REST APIs

CSC 326

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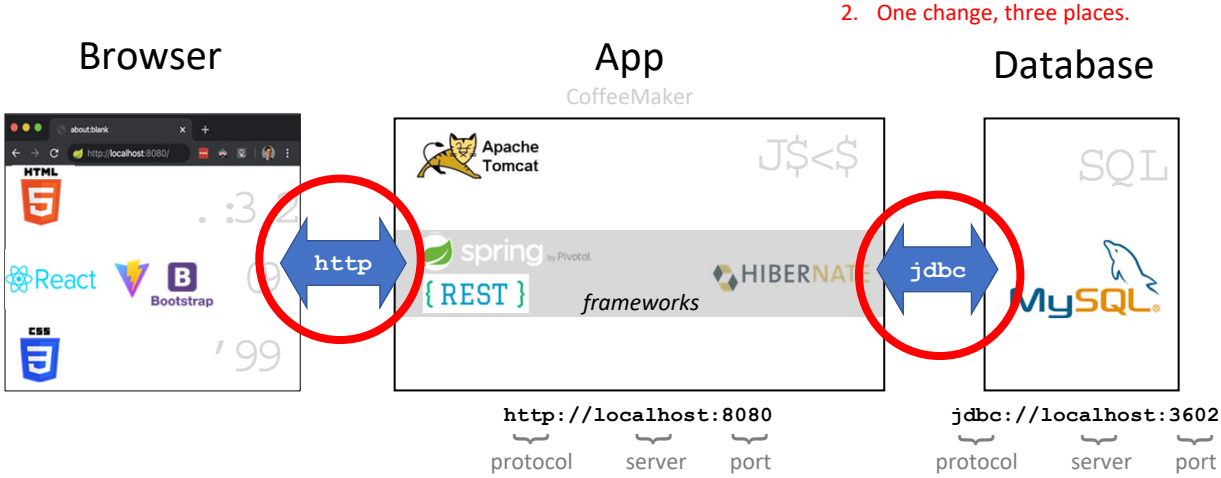
Key Pain Points

Transfer Representation of Data
1. Slow.
2. One change, three places.



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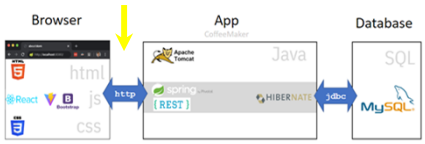
What are API's?



- Problem: *How can my software talk to other software?*
- Solution: ***APIs*** *Application Programming Interface*
- Example: { REST } • **REST** = **RE**presentational **S**tate **T**ransfer

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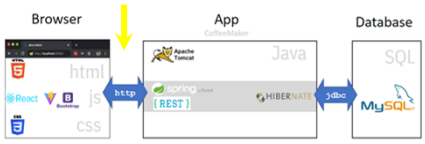
REST APIs



- Provide an interface for clients (typically web systems) to interact with back end models, controllers, and services
- Consume and produce JSON
- Actions use HTTP requests, like GET, POST, DELETE, PUT

GET	Retrieve record(s)	GET /recipes/	Retrieves all recipes
DELETE	Delete record(s)	DELETE /recipes/1	Deletes recipe with id of 1
POST	Create record	POST /recipes/	Creates a new recipe
PUT	Update record	PUT /recipes/3	Updates recipe 3

This is like the CRUD operations from the Backend lecture!

You'll need to send along some extra JSON data for the last two

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Pragmatic REST API Design

- Audience: developer
  - Goal: Make developer as successful as possible
- Nouns = Resources (top level object)
  - Collections
  - Element of collection
- Verbs = Operations on collections and element
  - Use HTTP Verbs
    - POST (**c**reate)
    - GET (**r**ead)
    - PUT (**u**pdate)
    - DELETE (**d**elete)

`/dogs`

`/dogs/1234`

Web API Design

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Example REST API Interactions

Resource	POST (create)	GET (read)	PUT (update)	DELETE (delete)
/dogs	Create a new dog	List dogs	Bulk update dogs	Delete all dogs
/dogs/1234	Error	Show Bo	If exists, update Bo If not, error	Delete Bo

Web API Design - Table from Page 7

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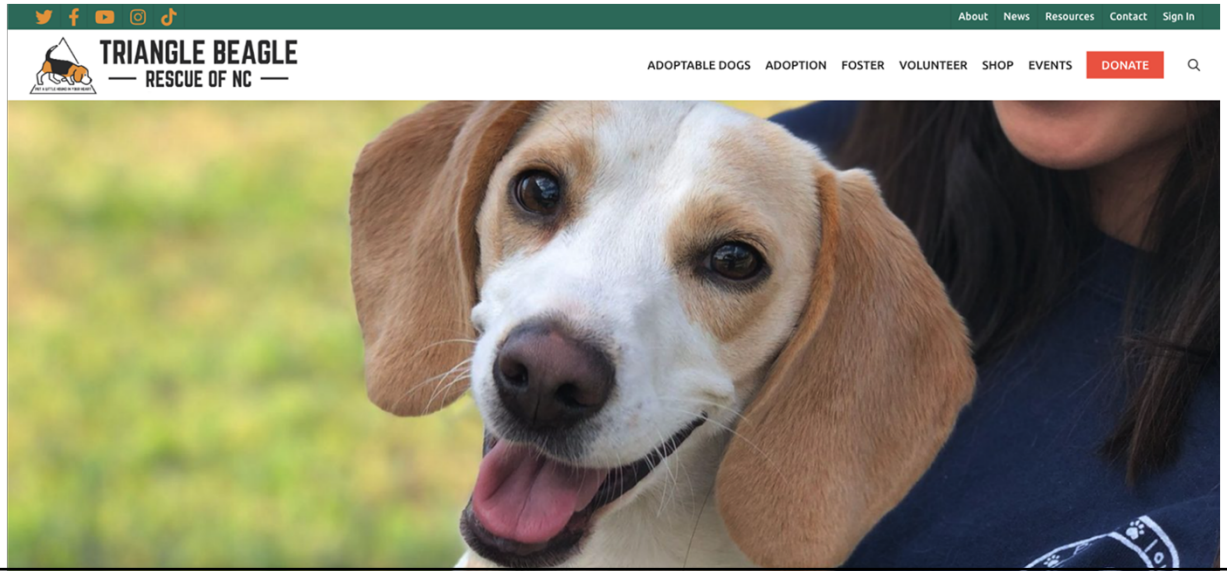
Example: Dog Rescue Website



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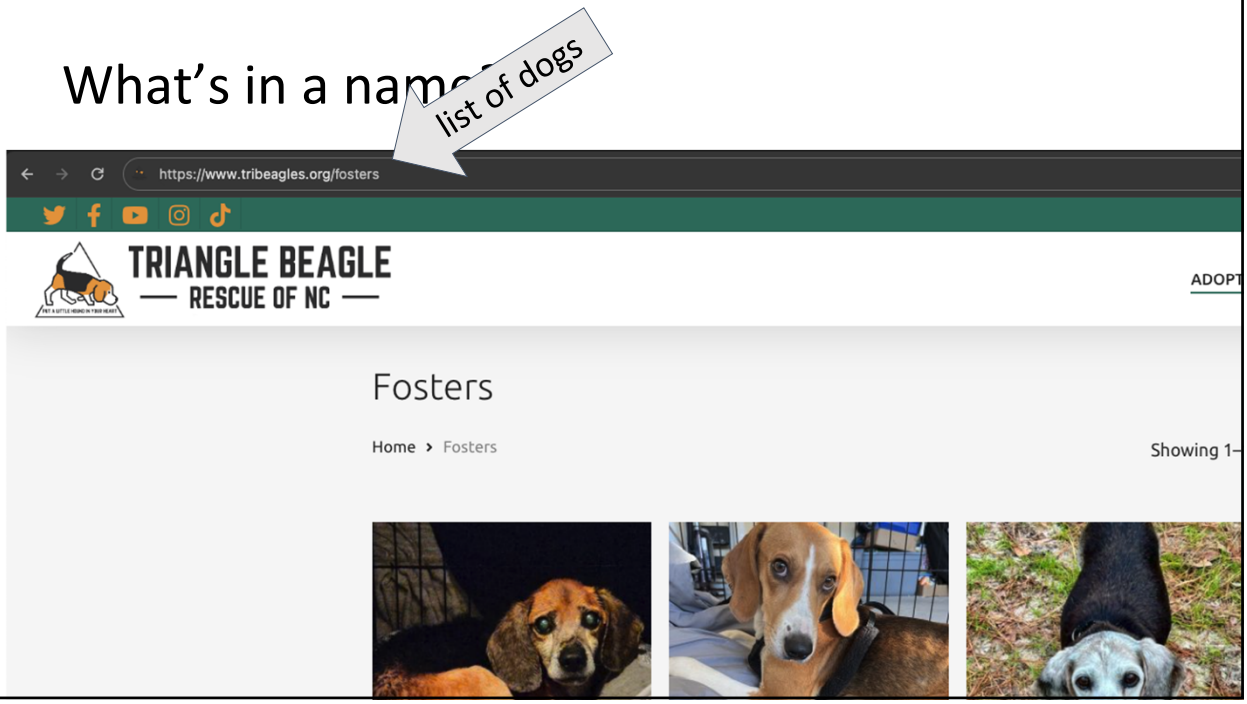
What's in a name?



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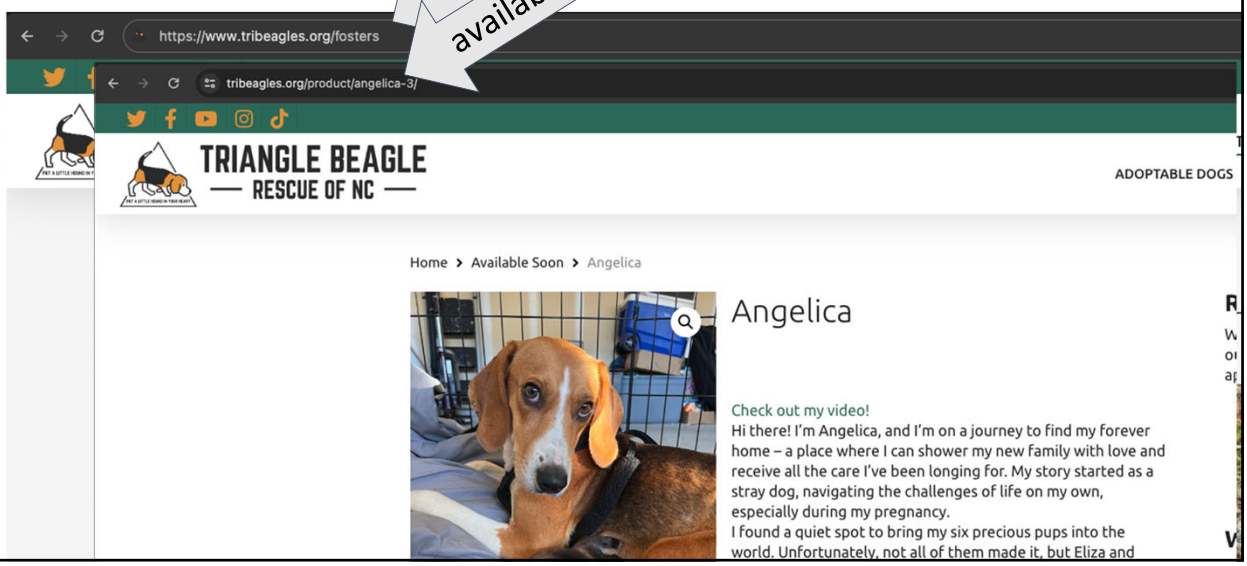
What's in a name?



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What's in a name?



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Resource Associations

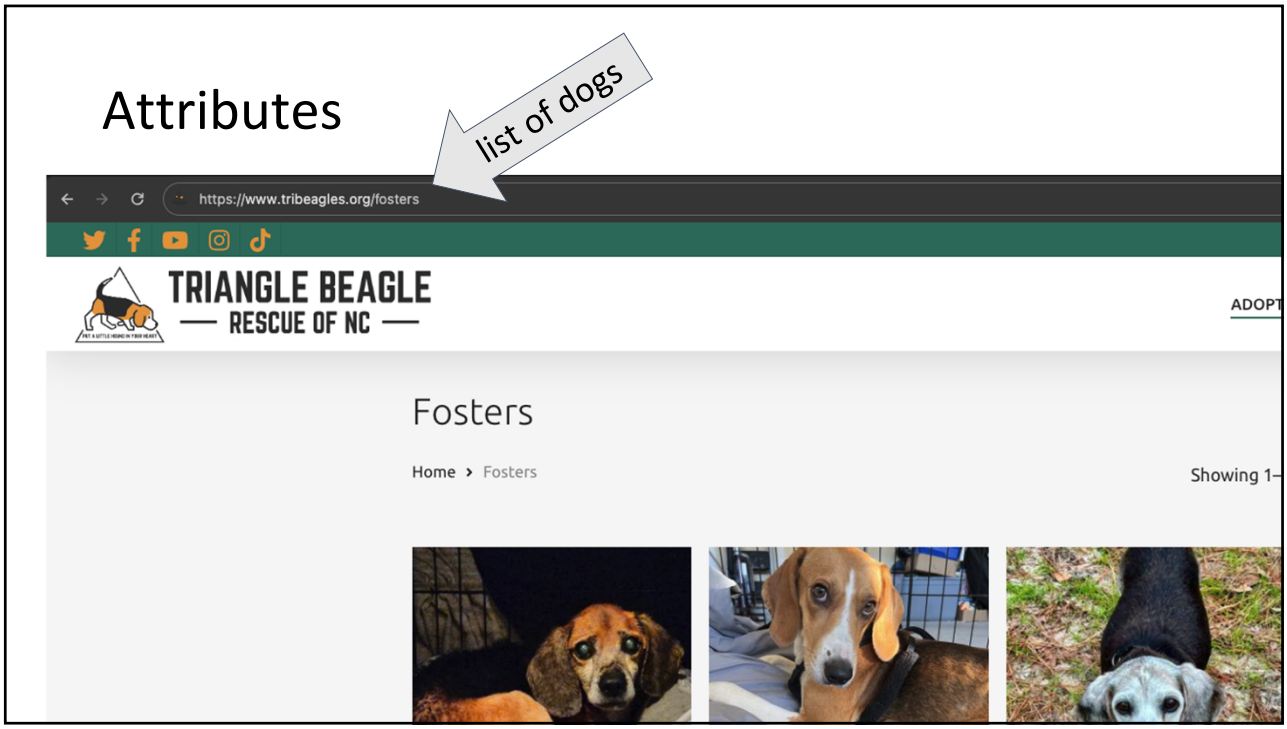
- Handling associations adds another level to the URL
  - Once have primary key for one level (an element) you don't need to include levels above it
  - Pattern `/resource/identifier/resource`
- Example: Dogs have owners
  - Get all the dogs for an owner `GET /owners/5678/dogs`
  - Create a new dog for an owner `POST /owners/5678/dogs`

Parameters: States and Attributes

- States and resource attributes shouldn't be handled as associations
  - Add them behind the HTTP question mark

```
GET /dogs?color=red&state=running&location=park
```

Attributes



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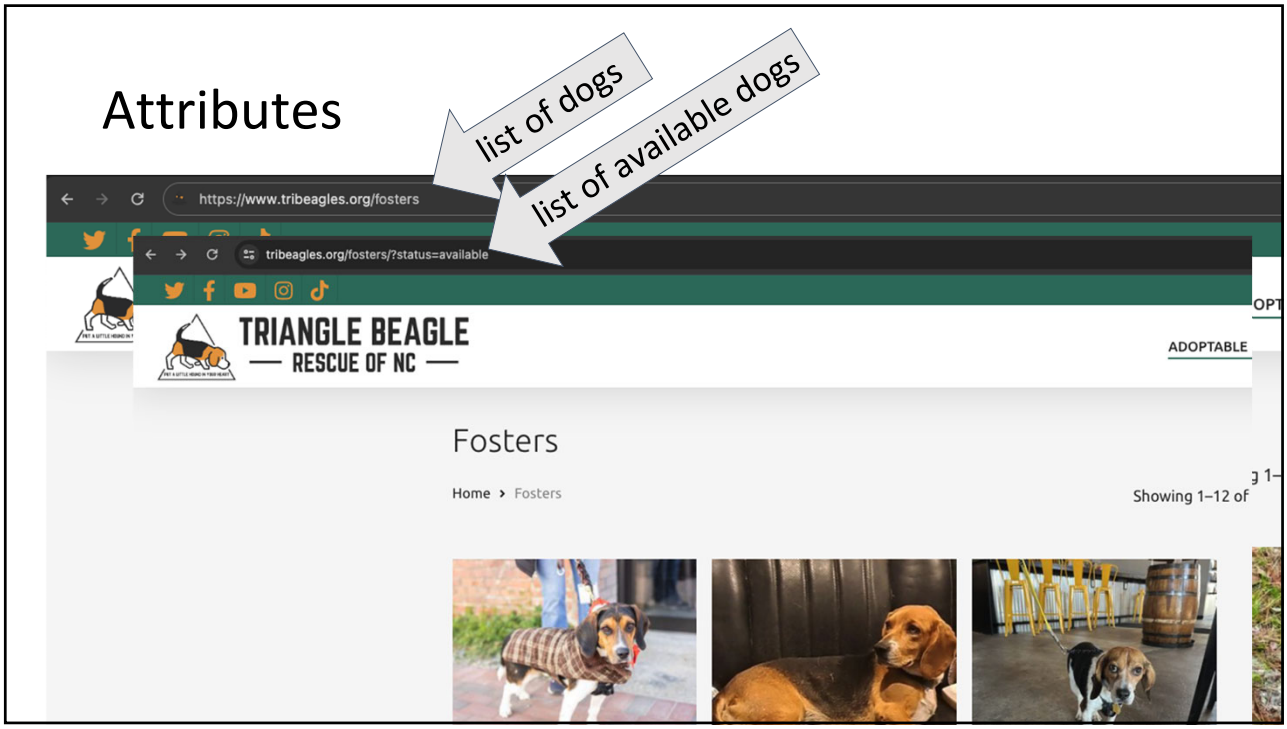
Attributes



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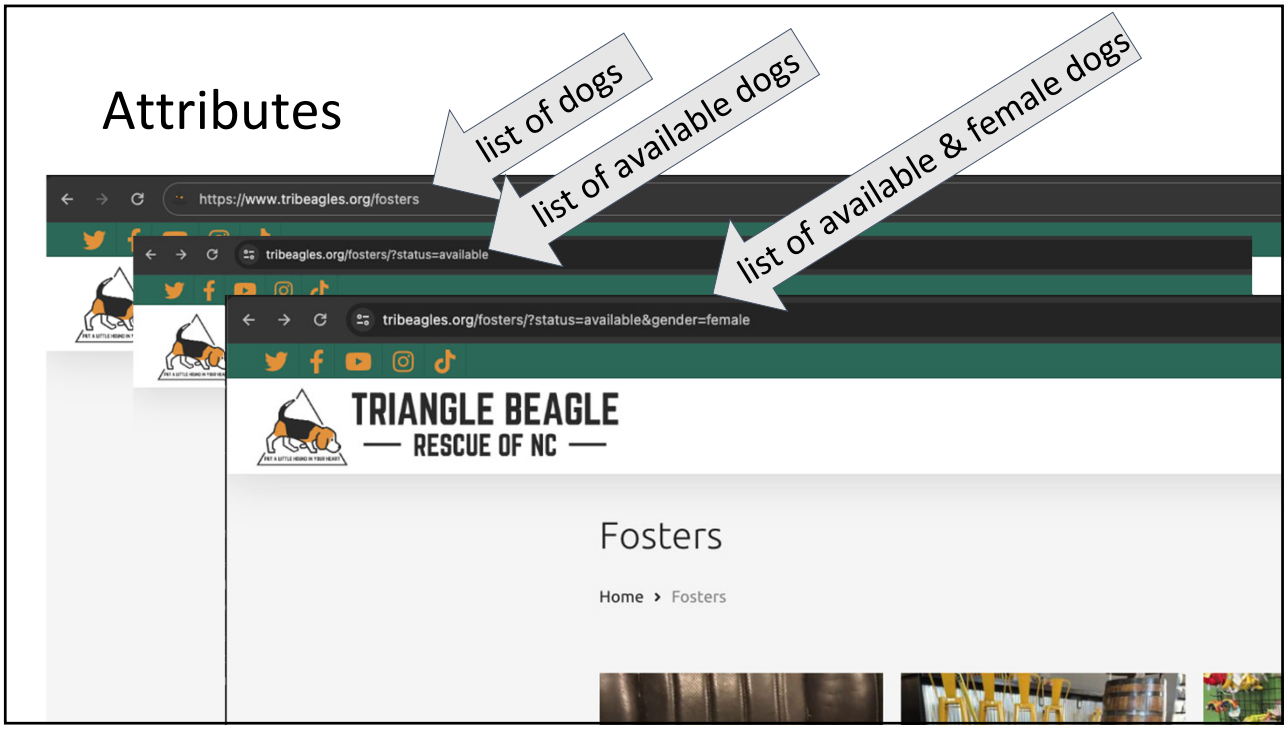
Attributes



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Handling Errors

- Errors provide context to client misuse of the black-box behind the API
  - Use HTTP status codes
    - Everything worked – success
      - 200 - OK
    - The application did something wrong – client error
      - 400 – Bad Request
    - The API did something wrong – server error
      - 500 – Internal Server Error
    - Add additional codes as appropriate
  - Returned messages should be verbose

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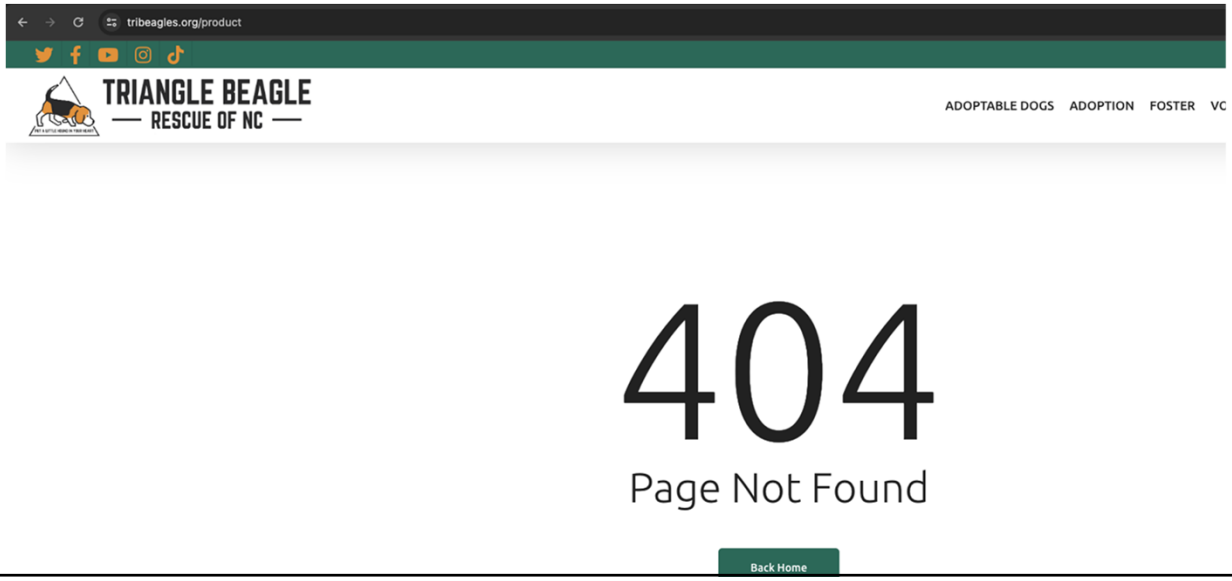
Errors



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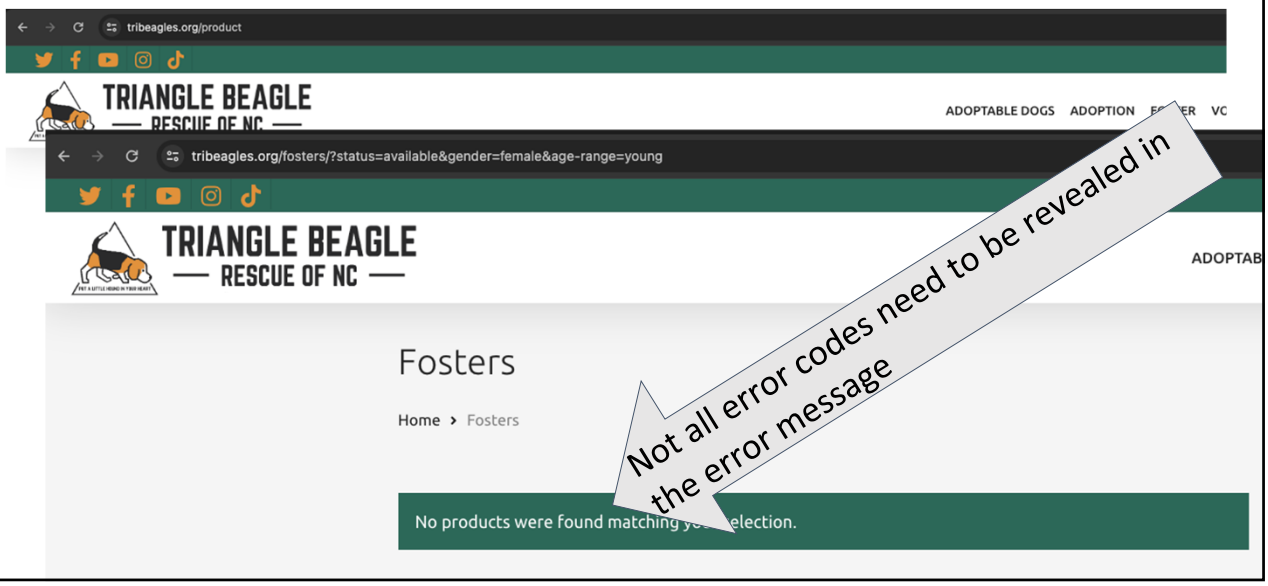
Errors



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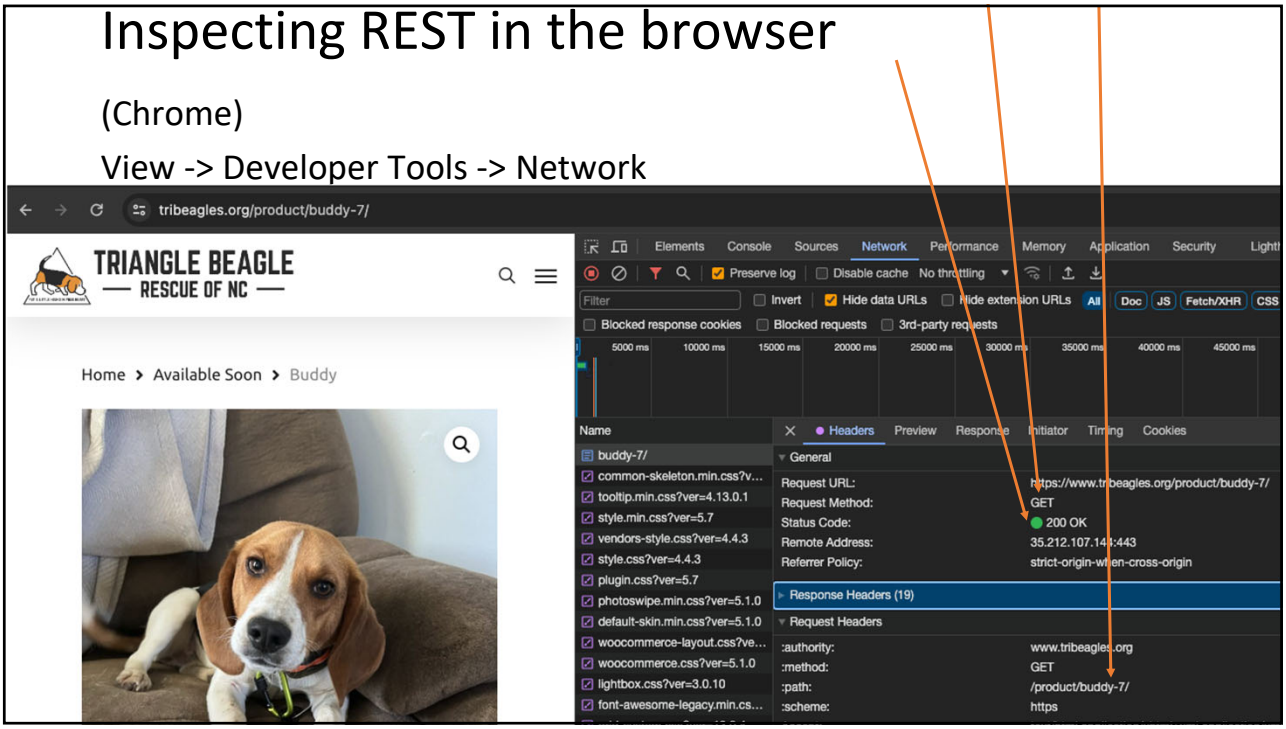
Inspecting REST in the browser

(Chrome)

View -> Developer Tools -> Network



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Exercise: REST APIs

- Provide the REST API interactions for the following scenarios
  - Create a new recipe
  - Get the coffee recipe
  - Get all the recipes

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GET recipe (M2 instructions)

GET Routes

GET routes are used to *fetch* data from the API, and as such, we care about seeing a description of the API endpoint and the data that is *returned* from the API.

GET Example

Name of function: `getRecipe(String name)`

Route: `GET /recipes/{name}`

Brief Description: This API endpoint will return a recipe with the name provided, or an error (404/Not Found) if a recipe with the provided name cannot be found.

Data Details:

If we have a recipe by the name `Mocha`, we would call our endpoint as `GET /recipes/Mocha` and expect the API to return a 200/OK and JSON data that looks like:

```
{  // start of Recipe object
  'name': 'Mocha',
  'price': 10,
  'sugar': 2,
  'milk': 3,
  'coffee': 5,
  'chocolate': 3
}
```

If we call our endpoint instead as `GET /recipes/nope` we would expect to get a 404/Not Found and no recipe JSON data.

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RESTful APIs

- Architectural Properties
  - Performance – appropriate component interactions
  - Scalability – support large numbers of components and interactions among components
  - Simplicity of interfaces
  - Modifiability of components
  - Visibility of communication between components by service agents
  - Portability of components by moving program code with the data
  - Reliability when failures within components, connectors, or data

Wikipedia

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RESTful APIs

- Architectural Constraints
  - Client-server
  - Stateless
  - Cacheable
  - Layered system
  - Code on demand (optional)
  - Uniform Interface
    - Identification of resources
    - Manipulation of resources through these representations
    - Self-descriptive messages
    - Hypermedia as the engine of application state

Wikipedia and REST API Tutorial

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Other Considerations

- Versioning – APIs should be versioned
  - Make version mandatory in URL/header
- Pagination
  - Provide way to limit number of responses
  - Offset and limit
- Partial Response
  - Let clients request a subset of information about a resource
- Authentication – Use common libraries (OAuth)

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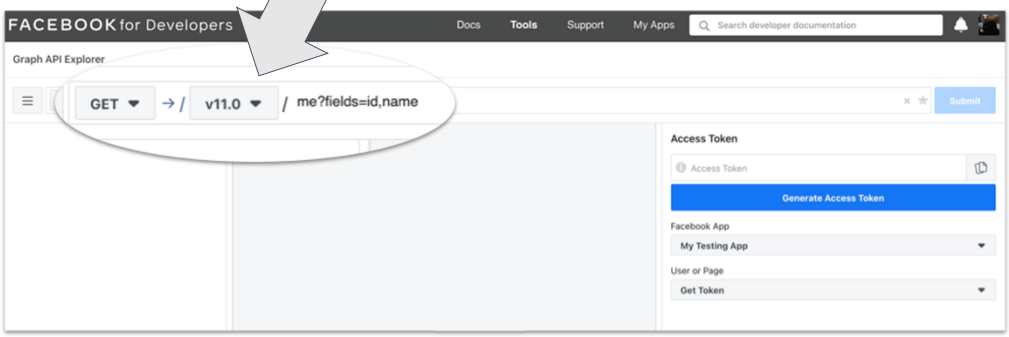
Versioning



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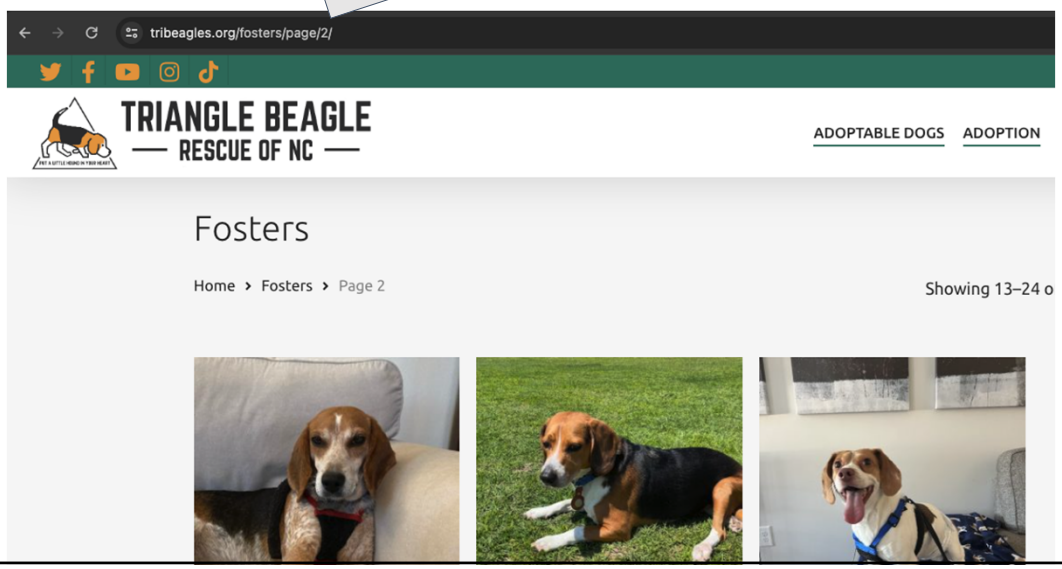
Pagination



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Responses without Resources

- Making sure you aren't having your client do things the API could do
  - Common actions `/convert?from=EUR&to=CNY&amount=100`
- Use verbs
  - Clearly define actions vs. resources in documentation
  - Consistency matters
  - Search
    - Global `/search?q=fluffy+fur`
    - Scoped `/owners/5678/dogs?q=fluffy+fur`

Web API Design

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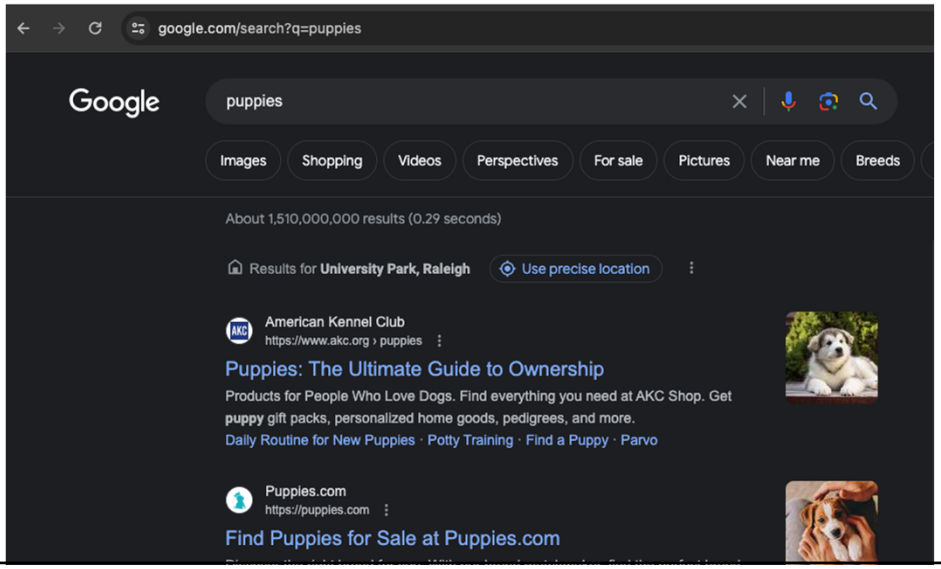
Global search example



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Response Formats

- XML (Extensible Markup Language)
  - Store and transport data
  - Schema defines the tags that describe the data
  - Libraries to help with binding XML to objects (JAXB)
- JSON (JavaScript Object Notation)
  - Lightweight data-interchange format
  - Collection of name/value pairs (object)
  - Ordered list of values (array)

```
var myObject = JSON.parse(response);
```

W3Schools – XML and JSON.org

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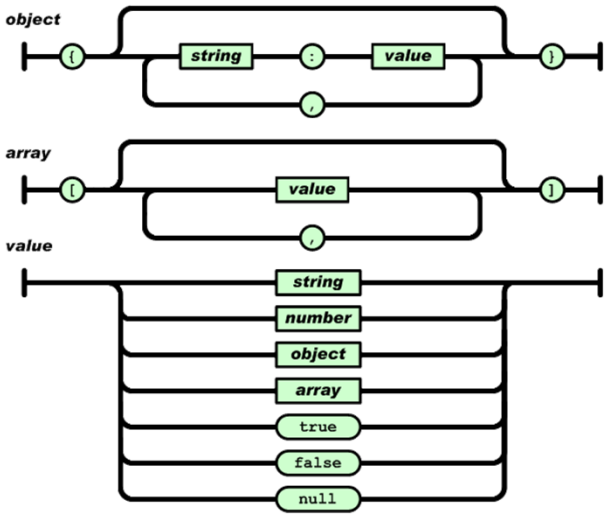
JSON Structures

- Object
- Array
- Value



JSON.org

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GET recipe (M2 instructions)

Start of JSON Object

string:value,
string:value,
string:value,
…

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API Design

- Joshua Bloch – How to Design a Good API and Why it Matters
  https://www.youtube.com/watch?v=aAb7hSCtvGw#t=2733

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Example APIs

- Facebook Graph API
  - https://developers.facebook.com/docs/graph-api
- Twitter
  - https://dev.twitter.com/rest/public
- GitHub
  - https://docs.github.com/rest
- Salesforce – Force API
  - https://developer.salesforce.com/page/REST_API
- Twilio
  - https://www.twilio.com/docs/api/rest

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API General Principles (1)

- Do one thing well
  - You can never remove
  - If it's hard to name, that's a bad sign (more later)
- Implementation should not impact API
  - Don't "leak" implementation details
  - Façade pattern
- Minimize accessibility of EVERYTHING
  - Information hiding
  - Modules used independently

Joshua Block Slides

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API General Principles (2)

- Names Matter
  - Names should be self-explanatory
  - Consistent naming – words mean the same
- Don't make the client do something the API could *easily* do
  - Reduce need for boilerplate code

Joshua Block Slides

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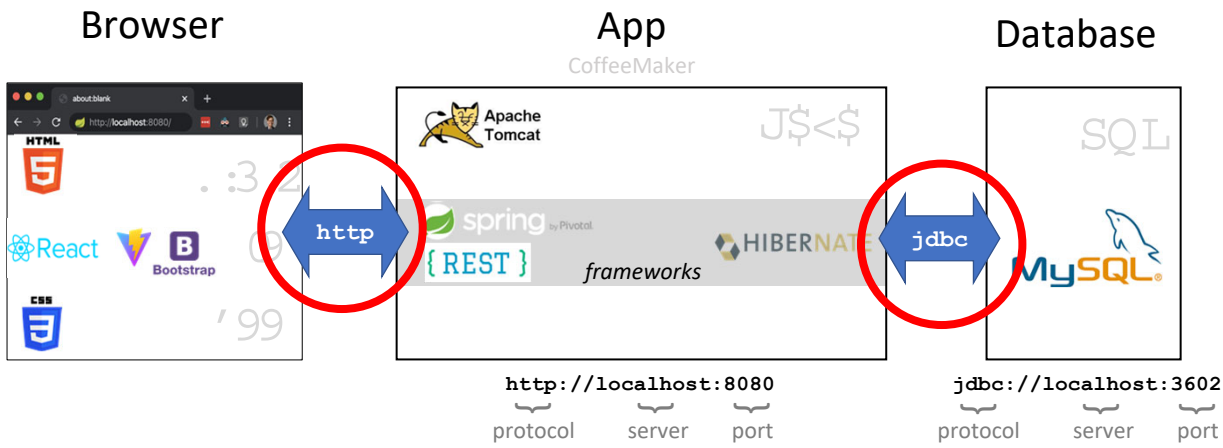
Key Pain Points

Transfer Representation of Data
1. Slow.
2. One change, three places.



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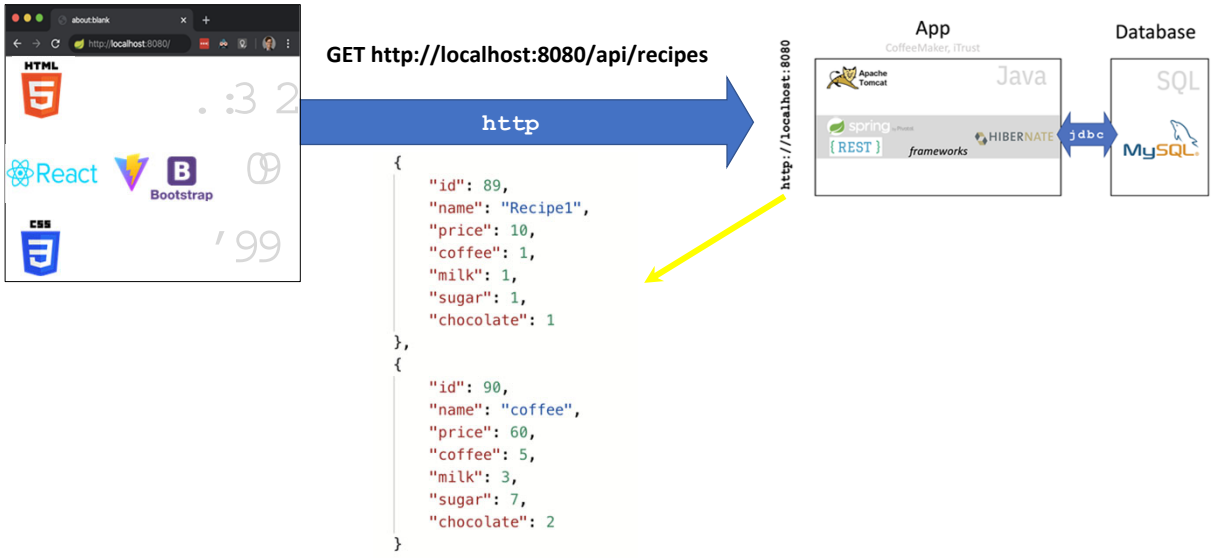
REST returns JSON

Browser



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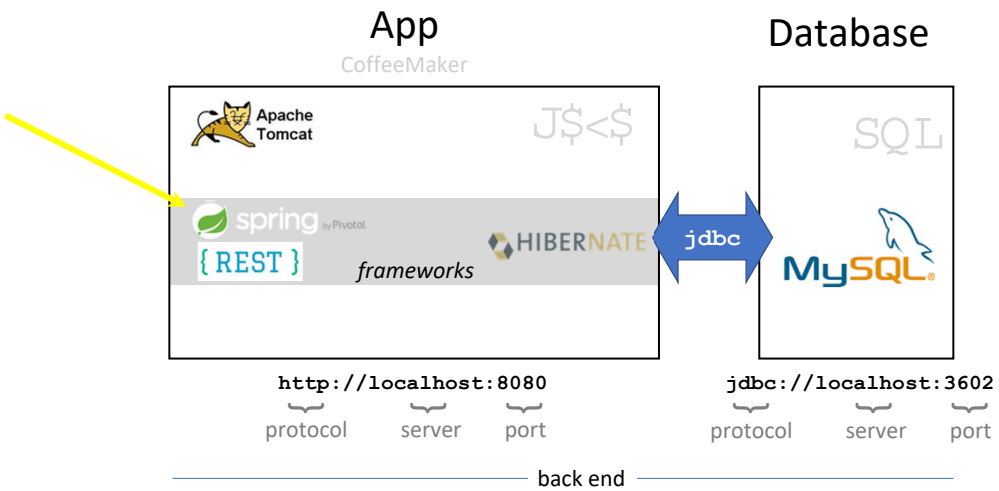
326 App Architecture



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{ REST } APIs in spring by Pivotal



Spring provides libraries to simplify the creation of REST APIs

```
@CrossOrigin("*")
@RestController
@RequestMapping("/api/recipes")
public class RecipeController {
    @Autowired
    private RecipeService recipeService;
    @GetMapping
    public List<Recipe> getRecipes() {
        return service.findAll();
    }
}
```

Identifies a REST controller in Spring.

REST API path

Connection to the *Service object

Type of REST request the method responds to.

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{ REST } APIs in spring by Pivotal



Spring provides libraries to simplify the creation of REST APIs

GET mapping

```
@GetMapping("{name}" )
public ResponseEntity<RecipeDto> getRecipe
                                    (@PathVariable("name") String name)
{
    RecipeDto recipeDto = recipeService.findByName(name);
    return ResponseEntity.ok(recipeDto);
}
```

Path variable with name "name"

Annotation connects to path variable {name}

Method returns a ResponseEntity
- Body of generic type – recipe if success, error otherwise
- HTTP status – use constants in HttpStatus - .ok method returns 200.

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{ REST } APIs in spring by Pivotal



Spring provides libraries to simplify the creation of REST APIs

POST mapping

Body of the POST request as object

```
@PostMapping
public ResponseEntity createRecipe ( @RequestBody RecipeDto recipeDto) {
   if (recipeService.isDuplicateName(recipeDto.getName())) {
      return new ResponseEntity<>(recipeDto, HttpStatus.CONFLICT);
   }
   if (recipeService.getAllRecipes().size() < 3) {
      RecipeDto savedRecipeDto = recipeService.createRecipe(recipeDto);
      return ResponseEntity.ok(savedRecipeDto);
   }
   return new ResponseEntity<>(recipeDto, HttpStatus.INSUFFICIENT_STORAGE);
}
```

Method returns a ResponseEntity
- Body of generic type – string success message
- HTTP status – use constants in HttpStatus

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REST API Design Documentation

Name of function

Function: **`getRecipe(String name)`**

Route: **`GET /recipes/{name}`**

REST API endpoint (relative URL)

Description

Description: This API endpoint will return a recipe with the name provided, or an error (404/Not Found) if a recipe with the provided name cannot be found.

Data Details:
If we have a recipe by the name Mocha, we would call our endpoint as **`GET /recipes/Mocha.`** The API should return a 200/OK and JSON data that looks like:

Data details

```
{ //start of Recipe object
    'name': 'Mocha',
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}
```

If we call our endpoint instead as **`GET /recipes/nope`** we would expect to get a 404/Not Found and no recipe JSON data.

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References

- R. T. Fielding, “Architectural Styles and the Design of Network-based Software Architectures,” Ph.D. Dissertation, University of California, Irvine, 2000.
  https://www.ics.uci.edu/~fielding/pubs/dissertation/fielding_dissertation.pdf
- T. Fredrich, “Learn REST: A RESTful Tutorial,” http://www.restapitutorial.com/
- B. Mulloy, “Web API Design,” Apigee. http://apigee.com/about/resources/ebooks/web-api-design
- C. Parnin, “Frameworks, APIs, and Technology Stacks” Lecture Notes.
- Wikipedia
  - “Representation State Transfer”. Last modified 10/27/2015 at 23:06. https://en.wikipedia.org/wiki/Representational_state_transfer
  - “Dependency Injection”. Last modified 10/22/2015 at 12:39. https://en.wikipedia.org/wiki/Dependency_injection