

Controller/server communication

Mendel Rosenblum

Controller's role in Model, View, Controller

- Controller's job to fetch model for the view
 - May have other server communication needs as well (e.g. authentication services)
- Browser is already talking to a web server, ask it for the model
- Early approach: have the browser do a HTTP request for the model
 - First people at Microsoft liked XML so the DOM extension got called: **XMLHttpRequest**
- Allowed JavaScript to do a HTTP request without switching page
- Widely used and called **AJAX** - **A**synchronous **J**avaScript and **X**ML
- Since it is using an HTTP request it can carry XML or anything else
 - More often used with JSON

XMLHttpRequest

Sending a Request

```
xhr = new XMLHttpRequest();  
xhr.onreadystatechange = xhrHandler;  
xhr.open("GET", url);  
xhr.send();
```

Any HTTP method (GET, POST, etc.) possible.

Responses/errors come in as events

Event handling

```
function xhrHandler() {  
    if (this.readyState != 4) { // DONE  
        return;  
    }  
    if (this.status != 200) { // OK  
        // Handle error ...  
        return;  
    }  
    ...  
    var text = this.responseText;  
    ...
```

XMLHttpRequest event processing

- Event handler gets called at various stages in the processing of the request

0	UNSENT	open() has not been called yet.
1	OPENED	send() has been called.
2	HEADERS_RECEIVED	send() has been called, and headers and status are available.
3	LOADING	Downloading; responseText holds partial data.
4	DONE	The operation is complete.

- Response available as:
 - raw text - responseText
 - XML document - responseXML
- Can set request headers and read response headers

Traditional AJAX uses patterns

- Response is HTML

```
elem.innerHTML = xhr.responseText;
```

- Response is JavaScript

```
eval(xhr.responseText);
```

Neither of the above are the AngularJS way

- Response is model data (JSON frequently uses here)

```
JSON.parse(xhr.responseText);
```

Fetching models with XMLHttpRequest

- Controller needs to communicate in the request what model is needed
- Can encode model selection information in request in:

URL path: `xhr.open("GET", "userModel/78237489/fullname");`

Query params: `xhr.open("GET", "userModel?id=78237489&type=fullname");`

Request body:

```
xhr.open("POST", url);  
xhr.setRequestHeader("Content-type",  
    "application/x-www-form-urlencoded");  
xhr.send("id=78237489&type=fullname");
```

REST APIs

- REST - **r**epresentational **s**tate **t**ransfer
- Guidelines for web app to server communications
- 2000 PhD dissertation that was highly impactful
 - Trend at the time was complex Remote Procedure Calls (RPCs) system
 - Became a must have thing: Do you have a REST API?
- Some good ideas, some not so good
 - Doesn't work for everything

Some RESTful API attributes

- Server should export **resources** to clients using unique names (**URIs**)
 - Example: `http://www.example.com/photo/` is a collection
 - Example: `http://www.example.com/photo/78237489` is a resource
- Keep servers "stateless"
 - Support easy load balancing across web servers
 - Allow caching of resources
- Server supports a set of HTTP methods mapping to **Create, Read, Update, Delete (CRUD)** on resource specified in the URL
 - GET method - Read resource (list on collection)
 - PUT method - Update resource
 - POST method - Create resource
 - DELETE method - Delete resource

REST API design

- Define the **resources** of the service and give them unique names (URIs)
 - Example: Photos, Users, Comments, ...
- Have clients use a CRUD operations using HTTP methods
- Extend when needed (e.g. transaction across multiple resources)

Angular accessing RESTful APIs

- `$http` - Send an arbitrary HTTP request (`$http.get`, `$http.post`)
- `$resource` - Interact with RESTful server-side data sources

Define a REST resource `$resource`

```
var resource = $resource(resourceURL, parameters);
```

Perform REST method on the resource

```
resource.get(parameters, callback);  
resource.save(parameters, callback);  
(query, delete as well)
```

Angular \$resource service example - Fetch model

```
var PhotoListOfUser = $resource('/photos/:id', {id: '@id'}, {  
    get: {method: 'get', isArray: true}  
});
```

```
PhotoListOfUser.get({id: userId}, function(userPhotos) {  
    console.log('userPhotos', userPhotos);  
});
```

Generates a HTTP GET to the URL and returns the model (an array of Photo Models)

Angular \$resource service example - Store model

```
var AddComment = $resource('/commentsOfPhoto/:id', {id: photoId});  
  
AddComment.save({commentText: 'New Comment!'}, function (comment) {  
    console.log('Added comment', comment);  
});
```

Generates a HTTP POST (rest create) to the URL and the model created

Other Transports: HTML5 WebSockets

- Rather than running over HTTP, HTML5 brings sockets to the browser
 - TCP connection from JavaScript to backend Web Server

- Event-based interface like XMLHttpRequest:

```
var socket = new WebSocket("ws://www.example.com/socketserver");
socket.onopen = function (event) {
    socket.send(JSON.stringify(request));
};
```

```
socket.onmessage = function (event) {
    JSON.parse(event.data);
};
```

Remote Procedure Call (RPC)

- Traditional distributed computation technology supporting calling of a function on a remote machine.
 - Browser packages function's arguments into a message to the web server.
 - Function is invoked with the arguments on the server.
 - Function's return value is sent back to the browser.
- Allows arbitrary code to be run on server - handles complex, multiple resource operations
 - Reduces number of round trip messages and makes failure handling easier.
- Can result in more complex to use interface compared to REST
 - Need to document the API (i.e. functions and their calling sequence)
- RPC can be done over HTTP (e.g. POST) or WebSockets

GraphQL

- Standard protocol for backends from Facebook
 - Like REST, server exports resources that can be fetched by the web app
 - Unlike REST
 - Server exports a "schema" describing the resources and supported queries.
 - Client specifies what properties of the resource it is interested in retrieving.
 - Can fetch from many different resources in the same request (i.e. entire model in one query).
- Update operations specified in the exported schema
 - Allows an RPC-like interface
- Gaining in popularity particularly compared to REST