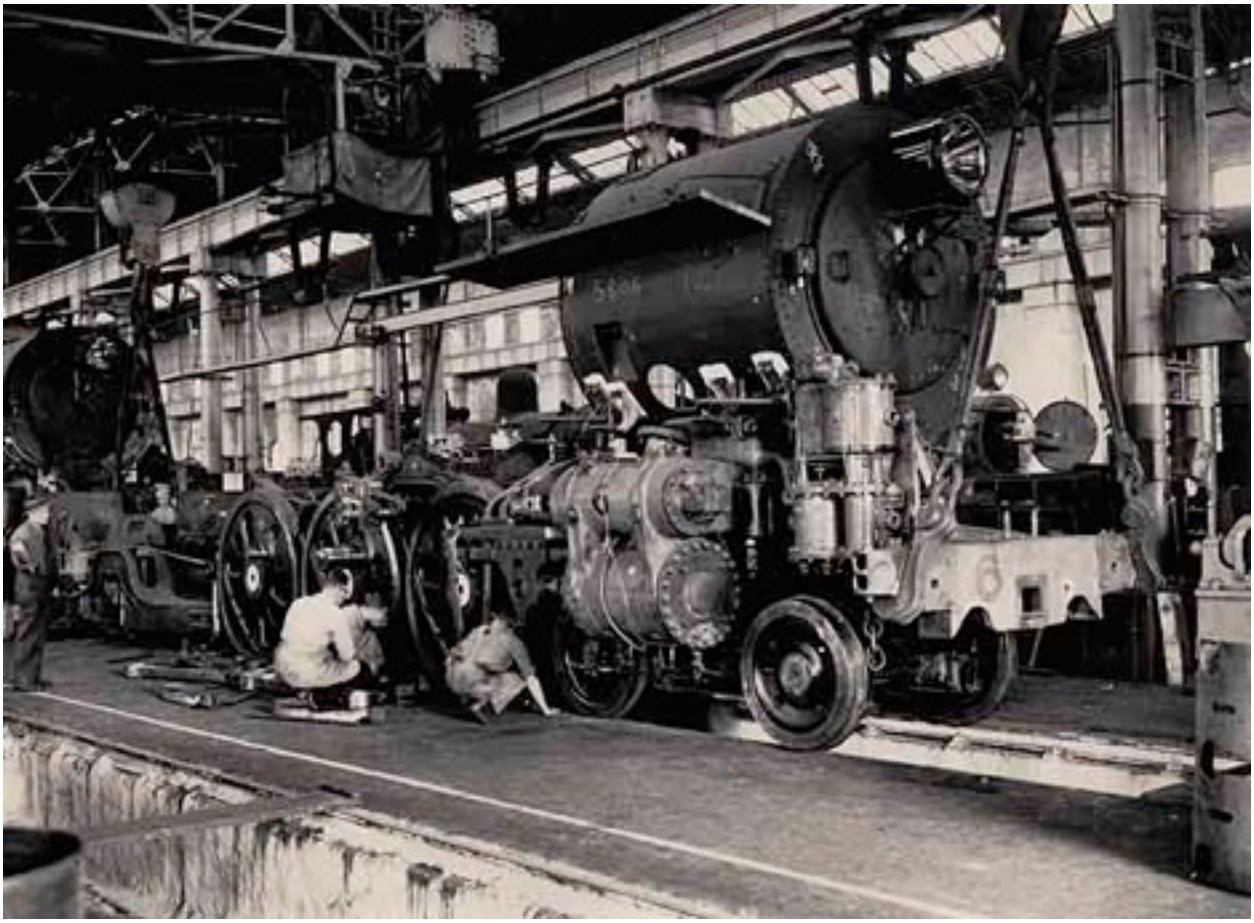
Rebuilding Rails

Get Your Hands Dirty and Build Your Own Ruby Web Framework



"Locomotive Construction", New South Wales State Records

Version: February 17th, 2014

0. Rebuilding Rails for Yourself

Why Rebuild Rails?

Knowing the deepest levels of any piece of software lets you master it. It's a special kind of competence you can't fake. You have to know it so well you could build it. What if you *did* build it? Wouldn't that be worth it?

This book will take you through building a Rails-like framework from an empty directory, using the same Ruby features and structures that make Rails so interesting.

Ruby on Rails is known for being "magical". A *lot* of that magic makes sense after you've built with those Ruby features.

Also, Ruby on Rails is an opinionated framework; the Rails team says so, loudly. What if you have different opinions? You'll build a Rails-like framework, but you'll have plenty of room to add your own features and make your own trade-offs.

Whether you want to master Rails exactly as it is or want to build your own personal version, this book can help.

Who Should Rebuild Rails?

You'll need to know some Ruby. If you've built several little Ruby apps or one medium-sized Rails app, you should be fine. If you consult the pickaxe book as you go along, that helps too ("http://ruby-doc.com/docs/ProgrammingRuby/"). You should be able to write basic Ruby without much trouble.

If you want to brush up on Rails, Michael Hartl's tutorials are excellent: "http://ruby.railstutorial.org/ruby-on-rails-tutorial-book". There's a free HTML version of them, or you can pay for PDF or

screencasts. Some concepts in this book are clearer if you already know them from Rails.

In most chapters, we'll use a little bit of Ruby magic. Each chapter will explain as we go along. None of these features are hard to understand. It's just surprising that Ruby lets you do it!

Working Through

Each chapter is about building a system in a Rails-like framework, which we'll call Rulers (like, Ruby on Rulers). Rulers is much simpler than the latest version of Rails. But once you build the simple version, you'll know what the complicated version does and a lot of how it works.

Later chapters have a link to source code -- that's what book-standard Rulers looks like at the end of the previous chapter. You can download the source and work through any specific chapter you're curious about.

Late in each chapter are suggested features and exercises. They're easy to skip over, and they're optional. But you'll get much more out of this book if you stop after each chapter and think about what you want in your framework. What does Rails do that you want to know more about? What doesn't Rails do but you really want to? Does Sinatra have something awesome? The best features to add are the ones you care about!

Cheating

You can download next chapter's sample code from GitHub instead of typing chapter by chapter. You'll get a **lot** more out of the material if you type it yourself, make mistakes yourself and, yes, painstakingly debug it yourself. But if there's something you

just can't get, use the sample code and move on. It'll be easier on your next time through.

It may take you more than once to get everything perfectly. Come back to code and exercises that are too much. Skip things but come back and work through them later. If the book's version is hard for you to get, go read the equivalent in Rails, or in a simpler framework like Sinatra. Sometimes you'll just need to see a concept explained in more than one way.

Oh, and you usually don't get the source code to the exercises, just the main chapter. There's a little bit of challenge left even for cheaters. You're welcome.

At the end of the chapter are pointers into the Rails source for the Rails version of each system. Reading Rails source is optional. But even major components (ActiveRecord, ActionPack) are still around 25,000 lines - short and readable compared to most frameworks. And generally you're looking for some specific smaller component, often between a hundred and a thousand lines.

You'll also be a better Rails programmer if you take the time to read good source code. Rails code is very rich in Ruby tricks and interesting examples of metaprogramming.

0.5 Getting Set Up

You'll need:

- Ruby 1.9 or higher
- a text editor
- a command-line or terminal
- Git (preferably)
- Bundler.
- SQLite, only for one later chapter... But it's a good one!

If you don't have them, you'll need to install them. This book contains an appendix with current instructions for doing so. Or you can install from source, from your favorite package manager, from RubyGems, or Google it and follow instructions.

Ruby 1.9 or higher is important. It's worth upgrading if you don't already use it. 1.9 averages *twice* the speed. Ruby 1.8 is deprecated and insecure. Rails 4 requires 1.9. New projects should *always* be started in Ruby 1.9+, even if they need 1.8 compatibility for a little while yet. 2.0 is basically the same as 1.9.

By "text editor" above, I specifically mean a programmer's editor. More specifically, I mean one that uses Unix-style newlines. On Windows this means a text editor with that feature such as Notepad++, SublimeText or TextPad. On Unix or Mac it means any editor that can create a plain text file with standard newlines such as TextEdit, SublimeText, AquaMacs, vim or TextMate.

I'll be assuming you type at a command line. That could be Terminal, xterm, Windows "cmd" or my personal favorite, iTerm2. The command line is likely familiar to you as a Ruby developer.

This book instructs in the command line because it is the most powerful way to develop. It's worth knowing.

It's possible to skip git in favor of different version control software (Subversion, Perforce, ClearCase, or even SourceSafe). It's highly recommended that you use some kind of version control. It should be in your fingers so deeply that you feel wrong when you program without it. Git is my favorite, but use your favorite. The example text will all use git and you'll need it to grab sample code. If you "git pull" to update your sample repo, make sure to use "-f". I'm using a slightly weird system for the chapters and I may add commits out of order.

Bundler is just a Ruby gem -- you can install it with "gem install bundler". Gemfiles are another excellent habit to cultivate, and we'll use them throughout the book.

SQLite is a simple SQL database stored in a local file on your computer. It's great for development, but please don't deploy on it. The lessons from it apply to nearly all SQL databases and adapters in one way or another, from MySQL and PostgreSQL to Oracle, VoltDB or JDBC. You'll want some recent version of SQLite 3. As I type this, the latest stable version is 3.7.11.

This edition of Rebuilding Rails uses Ruby 1.9.3-p327 and Bundler 1.2.2 for example output. You shouldn't need these exact versions.

1. Zero to “It Works!”

Now that you’re set up, it’s time to start building. Like Rails, your framework will be a gem (a Ruby library) that an application can include and build on. Throughout the book, we’ll call our framework “Rulers”, as in “Ruby on Rulers”.

In the Rough

First create a new, empty gem:

```
$ bundle gem rulers
      create  rulers/Gemfile
      create  rulers/Rakefile
      create  rulers/LICENSE.txt
      create  rulers/README.md
      create  rulers/.gitignore
      create  rulers/rulers.gemspec
      create  rulers/lib/rulers.rb
      create  rulers/lib/rulers/version.rb
Initializating git repo in src/rulers
```

Rulers is a gem (a library), and so it declares its dependencies in rulers.gemspec. Open that file in your text editor. You can customize your name, the gem description and so on if you like. You can customize various sections like this:

```
# rulers.gemspec
gem.name        = "rulers"
gem.version     = Rulers::VERSION
```

```
gem.authors     = ["Singleton Ruby-Webster"]
gem.email       = ["webster@singleton-rw.org"]
gem.homepage    = ""
gem.summary     = %q{A Rack-based Web Framework}
gem.description = %q{A Rack-based Web Framework,
                     but with extra awesome.}
```

Traditionally the summary is like the description but shorter. The summary is normally about one line, while the description can go on for four or five lines.

Make sure to replace “FIXME” and “TODO” in the descriptions - “`gem build`” doesn’t like them and they look bad to users.

You’ll need to add dependencies at the bottom. They can look like this:

```
gem.add_development_dependency "rspec"
gem.add_runtime_dependency "rest-client"
gem.add_runtime_dependency "some_gem", "1.3.0"
gem.add_runtime_dependency "other_gem", ">0.8.2"
```

Each of these adds a runtime dependency (needed to run the gem at all) or a development dependency (needed to develop or test the gem). For now, just add the following:

```
gem.add_runtime_dependency "rack"
```

Rack is a gem to interface your framework to a Ruby application server such as Mongrel, Thin, Lighttpd, Passenger, WEBrick or Unicorn. An application server is a special type of web server that

runs server applications, often in Ruby. In a real production environment you would run a web server like Apache or NGinX in front of the application servers. But in development we'll run a single application server and no more. Luckily, an application server also works just fine as a web server.

We'll cover Rack in a lot more detail in the Controllers chapter, and again in the Middleware chapter. For now, you should know that Rack is how Ruby turns HTTP requests into code running on your server.

Let's build your gem and install it:

```
> gem build rulers.gemspec
> gem install rulers-0.0.1.gem
```

Eventually we'll use your gem from the development directory with a Bundler trick. But for now we'll do it the simple way to get it in your fingers. It's always good to know the simplest way to do a task -- you can fall back to it when clever tricks aren't working.

Hello World, More or Less

Rails is a library like the one you just built, but what application will it run? We'll start a very simple app where you submit favorite quotes and users can rate them. Rails would use a generator for this ("rails new best_quotes"), but we're going to do it manually.

Make a directory and some subdirectories:

```
> mkdir best_quotes
> cd best_quotes
> git init
```

```
Initialized empty Git repository in src/
best_quotes/.git/
> mkdir config
> mkdir app
```

You'll also want to make sure to use your library. Add a Gemfile:

```
# best_quotes/Gemfile
source 'https://rubygems.org'
gem 'rulers'  # Your gem name
```

Then run "bundle install" to create a Gemfile.lock and make sure all dependencies are available.

We'll build from a trivial rack application. Create a config.ru file:

```
# best_quotes/config.ru
run proc {
  [200, {'Content-Type' => 'text/html'},
    ["Hello, world!"]]
}
```

Rack's "run" means "call that object for each request". In this case the proc returns success (200) and "Hello, world!" along with the HTTP header to make your browser display HTML.

Now you have a simple application which shows "Hello, world!" You can start it up by typing "rackup -p 3001" and then pointing a web browser to "http://localhost:3001". You should see the text "Hello, world!" which comes from your config.ru file.

(Problems? If you can't find the rackup command, make sure you updated your PATH environment variable to include the gems directory, back when you were installing Ruby and various gems! A ruby manager like rvm or rbenv can do this for you.)

Making Rulers Use Rack

In your Rulers directory, open up lib/rulers.rb. Change it to the following:

```
# rulers/lib/rulers.rb
require "rulers/version"

module Rulers
  class Application
    def call(env)
      [200, {'Content-Type' => 'text/html'},
        ["Hello from Ruby on Rulers!"]]
    end
  end
end
```

Build the gem again and install it (gem build rulers.gemspec; gem install rulers-0.0.1.gem). Now change into your application directory, best_quotes.

Now you can use the Rulers::Application class. Under config, open a new file config/application.rb and add the following:

```
# best_quotes/config/application.rb
require "rulers"
```

```
module BestQuotes
  class Application < Rulers::Application
  end
end
```

The "BestQuotes" application object should use your Rulers framework and show “Hello from Ruby on Rulers” when you use it. To use it, open up your config.ru, and change it to say:

```
# best_quotes/config.ru
require './config/application'
run BestQuotes::Application.new
```

Now when you type "rackup -p 3001" and point your browser to "http://localhost:3001", you should see "Hello from Ruby on Rulers!". You've made an application and it's using your framework!

Review

In this chapter, you created a reusable Ruby library as a gem. You included your gem into a sample application. You also set up a simple Rack application that you can build on using a Rackup file, config.ru. You learned the very basics of Rack, and hooked all these things together so that they're all working.

From here on out you'll be adding and tweaking. But this chapter was the only time you start from a blank slate and create something from nothing. Take a bow!

In Rails

By default Rails includes not one, but five reusable gems. The actual "Rails" gem contains very little code. Instead, it delegates to the supporting gems. Rails itself just ties them together.

Rails allows you to change out many components - you can specify a different ORM, a different testing library, a different Ruby template library or a different JavaScript library. So the descriptions below aren't always 100% accurate for applications that customize heavily.

Below are the basic Rails gems -- not dependencies and libraries, but the fundamental pieces of Rails itself.

- ActiveSupport is a compatibility library including methods that aren't necessarily specific to Rails. You'll see ActiveSupport used by non-Rails libraries because it contains such a lot of useful baseline functionality. ActiveSupport includes methods like how Rails changes words from single to plural, or CamelCase to snake_case. It also includes significantly better time and date support than the Ruby standard library.
- ActiveModel hooks into features of your models that aren't really about the database - for instance, if you want a URL for a given model, ActiveModel helps you there. It's a thin wrapper around many different ActiveModel implementations to tell Rails how to use them. Most commonly, ActiveModel implementations are ORMs (see ActiveRecord, below), but they can also use non-relational storage like MongoDB, Redis, Memcached or even just local machine memory.
- ActiveRecord is an Object-Relational Mapper (ORM). That means that it maps between Ruby objects and tables in a SQL database. When you query from or write to the SQL

database in Rails, you do it through ActiveRecord. ActiveRecord also implements ActiveModel. ActiveRecord supports MySQL and SQLite, plus JDBC, Oracle, PostgreSQL and many others.

- ActionPack does routing - the mapping of an incoming URL to a controller and action in Rails. It also sets up your controllers and views, and shepherds a request through its controller action and then through rendering the view. For some of it, ActionPack uses Rack. The template rendering itself is done through an external gem like Erubis for .erb templates, or Haml for .haml templates. ActionPack also handles action- or view-centered functionality like view caching.
- ActionMailer is used to send out email, especially email based on templates. It works a lot like you'd hope Rails email would, with controllers, actions and "views" - which for email are text-based templates, not regular web-page templates.

Not everything is in Rails, of course.

Some of what you built in this chapter was in the application, not in Rulers. Go ahead and make a new Rails 3 app - type "rails new test_app". If you look in config/application.rb, you'll see Rails setting up a Rails Application object, a lot like your Rulers Application object. You'll also see Rails' config.ru file, which looks a lot like yours. Right now is a good time to poke through the config directory and see what a Rails application sets up for you by default. Do you see anything that now makes more sense?

Exercises

Exercise One: Reloading Rulers

Let's add a bit of debugging to the Rulers framework.

```
# rulers/lib/rulers.rb
module Rulers
  class Application
    def call(env)
      `echo debug > debug.txt`;
      [200, {'Content-Type' => 'text/html'},
        ["Hello from Ruby on Rulers!"]]
    end
  end
end
```

When this executes, it should create a new file called debug.txt in best_quotes, where you ran rackup .

Try restarting your server and reloading your browser at "http://localhost:3001". But you won't see the debug file!

Try rebuilding the gem and reinstalling it (gem build rulers; gem install rulers-0.0.1.gem). Reload the browser. You still won't see it. Finally, restart the server again and reload the browser. Now you should finally see that debug file.

Rails and Rulers can both be hard to debug. In chapter 3 we'll look at Bundler's :path option as a way to make it easier. For now you'll need to reinstall the gem and restart the rack server before your new Rulers code gets executed. When the various conveniences fail, you'll know how to do it the old-fashioned way.

Exercise Two: Your Library's Library

You can begin a simple library of reusable functions, just like ActiveSupport. When an application uses your Rulers gem and then requires it ("require rulers"), the application will automatically get any methods in that file. Try adding a new file called lib/rulers/array.rb, with the following:

```
# rulers/lib/rulers/array.rb
class Array
  def sum(start = 0)
    inject(start, &:+)
  end
end
```

Have you seen "&:+" before? It's a fun trick. ":+" means "the symbol +" just like ":foo" means "the symbol foo." The "&" means "pass as a block" -- the code block in curly-braces that usually comes after. So you're passing a symbol as if it were a block. Ruby knows to convert a symbol into a proc that calls it. When you do it with "plus", you get "add these together."

Now add "`require "rulers/array"`" to the top of lib/rulers.rb. That will include it in all Rulers apps.

You'll need to go into the rulers directory and "git add ." before you rebuild the gem (git add .; gem build rulers.gemspec; gem install rulers-0.0.1.gem). That's because rulers.gemspec is actually calling git to find out what files to include in your gem. Have a look at this line from rulers.gemspec:

```
gem.files = `git ls-files`.split($/)
```

"git ls-files" will only show files git knows about -- the split is just to get the individual lines of output. If you create a new file, be sure to "git add ." before you rebuild the gem or you won't see it!

Now with your new rulers/array.rb file, any application including Rulers will be able to write $[1, 2, 37, 9].\text{sum}$ and get the sum of the array. Go ahead, add a few more methods that could be useful to the applications that will use your framework.

Exercise Three: Test Early, Test Often

Since we're building a Rack app, the rack-test gem is a convenient way to test it. Let's do that.

Add rack-test as a development (not runtime) dependency to your gemspec:

```
# rulers/rulers.gemspec, near the bottom
  # ...
  gem.add_runtime_dependency "rack"
  gem.add_development_dependency "rack-test"
  gem.add_development_dependency "test-unit"
end
```

(On Ruby 2.0 and higher, you'll need to explicitly declare a dependency on Test/Unit as well -- it's not automatic any more.)

Why use the Gemspec when you have a Gemfile? The gemspec is taken into account by apps and libraries that depend on your gem, so it's a good habit. In this case it's a development dependency, so it doesn't matter much, though.

Now run "bundle install" to make sure you've installed rack-test. We'll add one usable test for Rulers. Later you'll write more.

Make a test directory:

```
# From rulers directory
> mkdir test
```

Now we'll create a test helper:

```
# rulers/test/test_helper.rb
require "rack/test"
require "test/unit"

# Always use local Rulers first
d = File.join(File.dirname(__FILE__), "..", "lib")
$LOAD_PATH.unshift File.expand_path(d)

require "rulers"
```

The only surprising thing here should be the $LOAD_PATH magic. It makes sure that requiring "rulers" will require the local one in the current directory rather than, say, the one you installed as a gem. It does that by unshifting (prepending) the local path so it's checked before anything else in $LOAD_PATH.

We also do an expand_path so that it's an absolute, not a relative path. That's important if anything might change the current directory.

Testing a different local change to a gem you have installed can be annoying -- what do you have installed? What's being used? By explicitly prepending to the load path, you can be sure that the local not-necessarily-installed version of the code is used *first*.

Now you'll need a test, which we'll put in test_application.rb:

```
# rulers/test/test_application.rb
require_relative "test_helper"

class TestApp < Rulers::Application
end

class RulersAppTest < Test::Unit::TestCase
  include Rack::Test::Methods

  def app
    TestApp.new
  end

  def test_request
    get "/"

    assert last_response.ok?
    body = last_response.body
    assert body["Hello"]
  end

end
```

The require_relative just means "require, but check from this file's directory, not the load path". It's a fun, simple trick.

This test creates a new TestApplication class, creates an instance, and then gets "/" on that instance. It checks for error with "last_response.ok?" and that the body text contains "Hello".

To run the test, type “ruby test/test_application.rb”. It should run the test and display a message like this:

```
# Running tests:

.

Finished tests in 0.007869s, 127.0810 tests/s,
254.1619 assertions/s.

1 tests, 2 assertions, 0 failures, 0 errors, 0
skips
```

The line “get “/”” above can be “post “/my/url”” if you prefer, or any other HTTP method and URL.

Now, write at least one more test.

2. Your First Controller

In this chapter you'll write your very first controller and start to see how Rails routes a request.

You already have a very basic gem and application, and the gem is installed locally. If you don't, or if you don't like the code you wrote in the first chapter, you can download the sample source.

We'll bump up the gem version by 1 for every chapter of the book. If you're building the code on your own, you can do this or not.

To change the gem version, open up rulers/lib/rulers/version.rb and change the constant from "0.0.1" to "0.0.2". Next time you reinstall your gem, you'll need to type "gem build rulers.gemspec; gem install rulers-0.0.2.gem". You should delete rulers/rulers-0.0.1.gem, just so you don't install and run old code by mistake.

Sample Source

Sample source for all chapters is on GitHub:

http://github.com/noahgibbs/rulers

http://github.com/noahgibbs/best_quotes

Once you've cloned the repositories, in EACH directory do "git checkout -b chapter_2_mine chapter_2" to create a new branch called "chapter_2_mine" for your commits.

On the Rack

Last chapter's big return values for Rack can take some explaining. So let's do that. Here's one:

```
[200, {‘Content-Type’ => ‘text/html’},
  [ “Hello!” ]]
```

Let’s break that down. The first number, 200, is the HTTP status code. If you returned 404 then the web browser would show a 404 message -- page not found. If you returned 500, the browser should say that there was a server error.

The next hash is the headers. You can return all sorts of headers to set cookies, change security settings and many other things. The important one for us right now is ‘Content-Type’, which must be ‘text/html’. That just lets the browser know that we want the page rendered as HTML rather than text, JSON, XML, RSS or something else.

And finally, there’s the content. In this case we have only a single part containing a string. So the browser would show “Hello!”

Soon we’ll examine Rack’s “env” object, which is a hash of interesting values. For now all you need to know is that one of those values is called PATH_INFO, and it’s the part of the URL after the server name but minus the query parameters, if any. That’s the part of the URL that tells a Rails application what controller and action to use.

Routing Around

A request arrives at your web server or application server. Rack passes it through to your code. Rulers will need to route the request -- that means it takes the URL from that request and answers the question, "what controller and what action handle this request?" We're going to start with very simple routing.

Specifically, we're going to start with what was once Rails' default routing. That means URLs of the form "http://host.com/category/action" are routed to CategoryController#action.

Under "rulers", open lib/rulers.rb.

```
# rulers/lib/rulers.rb
require "rulers/version"
require "rulers/routing"

module Rulers
  class Application
    def call(env)
      klass, act = get_controller_and_action(env)
      controller = klass.new(env)
      text = controller.send(act)
      [200, {'Content-Type' => 'text/html'},
        [text]]
    end
  end

  class Controller
    def initialize(env)
      @env = env
    end

    def env
      @env
    end
  end
end
```

Our Application#call method is now getting a controller and action from the URL and then making a new controller and sending it the action. With a URL like "http://mysite.com/people/create", you'd hope to get PeopleController for klass and "create" for the action. We'll make that happen in rulers/routing.rb, below.

The controller just saves the environment we gave it. We'll use it later.

Now in lib/rulers/routing.rb:

```
# rulers/lib/rulers/routing.rb
module Rulers
  class Application
    def get_controller_and_action(env)
      _, cont, action, after =
        env["PATH_INFO"].split('/', 4)
      cont = cont.capitalize # "People"
      cont += "Controller" # "PeopleController"

      [Object.const_get(cont), action]
    end
  end
end
```

This is very simple routing, so we'll just get a controller and action as simply as possible. We split the URL on "/". The "4" just means "split no more than 4 times". So the split assigns an empty string to "_" from before the first slash, then the controller, then the action, and then everything else un-split in one lump. For now we throw away everything after the second "/" - but it's still in the environment, so it's not really gone.

The method “const_get” is a piece of Ruby magic - it just means look up any name starting with a capital letter - in this case, your controller class.

Also, you’ll sometimes see the underscore used to mean “a value I don’t care about”, as I do above. It’s actually a normal variable and you can use it however you like, but many Rubyists like to use it to mean “something I’m ignoring or don’t want.”

Now you’ll make a controller in best_quotes. Under app/controllers, make a file called quotes_controller.rb:

```
# best_quotes/app/controllers/quotes_controller.rb
class QuotesController < Rulers::Controller
  def a_quote
    "There is nothing either good or bad " +
      "but thinking makes it so."
  end
end
```

That looks like a decent controller, even if it’s not quite like Rails. You’ll need to add it to the application manually since you haven’t added magic Rails-style autoloading for your controllers yet. So open up best_quotes/config/application.rb. You’re going to add the following lines after “require ‘rulers’” and before declaring your app:

```
# best_quotes/config/application.rb (excerpt)
$LOAD_PATH << File.join(File.dirname(__FILE__),
                        "..", "app",
                        "controllers")
require "quotes_controller"
```

The LOAD_PATH line lets you load files out of “app/controllers” just by requiring their name, as Rails does. And then you require your new controller.

Now, go to the rulers directory and type “git add .; gem build rulers.gemspec; gem install rulers-0.0.2.gem”. Then under best_quotes, type “rackup -p 3001”. Finally, open your browser to “http://localhost:3001/quotes/a_quote”.

If you did everything right, you should see a quote from Hamlet. And you’re also seeing the very first action of your very first controller.

If you didn’t quite get it, please make sure to include “quotes/a_quote” in the URL, like you see above -- just going to the root no longer works.

It Almost Worked!

Now, have a look at the console where you ran rackup. Look up the screen. See that error? It’s possible you won’t on some browsers, but it’s likely you have an error like this:

```
NameError: wrong constant name
Favicon.icoController
  .../gems/rulers-0.0.3/lib/rulers/routing.rb:9:in
`const_get'
  .../gems/rulers-0.0.3/lib/rulers/routing.rb:9:in
`get_controller_and_action'
  .../gems/rulers-0.0.3/lib/rulers.rb:7:in `call'
  .../gems/rack-1.4.1/lib/rack/lint.rb:48:in
`_call'
  (...more lines...)
```

```
127.0.0.1 - - [21/Feb/2012 19:46:51] "GET /
favicon.ico HTTP/1.1" 500 42221 0.0092
```

You're looking at an error from the browser fetching a file... Hm... Check that last line... Yup, favicon.ico. Most browsers do this automatically. Eventually we'll have our framework or our web server take care of serving static files like this. But for now, we'll cheat horribly.

Open up rulers/lib/rulers.rb, and have a look at Rulers::Application#call. We can just check explicitly for PATH_INFO being /favicon.ico and return a 404:

```
# rulers/lib/rulers.rb
module Rulers
  class Application
    def call(env)
      if env['PATH_INFO'] == '/favicon.ico'
        return [404,
          {'Content-Type' => 'text/html'}, []]
      end

      klass, act = get_controller_and_action(env)
      controller = klass.new(env)
      text = controller.send(act)
      [200, {'Content-Type' => 'text/html'},
        [text]]
    end
  end
```

A horrible hack? Definitely. And eventually we'll fix it. For now, that will let you see your *real* errors without gumming up your terminal with unneeded ones.

Review

You've just set up very basic routing, and a controller action that you can route to. If you add more controller actions, you get more routes. Rulers 0.0.2 would be just barely enough to set up an extremely simple web site. We'll add much more as we go along.

You've learned a little more about Rack -- see the "Rails" section of this chapter for even more. You've also seen a little bit of Rails magic with LOAD_PATH and const_get, both of which we'll see more of later.

Exercises

Exercise One: Debugging the Rack Environment

Open app/controllers/quotes_controller.rb, and change it to this:

```
# best_quotes/app/controllers/quotes_controller.rb
class QuotesController < Rulers::Controller
  def a_quote
    "There is nothing either good or bad " +
      "but thinking makes it so." +
      "\n<pre>\n#{env}\n</pre>"
  end
end
```

Now restart the server -- you don't need to rebuild the gem if you just change the application. Reload the browser, and you should

see a big hash table full of interesting information. It's all in one line, so I'll reformat mine for you:

```
{"GATEWAY_INTERFACE"=>"CGI/1.1", "PATH_INFO"=>"/
quotes/a_quote", "QUERY_STRING"=>"",
"REMOTE_ADDR"=>"127.0.0.1",
"REMOTE_HOST"=>"localhost",
"REQUEST_METHOD"=>"GET", "REQUEST_URI"=>"http://
localhost:3001/quotes/a_quote", "SCRIPT_NAME"=>"",
"SERVER_NAME"=>"localhost", "SERVER_PORT"=>"3001",
"SERVER_PROTOCOL"=>"HTTP/1.1",
"SERVER_SOFTWARE"=>"WEBrick/1.3.1 (Ruby/
1.9.3/2012-11-10)", "HTTP_HOST"=>"localhost:3001",
"HTTP_CONNECTION"=>"keep-alive",
"HTTP_CACHE_CONTROL"=>"max-age=0",
"HTTP_USER_AGENT"=>"Mozilla/5.0 (Macintosh; Intel
Mac OS X 10_6_8) AppleWebKit/537.11 (KHTML, like
Gecko) Chrome/23.0.1271.64 Safari/537.11",
"HTTP_ACCEPT"=>"text/html,application/xhtml
+xml,application/xml;q=0.9,*/*;q=0.8",
"HTTP_ACCEPT_ENCODING"=>"gzip,deflate,sdch",
"HTTP_ACCEPT_LANGUAGE"=>"en-US,en;q=0.8",
"HTTP_ACCEPT_CHARSET"=>"ISO-8859-1,utf-8;q=0.7,*;q=
0.3", "rack.version"=>[1, 1], "rack.input"=>#>,
"rack.errors"=>#>>, "rack.multithread"=>true,
"rack.multiprocess"=>false, "rack.run_once"=>false,
"rack.url_scheme"=>"http", "HTTP_VERSION"=>"HTTP/
1.1", "REQUEST_PATH"=>"/quotes/a_quote"}
```

That looks like a lot, doesn't it? It's everything your application gets from Rack. When your Rails controller uses accessors like "post?", under the covers it's checking the Rack environment. If

your controller checked whether env[“REQUEST_METHOD”] == “POST”, you could easily add your own “post?” method.

Better yet, you can now see everything that Rails has to work with. Everything that Rails knows about the request coming in is extracted from the same hash you get.

Exercise Two: Debugging Exceptions

Let’s add a new method to our controller to raise an exception:

```
# best_quotes/app/controllers/quotes_controller.rb
class QuotesController < Rulers::Controller
  def exception
    raise "It's a bad one!"
  end
end
```

Re-run rackup, and go to “http://localhost:3001/quotes/exception” in your browser, which should raise an exception. You’ll probably see a prettily-formatted page saying there was a RuntimeError at /quotes/exception and a big stack trace.

In chapter 8 we’ll look very deeply into Rack middleware and why you’re seeing that. It’s not built into your browser, and you can actually turn it off by setting RACK_ENV to production in your environment. Basically, it’s a development-only debugging tool that you’re benefiting from.

However, you don’t have to use it. You could add a begin/rescue/end block in your Rulers application request and then decide what to do with exceptions.

Go into rulers/lib/rulers.rb and in your call method, add a begin/rescue/end around the controller.send() call. Now you have to

decide what to do if an exception is raised -- you can start with a simple error page, or a custom 500 page, or whatever you like.

What else can your framework do on errors?

Exercise Three: Roots and Routes

It's inconvenient that you can't just go to "http://localhost:3001" any more and see if things are working. Just getting an exception doesn't tell you if *you* broke anything.

Head back into rulers/lib/rulers.rb. Under the check for favicon.ico, you could put a check to see if PATH_INFO is just "/".

First, try hard-coding it to always go to "/quotes/a_quote" and test in your browser. Then, try one of the following:

- Return the contents of a known file -- maybe public/index.html?
- Look for a HomeController and its index action.
- Extra credit: try a browser redirect. This requires returning a code other than 200 or 404 and setting some headers.

In chapter 9 we'll build a much more configurable router, more like how Rails does it. Until then, it's pretty easy to hack a router in Ruby in your framework.

In Rails

ActionPack in Rails includes the controllers. Rails also has an ApplicationController which inherits from its controller base class, and then each individual controller inherits from that. Your framework could do that too!

Different Rails versions had substantially different routers. You can read about the current one in "*Rails Routing from the Outside In*": "http://guides.rubyonrails.org/routing.html". The routing Rulers is doing is similar to the old-style Rails 1.2 routes (still the

default in Rails 2.3) which would automatically look up a controller and action without you specifying the individual routes. That's not great security, but it's not a bad way to start, either. Rails 3 default routes work by generating a lot of individual matched routes, so they're not quite like this either.

Rails encapsulated the Rack information into a "request" object rather than just including the hash right into the controller. That's a good idea when you want to abstract it a bit -- normalize values for certain variables, for instance, or read and set cookies to store session data. Rails does a lot of that, and in chapter 6 you'll see how to make Rulers do it too. Rails also uses Rack under the hood, so it's working with the same basic information you are.

Rack is a simple, CGI-like interface, and there's less to it than you'd think. If you're curious, have a look at "http://rack.rubyforge.org/doc/SPEC.html" for all the details. It's a little hard to read, but it can tell you everything you need to know.

You'll learn more about Rack as we go along, especially in chapter 8. But for the impatient, Rails includes a specific guide to how it uses Rack: "http://guides.rubyonrails.org/rails_on_rack.html". It's full of things you can apply to your own framework. Some of them will be added in later chapters of this book.

3. Rails Automatic Loading

If you've used Rails much, it probably struck you as odd that you had to require your controller file. And that you had to restart the server repeatedly. In fact, all kinds of "too manual." What's up with that?

Rails actually does all kinds of neat automatic loading for you when it sees something it thinks it recognizes. If it sees BoboController and doesn't have one yet it loads "app/controllers/bobo_controller.rb". We're going to do that in this chapter.

You may already know about Ruby's method_missing. When you call a method that doesn't exist on an object, Ruby tries calling "method_missing" instead. That lets you make "invisible" methods with unusual names.

It turns out that Ruby *also* has const_missing, which does the same thing for constants that don't exist. Class names in Ruby... are just constants. Hmm...

Sample Source

Sample source for all chapters is on GitHub:

http://github.com/noahgibbs/rulers

http://github.com/noahgibbs/best_quotes

Once you've cloned the repositories, in EACH directory do "git checkout -b chapter_3_mine chapter_3" to create a new branch called "chapter_3_mine" for your commits.

Where's My Constant?

First, let's see how const_missing works.

Try putting this into a file called const_missing.rb and running it:

```
# some_directory/const_missing.rb
class Object
  def self.const_missing(c)
    STDERR.puts "Missing constant: #{c.inspect}!"
  end
end

Bobo
```

When you run it, you should see “Missing constant: :Bobo”. So that would let us know the class was used but not loaded. That seems promising. But we still get an error.

By the way -- you’ll see STDERR.puts repeatedly through this book. When debugging or printing error messages I like to use STDERR because it’s a bit harder to redirect than a normal “puts” and so you’re more likely to see it even when using a log file, background process or similar.

You’ll also see a lot of “inspect”. For simple structures, “inspect” shows them exactly as you’d type them into Ruby -- strings with quotes, numbers bare, symbols with a leading colon and so on. Much like STDERR.puts, it’s great to get “inspect” into your fingers every time you’re debugging -- then when you have a problem where something is the wrong type, you’ll generally know exactly what’s wrong. Make it a habit now!

Try creating another file, this one called bobo.rb, next to const_missing.rb. It should look like this:

```
# some_directory/bobo.rb
```

```
class Bobo
  def print_bobo
    puts "Bobo!"
  end
end
```

Pretty simple. Let's change const_missing.rb:

Appendix: Installing Ruby 2.0, Git, Bundler and SQLite3

Ruby 2.0

Ruby 2.0 is the latest, fastest, best version of Ruby out there as I write this. But it may not be installed on your machine. Let's get it. If you can't get 2.0, anything 1.9.2 or higher should be fine.

(You can also install through RVM. But RVM can be complicated, so I'm not recommending it if you don't already use it.)

Windows

To install Ruby on Windows, go to http://rubyinstaller.org/, hit "download", and choose version 1.9.3 or later. This should download an EXE to install Ruby.

Mac OS X

To install Ruby on Mac OS X, you can first install Homebrew ("http://mxcl.github.com/homebrew/") and then "brew install ruby". For other ways, you can Google "mac os x install ruby" or several similar phrases.

Ubuntu Linux

To install Ruby 1.9 on Linux , use apt-get:

```
> sudo apt-get install ruby-1.9.1
```

Despite the package name, this actually installs Ruby 1.9.2, which should work great.

Others

Google for “install Ruby on <my operating system>”. If you’re using an Amiga, email me!

Git (Source Control)

Windows

To install git on Windows, we recommend GitHub’s excellent documentation with lots of screenshots: “http://help.github.com/win-set-up-git/”. It will walk you through installing msysgit (“http://code.google.com/p/msysgit/”), a git implementation for Windows.

Mac OS X

To install git on Mac OS X, download and install the latest version from “http://git-scm.com/”. You won’t see an application icon for git, which is fine - it’s a command-line application that you run from the terminal. You can also install through Homebrew.

Ubuntu Linux

To install git on Ubuntu Linux, use apt.

```
> sudo apt-get install git-core
```

Others

Google for “install git on <my operating system>”.

Bundler

Bundler is a gem that Rails 3 uses to manage all the various Ruby gems that a library or application in Ruby uses these days. The

number can be huge, and there wasn't a great way to declare them before Gemfiles, which come from Bundler.

To install bundler:

```
> gem install bundler
Fetching: bundler-1.0.21.gem (100%)
Successfully installed bundler-1.0.21
1 gem installed
```

Other gems will be installed via Bundler later. It uses a file called a Gemfile that just declares what gems your library or app uses, and where to find them.

SQLite

Windows

Go to sqlite.org. Pick the most recent stable version and scroll down until you see "Precompiled Binaries for Windows". There is a This is what you'll be using.

Mac OS X

Mac OS X ships with SQLite3. If the SQLite3 gem is installed correctly it should use it without complaint.

Ubuntu Linux

You'll want to use apt-get (or similar) to install SQLite. Usually that's:

```
> sudo apt-get install sqlite3 libsqlite3-dev
```

Others

Google for “install sqlite3 on <my operating system>”.

Other Rubies

If you’re adventurous, you know about other Ruby implementations (e.g. JRuby, Rubinius). You may need to adjust some specific code snippets if you use one.