsInjector({
    'axios': {
      get () {
        return new Promise(resolve => {
          resolve({
            data: [buyHouseTodo]
          })
        })
      }
    }
  })
  it('downloads new posts', () => {
    expect(actions.downloadNew).to.be.a('function')
    actions.downloadNew()
    expect(store.state.items.length).to.equal(1)
    expect(store.state.items[0].text).to.equal('Buy house')
  })
})
```

```
        })
    })
}
}).default
}
```

This will ensure that any call to the `get` method of `axios` will always return a new to-do item.

Then, we want to ensure that the `ADD_ITEMS` mutation is called upon dispatch:

```
describe('actions', () => {
  const actionsInjector =
    require('inject-loader!@/store/actions')
  const buyHouseTodo = {
    id: 84,
    text: 'Buy house',
    done: true
  }
  const actions = actionsInjector({
    'axios': {
      get () {
        return new Promise(resolve => {
          resolve({ data: [buyHouseTodo] })
        })
      }
    }
  }).default
  it(`downloadNew should commit ADD_ITEMS
  with the 'Buy house' todo when successful`, done => {
    const commit = (type, payload) => {
      try {
        expect(type).to.equal('ADD_ITEMS')
        expect(payload).to.deep.equal([buyHouseTodo])
        done()
      } catch (error) {
        done(error)
      }
    }
    actions.downloadNew({ commit })
  })
})
```

## How it works...

While the testing of the mutations is pretty straightforward, I think the testing of the actions deserves some more explaining.

Since we didn't want to depend on external services for actions, we had to mock the `axios` service. We used the `inject-loader`, which takes the original library and mocks the parts we specify with arbitrary code (the `@` symbol is a shorthand for `src`); in our case, we mocked the `axios` library and, precisely, the `get` method. We had to use the CommonJS syntax (with the `require`) because that's the only way to tell Webpack to use loaders in imports.

What we have done in the test is that we also mocked the `commit` function. Normally, this function calls a mutation that modifies the state. We just want to know if the correct mutation is called and with the right arguments. Moreover, we had to wrap everything in a `try` block; without it, the test would fail over a timeout and we'd lose the error. Instead, now we fail immediately and we can read, from the console, what error caused the test to fail.

# 19

# Integrating with Other Frameworks

In this chapter, we'll explore the following topics:

- Building universal applications with Electron
- Using Vue with Firebase
- Creating a real-time app with Feathers
- Creating a reactive app with Horizon

## Introduction

Vue is powerful, but if you need a backend, it can't do much alone; at a minimum you will need a server to deploy your software. In this section, you will actually build small, but complete and working, applications with popular frameworks. Electron is used to bring Vue apps to the desktop. Firebase is a modern cloud backend and, finally, FeatherJS is a minimalistic but full-featured JavaScript backend. When you are finished with these, you will have all the tools required to interact with them and quickly build professional applications.

## Building universal applications with Electron

Electron is a framework for creating universal applications that run on Mac, Linux, and Windows. At its core is a stripped down version of a web browser. It has been used to create widely used applications such as Slack and Visual Studio Code, among others. In this recipe, you'll build a simple app with Electron.

## Getting ready

To build this app, we will use only basic Vue functionalities. Electron is out of scope for this book, but for this recipe no knowledge of Electron is required; in fact, this is a good starting point to learn more about Electron.

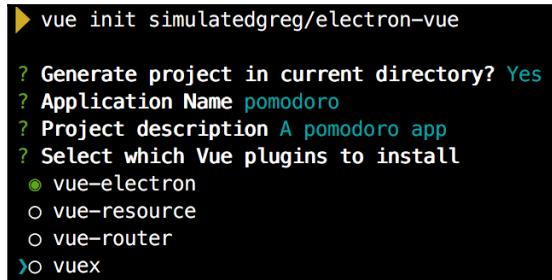
## How to do it...

In this recipe, we will build a small but complete app--a pomodoro application. A pomodoro is an interval of about 25 units of time, in which you should concentrate on doing work. It's called this because you usually use a tomato-shaped kitchen timer to measure that. This app will track the time instead, so you don't have to buy an expensive kitchen timer.

The best way to spin up a Vue project with Electron is to use the Electron-Vue boilerplate (you don't say!). This can be easily achieved with the following command:

```
vue init simulatedgreg/electron-vue pomodoro
```

You can answer with the default values, but when asked which plugin to install, just select vue-electron. Install all the dependencies with `npm intall` and, if you like, you can keep the application open with hot-reloading while you make the necessary modifications with `npm run dev`. You can hide the dev tools by just clicking on the *x* in the corner:



```
▶ vue init simulatedgreg/electron-vue
? Generate project in current directory? Yes
? Application Name pomodoro
? Project description A pomodoro app
? Select which Vue plugins to install
  ● vue-electron
  ○ vue-resource
  ○ vue-router
  >○ vuex
```

First of all, we want our app to be small-ish. Let's go to the `app/src/main/index.js` file; this file controls the life cycle of our application. Change the window size to the following:

```
mainWindow = new BrowserWindow({
  height: 200,
  width: 300
})
```

Then, we don't really want the boilerplate components in the `app/src/render/components` folder, so you can delete everything. Instead, create a `Pomodoro.vue` file and put this template inside:

```
<template>
<div class="pomodoro">
  <p>Time remaining: {{formattedTime}}</p>
  <button v-if="remainingTime === 1500" @click="start">Start</button>
  <button v-else @click="stop">Stop</button>
</div>
</template>
```

To make it work, we also have to write the JavaScript part, as follows:

```
<script>
export default {
  data () {
    return {
      remainingTime: 1500,
      timer: undefined
    }
  },
  methods: {
    start () {
      this.remainingTime -= 1
      this.timer = setInterval(() => {
        this.remainingTime -= 1
        if (this.remainingTime === 0) {
          clearInterval(this.timer)
        }
      }, 1000)
    },
    stop () {
      clearInterval(this.timer)
      this.remainingTime = 1500
    }
  }
}
</script>
```

This way, clicking on the start button in the program will subtract 1 second every second. Clicking on the stop button will clear the timer and reset the remaining time to 1500 seconds (25 minutes). The timer object is basically the result of the `setInterval` operation, and `clearInterval` just stops whatever the timer was doing.

In our template, we want a `formattedTime` method in the sense that we'd like to see the time in `mm:ss` format, which is much more human-readable than just the number of remaining seconds (even if that's more geeky), so we need to add the computed function:

```
computed: {
  formattedTime () {
    const pad = num => ('0' + num).substr(-2)
    const minutes = Math.floor(this.remainingTime / 60)
    const seconds = this.remainingTime - minutes * 60
    return `${minutes}:${pad(seconds)}`}
}
```

To add this component to the app, go to the `App.vue` file and edit the following lines, replacing the `landingPage` placeholder element:

```
<template>
  <div id="#app">
    <pomodoro></pomodoro>
  </div>
</template>

<script>
  import Pomodoro from 'components/Pomodoro'
  export default {
    components: {
      Pomodoro
    }
  }
</script>
```

Launching the app with `npm run dev`, you should now be able to track the time while working or studying:



You can even build a distributable version of the application with the `npm run build` command.

## How it works...

The way we implemented the timer is not particularly accurate for time tracking. Let's review the code:

```
this.timer = setInterval(() => {
  this.remainingTime -= 1
  if (this.remainingTime === 0) {
    clearInterval(this.timer)
  }
}, 1000)
```

This means that we decrease the remaining time every second. The problem is that the `setInterval` function itself is not 100% accurate and may fire the function a bit before or after 1000 milliseconds, depending on the machine's computational load; this way, the margin of error can accumulate and become a considerable amount. A better approach would be to check the clock every time the function gets called and adjust for the error at each loop, though we won't cover that here.

## Using Vue with Firebase

Using Vue with Firebase as a backend is very easy, thanks to `VueFire`--a plugin that contains bindings for Firebase. In this recipe, you will develop a fully functional database of smells.

## Getting ready

Firebase is out of the scope of this book, but I will assume, for this recipe, that you have a familiarity with the basic concepts. Except for this, there is really not much you need to know, as we will build a very basic Vue application on top of that.

## How to do it...

Before starting to write code, we need to create a new Firebase application. To do this, you have to log in at <https://firebase.google.com/> and create a new application. In our case, it will be called `smell-diary`. You will also need to take note of your API key, which is found in the project settings:

The screenshot shows the Firebase console interface. The top navigation bar has the 'smell-diary' project name. On the left, there's a sidebar with 'Overview', 'Analytics', 'DEVELOP', 'Authentication', 'Database', 'Storage', 'Hosting', 'Test Lab', and 'Crash Reporting'. The main area is titled 'Project settings' under 'smell-diary'. It includes tabs for 'CLOUD MESSAGING', 'ANALYTICS', 'ACCOUNT LINKING', and 'SERVICES'. Below these tabs, there's a section for 'Your project' with fields for 'Project name' (smell-diary), 'Public-facing name' (smell-diary), 'Project ID' (smell-diary), and 'Web API Key' (AlzaSyBJF0DclqxwY5p\_wcRqCyq2GNFa4cydczY). There are edit icons next to each field.

Also, you will need to disable authentication; go to the **Database** section and, in the **Rules** tab, set both read and write to true:

```
{  
  "rules": {  
    ".read": true,  
    ".write": true  
  }  
}
```

We are finished with the Firebase configuration.

Open a clean HTML5 boilerplate or JSFiddle, with `vue` as a library. We will need the following dependencies expressed as script tags inside the head of the file:

```
<script src="https://unpkg.com/vue/dist/vue.js"></script>  
<script  
src="https://www.gstatic.com/firebasejs/3.6.9.firebaseio.js"></script>  
<script src="https://unpkg.com/vuefire/dist/vuefire.js"></script>
```

VueFire will automatically detect Vue (so the order is important) and install itself as a plugin. We will build a very simple database to keep track of the odor of things that surround us. The following is the HTML layout of our app:

```
<div id="app">
  <ul>
    <li v-for="item in items">
      {{item.name}}: {{item.smell}}
      <button @click="removeItem(item['.key'])">X</button>
    </li>
  </ul>
  <form @submit.prevent="addItem">
    <input v-model=" newItem" />
    smells like
    <input v-model=" newSmell" />
    <button>Add #{{items.length}}</button>
  </form>
</div>
```

In the JavaScript part of our app, we need to specify the API key to authenticate with Firebase, write the following:

```
const config = {
  databaseURL: 'https://smell-diary.firebaseio.com/'
}
```

Then, we feed the configuration to Firebase and get a hold of the database:

```
const firebaseApp = firebase.initializeApp(config)
const db = firebaseApp.database()
```

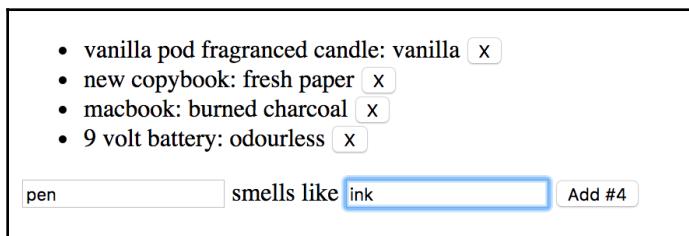
This can be done outside the Vue instance. The VueFire plugin installs a new option in the Vue instance, named `firebase`; we have to specify that we want to access the `/items` in the Firebase app with the `item` variable:

```
new Vue({
  el: '#app',
  firebase: {
    items: db.ref('/items')
  }
})
```

The `newItem` and `newSmell` variables will temporarily hold the values we entered in the input boxes; then, the `addItem` and `removeItem` methods will publish and remove data from our database:

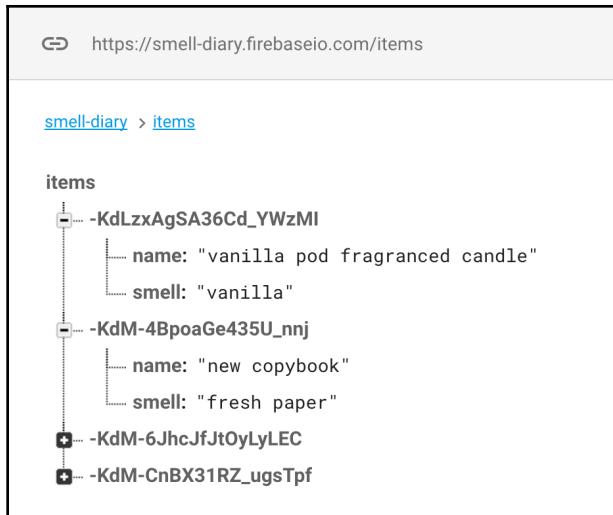
```
data: {
  newItem: '',
  newSmell: ''
},
methods: {
  addItem () {
    this.$firebaseRefs.items
      .push({
        name: this.newItem,
        smell: this.newSmell
      })
    this.newItem = ''
    this.newSmell = ''
  },
  removeItem (key) {
    this.$firebaseRefs.items
      .child(key).remove()
  }
}
```

If you launch your app now, you'll already be able to add your favorite scents and what to sniff to find them:



## How it works...

Firebase works as a simple key value store. In our case, we are never storing values but always adding children; you can take a look at what you've created in the Firebase console:



The keys are created automatically and they contain empty values and 32 levels of nested data. We are using one level of nesting to insert the name and the smell for each object.

## Creating a real-time app with Feathers

Most modern applications are real time, not in the traditional sense, but in the sense that they don't need the page to reload for them to be updated. The most common way to implement this is through WebSockets. In this recipe, we will leverage Feathers and Socket.io to build a cat database.

## Getting ready

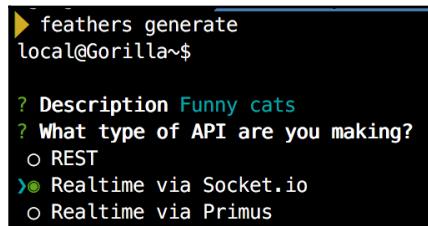
There is no prerequisite for this recipe, but you can complete the *Creating a REST client (and server!)* recipe before starting this one if you want to have more context.

## How to do it...

To complete this recipe, you'll need the Feathers' command line; install it with the following command:

```
npm install -g feathers-cli
```

Now, run `feathers generate`, which will create all the boilerplate for you. When asked about the API, select **Socket.io**:



```
▶ feathers generate
local@Gorilla~$ ? Description Funny cats
? What type of API are you making?
  ○ REST
> ○ Realtime via Socket.io
  ○ Realtime via Primus
```

All the other questions can be left to the default value. While still in the Feather console, type `generate service` to create a new service. You can call it `cats` and leave the other questions to their default values.

Inside the `public` folder, open `index.html` and delete everything except a HTML5 boilerplate. You will need three dependencies in the head:

```
<script src="//cdnjs.cloudflare.com/ajax/libs/vue/2.1.10/vue.js"></script>
<script
src="//cdnjs.cloudflare.com/ajax/libs/socket.io/1.7.3/socket.io.js"></script>
<script src="//unpkg.com/feathers-client@^1.0.0/dist/feathers.js"></script>
```

Write the HTML layout, as follows, in the `body` tag:

```
<div id="app">
  <div v-for="cat in cats" style="display:inline-block">
    
    <p>{{cat.name}}</p>
  </div>
  <form @submit.prevent="addCat">
    <div>
      <label>Cat Name</label>
      <input v-model="newName" />
    </div>
    <div>
      <label>Cat Url</label>
      <input v-model="newUrl" />
    </div>
    <button>Add cat</button>
    
  </form>
</div>
```

The first `<div>` tag is a gallery of cats. Then, build a form to add new images of the cats you collect.

In the body tag, you can always configure the Feathers service with the following lines:

```
<script>
  const socket = io('http://localhost:3030')
  const app = feathers()
    .configure(feathers.socketio(socket))
  const catService = app.service('cats')
```

This is for configuring the client for the browser that will connect to the WebSockets. The `catService` method is a handle to the cat database. Next, we write the `Vue` instance:

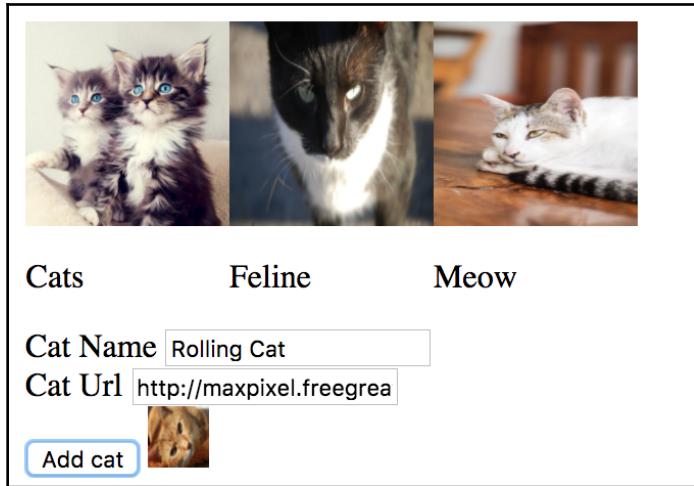
```
new Vue({
  el: '#app',
  data: {
    cats: [],
    newName: '',
    newUrl: ''
  },
  methods: {
    addCat () {
      catService.create({
        name: this.newName,
        url: this.newUrl
      })
      this.newName = ''
      this.newUrl = ''
    }
  },
})
```

Finally, we need to ask for all the cats in the database on startup, while installing a listener in case new cats are created (even by other users):

```
mounted () {
  catService.find()
    .then(page => {
      this.cats = page.data
    })
  catService.on('created', cat => {
    this.cats.push(cat)
  })
}
})
```

---

If you run your application with `npm start`, you can navigate to the URL written in the console to view your new app. Open another browser window and see how it changes in real-time:



## How it works...

Seeing the cats added in real time is clearly the way to go for modern applications. Feathers let you create them in a snap and with a fraction of the code, thanks to the underlying Socket.io, which in turn uses WebSockets.

WebSockets are really not that complex and what Feathers do, in this case, is just listen for messages in the channel and associate them with actions like adding something to the database.

The power of Feathers is visible when you can just swap database and WebSocket provider, or switch to REST, without even touching your Vue code.

## Creating a reactive app with Horizon

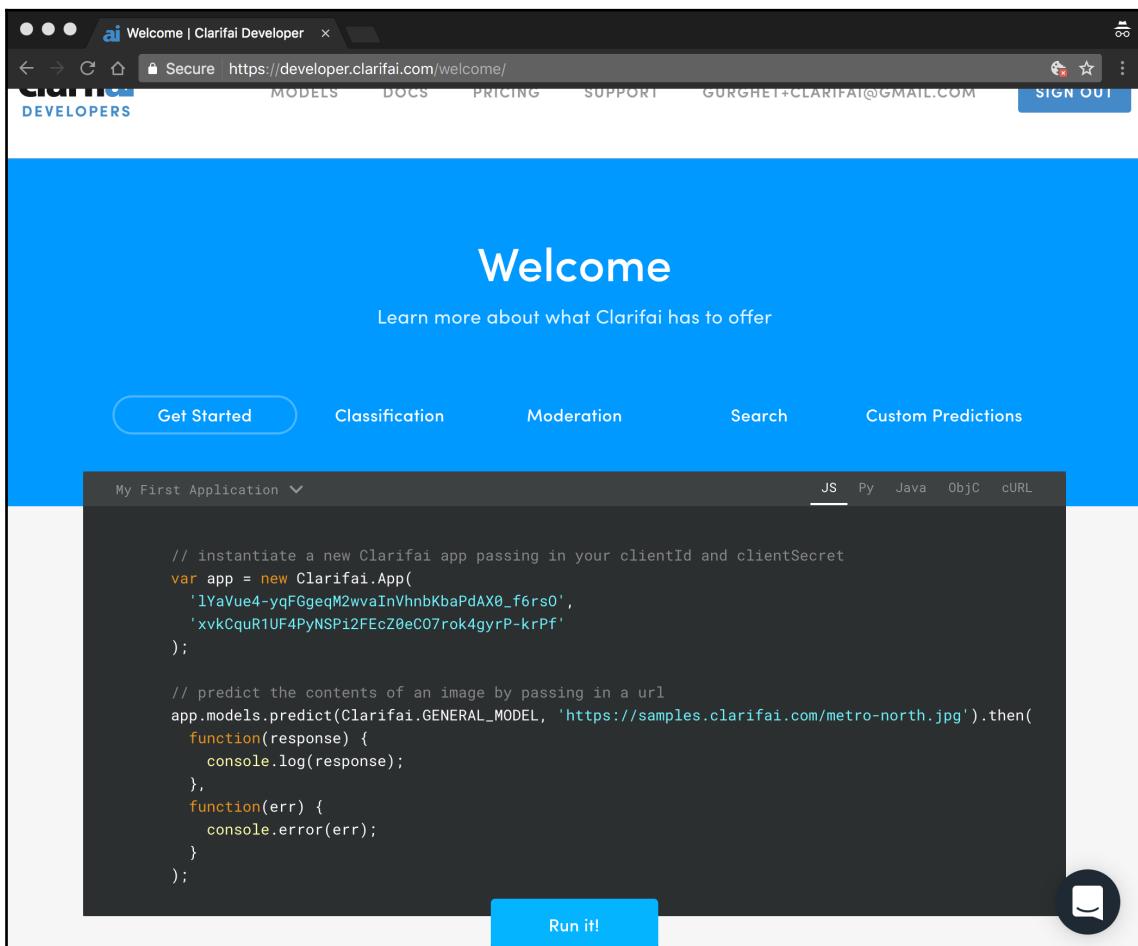
Horizon is a platform to build reactive, real-time scalable apps. It uses RethinkDB internally and is immediately compatible with Vue. In this recipe, you'll build an automatic personal diary.

## Getting ready

This recipe just requires a bit of Vue fundamentals, but really not much else.

Before starting though, ensure that you install RethinkDB. You can find more info on this on their website (<https://www.rethinkdb.com/docs/install/>). If you have Homebrew, you can install it with `brew install rethinkdb`.

Also, you will need a Clarifai token. To get one for free, go to <https://developer.clarifai.com/welcome/> and sign up. You'll be presented with the code you are supposed to write in your application, like in the following image:



In particular, you will need the `clientId` and the `clientSecret`, which are displayed in this fashion:

```
var app = new Clarifai.App(  
  'your client id would be printed here',  
  'your client secret would be here'  
)
```

Take note of this code or be ready to copy and paste it into your application.

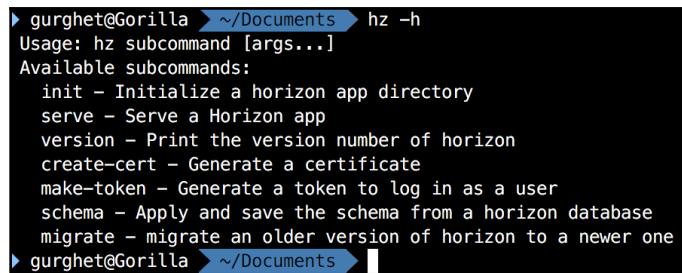
## How to do it...

Writing a journal is a difficult task, you have to write a lot every day. In this recipe, we'll build an automatic journal that will write for us, based on pictures we take during the day.

Horizon will help us to memorize everything and to sync the diary between our devices. After installing RethinkDB, install Horizon with the following command:

```
npm install -g horizon
```

Now, you'll have the new command, `hz`, available. Check it by typing `hz -h`; you should see something like the following:



```
▶ gurghet@Gorilla ~/Documents▶ hz -h  
Usage: hz subcommand [args...]  
Available subcommands:  
  init - Initialize a horizon app directory  
  serve - Serve a Horizon app  
  version - Print the version number of horizon  
  create-cert - Generate a certificate  
  make-token - Generate a token to log in as a user  
  schema - Apply and save the schema from a horizon database  
  migrate - migrate an older version of horizon to a newer one  
▶ gurghet@Gorilla ~/Documents▶
```

To create a directory that will host our new app, type the following:

```
hz init vue_app
```

Then, enter the newly created `vue_app` directory and take a look at the `index.html` in the `dist` folder. This is the file that will be the entry point to our server, open it with an editor. You can clear everything and leave only an empty HTML5 boilerplate with an empty `<head>` and `<body>`. In the head section, we need to declare dependencies on Vue, Horizon, and Clarifai, as illustrated:

```
<script src="https://unpkg.com/vue"></script>
<script src="/horizon/horizon.js"></script>
<script src="https://sdk.clarifai.com/js/clarifai-latest.js"></script>
```

Just note how Horizon doesn't come from a CDN but from a local dependency.

We start by laying out a template for our journal. We have two parts. In the first, we will list what we did in the past. Write the following in the body of the HTML:

```
<div id="app">
  <div>
    <h3>Dear diary...</h3>
    <ul>
      <li v-for="entry in entries">
        {{ entry.datetime.toLocaleDateString() }}:
        {{ entry.text }}
      </li>
    </ul>
  </div>
  ...

```

In the second part, we will enter new entries:

```
...
<h3>New Entry</h3>

<input type="file" @change="selectFile" ref="file">
<p v-if="tentativeEntries.length">Choose an entry</p>
<button v-for="tentativeEntry in tentativeEntries"
@click="send(tentativeEntry)">
  {{tentativeEntry}}
</button>
</div>
```

After this, open a `<script>` tag in which we'll write all of the following JavaScript.

First, we need to log in to Clarifai:

```
var app = new Clarifai.App(  
  '7CDIjv_VqEYfmFi_ygwKsKAaDe-LwEzc78CcW1sA',  
  'XC0S9GHxS0iONFsAdiA2xOUuBsOhAT0jZWQTx4hl'  
)
```

Obviously, you want to enter your `clientId` and `clientSecret` from Clarifai.

Then, we need to spin up Horizon and have a handle to the `entries` collection that we will create:

```
const horizon = new Horizon()  
const entries = horizon('entries')
```

Now, we finally write our Vue instance with three state variables:

```
new Vue({  
  el: '#app',  
  data: {  
    tentativeEntries: [],  
    data_uri: undefined,  
    entries: []  
  },  
  ...
```

The `tentativeEntries` array will contain a list of possible entries for the diary we can choose from; `data_uri` will contain the (base64 code of the) image we want to use as a reference for what we did today; `entries` are all the past entries.

When we load an image, we ask Clarifai to come up with possible entries:

```
...  
methods: {  
  selectFile(e) {  
    const file = e.target.files[0]  
    const reader = new FileReader()  
    if (file) {  
      reader.addEventListener('load', () => {  
        const data_uri = reader.result  
        this.data_uri = data_uri  
        const base64 = data_uri.split(',') [1]  
        app.models.predict(Clarifai.GENERAL_MODEL, base64)  
        .then(response => {  
          this.tentativeEntries =  
            response.outputs[0].data.concepts  
            .map(c => c.name)  
        })  
    }  
  }  
}
```

```
        })
        reader.readAsDataURL(file)
    }
},
...
```

Then when we press the send button, we tell the Horizon collection of entries to store this new one:

```
...
send(concept) {
  entries.store({
    text: concept,
    datetime: new Date()
  }).subscribe(
    result => console.log(result),
    error => console.log(error)
  )
  this.tentativeEntries = []
  this.$refs.file.value = ''
  this.data_uri = undefined
}
})
})
```

Finally, we want to ensure that we have the last ten entries on the screen when the page loads and that every time a new entry is added, it pops up in real time. Add the following hook inside the Vue instance, after the methods:

```
created() {
  entries.order('datetime', 'descending').limit(10).watch()
    .subscribe(allEntries => {
      this.entries = [...allEntries].reverse()
    })
}
```

To run the Horizon server, use the following command:

```
hz serve --dev
```

The output for the preceding code is as follows:

```
▶ gurghet@Gorilla ~ /Documents/vue_app ➤ hz serve --dev
App available at http://127.0.0.1:8181
RethinkDB
└ Admin interface: http://localhost:59953
  Drivers can connect to port 59952
Starting Horizon...
Horizon ready for connections
```

Go to the specified address (the first line, not the admin interface), and you will see the following:

**Dear diary...**

- 23/02/2017: pizza
- 23/02/2017: landscape
- 23/02/2017: family
- 23/02/2017: business
- 23/02/2017: theater

**New Entry**



Choose file IMG\_0688.jpg

Choose an entry

dog canine mammal no person nature outdoors cute pet animal  
portrait one wood puppy summer fur park grass looking  
terrier little

You will note that if you have other browser windows open, they will be updated in real time. Now you can finally write a journal every day without typing!

## How it works...

Our application uses a pattern called reactive. Its core can be clearly seen in the handle created:

```
entries.order('datetime', 'descending').limit(10).watch()  
    .subscribe(allEntries => {  
        this.entries = [...allEntries].reverse()  
    })
```

The first line returns what is called an observable in reactive. An observable can be thought of as a source of events. Every time an event is fired, the subscriber to that source will process it. In our case, we are taking the whole entries collection and the events thrown are modifications to that collection. Every time we receive an event of this type, we update the `entries` array.

I will not provide a deep explanation of reactive programming here, but I would like to highlight that this pattern is very helpful for scalability because of the ease with which you can implement controls for your data flow; `limit(10)` is an example this.

# 20 Vue Router Patterns

Routing is a vitally important part of any **Single Page Application (SPA)**. This chapter focuses on maximizing the Vue router and looks at everything from routing a user between pages, to parameters, to optimal configuration.

By the end of this chapter, we will have covered the following:

- Implementing routing in a Vue.js application
- Using dynamic route matching to create route parameters
- Passing route parameters as component props

## Single Page Applications

Modern JavaScript applications implement a pattern known as an SPA. In its most simplistic form, it can be thought of as an application that displays components based on a URL. As the templates are mapped to routes, there is no need for a page reload, as they can be injected depending on where the user navigated.

This is the job of the router.

By creating our application this way, we're able to increase both perceived and actual speed, because our application is much more dynamic.

# Using the router

Let's spin up a playground project and install the `vue-router` library. This allows us to take advantage of routing inside our application and give us the power of a modern SPA.

Run the following commands in your Terminal:

```
# Create a new Vue project
$ vue init webpack-simple vue-router-basics

# Navigate to directory
$ cd vue-router-basics

# Install dependencies
$ npm install

# Install Vue Router
$ npm install vue-router

# Run application
$ npm run dev
```

As we're using webpack as part of our build system, we've installed the router with `npm`. We can then initialize the router inside of `src/main.js`:

```
import Vue from 'vue';
import VueRouter from 'vue-router';

import App from './App.vue';

Vue.use(VueRouter);

new Vue({
  el: '#app',
  render: h => h(App)
});
```

This effectively registers `VueRouter` as a global plugin. A plugin simply is just a function that receives `Vue` and `options` as parameters and allows libraries such as `VueRouter` to add functionality to our `Vue` application.

## Creating routes

We can then define two small components inside our `main.js` file that simply have a template that shows `h1` with some text inside:

```
const Hello = { template: `<h1>Hello</h1>` };
const World = { template: `<h1>World</h1>` };
```

Then, in order to display these components on screen at particular URLs (such as `/hello` and `/world`), we can define routes inside our application:

```
const routes = [
  { path: '/hello', component: Hello },
  { path: '/world', component: World }
];
```

Now that we've defined what components we want to use as well as the routes inside of our application, we'll need to create a new instance of `VueRouter` and pass along the routes.

Although we've used `Vue.use(VueRouter)`, we still need to create a new instance of `VueRouter` and initialize our routes. This is because merely registering `VueRouter` as a plugin gives us access to the `router` option within our `Vue` instance(s):

```
const router = new VueRouter({
  routes
});
```

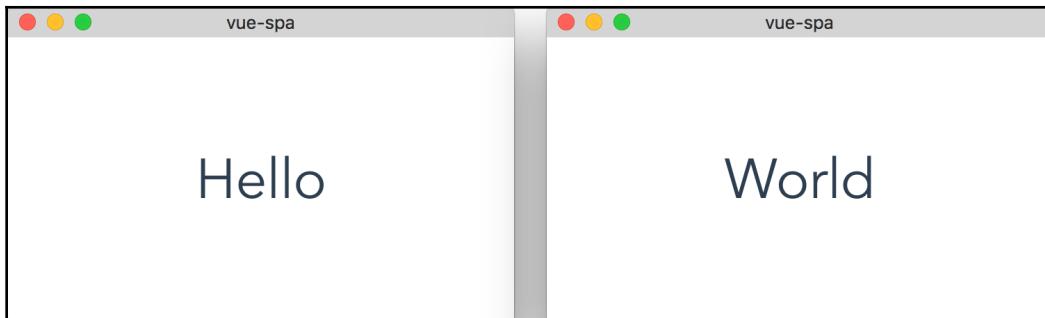
We then need to pass the `router` to our root `Vue` instance:

```
new Vue({
  el: '#app',
  router,
  render: h => h(App)
});
```

Finally, to display our routed components inside of our `App.vue` component, we need to add the `router-view` component inside the template:

```
<template>
  <div id="app">
    <router-view/>
  </div>
</template>
```

If we then navigate to `/#/hello/` or `/#/world`, the appropriate component is displayed:



## Dynamic routes

We can also dynamically match routes depending on a particular parameter. This is done by specifying a route with a colon before the parameter name. Here's an example using a similar greeting component:

```
// Components
const Hello = { template: `<h1>Hello</h1>` };
const HelloName = { template: `<h1>Hello {{ $route.params.name }}` }

// Routes
const routes = [
  { path: '/hello', component: Hello },
  { path: '/hello/:name', component: HelloName },
]
```

If our user navigates to `/hello`, they'll see `h1` with the text `Hello`. Otherwise, if they navigate to `/hello/{name}` (that is, `Paul`), they'll see `h1` with the text `Hello Paul`.

We've made a lot of progress, but it's important to know that when we navigate to parameterized URLs, component lifecycle hooks aren't fired again if the parameter changes (that is, from `/hello/paul` to `/hello/katie`). We'll look at this soon!

## Route props

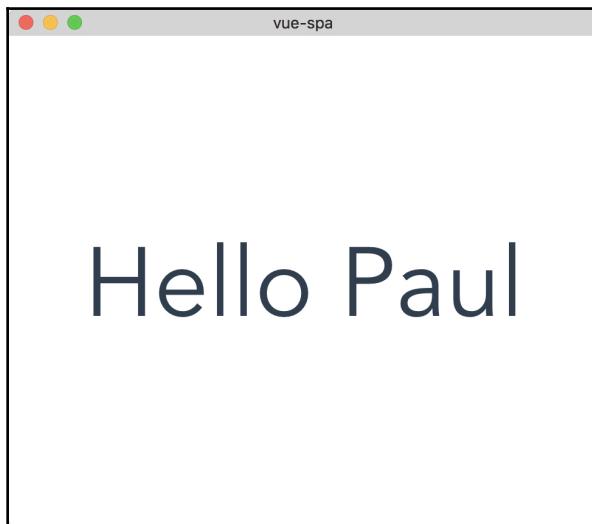
Let's change our `/hello/:name` route to pass the `name` parameter as a component prop, which can be done by adding the `props: true` flag to the route:

```
const routes = [
  { path: '/hello', component: Hello },
  { path: '/hello/:name', component: HelloName, props: true},
]
```

We can then update our component to take in a prop with an `id` of `name` and also log this to the console within the life cycle hook:

```
const HelloName = {
  props: ['name'],
  template: `<h1>Hello {{ name }}</h1>`,
  created() {
    console.log(`Hello ${this.name}`)
  }
}
```

If we then try and navigate to different dynamic routes, we'll see that the created hook only fires once (unless we refresh the page) even though our page shows the correct name:



## Component Navigation Guards

How do we fix the lifecycle hook problem? In this instance, we can use what's known as a Navigation Guard. This allows us to hook into different lifecycles of the router, such as the `beforeRouteEnter`, `beforeRouteUpdate`, and `beforeRouteLeave` methods.

### beforeRouteUpdate

Let's use the `beforeRouteUpdate` method to access information about the route change:

```
const HelloName = {
  props: ['name'],
  template: `<h1>Hello {{ name }}</h1>`,
  beforeRouteUpdate(to, from, next) {
    console.log(to);
    console.log(from);
    console.log(`Hello ${to.params.name}`)
  },
}
```

If we check the JavaScript console after navigating to a different route under `/hello/{name}`, we'll be able to see which route the user is going to and where they are coming from. The `to` and `from` objects also give us access to `params`, `queries`, the full path, and much more.

While we correctly get the log statements, if we try and navigate between routes, you'll note that our application doesn't update with the parameter `name` prop. This is because we haven't used the `next` function after we've finished doing any computations within the guard. Let's add that in:

```
beforeRouteUpdate(to, from, next) {
  console.log(to);
  console.log(from);
  console.log(`Hello ${to.params.name}`)
  next();
},
```

## beforeRouteEnter

We can also take advantage of `beforeRouteEnter` to perform actions prior to entering the component route. Here's an example:

```
beforeRouteEnter(to, from, next) {  
  console.log(`I'm called before entering the route!`)  
  next();  
}
```

We still have to call `next` to pass the stack down to the next route handler.

## beforeRouteLeave

We can also hook into `beforeRouteLeave` to perform actions whenever we're navigating away from a route. As we're already on this route within the context of this hook, we have access to the component instance. Let's look at an example:

```
beforeRouteLeave(to, from, next) {  
  console.log(`I'm called before leaving the route!`)  
  console.log(`I have access to the component instance, here's proof!  
Name: ${this.name}`);  
  next();  
}
```

Once again, we have to call `next` in this instance.

## Global router hooks

We've looked at component Navigation Guards and while these work on a component-by-component basis, you may want to establish global hooks that listen to navigation events.

## beforeEach

We can use `router.beforeEach` to listen for routing events globally across the application. This is worth using if you have authentication checks or other pieces of functionality that should be used in every route.

Here's an example that simply logs out the route the user is going to and coming from. Each one of the following examples assume that the router exists in scope similar to the following:

```
const router = new VueRouter({
  routes
})

router.beforeEach((to, from, next) => {
  console.log(`Route to`, to)
  console.log(`Route from`, from)
  next();
});
```

Once again, we have to call `next()` to trigger the next route guard.

## beforeResolve

The `beforeResolve` global route guard is triggered just before navigation is confirmed, but it's important to know that this is only after all component-specific guards and `async` components have been resolved.

Here's an example:

```
router.beforeResolve((to, from, next) => {
  console.log('Before resolve:')
  console.log(`Route to`, to)
  console.log(`Route from`, from)
  next();
});
```

## afterEach

We can also hook into the global `afterEach` function that allows us to perform the action(s), but we can't affect navigation and thus only have access to the `to` and `from` parameters:

```
router.afterEach((to, from) => {
  console.log('After each:')
  console.log(`Route to`, to)
  console.log(`Route from`, from)
});
```

## Resolution stack

Now that we've familiarized ourselves with the various different route lifecycle hooks on offer, it's worth investigating the entire resolution stack whenever we attempt to navigate to another route:

- 1. Trigger a route change:**

This is the first stage of any route lifecycle and is triggered any time we *attempt* to navigate to a new route. An example would be going from /hello/Paul to /hello/Katie. No Navigation Guards have been triggered at this point.

- 2. Trigger component leave guards:**

Next, any leave guards are triggered, such as `beforeRouteLeave`, on loaded components.

- 3. Trigger global beforeEach guards:**

As global route middleware can be created with `beforeEach`, these functions will be called prior to any route update.

- 4. Trigger local beforeRouteUpdate guards in reused components:**

As we saw earlier, whenever we navigate to the same route with a different parameter, the lifecycle hooks aren't fired twice. Instead, we use `beforeRouteUpdate` to trigger lifecycle changes.

- 5. Trigger beforeRouteEnter in components:**

This is called each time prior to navigating to any route. At this stage, the component isn't rendered, so it doesn't have access to the `this` component instance.

- 6. Resolve asynchronous route components:**

It then attempts to resolve any asynchronous components in your project. Here's an example of one:

```
const MyAsyncComponent = () => ({
  component: import ('./LazyComponent.vue'),
  loading: LoadingComponent,
  error: ErrorComponent,
  delay: 150,
  timeout: 3000
})
```

- 7. Trigger beforeRouteEnter in successfully activated components:**

We now have access to the `beforeRouteEnter` hook and can perform any action(s) prior to resolving the route.

**8. Trigger global beforeResolve hooks:**

Providing in-component guards and async route components have been resolved, we can now hook into the `router.beforeResolve` method that allows us to perform action(s) at this stage.

**9. Navigation:**

All prior Navigation Guards have been fired, and the user is now successfully navigated to a route.

**10. Trigger afterEach hooks:**

Although the user has been navigated to the route, it doesn't stop there. Next, the router triggers a global `afterEach` hook that has access to the `to` and `from` parameters. As the route has already been resolved at this stage, it doesn't have the `next` parameter and thus cannot affect navigation.

**11. Trigger DOM updates:**

Routes have been resolved, and Vue can appropriately trigger DOM updates.

**12. Trigger callbacks within next in beforeRouteEnter:**

As `beforeRouteEnter` does not have access to the component's `this` context, the `next` parameter takes a callback that resolves to the component instance on navigation. An example can be seen here:

```
beforeRouteEnter (to, from, next) {
  next(comp => {
    // 'comp' inside this closure is equal to the component instance
  })
}
```

## Programmatic navigation

We're not limited to template navigation using `router-link`; we can also programmatically navigate the user to different routes from within our JavaScript. Inside of our `App.vue`, let's expose the `<router-view>` and give the user the ability to select a button that will navigate them to either the `/hello` or `/hello/:name` route:

```
<template>
  <div id="app">
    <nav>
      <button @click="navigateToRoute('/hello')">/Hello</button>
      <button
        @click="navigateToRoute('/hello/Paul')">/Hello/Name</button>
    </nav>
    <router-view></router-view>
  </div>
</template>
```

We can then add a method that pushes a new route onto the route stack:

```
<script>
export default {
  methods: {
    navigateToRoute(routeName) {
      this.$router.push({ path: routeName });
    },
  },
};
</script>
```

At this point, any time we select a button, it should subsequently navigate the user to the appropriate route. The `$router.push()` function can take a variety of different arguments, depending on how you have your routes set up. Here are some examples:

```
// Navigate with string literal
this.$router.push('hello')

// Navigate with object options
this.$router.push({ path: 'hello' })

// Add parameters
this.$router.push({ name: 'hello', params: { name: 'Paul' } })

// Using query parameters /hello?name=paul
this.$router.push({ path: 'hello', query: { name: 'Paul' } })
```

## router.replace

Instead of pushing a navigation item on the stack, we can also replace the current history stack with `router.replace`. Here's an example of this:

```
this.$router.replace({ path: routeName });
```

## router.go

If we want to navigate the user backward or forward, we can use `router.go`; this is essentially an abstraction over the `window.history` API. Let's take a look at some examples:

```
// Navigate forward one record
this.$router.go(1);

// Navigate backward one record
```

```
this.$router.go(-1);

// Navigate forward three records
this.$router.go(3);

// Navigate backward three records
this.$router.go(-3);
```

## Lazy loading routes

We can also lazy load our routes to take advantage of code splitting with webpack. This allows us to have greater performance than when eagerly loading our routes. To do this, we can create a small playground project. Run the following in your Terminal:

```
# Create a new Vue project
$ vue init webpack-simple vue-lazy-loading

# Navigate to directory
$ cd vue-lazy-loading

# Install dependencies
$ npm install

# Install Vue Router
$ npm install vue-router

# Run application
$ npm run dev
```

Let's start off by creating two components, named `Hello.vue` and `World.vue`, inside `src/components`:

```
// Hello.vue
<template>
  <div>
    <h1>Hello</h1>
    <router-link to="/world">Next</router-link>
  </div>
</template>

<script>
export default {};
</script>
```

Now we have created our `Hello.vue` component, let's create the second `World.vue` like so:

```
// World.vue
<template>
<div>
  <h1>World</h1>
  <router-link to="/hello">Back</router-link>
</div>
</template>

<script>
export default {};
</script>
```

We can then initialize our router as we usually do, inside `main.js`:

```
import Vue from 'vue';
import VueRouter from 'vue-router';

Vue.use(VueRouter);
```

The main difference has to do with the way in which to import our components. This requires the use of the `syntax-dynamic-import` Babel plugin. Install it into your project by running the following in your Terminal:

```
$ npm install --save-dev babel-plugin-syntax-dynamic-import
```

We can then update `.babelrc` to use the new plugin:

```
{
  "presets": [ ["env", { "modules": false }], "stage-3" ],
  "plugins": [ "syntax-dynamic-import" ]
}
```

Finally, this allows us to import our components asynchronously, like this:

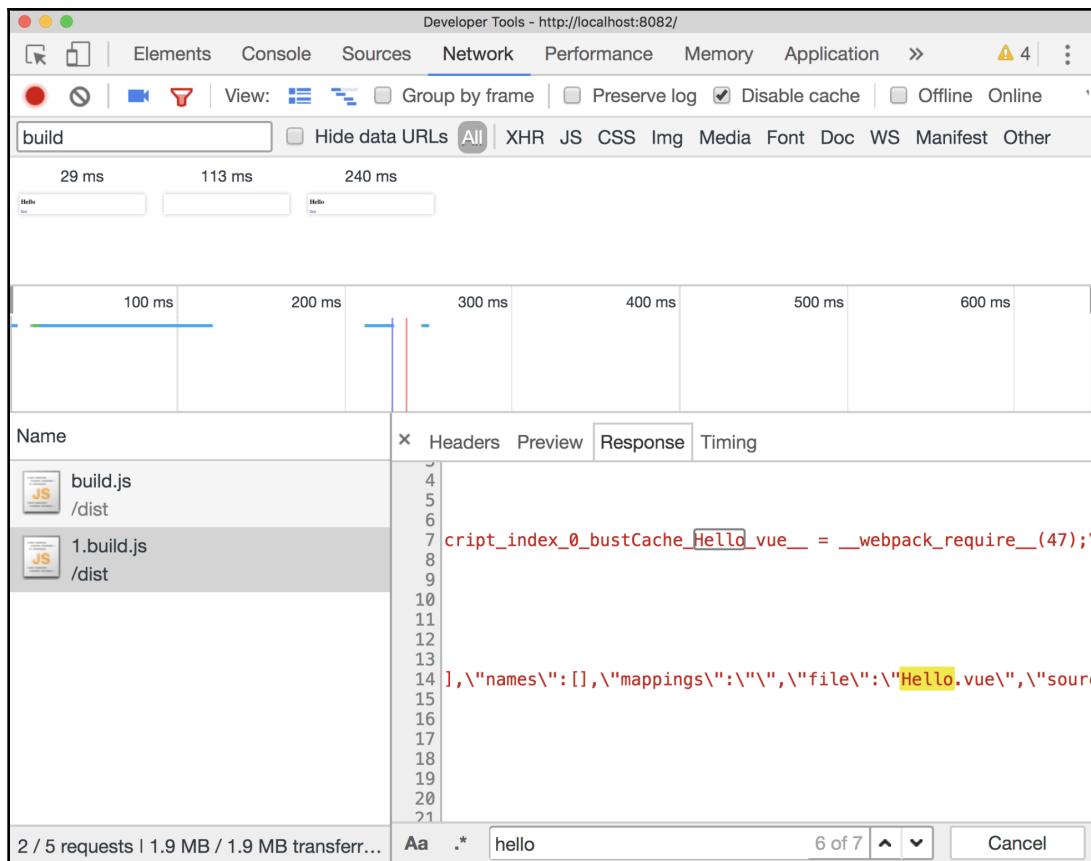
```
const Hello = () => import('./components/Hello');
const World = () => import('./components/World');
```

We can then define our routes and initialize the router, this time referencing the asynchronous import:

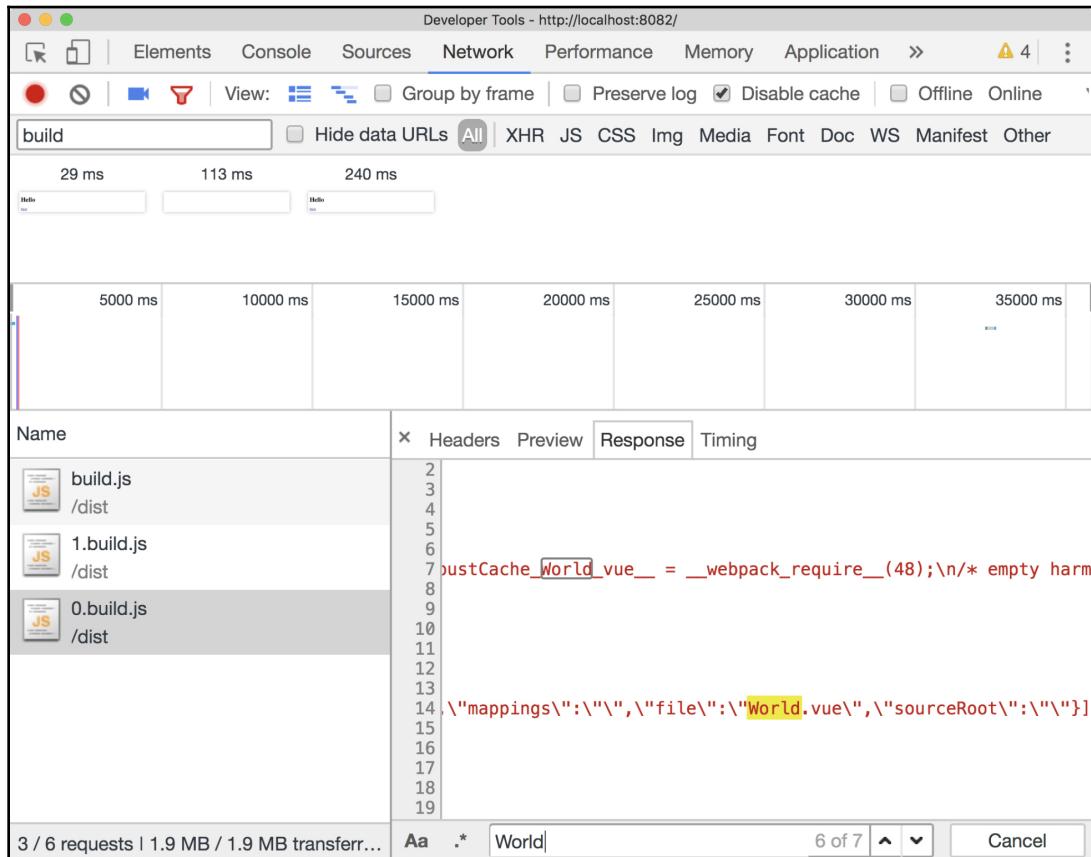
```
const routes = [
  { path: '/', redirect: '/hello' },
  { path: '/hello', component: Hello },
  { path: '/World', component: World },
];
```

```
const router = new VueRouter({  
  routes,  
});  
  
new Vue({  
  el: '#app',  
  router,  
  render: h => h(App),  
});
```

We can then see its results by looking in Chrome via **Developer Tools** | **Network tab** while navigating through our application:



Each route is added to its own bundle file and subsequently gives us an improved performance as the initial bundle is much smaller:



## An SPA project

Let's create a project that uses a RESTful API and the routing concepts that we've just learned. Create a new project by running the following in your Terminal:

```
# Create a new Vue project
$ vue init webpack-simple vue-spa

# Navigate to directory
```

```
$ cd vue-spa  
  
# Install dependencies  
$ npm install  
  
# Install Vue Router and Axios  
$ npm install vue-router axios  
  
# Run application  
$ npm run dev
```

## Enabling the router

We can start off by enabling the `VueRouter` plugin within our application. To do this, we can create a new file inside `src/router` named `index.js`. We'll use this file to contain all the router-specific configuration, but we'll separate out each route into different files depending on the underlying feature.

Let's import and add the router plugin:

```
import Vue from 'vue';  
import VueRouter from 'vue-router';  
  
Vue.use(VueRouter)
```

## Defining routes

To separate out the routes into different files within our application, we can first create a file under `src/components/user` named `user.routes.js`. Each time we have a different feature set (that requires routes), we can create our own `*.routes.js` file that can be imported into the router's `index.js`.

For now, we can just export a new empty array:

```
export const userRoutes = [];
```

We can then add the routes to our `index.js` (even though we have none defined yet):

```
import { userRoutes } from '../components/user/user.routes';  
  
const routes = [...userRoutes];
```

We're using the ES2015+ spread operator, which allows us to use each object in the array instead of the array itself.

To then initialize the router, we can then create a new `VueRouter` and pass along the routes, as follows:

```
const router = new VueRouter({
  // This is ES2015+ shorthand for routes: routes
  routes,
});
```

Finally, let's export the router so that it can be used inside our main Vue instance:

```
export default router;
```

Inside `main.js`, let's import the router and add it to the instance, as shown:

```
import Vue from 'vue';
import App from './App.vue';
import router from './router';

new Vue({
  el: '#app',
  router,
  render: h => h(App),
});
```

## Creating the `UserList` route

The first section of our application will be a home page that displays a list of users from an API. We've used this example in the past, so you should be familiar with the steps involved. Let's create a new component under `src/components/User` named `UserList.vue`.

The component will look something like this:

```
<template>
<ul>
  <li v-for="user in users" :key="user.id">
    {{user.name}}
  </li>
</ul>
</template>

<script>
export default {
  data() {
    return {
      users: [
        {
          id: 1,
          name: 'John Doe'
        },
        {
          id: 2,
          name: 'Jane Doe'
        }
      ]
    }
  }
}</script>
```

```
{  
  id: 1,  
  name: 'Leanne Graham',  
}  
],  
};  
};  
</script>
```

Feel free to add your own test data at this point. We'll be requesting this data from the API momentarily.

As we've created our component, we can then add a route to `user.routes.js`, which displays this component whenever the '/' (or a path of your choice) is activated:

```
import UserList from './UserList';  
  
export const userRoutes = [{ path: '/', component: UserList }];
```

In order to show this route, we need to update `App.vue` to subsequently inject the content into a `router-view` node. Let's update `App.vue` to handle this:

```
<template>  
  <div>  
    <router-view></router-view>  
  </div>  
</template>  
  
<script>  
export default {};  
</script>  
  
<style>  
</style>
```

Our application should then display a single user. Let's create an HTTP utility to get data from an API.

## Getting data from an API

Create a new file under `src/utils` named `api.js`. This will be used to create a base instance of `Axios`, which we can then perform HTTP requests on:

```
import axios from 'axios';
```

```
export const API = axios.create({
  baseURL: `https://jsonplaceholder.typicode.com/`
})
```

We can then use the `beforeRouteEnter` Navigation Guard to get user data whenever someone navigates to the `'/'` route:

```
<template>
  <ul>
    <li v-for="user in users" :key="user.id">
      {{user.name}}
    </li>
  </ul>
</template>

<script>
import { API } from '../utils/api';
export default {
  data() {
    return {
      users: [],
    };
  },
  beforeRouteEnter(to, from, next) {
    API.get(`users`)
      .then(response => next(vm => (vm.users = response.data)))
      .catch(error => next(error));
  },
};
</script>
```

We then find that we get a list of users on screen, as illustrated in the following screenshot, each represented as a different list item. The next step is to create a detail component, register the detail route, and find a way to link to that route:



## Creating a detail page

In order to create a detail page, we can create `UserDetail.vue` and follow steps similar to the previous component:

```
<template>
<div class="container">
  <div class="user">
    <div class="user__name">
      <h1>{{userInfo.name}}</h1>
      <p>Person ID {{ $route.params.userId }}</p>
      <p>Username: {{userInfo.username}}</p>
      <p>Email: {{userInfo.email}}</p>
    </div>
    <div class="user__address" v-if="userInfo && userInfo.address">
      <h1>Address</h1>
      <p>Street: {{userInfo.address.street}}</p>
      <p>Suite: {{userInfo.address.suite}}</p>
      <p>City: {{userInfo.address.city}}</p>
      <p>Zipcode: {{userInfo.address.zipcode}}</p>
      <p>Lat: {{userInfo.address.geo.lat}} Lng:
        {{userInfo.address.geo.lng}} </p>
    </div>
    <div class="user__other" >
      <h1>Other</h1>
      <p>Phone: {{userInfo.phone}}</p>
      <p>Website: {{userInfo.website}}</p>
      <p v-if="userInfo && userInfo.company">Company:
        {{userInfo.company.name}}</p>
    </div>
  </div>
</div>
</template>

<script>
import { API } from '../../../../../utils/api';

export default {
  data() {
    return {
      userInfo: {},
    };
  },
  beforeRouteEnter(to, from, next) {
    next(vm =>
      API.get(`users/${to.params.userId}`)
        .then(response => (vm.userInfo = response.data))
    );
  }
}
</script>
```

```
.catch(err => console.error(err))
)
},
};

</script>

<style>
.container {
  line-height: 2.5em;
  text-align: center;
}
</style>
```

As there should never be more than one user inside of our detail page, the `userInfo` variable has been created as a JavaScript object rather than an array.

We can then add the new component to our `user.routes.js`:

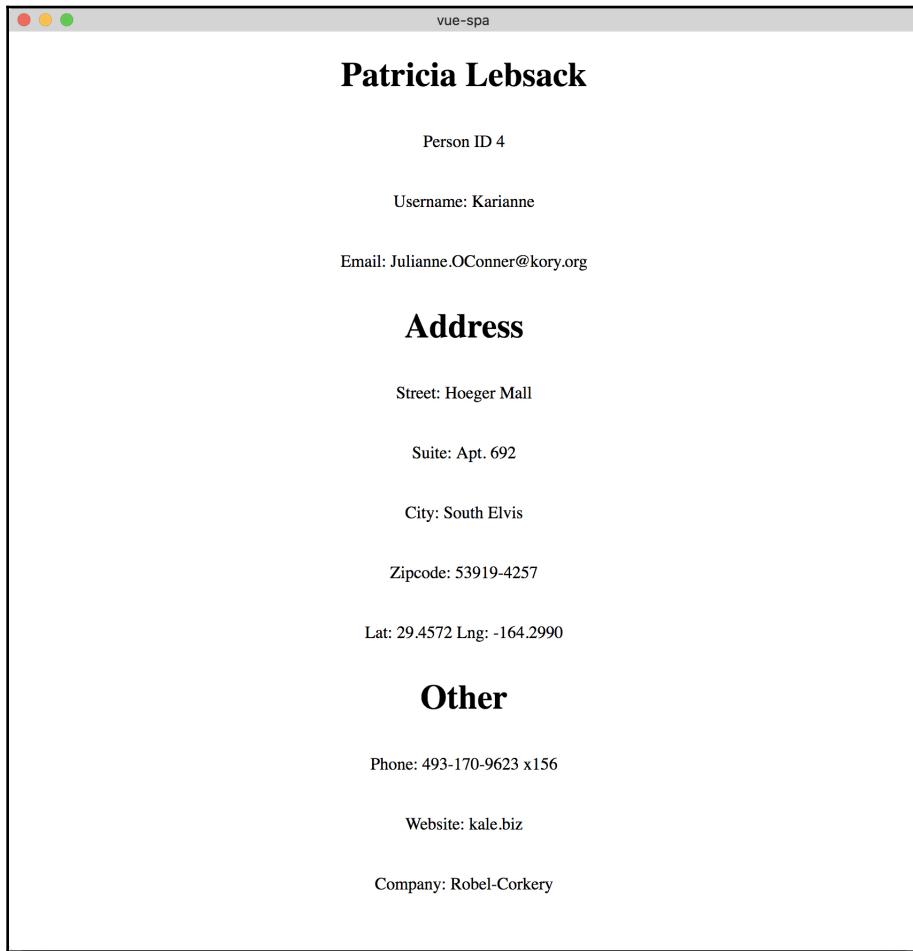
```
import UserList from './UserList';
import UserDetail from './UserDetail';

export const userRoutes = [
  { path: '/', component: UserList },
  { path: '/:userId', component: UserDetail },
];
```

In order to link to this component, we can add `router-link` within our `UserList` component:

```
<template>
  <ul>
    <li v-for="user in users" :key="user.id">
      <router-link :to="{ path: `/ ${user.id}` }">
        {{user.name}}
      </router-link>
    </li>
  </ul>
</template>
```

If we then take a look in our browser we can see that there is only one user listed with the information underneath coming from the user detail linked to that one user:



## Child routes

We can also access posts from our API, and as a result, we can display both the posts' information alongside our user information. Let's create a new component named `UserPosts.vue`:

```
<template>
```

```
<div>
  <ul>
    <li v-for="post in posts" :key="post.id">{{post.title}}</li>
  </ul>
</div>
</template>

<script>
import { API } from '../utils/api';
export default {
  data() {
    return {
      posts: [],
    };
  },
  beforeRouteEnter(to, from, next) {
    next(vm =>
      API.get(`posts?userId=${to.params.userId}`)
        .then(response => (vm.posts = response.data))
        .catch(err => console.error(err))
    );
  };
}
</script>
```

This allows us to get posts based on our `userId` route parameter. In order to display this component as a child view, we'll need to register it as such within the `user.routes.js`:

```
import UserList from './UserList';
import UserDetail from './UserDetail';
import UserPosts from './UserPosts';

export const userRoutes = [
  { path: '/', component: UserList },
  {
    path: '/:userId',
    component: UserDetail,
    children: [{ path: '/:userId', component: UserPosts }],
  },
];
```

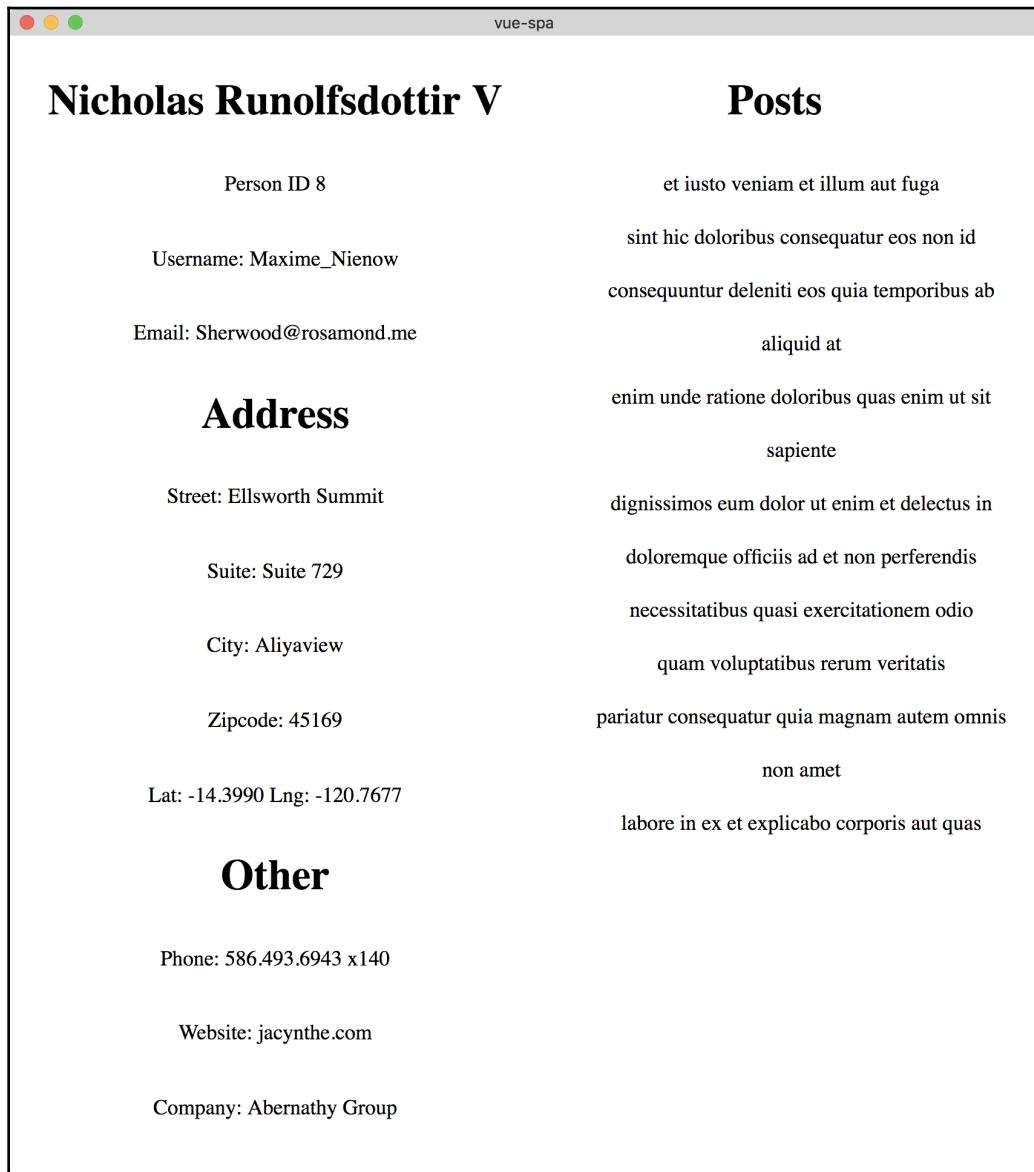
We can then add another `<router-view>` tag inside our `UserDetail.vue` component to display the child route. The template now looks like this:

```
<template>
  <div class="container">
    <div class="user">
      // Omitted
    </div>
    <div class="posts">
      <h1>Posts</h1>
      <router-view></router-view>
    </div>
  </div>
</template>
```

To top it off, we've also added some styles that display the user information on the left and posts on the right:

```
<style>
  .container {
    line-height: 2.5em;
    text-align: center;
  }
  .user {
    display: inline-block;
    width: 49%;
  }
  .posts {
    vertical-align: top;
    display: inline-block;
    width: 49%;
  }
  ul {
    list-style-type: none;
  }
</style>
```

If we then head to our browser, we can see how the data appears just as we had planned, with the user information displaying on the left and the posts on the right:



Ta-da! We've now created a Vue application with multiple routes, child routes, parameters, and more!

# Summary

In this section, we learned about the Vue Router and how we can use it to create Single Page Applications. As a result, we covered everything from initializing the router plugin to defining routes, components, Navigation Guards, and much more. We now have the necessary knowledge to create Vue applications that scale past a singular component.

Now that we have expanded our knowledge and understand how to use the Vue Router, we can move on to handling state management with `Vuex` in the next chapter.

# 21

## State Management with Vuex

In this chapter, we'll be looking at State Management Patterns with `Vuex`. `Vuex` may not be needed for every application created, but it is extremely important that you have an understanding of what it is when it becomes appropriate to use it, and how to implement it.

By the end of this chapter, you will have done the following:

- Understood what `Vuex` is and why you should use it
- Created your first `Vuex` store
- Investigated actions, mutations, getters, and modules
- Used the Vue devtools to step through `Vuex` mutations as they happen

### What is Vuex?

State management is an important part of modern-day web applications, and managing this state as the application grows is a problem every project faces. `Vuex` looks to help us achieve better state management by enforcing a centralized store, essentially a single source of truth within our application. It follows design principles similar to that of Flux and Redux and also integrates with the official Vue devtools for a great development experience.

Let's define these terms in a little more depth.

## State Management Pattern (SMP)

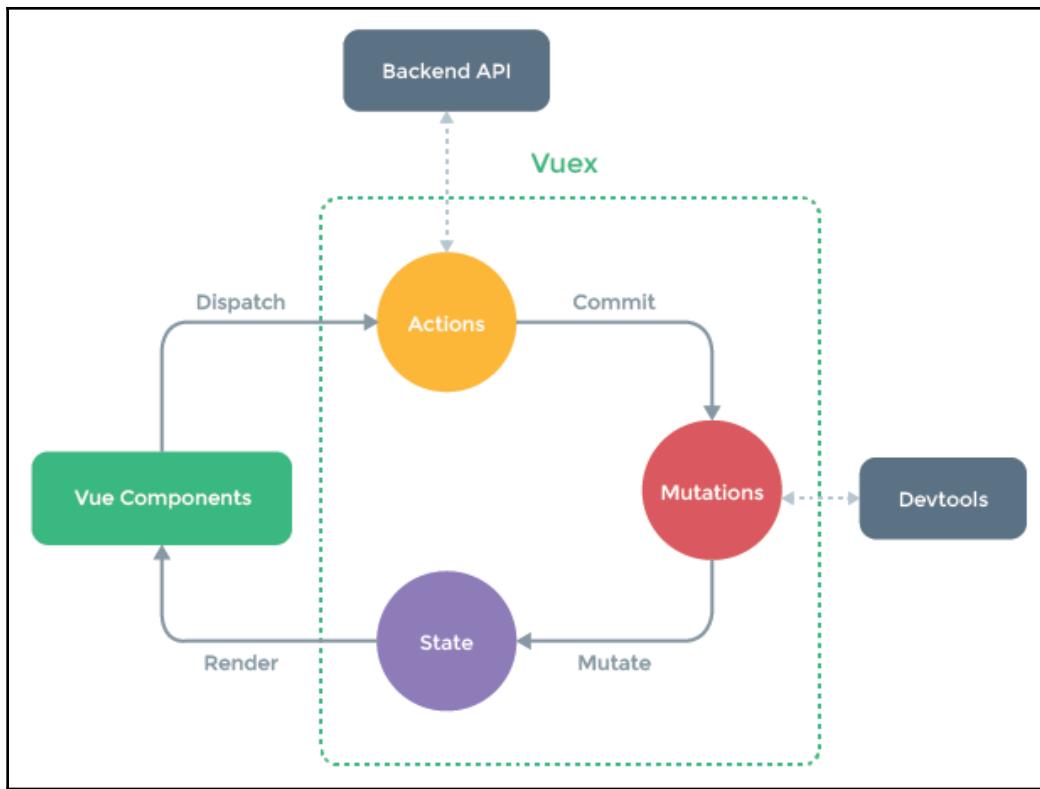
We can define a state as the current value(s) of a variable/object within our component or application. If we think about our functions as simple `INPUT -> OUTPUT` machines, the values stored outside of these functions make up the current condition (state) of our application.

Note how I've made a distinction between **component level** and **application level** state. The component level state can be defined as state confined to one component (that is, the data function within our component). Application level state is similar but is often used across multiple components or services.

As our application continues to grow, passing state across multiple components gets more difficult. We saw earlier in the book that we can use an Event bus (that is, a global Vue instance) to pass data around, and while this works, it's much better to define our state as part of a singular centralized store. This allows us to reason about the data in our application much easier, as we can start defining **actions** and **mutations** that always generate a new version of state, and managing state becomes much more systemized.

Event bus is a simple approach to state management relying on a singular view instance and may be beneficial in small Vuex projects, but in the majority of cases, Vuex should be used. As our application becomes larger, clearly defining our actions and intended side effects with Vuex allows us to better manage and scale the project.

A great example of how all this fits together can be seen in the following screenshot (<https://vuex.vuejs.org/en/intro.html>):



Vuex state flow

Let's break down this example into a step-by-step process:

1. Initial **State** is rendered inside of a Vue component.
2. A Vue component dispatches an **Action** to get some data from a **Backend API**.
3. This then fires a **Commit** event that is handled by a **Mutation**. This **Mutation** returns a new version of the state containing the data from the **Backend API**.
4. The process can then be seen in the Vue **Devtools**, and you have the ability to "time travel" between different versions of the previous state that takes place within the application.
5. The new **State** is then rendered inside of the **Vue Components**.

The main component of our Vuex application(s) is, therefore, the store, our single source of truth across all component(s). The store can be read but not directly altered; it must have mutation functions to carry out any changes. Although this pattern may seem strange at first, if you've never used a state container before, this design allows us to add new features to our application in a consistent manner.

As Vuex is natively designed to work with Vue, the store is reactive by default. This means any changes that happen from within the store can be seen in real time without the need for any hacks.

## Thinking about state

As a thought exercise, let's start off by defining the goals for our application as well as any state, actions, and potential mutations. You don't have to add the following code to your application just yet, so feel free to read on, and we'll bring it all together at the end.

Let's start off by considering the state as a collection of key/value pairs:

```
const state = {
  count: 0 // number
}
```

For our counter application, we just need one element of state—the current count. This will likely have a default value of 0 and will be of type number. As this is likely the only state inside of our application, you can consider this state to be application level at this point.

Next, let's think about any action types that the user may want to take our counter application.

These three action types can then be dispatched to the store and thus we can perform the following mutations, returning a new version of state each time:

- **Increment:** Add one to the current count ( $0 \rightarrow 1$ )
- **Decrement:** Remove one from the current count ( $1 \rightarrow 0$ )
- **Reset:** Set the current count back to zero ( $n \rightarrow 0$ )

We can imagine that at this point, our user interface will be updated with the correct bound version of our count. Let's implement this and make it a reality.

# Using Vuex

Now that we've had a detailed look at what makes up an application driven by Vuex, let's make a playground project to take advantage of these features!

Run the following in your Terminal:

```
# Create a new Vue project
$ vue init webpack-simple vuex-counter

# Navigate to directory
$ cd vuex-counter

# Install dependencies
$ npm install

# Install Vuex
$ npm install vuex

# Run application
$ npm run dev
```

## Creating a new store

Let's start off by creating a file named `index.js` inside `src/store`. This is the file we'll use to create our new store and bring together the various components.

We can start by importing both `Vue` and `Vuex` as well as telling Vue that we'd like to use the `Vuex` plugin:

```
import Vue from 'vue';
import Vuex from 'vuex';

Vue.use(Vuex);
```

We can then export a new `Vuex.Store` with a `state` object that contains all of our application states. We're exporting this so that we can import the state in other components when necessary:

```
export default new Vuex.Store({
  state: {
    count: 0,
  },
});
```

## Defining action types

We can then create a file inside `src/store` named `mutation-types.js`, which contains the various actions that the user may take within our application:

```
export const INCREMENT = 'INCREMENT';
export const DECREMENT = 'DECREMENT';
export const RESET = 'RESET';
```

Although we don't have to explicitly define our actions like this, it's a good idea to use constants where possible. This allows us to take better advantage of tooling and linting techniques, as well as allowing us to infer the actions within our entire application at a glance.

## Actions

We can use these action types to commit a new action to be subsequently handled by our mutations. Create a file inside `src/store` named `actions.js`:

```
import * as types from './mutation-types';

export default {
  [types.INCREMENT] ({ commit }) {
    commit(types.INCREMENT);
  },
  [types.DECREMENT] ({ commit }) {
    commit(types.DECREMENT);
  },
  [types.RESET] ({ commit }) {
    commit(types.RESET);
  },
};
```

Inside each method, we're destructuring the returned `store` object to only take the `commit` function. If we didn't do this, we'd have to call the `commit` function like this:

```
export default {
  [types.INCREMENT] (store) {
    store.commit(types.INCREMENT);
  }
}
```

If we revisit our state diagram, we can see that after committing an action, the action is picked up by the mutator.

## Mutations

A mutation is the only method in which the state of the store can be changed; this is done by committing/dispatching an action, as seen earlier. Let's create a new file inside `src/store` named `mutations.js` and add the following:

```
import * as types from './mutation-types';

export default {
  [types.INCREMENT] (state) {
    state.count++;
  },
  [types.DECREMENT] (state) {
    state.count--;
  },
  [types.RESET] (state) {
    state.count = 0;
  },
};
```

You'll note that once again, we're using our action types to define the method names; this is possible with a new feature from ES2015+ named computed property names. Now, any time that an action is committed/dispatched, the mutator will know how to handle this and return a new state.

## Getters

We can now commit actions and have these actions return a new version of the state. The next step is to create getters so that we can return sliced parts of our state across our application. Let's create a new file inside `src/store` named `getters.js` and add the following:

```
export default {
  count(state) {
    return state.count;
  },
};
```

As we have a minuscule example, the use of a getter for this property isn't entirely necessary, but as we scale our application(s), we'll need to use getters to filter state. Think of these as computed properties for values in the state, so if we wanted to return a modified version of this property for the view-layer, we could as follows:

```
export default {
  count(state) {
    return state.count > 3 ? 'Above three!' : state.count;
  },
};
```

## Combining elements

In order to pull this all together, we have to revisit our `store/index.js` file and add the appropriate `state`, `actions`, `getters`, and `mutations`:

```
import Vue from 'vue';
import Vuex from 'vuex';

import actions from './actions';
import getters from './getters';
import mutations from './mutations';

Vue.use(Vuex);

export default new Vuex.Store({
  state: {
    count: 0,
  },
  actions,
  getters,
  mutations,
});
```

In our `App.vue`, we can create a template that will give us the current count as well as some buttons to increment, decrement, and reset state:

```
<template>
<div>
  <h1>{{count}}</h1>
  <button @click="increment">+</button>
  <button @click="decrement">-</button>
  <button @click="reset">R</button>
</div>
</template>
```

Whenever the user clicks on a button, an action is dispatched from within one of the following methods:

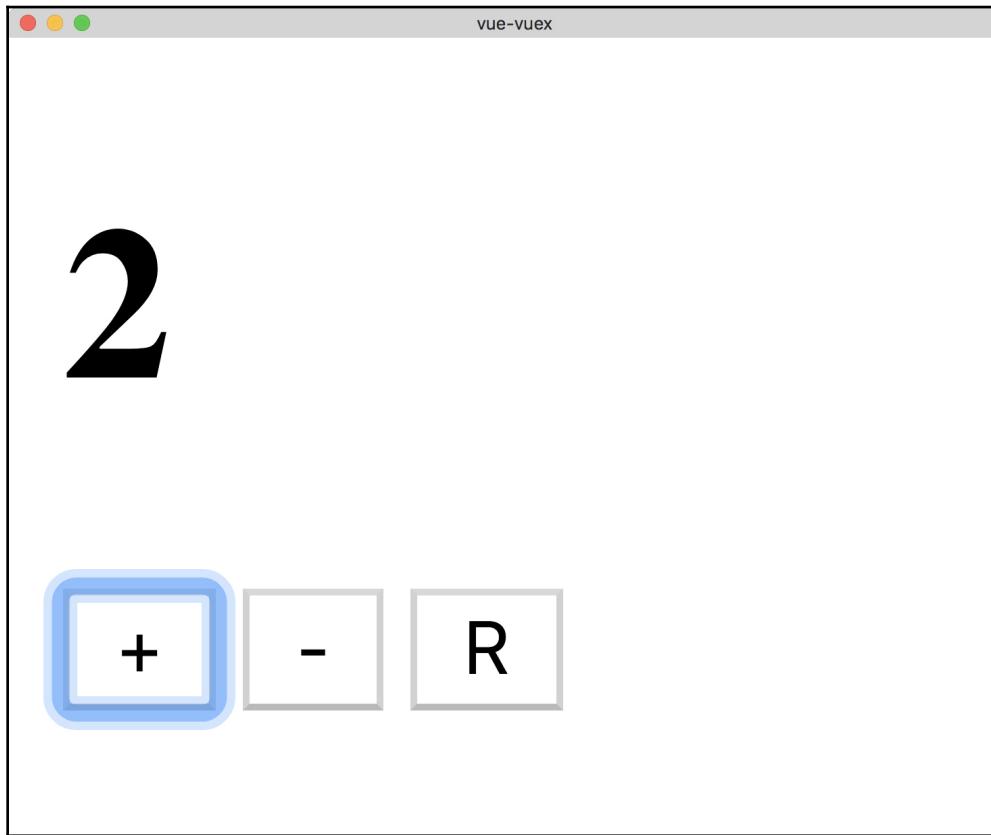
```
import * as types from './store/mutation-types';

export default {
  methods: {
    increment() {
      this.$store.dispatch(types.INCREMENT);
    },
    decrement() {
      this.$store.dispatch(types.DECREMENT);
    },
    reset() {
      this.$store.dispatch(types.RESET);
    },
  },
}
```

Once again, we're using constants to make for a better development experience. Next, in order to take advantage of the getter we created earlier, let's define a computed property:

```
export default {
  // Omitted
  computed: {
    count() {
      return this.$store.getters.count;
    },
  },
}
```

We then have an application that displays the current count and can be incremented, decremented, or reset:



## Payloads

What if we wanted to let the user decide how much they wanted to increment the count? Let's say we had a textbox that we could add a number and increment the count by that much. If the textbox was set to 0 or was empty, we'd increment the count by 1.

Our template would, therefore, look like this:

```
<template>
  <div>
    <h1>{{count}}</h1>

    <input type="text" v-model="amount">

    <button @click="increment">+</button>
    <button @click="decrement">-</button>
    <button @click="reset">R</button>
  </div>
</template>
```

We'd place the amount value on our local component state, as this doesn't necessarily need to be part of the main Vuex Store. This is an important realization to make, as it means we can still have local data/computed values if necessary. We can also update our methods to pass the amount through to our actions/mutations:

```
export default {
  data() {
    return {
      amount: 0,
    };
  },
  methods: {
    increment() {
      this.$store.dispatch(types.INCREMENT, this.getAmount);
    },
    decrement() {
      this.$store.dispatch(types.DECREMENT, this.getAmount);
    },
    reset() {
      this.$store.dispatch(types.RESET);
    },
  },
  computed: {
    count() {
      return this.$store.getters.count;
    },
    getAmount() {
      return Number(this.amount) || 1;
    },
  },
};
```

We then have to update `actions.js` as this now receives both the `state` object and our amount as an argument. When we use `commit`, let's also pass the `amount` through to the mutation:

```
import * as types from './mutation-types';

export default {
  [types.INCREMENT]({ commit }, amount) {
    commit(types.INCREMENT, amount);
  },
  [types.DECREMENT]({ commit }, amount) {
    commit(types.DECREMENT, amount);
  },
  [types.RESET]({ commit }) {
    commit(types.RESET);
  },
};
```

Therefore, our mutations look similar to before, but this time we increment/decrement based on the amount:

```
export default {
  [types.INCREMENT](state, amount) {
    state.count += amount;
  },
  [types.DECREMENT](state, amount) {
    state.count -= amount;
  },
  [types.RESET](state) {
    state.count = 0;
  },
};
```

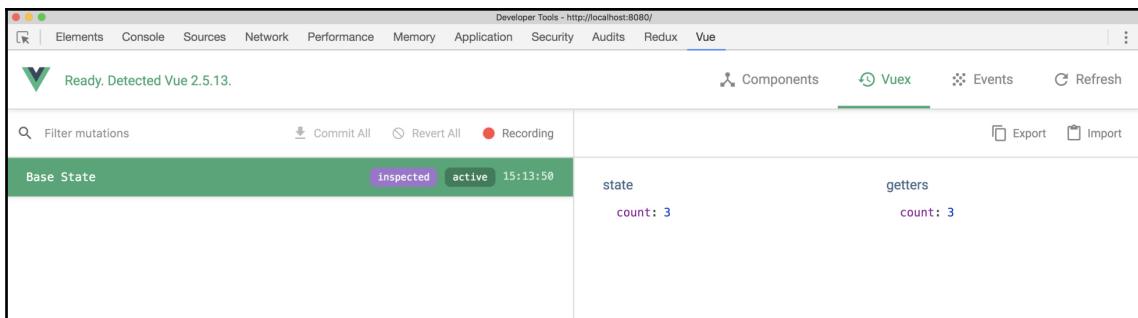
Ta-da! We can now increment the count based on a text value:



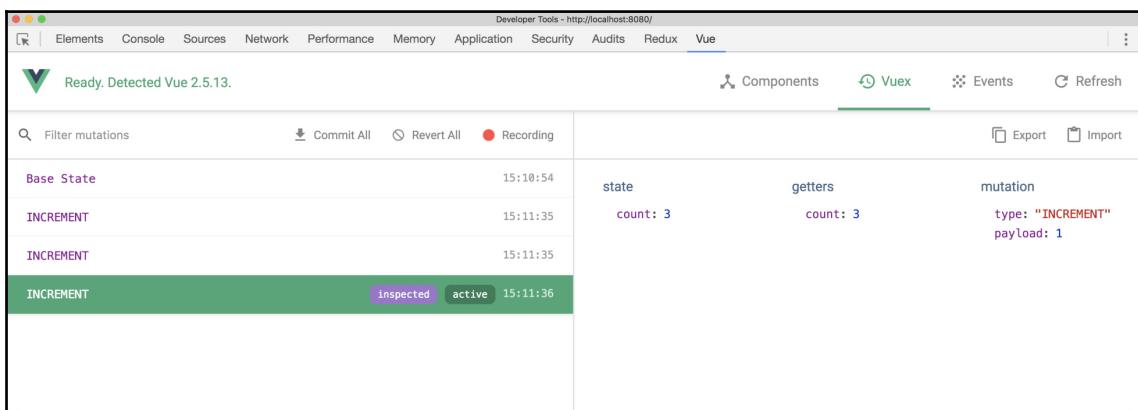
# Vuex and Vue devtools

Now that we have a consistent way of interacting with our store via actions, we can take advantage of the Vue devtools to see our state over time.

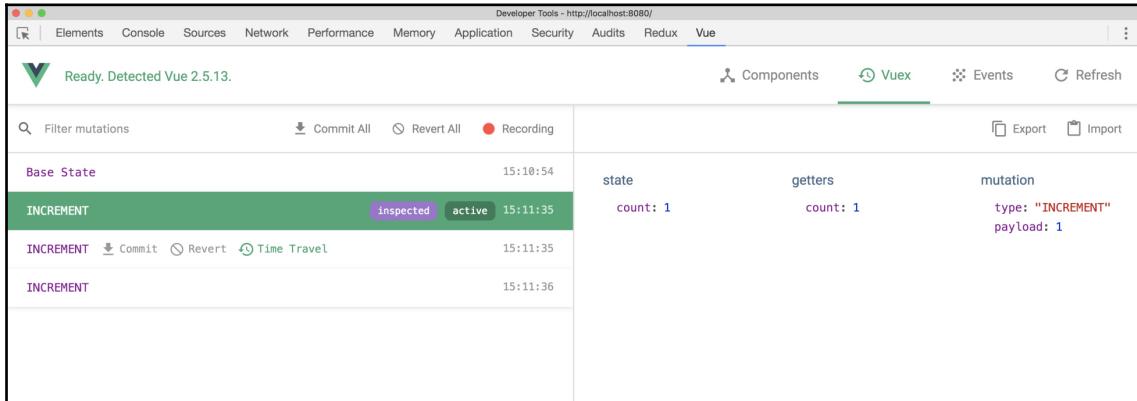
We'll be using the counter application as an example, to ensure that you have this project running, and right click on **Inspect Element** from within Chrome (or your browser's equivalent). If we head over to the **Vue** tab and select **Vuex**, we can see that the counter has been loaded with the initial application state:



From the preceding screenshot, you can see the count state member as well as the value of any getters. Let's click on the **increment** button a few times and see what happens:

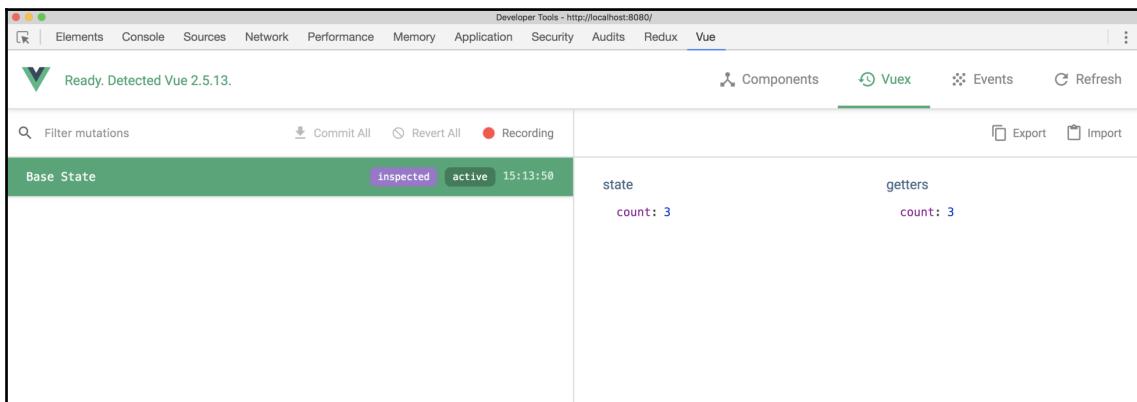


Awesome! We can see the **INCREMENT** action as well as a subsequent change to the **state and getters**, and more information about the **mutation** itself. Let's see how we can time travel throughout our state:



In the preceding screenshot, I've selected the **time travel** button on the first action. You can then see that our state is reverted to **count: 1**, and this is reflected in the rest of the metadata. The application is then updated to reflect this change in state, so we can literally step through each action and see the results on screen. Not only does this help with debugging, but any new state that we add to our application will follow the same process and be visible in this manner.

Let's hit the **commit** button on an action:



As you can see, this merges all of our actions up to when we hit **commit** to then be part of our **Base State**. As a result, the **count** property is then equal to the action you committed to **Base State**.

## Modules and scalability

At the moment, we have everything in root state. As our application gets larger, it would be a good idea to take advantage of modules so that we can appropriately split our container into different chunks. Let's turn our counter state into its own module by creating a new folder inside `store` named `modules/count`.

We can then move the `actions.js`, `getters.js`, `mutations.js`, and `mutation-types.js` files into the `count` module folder. After doing so, we can create an `index.js` file inside the folder that exports the state, actions, getters, and mutations for this module only:

```
import actions from './actions';
import getters from './getters';
import mutations from './mutations';

export const countStore = {
  state: {
    count: 0,
  },
  actions,
  getters,
  mutations,
};

export * from './mutation-types';
```

I've also elected to export the mutation types from the `index.js` file, so we can use these within our components on a per-module basis by importing from `store/modules/count` only. As we're importing more than one thing within this file, I gave the store the name of `countStore`. Let's define the new module inside `store/index.js`:

```
import Vue from 'vue';
import Vuex from 'vuex';
import { countStore } from './modules/count';

Vue.use(Vuex);

export default new Vuex.Store({
  modules: {
```

```
        countStore,  
    },  
});
```

Our `App.vue` then changes slightly; instead of referencing the `types` object, we reference the `types` specifically from this module:

```
import * as fromCount from './store/modules/count';  
  
export default {  
  data() {  
    return {  
      amount: 0,  
    };  
  },  
  methods: {  
    increment() {  
      this.$store.dispatch(fromCount.INCREMENT, this.getAmount);  
    },  
    decrement() {  
      this.$store.dispatch(fromCount.DECREMENT, this.getAmount);  
    },  
    reset() {  
      this.$store.dispatch(fromCount.RESET);  
    },  
  },  
  computed: {  
    count() {  
      return this.$store.getters.count;  
    },  
    getAmount() {  
      return Number(this.amount) || 1;  
    },  
  },  
};
```

We can then add more modules to our application by having the same files/structure as our `count` example. This allows us to scale as our application continues to grow.

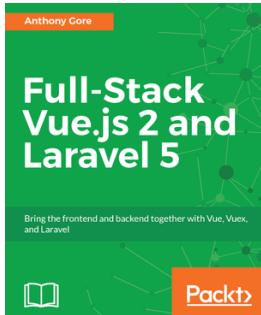
## Summary

In this chapter, we took advantage of the `Vuex` library for consistent state management within Vue. We defined what state is as well as component state and application-level state. We learned how to appropriately split our actions, getters, mutations, and store between different files for scalability as well as how to call these items within our components.

We also looked at using the Vue devtools with `Vuex` to step through mutations as they happened within our application. This gives us the ability to better debug/reason about the decisions we make when developing applications.

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# Index

## 4

404 page  
creating 220

## A

Add to basket button  
updating, on item addition 352  
alias routes 228, 229  
animate.css integration  
performing 384, 386  
working 387  
animating  
between states 109  
animations  
creating, with JavaScript 390, 391, 392, 393,  
394, 395, 396  
app enhancement  
unneeded code, removing 133, 134  
app  
outlining 230, 231  
planning 230, 231  
application level 648  
application space 8  
application  
integrating, with animate.css 384, 386  
autodetection formatting 54, 55  
Axios  
about 427  
used, for sending basic AJAX request 427, 428,  
429, 430

## B

Babel  
used, for compiling from ES6 523, 525, 526  
back and forward buttons  
using, in browser 133

balance  
formatting 28  
basic AJAX requests  
sending, with Axios 427, 428, 430  
basic web pages  
building 418  
basket array placeholder  
creating 347, 348  
basket quantity  
calculating 355  
basket  
products, adding to 349, 350  
breadcrumb  
creating, from current path 120, 121, 122, 123,  
124, 125  
updating 151  
browser automation 381

## C

caching  
alternative method 179, 180  
categories  
creating 304  
displaying 311, 313  
products, displaying in 314  
products, ordering in 319  
category list  
creating 304  
CDN (Content Delivery Network) 9  
checkbox filter change  
URL, updating on 340  
clean Webpack project  
creating 496  
code linter  
running, while developing 526, 529  
code  
optimizing 49

command line unit testing 380  
component data  
  using 64, 65  
component level 648  
component methods  
  using 64, 65  
Component Navigation Guards  
  about 626  
  beforeRouteEnter 627  
  beforeRouteLeave 627  
  beforeRouteUpdate 626  
components  
  about 231  
  bundling, with Webpack 500, 501, 503, 504, 506, 507  
  creating 98  
  data, passing to 65, 67, 71  
  HTML component 232  
  naming 221, 222  
  releasing, to public 532, 533, 534, 536, 537, 538, 540  
  rendering, JSX used 559  
  rendering, with children 555, 556, 557, 558  
  route component 231  
compound interest calculator  
  building 497, 499  
computed functions 14  
computed values  
  about 12, 13  
  inspecting 376  
concerns  
  separating, with modules 589, 590, 591, 592, 593  
conditional rendering  
  about 22  
  v-else directive 23, 24  
  v-if directive 22, 23  
content  
  filtering 34, 35, 36, 37, 38  
cross site scripting (XSS) 453  
CSS classes  
  modifying 40, 42, 43, 44  
CSV  
  loading 238, 239  
  loading, with CSV Parser 241  
  loading, with d3 library 239, 241  
  products, storing 243, 244, 245  
curated list  
  creating, for home page 299  
current path  
  breadcrumb, creating from 120, 121, 122, 123, 124, 125  
custom classes 44  
custom transition classes  
  adding 388, 389

## D

Data Object 555  
data  
  displaying 25, 98  
  fetching, before switching route 461, 463, 464  
  filtering 29  
  loading, from store 159, 160  
  passing, to components 65, 67, 71  
  storing 160, 161  
declarative rendering 21  
dependencies  
  organizing, with Webpack 509, 510, 511, 512, 513  
directive  
  about 542  
  creating 542, 543  
  working 544  
DocBlock 190  
download links  
  caching, on files 187, 188  
Dropbox app  
  creating 97, 98  
Dropbox data  
  displaying 102, 104  
  retrieving 99, 100  
dropbox-viewer component  
  updating, to work with Vuex 152, 153  
dynamic routes, with parameters  
  about 207, 209, 210, 211  
  GET parameters 212  
  props, using 212, 213  
dynamic routes  
  route props 625  
dynamic transitions

about 422  
performing 422, 423, 424  
working 425

## E

editable basket  
  creating 369, 370  
editable fields, creating 370  
  items, removing from cart 372  
Electron  
  about 602  
  used, for building universal applications 602, 606  
element  
  entering and leaving transitions, adding 409  
  key attribute, setting dynamically 403  
  letting leave, before enter phase in transition 404, 406  
  transitioning between 399, 400, 401, 402  
  two elements problem 404, 405, 406  
elements, moving in list  
  transitioning 409, 410, 412  
error, in request  
  recovering from 437, 438, 441, 442  
ES6 523  
event data  
  previewing 379

## F

Feathers  
  used, for creating real-time app 610, 612, 613  
file components  
  making 115  
file download ability  
  adding 127  
file meta information 104  
file size  
  formatting 105  
files  
  download links, caching on 187, 188  
  separating 113  
  storing 236, 237  
filter variables  
  grouping, logically 51  
  replacing 51

filtering 44  
filtering component  
  building, based on products 329, 330, 332, 334, 335  
filters, making component  
  about 85  
  component, creating 85  
  custom events, used for modifying filter field 87, 88  
  filter query, updating 89, 90  
  JavaScript errors, resolving 87  
filters  
  creating, dynamically 337, 338  
  filtering 39  
  preselecting, on page load 341  
  resetting 339  
Firebase  
  about 606  
  Vue, using with 607, 608, 609  
FLIP (First Last Invert Play) 388, 389  
folder components  
  making 115  
folder contents  
  caching 155, 157, 158  
folder structure  
  updating 116, 117, 118  
folders  
  displaying, based on URL 131  
  linking 116, 117, 118  
  modifying, for Vue-router 204  
  separating 113  
forcefeeding 393  
form  
  building 29, 30  
  creating, for sending data to server 433, 436, 437

format functions

  combining 54  
  second variable, passing into 55

format method

  creating 56

functional component

  creating 561, 562  
  working 564

## G

getters  
  accessing 595  
  argument, passing 596  
  building, for retrieving data 593, 595  
global router hooks  
  afterEach 628  
  beforeEach 627, 628  
  beforeResolve 628  
  resolution stack 629, 630

## H

home page  
  curated list, creating for 299  
HomePage component  
  routes, adding 282  
Horizon  
  used, for creating reactive app 614, 615, 618  
hot reloading  
  development process, speeding up with 518,  
    519, 520, 522  
HTML components 232  
HTML declarations  
  about 20  
  declarative rendering 21  
  v-html directive 20, 21

## I

infinite scrolling  
  implementing 447, 448, 449  
  working 449  
initial files  
  creating 233, 234  
initial render  
  transitioning on 396, 397, 398  
inputs  
  binding, to variables 31, 32

## J

JavaScript promises  
  reference 427  
JSX  
  about 559  
  used, for rendering component 559, 560, 561

## L

lazy loading routes 632, 633, 635  
libraries  
  loading 96  
linking  
  to sub-routes 206  
links  
  adding, to routes 204  
  creating, v-html used 27, 28  
ListProduct component  
  product information, displaying 301  
ListProducts component  
  building 358  
  creating 295  
loading screen  
  adding 106, 107, 108  
local server  
  setting up 237, 238  
logic  
  extracting, from components 496, 500

## M

message  
  displaying 10, 11  
methods 15  
minified and development .js file  
  building, with one command 530, 531, 532  
modules 662  
multiple router-view  
  adding, in pages 468, 469, 470, 471  
MVVM (Model-View-ViewModel) methodology 12

## N

named dynamic routes  
  using 464, 465, 466  
  working 467  
named views 224, 225  
navigation techniques  
  about 226  
  alias routes 228, 229  
  navigating programmatically 227  
  redirection 227, 228  
nested routes 217, 219  
Nightwatch.js

reference 381

## O

Order Checkout page

  creating 364

  details, copying between addresses 366, 367, 368

Order Confirmation screen 359

Order process

  building 358

## P

page load

  filters, preselecting on 341

PageNotFound route 246, 247

pagination component

  items per page, updating 294

  paginated list, displaying 287

  paginating buttons, creating 288

  pagination links, creating 291

  URL, updating on navigation 290

  values, calculating 283

pagination

  creating 283

parent folders

  caching 181, 182, 184

path variable

  breadcrumb component, updating 151

  dropbox-viewer component, updating to work with

    Vuex 152, 153

  using 151

paths 232

Patience JS 442

plugin

  about 549

  writing, for Vue 549, 550, 551

product count

  displaying, in app header 354, 355

product details

  updating, on switching URLs 276

product images 255, 258

product information

  adding, to store 349

  displaying 253, 255

  product images 260

product order

  wiring up 322

product price

  storing 320

product variations

  about 261

  variations display table 261

  variations, displaying in select box 269, 273, 274

products not found

  catching 250, 251, 252

products

  adding, to basket 349, 350

  displaying, in category 314

  filtering 342, 343, 345

  listing 281

  looping through 283

  ordering, in category 319

programmatic navigation

  about 630, 631

  router.go 631

  router.replace 631

progress bar

  adding, to load pages 483, 485, 486

promises

  reference 98

prop defaults

  setting 214

props

  about 65

  static props 216

  using 212, 213

## R

reactive app

  creating, with Horizon 613, 615, 618, 619

  working 620

real-time app

  creating, with Feathers 610, 612

  working 613

redirecting, routes

  dynamic redirect 489

  named redirect 488

  redirecting to 404s 488

registered date field

formatting 28, 29  
remote server  
  used 237  
repeatable component  
  computed functions, creating 76  
  creating 73, 74, 76  
  CSS class functions 76, 77  
  filtering, working with props 81, 83  
  formatted value functions 77, 78  
  methods, creating 76  
request  
  processing, before sending 450, 451, 452  
responsive table  
  building, with higher-order components 565, 566, 567, 569, 570  
REST (REpresentational State Transfer) 446  
REST client  
  creating 442, 443, 444, 445, 446  
REST server  
  creating 442, 443, 444, 445, 446  
reusable functions 15  
reusable transitions  
  building 420  
  packaging, into components 417, 418, 421  
  using, with elements in web page 420  
right product  
  selecting 247, 248, 249, 250  
route aliases  
  using 475, 476  
  working 478  
route component 231  
router-link element  
  advantages, over standard link 205  
router  
  Component Navigation Guards 626  
  dynamic routes 624  
  global router hooks 627  
  lazy loading routes 632, 633, 635  
  programmatic navigation 630  
  routes, creating 623, 624  
  using 622  
routes  
  composing, hierarchically 471, 472, 474, 475  
  errors, managing 480, 481, 482, 483  
  naming 222, 223, 224  
  redirecting 486, 487, 488

## S

scalability 662  
scrolling position  
  saving, when hitting back 489, 490, 491, 492, 493, 494  
SDK  
  initializing 97, 98  
Selenium  
  reference 382  
server setup  
  about 236  
  file, storing 236, 237  
  local server 238  
  local server, setting up 237  
  remote server, used 237  
Shop Vue-router URLs  
  finalizing 356  
Shopify CSV data  
  unifying 241, 242, 243  
simple component  
  rendering manually 553, 554, 555  
simple storage, for application  
  building 576, 577, 579, 580, 581  
Single Page Application (SPA) 621  
single product  
  displaying 245  
Page Not Found route 246  
PageNotFound route 247  
products not found, catching 250, 251, 252  
  right product, selecting 247, 248, 249, 250  
slots 68  
SPA (Single Page Applications)  
  about 456  
  creating, with vue-router 457, 459, 460, 461  
SPA project  
  about 635  
  child routes 642, 644, 645  
  data, obtaining from API 638, 639  
  detail page, creating 640, 641  
  router, enabling 636  
  routes, defining 636, 637  
  UserList route, creating 637  
SPA

testing 380  
state, of components  
  animating 413, 414, 415, 416  
states  
  animating between 109  
static props  
  using 216  
store mutation  
  creating 349, 350  
sub-routes  
  linking to 206  
subfolders, caching  
  about 167, 178  
  app methods, planning 168  
  data, displaying with displayFolderStructure  
    method 173  
  displayFolderStructure method 174  
  getFolderStructure method 169, 170, 171

## T

time-travel  
  viewing 378  
transitions  
  adding, between routes 478, 479, 480  
Tween.js library 415  
Typicode 434

## U

UMD (Universal Module Definition) module 508  
universal applications  
  building, with Electron 602, 604, 606  
unpkg service  
  reference 146  
URL change  
  structure, updating with 135, 136, 137  
URL hash  
  error message, displaying 131  
  updating 129  
  used, for navigating through folders 129  
URL  
  updating, on checkbox filter change 340  
user data  
  validating, before sending 431, 432, 433

## V

v-else directive 23, 24  
v-for directive 25  
v-html directive  
  about 20, 21  
  used, for creating links 27, 28  
v-if directive 22, 23  
variations display table  
  about 261  
  key, used with loops 261  
  variations, displaying in table 262, 264, 265,  
    267  
variations  
  displaying, in select box 269, 274  
Velocity.js  
  URL 390  
Vue components data  
  inspecting 376  
Vue components  
  creating 61, 62  
  initializing 62, 63  
Vue content  
  displaying 32, 33  
  hiding 32, 33  
Vue data  
  setting, outside of instance 135, 136, 137  
Vue devtools  
  about 660, 662  
Vue JavaScript  
  number of hard-coded variables, reducing 58  
  redundancy, reducing 58  
Vue library 9  
Vue life cycle hooks 100, 102  
Vue plugin  
  working 553  
Vue-router  
  folder, modifying for 204  
  initializing 200, 202  
  installing 200, 202  
vue-router  
  pages, loading dynamically 572, 573, 575, 576  
  used, for creating SPA 457  
Vue.js developer tools  
  using 376  
Vue

- initializing 9
  - message, displaying 10, 11
  - used, for obtaining data 98
  - using, with Firebase 606, 607, 609
  - Vuex getters**
    - creating 324, 326, 327
  - Vuex mutations**
    - about 581, 582, 585
    - viewing 377
    - working 583
  - Vuex store**
    - actions, testing 599
    - message, retrieving 148, 149
    - message, updating 149
    - mutations, testing 597
    - path methods, updating to use store commits 150, 151
    - software requisites 597
    - used, for folder path 149, 150
    - utilizing 147
    - working 601
  - Vuex**
    - about 647, 660
    - action types, defining 652
    - actions 652
    - actions, listing 585, 586, 587, 588
    - elements, combining 654
    - getters 653
    - initializing 146
  - mutations 653
  - payloads 656, 659
  - state 650
  - State Management Pattern (SMP) 648
  - store, creating 651
  - URL 648
  - using 651
- ## W
- Webpack project**
    - external components, using 513, 514, 515, 517, 518
  - Webpack**
    - components, bundling with 500
    - dependencies, organizing with 509, 510, 511, 512
    - working 508
  - WebSockets**
    - about 544
    - using, in Vue 544, 545
    - working 547, 548
  - workspace**
    - application space 8
    - creating 8
    - Vue library 9
- ## X
- XSS attacks**
    - preventing, to app 453, 454, 455