Backbone.js on Rails

Table of Contents

1. Preface (section unstarted)

2. Getting up to speed (section unstarted)

2.1. Backbone.js online resources

2.2. JavaScript online resources and books

3. Introduction (section unstarted)

3.1. Why use Backbone.js

3.2. When not to use Backbone.js

3.3. Why not SproutCore, Cappuccino, Knockout.js, Spine, etc.

3.4. The Example Application

Rails 3.1.0.rc5

Ruby 1.9.2

Backbone.js and Underscore.js are the non-minified versions. This is for informational purposes, but also because the Rails 3.1 asset pipeline will compress and minify them.

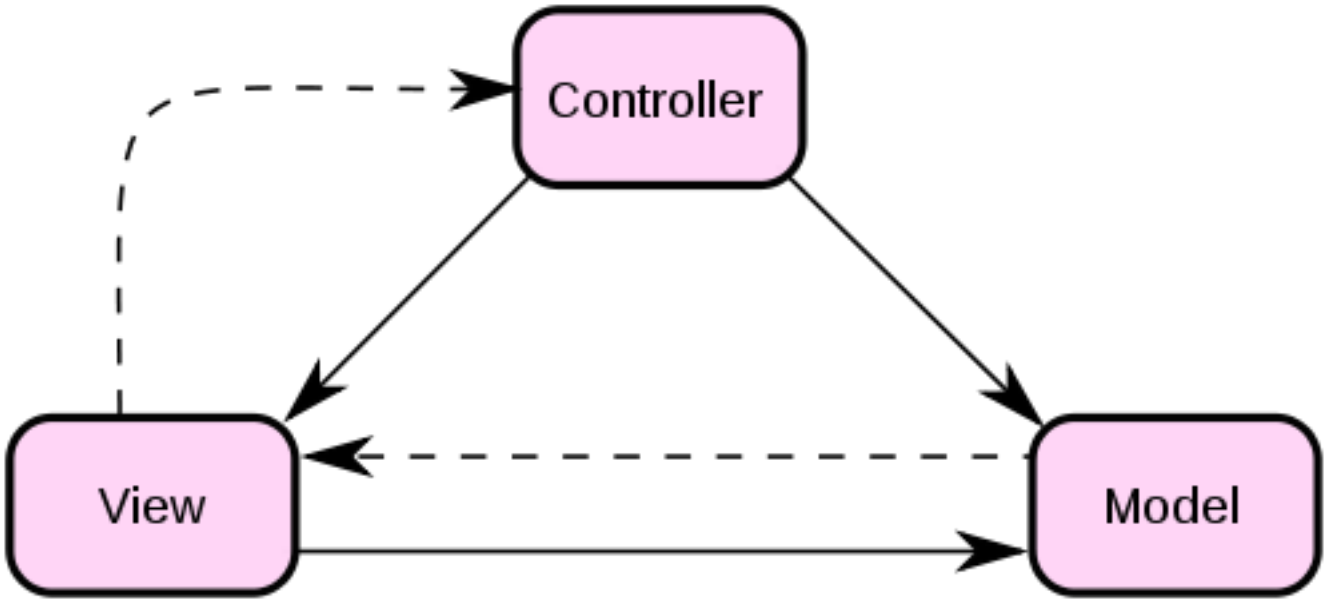
While Rails 3.1 defaults to Coffee script, we have decided to make all example code normal Javascript as we believe that will be the most understandable to the current readers.

4. Organization

4.1. Backbone.js and MVC

Model–View–Controller (MVC) is an architectural pattern used in many applications to isolate "domain logic" (the application logic for the user) from the user interface (input and presentation).

Figure 1. Model-view-controller concept



In the above diagram, a solid line represents a direct association, a dashed line an indirect association (for example, via an observer).

As a user of Rails, you're likely already familiar with the concept of MVC and the benefits that the separation of concerns can give you. However, Rails itself is not doing "traditional" MVC. A traditional MVC is event-based. This means that the views trigger events which the controller figures out what to do with. It can be argued that the requests generated by the browser are the "events" in Rails, however, due to the single-threaded, request-response nature of the web, the control flow between the different levels of MVC is much more straight-forward.

Given that Javascript has events, and that much of the interactions between the different components of Backbone.js in the browser are not limited to request/response, programming with Backbone.js is in a lot of ways more like working with a traditional MVC architecture.

That being said, technically speaking, Backbone.js is *not* MVC, and this was acknowledged by the creators of Backbone.js when they renamed Controllers to Routers in version 0.5.0.

So what is Backbone.js then if not MVC? Technically speaking, it's just the Models and the Views with a Router to handle flow between them. In Backbone.js the views will handle many of the aspects that controllers would typically handle, such as actually figuring out what to do next and what to render.

While you could do it, the benefit of actually introducing a Controller in your application would be limited, and the more pragmatic approach is to realize the great organization that Backbone.js gives you is much better than what you had before. The fact that it doesn't have a nice name, or strict adherence to a pattern, isn't worth worrying about.

4.2. What Goes Where

Part of the initial learning curve of Backbone.js can be figuring out what goes where, and mapping it to your expectations set by working with Rails. In Rails we have Models, Views, Controllers, and Routers. In Backbone.js, we have Models, Views, Templates, and Routers.

The models in Backbone.js and Rails are analogous. Because it lacks controllers, Backbone.js routers and views work together to pick up the functionality provided by Rails controllers. Finally, in Rails, when we say views, we actually mean templates. In Backbone.js, however, you have a separation between the view and templates.

Once you introduce Backbone.js into your stack, you grow the layers in your stack by four levels. This can be daunting at first, and frankly, at times it can be difficult to keep everything going on in your application straight. Ultimately, the additional organization and functionality of Backbone.js outweighs the costs, so let's break it down.

Rails

- Model
- Controller
- View

Backbone.js

- Model
- Router
- View
- Template

In a typical Rails and Backbone.js application, the initial interaction between the layers will be as follows:

- A request from a user comes in the **Rails router** identifies what should handle the request based on the URL
- The **Rails controller action** to handle the request is called, some initial processing may be performed
- The **Rails view template** is rendered and returned to the user's browser
- The **Rails view template** will include **Backbone.js initialization**, usually this is populating some **Backbone models** with JSON data provided by the **Rails view**
- The **Backbone.js router** determines which of its methods should handle the display based on the URL
- The **Backbone.js router** method calls that method, some initial processing may be performed, and one or more **Backbone.js views** are rendered
- The **Backbone.js view** reads **templates** and uses **Backbone.js** models to render itself onto the page

At this point, the user will see a nice page in their browser and be able to interact with it. The user interacting with elements on the page will trigger actions to be taken at any level of the above sequence: **Backbone.js model**, **Backbone.js views**, **Backbone.js router**, or requests to the remote server.

Requests to the remote server may be any one of the following:

- At the **Backbone.js model** level, communicating with Rails via JSON.
- Normal Ajax requests, not using Backbone.js at all.
- Normal requests that don't hit Backbone.js and trigger a full page reload.

Which of the above remote server interactions you use will depend upon the desired result, and the type of user interface. This book should help you understand which interaction you'll want to choose for each portion of your application.

4.3. Namespacing your application (chapter unstarted)

5. Rails Integration

5.1. Organizing your Backbone.js code in a Rails app

When using Backbone.js in a Rails app, you'll have two kinds of Backbone.js-related assets: classes, and templates.

5.2. Rails 3.0 and prior

With Rails 3.0 and prior, store your Backbone.js classes in `public/javascripts`:

```
public/
  javascripts/
    jquery.js
    jquery-ui.js
    collections/
      users.js
      todos.js
    models/
      user.js
      todo.js
    routers/
      users_router.js
      todos_router.js
    views/
      users/
        users_index.js
        users_new.js
        users_edit.js
      todos/
        todos_index.js
```

If you are using templates, we prefer storing them in `app/templates` to keep them separated from the server views:

```
app/
  views/
```

```
    pages/
      home.html.erb
      terms.html.erb
      privacy.html.erb
      about.html.erb
  templates/
    users/
      index.jst
      new.jst
      edit.jst
    todos/
      index.jst
      show.jst
```

On Rails 3.0 and prior apps, we use Jammit for packaging assets and precompiling templates:

http://documentcloud.github.com/jammit/
http://documentcloud.github.com/jammit/#jst

Jammit will make your templates available in a top-level JST object. For example, to access the above todos/index.jst template, you would refer to it as:

```
JST['todos/index']
```

Variables can be passed to the templates by passing a Hash to the template, as shown below.

```
JST['todos/index']({ model: this.model })
```

5.2.1. A note on Jammit and a JST naming gotcha

One issue with Jammit that we've encountered and worked around is that the JST template path can change when adding new templates.

When using Jammit, there is a slightly sticky issue as an app grows from one template subdirectory to multiple template subdirectories.

Let's say you place templates in app/templates. You work for a while on the "Tasks" feature, placing templates under app/templates/tasks. So, window.JST looks something like:

```
JST['form']
JST['show']
JST['index']
```

Now, you add another directory under app/templates, say app/templates/user. Now, all JST references are prefixed with their parent directory name so they are unambiguous:

```
JST['tasks/form']
JST['tasks/show']
JST['tasks/index']
JST['users/new']
JST['users/show']
JST['users/index']
```

This breaks existing JST references. You can work around this issue by applying the following monkeypatch to Jammit, in config/initializers/jammit.rb

```
Jammit::Compressor.class_eval do
  private
  def find_base_path(path)
```

```
    File.expand_path(Rails.root.join('app','templates'))
  end
end
```

As applications are moving to Rails 3.1, they're also moving to Sprockets for the asset packager. Until then, many apps are using Jammit for asset packaging. One issue with Jammit we've encountered and worked around is that the JST template path can change when adding new templates. We have an open issue and workaround:

https://github.com/documentcloud/jammit/issues/192

5.3. Rails 3.1

Rails 3.1 introduces the asset pipeline:

http://edgeguides.rubyonrails.org/asset_pipeline.html

which uses the Sprockets library for preprocessing and packaging assets:

http://getsprockets.org/

To take advantage of the built-in asset pipeline, organize your Backbone.js templates and classes in paths available to the asset pipeline. Classes go in `app/assets/javascripts/`, and templates go alongside, in `app/assets/templates/`:

```
app/
  assets/
    javascripts/
      collections/
        todos.js
      models/
        todo.js
      routers/
        todos_router.js
      views/
        todos/
          todos_index.js
    templates/
      todos/
        index.jst.ejs
        show.jst.ejs
```

In Rails 3.1, jQuery is provided by the jquery-rails gem, and no longer needs to be included in your directory structure.

Using Sprockets' preprocessors, we can use templates as before. Here, we're using the EJS template preprocessor to provide the same functionality as Underscore.js' templates. It compiles the `*.jst` files and makes them available on the client side via the `window.JST` object. Identifying the `.ejs` extension and invoking EJS to compile the templates is managed by Sprockets, and requires the `ejs` gem to be included in the application Gemfile.

Note

Underscore.js templates: http://documentcloud.github.com/underscore/#template

EJS gem: https://github.com/sstephenson/ruby-ejs

Sprockets support for EJS: https://github.com/sstephenson/sprockets/blob/master/lib/sprockets/ejs_template.rb

To make the `*.jst` files available and create the `window.JST` object, require them in your application.js Sprockets manifest:

```
//  other application requires
//= require_tree ../templates
//= require_tree .
```

Additionally, load order for Backbone.js and your Backbone.js app is very important. jQuery and Underscore.js must be loaded before Backbone.js, then the Rails authenticity token patch must be applied. Then your models must be loaded before your collections (because your collections will reference your models) and then your routers and views must be loaded.

Fortunately, sprockets can handle this load order for us. When all is said and done your application.js Sprockets manifest will be as shown below.

```
//= require jquery
//= require jquery_ujs
//
//= require underscore
//= require backbone
//= require backbone.authtokenadapter
//
//= require example_app
//
//= require_tree ./models
//= require_tree ./collections
//= require_tree ./views
//= require_tree ./routers
//= require_tree ../templates
//= require_tree .
```

The above is taken from the example application included with this book. You can view it at example_app/app/assets/javascripts/application.js.

5.4. Converting your Rails models to Backbone.js-friendly JSON

By default Backbone.js communicates with your Rails application via JSON gets and posts. If you've ever made a JSON api for your Rails app, then for the most part this will be very similar.

If you haven't ever made a JSON api for your Rails application before, lucky you, it's pretty straightforward.

5.4.1. Setting Up Models

One important aspect to keep in mind as you plan out how your Backbone.js interface will behave, and how it will use your Rails back-end is that there is no need to have a one-to-one mapping between your Rails models and your Backbone.js models.

The smaller an application is, the more likely that there will be a one-to-one mapping between both Backbone.js and Rails models and controllers.

However, if you have a sufficiently complex application, its more likely that you *won't* have a one-to-one mapping due to the differences in the tools Backbone.js gives you and the fact that you're building a user-interface, not a back-end. Some of the reasons why you won't have a one to one mapping include:

- Because you're building a user interface, not a back-end, it's likely that some of your backbone models will aggregate information from multiple Rails models into one Backbone.js model.
- This Backbone.js model may or may not be named the same as one of your Rails models.
- Backbone.js gives you a new type of object not present in Rails: Collections.
- Backbone.js doesn't have the concept of relationships out of the box.

With that said, lets take the simple case first and look at how you might make a Backbone.js version of a Rails model.

In our example application, we have a Task model. The simplest Backbone.js representation of this model would be as shown below.

```
var Task = Backbone.Model.extend({
  urlRoot: '/tasks'
});
```

The urlRoot property above indicates to Backbone.js that the server url for instances of this model will be found at /tasks/:id.

In Rails, its possible to access individual Tasks, as well as all Tasks (and query all tasks) through the same Task model. However, in Backbone.js models only represent the singular representation of a Task. Backbone.js splits out the plural representation of Tasks into what it calls Collections.

The simplex Backbone.js collection to represent our Tasks would be the following.

```
var Tasks = Backbone.Collection.extend({
  model: Task
});
```

If we specify the url for Tasks in our collection instead, then models within the collection will use the collection's url to construct their own urls, and the urlRoot no longer needs to be specified in the model. If we make that change, then our collection and models will be as follows.

```
var Tasks = Backbone.Collection.extend({
  model: Task,
  url: '/tasks'
});

var Task = Backbone.Model.extend({});
```

Notice in the above model definitions that there is no specification of the attributes on the model. Like ActiveRecord, Backbone.js models get their attributes from the schema and data given to them. In the case of Backbonejs, this schema and data are the JSON from the server.

The default JSON representation of an ActiveRecord model is a Hash that includes all the model's attributes. It does not include the data for any related models or any methods on the model, but it does include the ids of any related models as those are stories in a relation name _id attribute on the model.

The JSON representation of your ActiveRecord models will be retrieved by calling to_json on them. You customize the output of to_json by overriding the as_json method in your model.

The most common things you'll do in your Rails app when working with Backbone.js are the following.

Its likely that you'll wan to switch from including all attributes by default to excluding some attributes. This can be done by specifying explicitly only the attributes that are to be included, or specifying the attributes that should be included. Which one you choose will depend on how many attributes your model has and how paranoid you are about something important appearing in the JSON when it shouldn't be there. If your concerned about sensitive data unintentionally being included in the json when it shouldn't be then you'll want to switch to everything being explicitly included in the json. Otherwise, its a matter of preference and you can do what feels best for you an your app.

To explicitly specify the attributes to be included in the json, use the :only option, as shown in the following as_json implementation.

```
def as_json(options = {})
  super(options.merge(:only => [ :id, :title ]))
end
```

The above as_json override will make it so that the json will *only* include the id and title attributes, even if there are many other attributes on the model.

If instead you want to include all attributes by default and just exclude a few, you accomplish this with the :except option, as shown below.

```
def as_json(options = {})
  super(options.merge(:except => [ :encrypted_password ]))
end
```

Another common customization you will want to do in the json is include the output of methods on your model. This is accomplished with the :methods option, as shown in the following example.

```
def as_json(options = {})
  super(options.merge(:methods => [ :calculated_value ]))
end
```

The final thing you'll most commonly do with your JSON is include related objects. If our Tasks have_many Comments, to include all of the JSON for comments on a Task in the JSON for a Task. You do this with the :include option, as shown in the following example.

```
def as_json(options = {})
  super(options.merge(:include => [ :comments ]))
end
```

As you probably suspect, you can then customize the JSON for the comments by overriding the as_json method on the Comment model.

In Rails 3.1 ActiveRecord::Base.include_root_in_json is set to false. This is in contrast to Rails 3.0 which had it set to true. This reversal was made to simplify the JSON returned by default in Rails application, but it is fairly big change from the default behavior of Rails 3.0.

Practically speaking, this change is a good one, but if you're upgrading an existing Rails 3.0 application to Rails 3.1 and you already have a published api or Backbone.js code, you probably want to set it back to true, as it will cause your public api to change, breaking a lot of code, including your Backbone.js application.

While these are the most common as_json options you'll use when working with Backbone.js, it certainly isn't all of them. The official, complete, documentation for the as_json method can be found here: http://apidock.com/rails/ActiveModel/Serializers/JSON/as_json

5.4.2. Setting Up Controllers

The Backbone models and collections will talk to your Rails controllers. While your models may not have a one-to-one mapping with their Rails counterparts, it is likely that you'll have at least one controller corresponding to every Backbone.js model.

Fortunately for us, Backbone.js models will communicate in the normal RESTful way that Rails controllers understand, using the proper verbs to support the standard RESTful Rails controller actions: index, show, create, update, and destroy. Backbone.js does not make any use the new action.

Therefore, it's just up to us to write a *normal* restful controller.

There are a few different ways you can write your controllers for interacting with you Backbone.js models and collections. However, the newest and cleanest way is to use the respond_with method introduced in Rails 3.0.

When using respond_with, in your controller you specify what formats are supported with the method respond_to. In your individual actions, you then specify the resource or resources to be delivered using respond_with, as shown in the example Tasks controller and index action below.

```
class TasksController < ApplicationController::Base
  respond_to :html, :json

  def index
    respond_with(@tasks = Task.all)
  end
end
```

In the above example Tasks controller, the respond_to line declares that this controller should respond to both the HTML and JSON formats. Then, in the index action, the respond_with call will perform the appropriate action for the requested format.

The above controller is equivalent to the following one, using the older respond_to method.

```
class TasksController < ApplicationController::Base
  def index
    @tasks = Task.all
    respond_to do |format|
      format.html
      format.json { render :json => @tasks }
    end
  end
end
```

Using respond_with you can create succinct controllers that respond with a normal web page, but also expose a JSON api that Backbone.js will use.

5.4.2.1. Validations

If a model has a validate method defined, it will be validated before it's attributes are set. If validation fails, no changes to the model will occur, and the "error" event will be fired. Your validate method will be passed the attributes that are about to be updated. You can signal that validation passed by returning nothing from your validate method. You can signify that validation has failed by returning something from the method. What you return can be as simple as a string, or a more complex object that describes the error in all its gory detail.

In practice, much of the validation logic for your models will continue to be handled on the server, as fully implementing validations on the client side would often require duplicating a lot of server-side business logic.

Instead, your Backbone.js applications will likely rely on server-side validation logic. How to handle a failure scenario is passed in to Backbone.js model save call as a callback, as shown below.

```
task.save({title: "New Task title"}, {
  error: function(){
    // handle error from server
  }
});
```

The error callback will be triggered if your server returns a non-200 response. Therefore, you'll want your controller to return a non-200 HTTP response code if validations fail.

A controller that does this would be as shown in the following example.

```
class TasksController < ApplicationController::Base
  respond_to :json

  def create
    @task = Task.new(params[:task])
    if @task.save
      respond_with(@task)
    else
      respond_with(@task, :status => :unprocessable_entity)
    end
  end
end
```

Your error callback will receive both the model as it was attempted to be saved and the response from the server. You can take that response and handle the errors returned by the above controller in whatever way is fit for your application. For more information about handling and displaying errors, see the Form helpers section of the Views and Templates chapter.

5.4.3. Setting Up Views

Most Backbone.js applications will be a "single-page app". This means that your Rails application will render a single-page which properly sets up Backbone.js and the data it will use. From there, ongoing interaction with your Rails application occurs via the JSON apis.

The most common page for this single-page application will be the index action of a controller, as in our example application and the tasks controller.

You will want to create a Hash variable in Javascript for your Backbone,js application to reside. This variable will serve as a namespace for your Backbone,js application. Namespacing all of the javascript

is desirable to to avoid potential collisions in naming. For example, its possible that a Javascript library you want to use might also create a Task variable. If you didn't namespace your Task model then this would conflict and be unusable.

This variable includes a place to hold Models, Collections, Views, and Routes, and an init method which will be called to initialize the application. Its very common to create a new Router in the init function, and Backbone.history.start() must be called in order to route the initial URL. This app variable will look like the following.

```
var ExampleApp = {
  Models: {},
  Collections: {},
  Views: {},
  Routers: {},
  init: function() {
    new ExampleApp.Routers.Tasks();
    Backbone.history.start();
  }
};
```

You can find this file in the example app in app/assets/javascripts/example_app.js.

Important

You must instantiate a Backbone.js router before calling Backbone.history.start() otherwise Backbone.history will be undefined.

Then, inside app/views/tasks/index.html.erb you will call the initialize method. This will appear as follows.

```
<%= content_for :javascript do -%>
  <%= javascript_tag do %>
    ExampleApp.init();
  <% end %>
<% end -%>
```

For performance reasons, you will almost always "prime the pump" and give Backbone.js its initial data within the HTML view for this page. In our example, the tasks have already been provided to the view in a @tasks instance variable, and that can be used to prime the pump, as shown below.

```
<%= content_for :javascript do -%>
  <%= javascript_tag do %>
    ExampleApp.init(<%= @tasks.to_json %>);
  <% end %>
<% end -%>
```

The above example uses Erb to pass the JSON for the tasks to the init method.

Once you make this change, the ExampleApp.init method then becomes:

```
var ExampleApp = {
  Models: {},
  Collections: {},
  Views: {},
  Routers: {},
  init: function(tasks) {
    new ExampleApp.Routers.Tasks();
    this.tasks = new ExampleApp.Collections.Tasks(tasks);
```

```
    Backbone.history.start();
  }
};
```

Finally, you must have a Router in place which knows what to do. We'll cover routers in more detail in the Views and Templates chapter. For a more in-depth presentation on writing and using routes please go there. However, routers are an important part of the infrastructure you need to start using Backbone.js and we can't make our example here work without them.

Backbone.js routers provide methods for routing application flow based on client-side URL fragments (#fragment).

Note

Backbone.js now includes support for pushState, which can use real, full URLs instead of url fragments for routing.

However, pushState support in Backbone.js is fully opt-in due to lack of browser support and that additional server-side work is required to support it.

pustState support is current limited to the latest versions of Firefox, Chrome, and Safari and Mobile Safari. For a full listing of support and more information about the History API, of which pushState is a part, visit http://diveintohtml5.org/history.html#how

Thankfully, if you opt-in to pushState in Backbone.js, browsers that don't support pushState will continue to use hash-based URL fragments, and if a hash URL is visited by a pushState-capable browser, it will be transparently upgraded to the true URL.

In addition to browser support, another hurdle to seamless use of pushState is that because the URL used are real URLs, your server must now how to render each of the urls. For example, if your Backbone.js application as a route of /tasks/1, your server-side application must be able to respond to that page if the browser visits that URL directly.

For most applications, you can handle this by just rendering the content you would have for the root URL and letting backbone handle the rest of the routing to the proper location. But for full search-engine crawlability, your server-side application will need to render the entire HTML of the requested page.

```
ExampleApp.Routers.Tasks = Backbone.Router.extend({
  routes: {
    "": "index"
  },

  index: function() {
  }
});
```

A basic router consists of a routes hash which is a mapping between url fragments and methods on the router. If the current URL fragment, or one that is being visited matches one of the routes in the hash, its method will be called.

The example router above is all that is needed to complete our Backbone.js infrastructure. When a user visits /tasks the index.html.erb view will be rendered which properly initialized Backbone.js and its dependencies and the Backbone.js models, collections, routers, and views.

5.5. Converting an existing page/view area to use Backbone.js (chapter unstarted)

5.6. Automatically using the Rails authentication token

When using Backbone.js in a Rails app, you will run into a conflict with the Rails built in Cross Site Scripting (XSS) protection.

When Rails XSS is enabled, each POST or PUT request to Rails should include a special token which is verified to ensure that the request originated from a user which is actually using the Rails app. In recent versions of Rails, Backbone.js Ajax requests are no exception.

To get around this, you have two options. Disable Rails XSS protection (not recommended), or make Backbone.js play nicely with Rails XSS.

To make Backbone.js play nicely with Rails XSS you can monkeypatch Backbone.js to include the Rails XSS token in any requests it makes.

The following is one such script.

```
//
// With additions by Maciej Adwent http://github.com/Maciek416
// If token name and value are not supplied, this code Requires jQuery
//
// Adapted from:
// http://www.ngauthier.com/2011/02/backbone-and-rails-forgery-protection.html
// Nick Gauthier @ngauthier
//

var BackboneRailsAuthTokenAdapter = {

  //
  // Given an instance of Backbone, route its sync() function so that
  // it executes through this one first, which mixes in the CSRF
  // authenticity token that Rails 3 needs to protect requests from
  // forgery. Optionally, the token's name and value can be supplied
  // by the caller.
  //
  fixSync: function(Backbone, paramName /*optional*/, paramValue /*optional*/){

    if(typeof(paramName)=='string' && typeof(paramValue)=='string'){
      // Use paramName and paramValue as supplied
    } else {
      // Assume we've rendered meta tags with erb
      paramName = $("meta[name='csrf-param']").attr('content');
      paramValue = $("meta[name='csrf-token']").attr('content');
    }

    // alias away the sync method
    Backbone._sync = Backbone.sync;

    // define a new sync method
    Backbone.sync = function(method, model, success, error) {
```

```
      // only need a token for non-get requests
      if (method == 'create' || method == 'update' || method == 'delete') {

        // grab the token from the meta tag rails embeds
        var auth_options = {};
        auth_options[paramName] = paramValue;

        // set it as a model attribute without triggering events
        model.set(auth_options, {silent: true});
      }

      // proxy the call to the old sync method
      return Backbone._sync(method, model, success, error);
    };
  },


  // change Backbone's sync function back to the original one
  restoreSync: function(Backbone){
    Backbone.sync = Backbone._sync;
  }
};

BackboneRailsAuthTokenAdapter.fixSync(Backbone);
```

The above patch depends on jQuery, and should be included in your after jQuery and Backbone.js are loaded. Using Jammit, you'd list it below the backbone.js file.

In Rails 3.1, you'll place this file in lib/assets/javascripts. In the example app, you can find this this in example_app/lib/assets/javascripts/backbone.authtokenadapter.js.

6. Views and Templates

6.1. View explanation (chapter unstarted)

6.2. Templating strategy (chapter unstarted)

6.3. View helpers (chapter unstarted)

6.4. Form helpers (chapter unstarted)

6.5. Event binding (chapter unstarted)

6.6. Cleaning up: understanding binding and unbinding

Imagine you're writing a todo app. Consider two views: an index view which contains all the tasks, and a detail view that shows detail on one task. The interface switches between the two views, and both views can modify existing tasks (say, to indicate that the task is complete or incomplete.)

Figure 2. Tasks index view

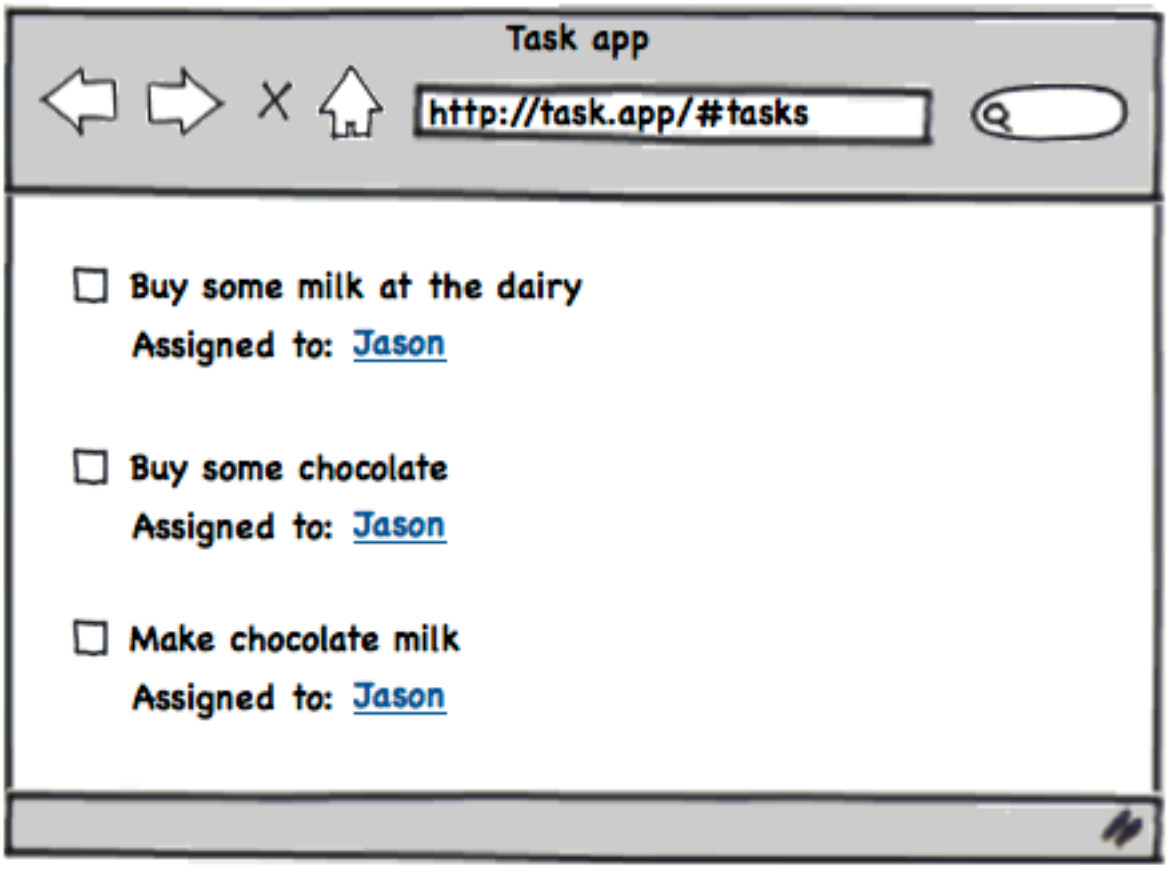
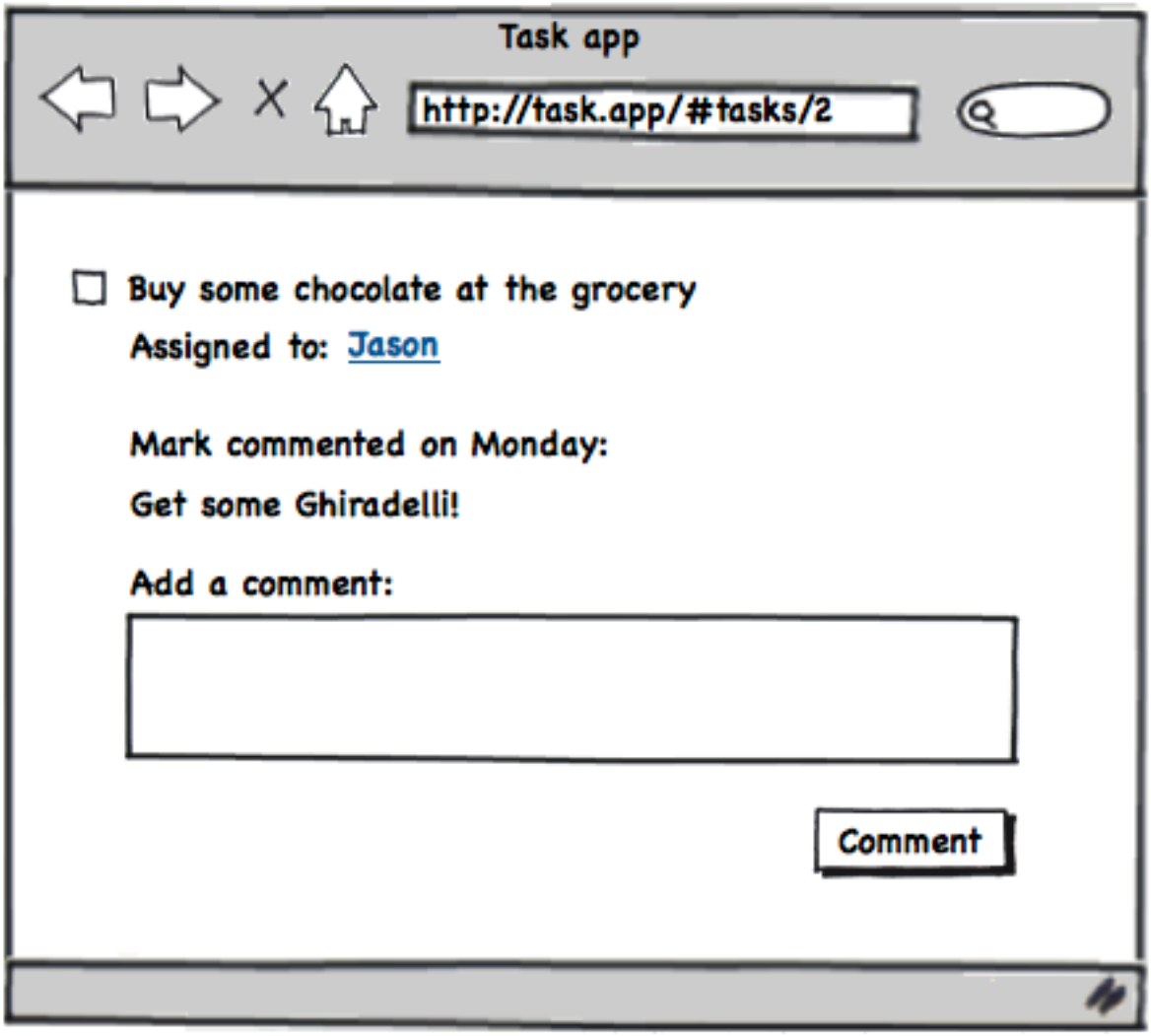


Figure 3. Tasks detail view



The view classes for these pages could be written as follows:

```
var TasksIndex = Backbone.View.extend({
  template: JST['tasks/tasks_index'],
  tagName: 'section',
  id: 'tasks',

  initialize: function() {
    _.bindAll(this, "render");
    TaskApp.tasks.bind("change", this.render);
    TaskApp.tasks.bind("add", this.render);
  },

  render: function() {
    $(this.el).html(this.template({tasks: this.collection}));
  }
});
```

```
var TaskDetail = Backbone.View.extend({
  template: JST['tasks/tasks_detail'],
  tagName: 'section',
  id: 'task',
```

```
  events: {
    "click .comments .form-inputs button": "createComment"
  },

  initialize: function() {
    _.bindAll(this, "render");

    this.model.bind("change", this.render);
    this.model.comments.bind("change", this.render);
    this.model.comments.bind("add", this.render);
  },

  render: function() {
    $(this.el).html(this.template({task: this.model}));
  },

  createComment: function() {
    var comment = new Comment({ text: this.$('.new-comment-input').val() });
    this.$('.new-comment-input').val('');
    this.model.comments.create(comment);
  }
});
```

Each task on the index page links to the detail view for itself. When a user follows one of these links and navigates from the index page to the detail page, then interacts with the detail view to change a model, the `change` event on the `TaskApp.tasks` collection is fired. One consequence of this is that the index view, which is still bound and observing the `change` event, will re-render itself.

This is both a functional bug and a memory leak: not only will the index view re-render and disrupt the detail display momentarily, but navigating back and forth between the views without disposing of the previous view will keep creating more views and binding more events on the associated models or collections.

These can be extremely tricky to track down on a production application, especially if you are rendering children views, much like how Rails can render a partial for each member of a collection. Sadly, there’s no "garbage collection" for views in Backbone, so your application needs to manage this itself.

The solution is to make sure you unbind events and remove views when you leave them. Our approach to this is to use a convention in `Router` instances, and reuse this as a `Router` subclass, `SwappingRouter`.

6.7. Swapping router

When switching from one view to another, we should clean up the previous view. Let’s augment our view to include the ability to clean itself up by "leaving" the DOM:

```
var MyView = Backbone.View.extend({
  // ...

  leave: function() {
    this.unbind();
    this.remove();
  },
```

```
  // ...
});
```

The `unbind()` and `remove()` functions are provided by `Backbone.Events` and `Backbone.View`. `unbind()` will remove all callbacks registered on the view, and `remove()` will remove the view's element from the DOM.

In simple cases, we replace one full page view with another full page (less any shared layout). We introduce a convention that all actions underneath one `Router` share the same root element, and define it as `el` on the router.

Now, a `SwappingRouter` can take advantage of the `leave()` function, and clean up any existing views before swapping to a new one. It swaps into a new view by rendering that view into its own `el`:

```
SwappingRouter = function(options) {
  Backbone.Router.apply(this, [options]);
};

_.extend(SwappingRouter.prototype, Backbone.Router.prototype, {
  swap: function(newView) {
    if (this.currentView && this.currentView.leave) {
      this.currentView.leave();
    }

    this.currentView = newView;
    this.currentView.render();
    $(this.el).empty().append(this.currentView.el);
  }
});

SwappingRouter.extend = Backbone.Router.extend;
```

Now all you need to do in a route function is call `swap()`, passing in the new view that should be rendered. The `swap()` function's job is to call `leave()` on the current view, render the new view and append it to the router's `el`, and finally store who the current view is, so that next time `swap()` is invoked, it can be properly cleaned up as well.

6.7.1. SwappingRouter and Backbone internals

If the code for `SwappingRouter` seems a little confusing, don't fret: it is, thanks to JavaScript's object model! Sadly, it's not as simple to just drop in the `swap` method into `Backbone.Router`, or call `Backbone.Router.extend` to mixin the function we need.

Our goal here is essentially to create a subclass of `Backbone.Router`, and to extend it without modifying the original class. This gives us a few benefits: first, `SwappingRouter` should work with Backbone upgrades. Second, it shold be **obvious** and **intention-revealing** when a controller needs to swap views. If we chose to just mix in a `swap` method, and called it from a direct descendant of `Backbone.Router`, an unaware (and unlucky) programmer now needs to go on a deep source dive in an attempt to figure out where that's coming from. At least with a subclass, the hunt should start at the file where it was defined.

The procedure used to create `SwappingRouter` is onerous thanks to a mix of Backbone-isms and just how clunky inheritance is in JavaScript. First off, we need to define the constructor, which

delegates to the `Backbone.Router` constructor with the use of `Function#apply`. The next block of code uses Underscore's `Object#extend` to create the set of functions and properties that will become `SwappingRouter`. The `extend` function takes a destination, in this case the empty prototype for `SwappingRouter`, and copies in the properties in the `Backbone.Router` prototype along with our new custom object that includes the `swap` function.

Finally, the subclass cake is topped off with some Backbone frosting: setting `extend`, which is a self-propagating function that all Backbone public classes use. Let's take a quick look at this function, as of Backbone 0.5.3:

```
var extend = function (protoProps, classProps) {
  var child = inherits(this, protoProps, classProps);
  child.extend = this.extend;
  return child;
};

// Helper function to correctly set up the prototype chain, for subclasses.
// Similar to `goog.inherits`, but uses a hash of prototype properties and
// class properties to be extended.
var inherits = function(parent, protoProps, staticProps) {
  // sparing our readers the internals of this function... for a deep dive
  // into the dark realms of JavaScript's prototype system, read the source!
}
```

So, it's a function that calls `inherits` to make a new subclass. The comments reference `goog.inherits` from Google's Closure Library, which contains similar utility functions to allow more class-style inheritance.

The end result here is that whenever you make a custom controller, internally in Backbone, you're making **another** subclass. The inheritance chain for `TasksRouter` would then look like:

Figure 4. Router class inheritance

Phew! Hopefully this adventure into Backbone and JavaScript internals has taught you that although it's more code, it's hopefully going to save time down the road for those maintaining your code.

6.8. Composite views

The `SwappingRouter` above calls `leave()` on the view it currently holds. This function is not part of Backbone itself, and is part of our extension library to help make views more modular and maintainable. This section goes over the Composite View pattern, the `CompositeView` class itself, and some concerns to keep in mind while creating your views.

6.8.1. Refactoring from a large view

One of the first refactorings you find yourself doing in a non-trivial Backbone app is splitting up large views into composable parts. Let's take another look at the `TaskDetail` source code from the beginning of this section:

```
var TaskDetail = Backbone.View.extend({
  template: JST['tasks/tasks_detail'],
  tagName: 'section',
  id: 'task',

  events: {
    "click .comments .form-inputs button": "createComment"
  },

  initialize: function() {
    _.bindAll(this, "render");

    this.model.bind("change", this.render);
    this.model.comments.bind("change", this.render);
    this.model.comments.bind("add", this.render);
  },

  render: function() {
    $(this.el).html(this.template({task: this.model}));
  },

  createComment: function() {
    var comment = new Comment({ text: this.$('.new-comment-input').val() });
    this.$('.new-comment-input').val('');
    this.model.comments.create(comment);
  }
});
```

The view class references a template, which renders out the HTML for this page:

```
<section class="task-details">
  <input type="checkbox"<%= task.isComplete() ? ' checked="checked"' : '' %> />
  <h2><%= task.escape("title") %></h2>
</section>

<section class="comments">
  <ul>
    <% task.comments.each(function(comment) { %>
      <li>
        <h4><%= comment.user.escape('name') %></h4>
        <p><%= comment.escape('text') %></p>
      </li>
    <% } %>
  </ul>

  <div class="form-inputs">
    <label for="new-comment-input">Add comment</label>
    <textarea id="new-comment-input" cols="30" rows="10"></textarea>
    <button>Add Comment</button>
  </div>
</section>
```

There are clearly several concerns going on here: rendering the task, rendering the comments that folks have left, and rendering the form to create new comments. Let’s separate those concerns. A first approach might be to just break up the template files:

```
<!-- tasks/show.jst -->
<section class="task-details">
  <%= JST['tasks/details']({ task: task }) %>
```

```
</section>

<section class="comments">
  <%= JST['comments/list']({ task: task }) %>
</section>
```

```
<!-- tasks/details.jst -->
<input type="checkbox"<%= task.isComplete() ? ' checked="checked"' : '' %> />
<h2><%= task.escape("title") %></h2>
```

```
<!-- comments/list.jst -->
<ul>
  <% task.comments.each(function(comment) { %>
    <%= JST['comments/item']({ comment: comment }) %>
  <% } %>
</ul>

<%= JST['comments/new']() %>
```

```
<!-- comments/item.jst -->
<h4><%= comment.user.escape('name') %></h4>
<p><%= comment.escape('text') %></p>
```

```
<!-- comments/new.jst -->
<div class="form-inputs">
  <label for="new-comment-input">Add comment</label>
  <textarea id="new-comment-input" cols="30" rows="10"></textarea>
  <button>Add Comment</button>
</div>
```

But this is really only half the story. The `TaskDetail` view class still handles multiple concerns: displaying the task, and creating comments. Let's split that view class up, using the `CompositeView` base class:

```
CompositeView = function(options) {
  this.children = [];
  Backbone.View.apply(this, [options]);
};

_.extend(CompositeView.prototype, Backbone.View.prototype, {
  leave: function() {
    this.unbind();
    this.remove();
    this._leaveChildren();
    this._removeFromParent();
  },

  removeChild: function(view) {
    var index = this.children.indexOf(view);
    this.children.splice(index, 1);
  },

  renderChild: function(view) {
    view.render();
    this.children.push(view);
    view.parent = this;
  },

  appendChild: function(view) {
```

```
    this.renderChild(view);
    $(this.el).append(view.el);
  },

  renderChildInto: function(view, container) {
    this.renderChild(view);
    $(container).html('').append(view.el);
  },

  _leaveChildren: function() {
    var clonedChildren = this.children.slice(0);
    _.each(clonedChildren, function(view) {
      if (view.leave) {
        view.leave();
      }
    });
  },

  _removeFromParent: function() {
    if (this.parent) {
      this.parent.removeChild(this);
    }
  }
});

CompositeView.extend = Backbone.View.extend;
```

Similar to the `SwappingRouter`, the `CompositeView` base class solves common housekeeping problems by establishing a convention. See the Swapping Router and Backbone internals section for an in-depth analysis of how this subclassing pattern works.

Now our `CompositeView` maintains an array of its immediate children as `this.children`. With this reference in place, a parent view's `leave()` method can invoke `leave()` on its children, ensuring that an entire tree of composed views is cleaned up properly.

For child views that can dismiss themselves, such as dialog boxes, children maintain a back-reference at `this.parent`. This is used to reach up and call `this.parent.removeChild(this)` for these self-dismissing views.

Making use of `CompositeView`, we split up the `TaskDetail` view class:

```
var TaskDetail = Backbone.View.extend({
  tagName: 'section',
  id: 'task',

  initialize: function() {
    _.bindAll(this, "renderDetails");
    this.model.bind("change", this.renderDetails);
  },

  render: function() {
    this.renderLayout();
    this.renderDetail();
    this.renderCommentsList();
  },

  renderLayout: function() {
```

```
    $(this.el).html(JST['tasks/show']());
  },

  renderDetails: function() {
    var detailsMarkup = JST['tasks/details']({ task: this.model });
    this.$('.task-details').html(detailsMarkup);
  },

  renderCommentsList: function() {
    var commentsList = new CommentsList({ model: this.model });
    var commentsContainer = this.$('comments');
    this.renderChildInto(commentsList, commentsContainer);
  }
});
```

```
var CommentsList = CompositeView.extend({
  tagName: 'ul',

  initialize: function() {
    this.model.comments.bind("add", this.renderComments);
  },

  render: function() {
    this.renderLayout();
    this.renderComments();
    this.renderCommentForm();
  },

  renderLayout: function() {
    $(this.el).html(JST['comments/list']());
  },

  renderComments: function() {
    var commentsContainer = this.$('comments-list');
    commentsContainer.html('');

    this.model.comments.each(function(comment) {
      var commentMarkup = JST['comments/item']({ comment: comment });
      commentsContainer.append(commentMarkup);
    });
  },

  renderCommentForm: function() {
    var commentForm = new CommentForm({ model: this.model });
    var commentFormContainer = this.$('.new-comment-form');
    this.renderChildInto(commentForm, commentFormContainer);
  }
});
```

```
var CommentForm = CompositeView.extend({
  events: {
    "click button": "createComment"
  },

  initialize: function() {
    this.model = this.options.model;
  },

  render: function() {
    $(this.el).html(JST['comments/new']);
```

```
  },

  createComment: function() {
    var comment = new Comment({ text: $('.new-comment-input').val() });
    this.$('.new-comment-input').val('');
    this.model.comments.create(comment);
  }
});
```

Along with this, remove the `<%= JST(…) %>` template nestings, allowing the view classes to assemble the templates instead. In this case, each template contains placeholder elements that are used to wrap child views:

```
<!-- tasks/show.jst -->
<section class="task-details">
</section>

<section class="comments">
</section>
```

```
<!-- tasks/details.jst -->
<input type="checkbox"<%= task.isComplete() ? ' checked="checked"' : '' %> />
<h2><%= task.escape("title") %></h2>
```

```
<!-- comments/list.jst -->
<ul class="comments-list">
</ul>

<section class="new-comment-form">
</section>
```

```
<!-- comments/item.jst -->
<h4><%= comment.user.escape('name') %></h4>
<p><%= comment.escape('text') %></p>
```

```
<!-- comments/new.jst -->
<label for="new-comment-input">Add comment</label>
<textarea class="new-comment-input" cols="30" rows="10"></textarea>
<button>Add Comment</button>
```

There are several advantages to this approach:

- Each view class has a smaller and more cohesive set of responsibilities.
- The comments view code, extracted and decoupled from the task view code, can now be reused on other domain objects with comments.
- The task view performs better, since adding new comments or updating the task details will only re-render the pertinent section, instead of re-rendering the entire task + comments composite.

6.8.2. Cleaning up views properly

6.9. How to use multiple views on the same model/ collection (chapter unstarted)

6.10. Internationalization (chapter unstarted)

7. Models and collections

7.1. Naming conventions (chapter unstarted)

7.2. Nested resources (chapter unstarted)

7.3. Model associations

Backbone.js doesn't prescribe a way to define associations between models, so we need to get creative and use the power of JavaScript to set up associations in a way that it's usage is natural.

7.3.1. Belongs to associations

Setting up a `belongs_to` association in Backbone is a two step process. Let's discuss setting up the association that may occur between a task and a user. The end result of the approach is a `Task` instance having a property called `user` where we store the associated `User` object.

To set this up, let's start by telling Rails to augment the task's JSON representation to also send over the associated user attributes:

```
class Task < ActiveRecord::Base
  belongs_to :user

  def as_json(options = {})
    super(include: { user: { only: [:name, :email] } })
  end
end
```

This means that when Backbone calls `fetch()` for a `Task` model, it will include the name and email of the associated user nested within the task JSON representation. Something like this:

```
{
  "title": "Buy more Cheeseburgers",
  "due_date": "2011-03-04",
  "user": {
    "name": "Robert McGraffalon",
    "email": "bobby@themcgraffalons.com"
  }
}
```

Now that we receive user data with the task's JSON representation, let's tell our Backbone User model to store the User object. We do that on the task's initializer. Here's a first cut at that:

```
var Task = Backbone.Model.extend({
```

```
  initialize: function() {
    this.user = new User(this.get('user'));
  }
});
```

A couple of improvements to the above: You'll soon realize that you will might be setting the user outside of the initialize as well. Also, the initializer should check whether there user data in the first place. To address the first concern, let's create a setter for the object. Backbone provides a handy function called `has` that returns whether the provided option is set for the object:

```
var User = Backbone.Model.extend({
  initialize: function() {
    if (this.has('user')) {
      this.user = setUser(new User(this.get('user')));
    }
  },

  setUser: function(user) {
    this.user = user;
  }
});
```

The final setup allows for a nice clean interface to a task's user, by accessing the task property fo the user instance.

```
var task = Task.fetch(1);
console.log(task.get('title') + ' is being worked on by ' + task.user.get('name'));
```

7.3.2. Has many associations

You can take a similar approach to set up a `has_many` association on the client side models. This time, however, the object's property will be a Backbone collection.

Following the example, say we need access to a user's tasks. Let's set up the JSON representation on the Rails side first:

```
class User < ActiveRecord::Base
  has_many :tasks

  def as_json(options = {})
    super(include: { tasks: { only: [:body, :due_date] } })
  end
end
```

Now, on the Backbone `User` model's initializer, let's call the `setTasks` function:

```
var User = Backbone.Model.extend({
  initialize: function() {
    var tasks = new Tasks.reset(this.get('tasks'));
    this.setTasks(tasks);
  },

  setTasks: function(tasks) {
    this.tasks = tasks;
  }
});
```

Note that we are setting the relation to an instance of the `Tasks` collection.

7.4. Scopes and filters

To filter a `Backbone.Collection`, like with Rails named scopes, define functions on your collections that filter by your criteria and return new instances of the collection class. A first implementation might look like this:

```
var Tasks = Backbone.Collection.extend({
  model: Task,
  url: '/tasks',

  complete: function() {
    var filteredTasks = this.select(function(task) {
      return task.get('completed_at') !== null;
    });
    return new Tasks(filteredTasks);
  }
});
```

Ideally, the filter functions will reuse logic already defined in your model class:

```
var Task = Backbone.Model.extend({
  isComplete: function() {
    return this.get('completed_at') !== null;
  }
});

var Tasks = Backbone.Collection.extend({
  model: Task,
  url: '/tasks',

  complete: function() {
    var filteredTasks = this.select(function(task) {
      return task.isComplete();
    });
    return new Tasks(filteredTasks);
  }
});
```

Going further, you can separate the two concerns here, and extract a `filtered` function:

```
var Task = Backbone.Model.extend({
  isComplete: function() {
    return this.get('completed_at') !== null;
  }
});

var Tasks = Backbone.Collection.extend({
  model: Task,
  url: '/tasks',

  complete: function() {
    return this.filtered(function(task) {
      return task.isComplete();
    });
  },

  filtered: function(criteriaFunction) {
    return new Tasks(this.select(criteriaFunction));
```

```
  }
});
```

7.5. Sorting

The simplest way to sort a `Backbone.Collection` is to define a `comparator` function:

```
var Tasks = Backbone.Collection.extend({
  model: Task,
  url: '/tasks',

  comparator: function(task) {
    return task.dueDate;
  }
});
```

If you'd like to provide more than one sort order on your collection, you can use an approach similar to the `filtered` function above, and return a new `Backbone.Collection` whose `comparator` is overridden. Call `sort` to update the ordering on the new collection:

```
var Tasks = Backbone.Collection.extend({
  model: Task,
  url: '/tasks',

  comparator: function(task) {
    return task.dueDate;
  },

  byCreatedAt: function() {
    var sortedCollection = new Tasks(this.models);
    sortedCollection.comparator = function(task) {
      return task.createdAt;
    };
    sortedCollection.sort();
    return sortedCollection;
  }
});
```

Similarly, you can extract the resuable concern to another function:

```
var Tasks = Backbone.Collection.extend({
  model: Task,
  url: '/tasks',

  comparator: function(task) {
    return task.dueDate;
  },

  byCreatedAt: function() {
    return this.sortedBy(function(task) {
      return task.createdAt;
    });
  },

  byCompletedAt: function() {
    return this.sortedBy(function(task) {
      return task.completedAt;
    });
  },
```

```
  sortedBy: function(comparator) {
    var sortedCollection = new Tasks(this.models);
    sortedCollection.comparator = comparator;
    sortedCollection.sort();
    return sortedCollection;
  }
});
```

7.6. Client/Server duplicated business logic (chapter unstarted)

7.7. Validations (chapter unstarted)

7.8. Synchronizing between clients (chapter unstarted)

8. Binding models and views (section unstarted)

9. Testing (section unstarted)

9.1. Full-stack integration testing

9.2. Isolated unit testing

10. The JavaScript language (section unstarted)

10.1. Model attribute types and serialization

10.2. Context binding (JS `this`)

10.3. CoffeeScript with Backbone.js

11. Security (stub)

11.1. XSS with JSON bootstrapping (stub)

Use `json2.js` and:

```
<script type="text/json" id="something">
  <%= something.to_json %>
</script>

<script type="text/javascript">
  (function () {
    var something = JSON.parse($('#something').text());
    someJavascriptFunction(something);
  })();
</script>
```

11.2. XSS in HTML templates (stub)

TODO: Discuss `Backbone.Model.escape`, `_.escape`, defaulting to escape with `<%=` vs `<%==`, escaping in other templating.