

# Understanding HTTP and REST

Oxford University  
Software Engineering  
Programme  
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# World Wide Web

- navigating document collections
- multimedia documents
- hypertext cross-references
- hypertext markup language
- (HTML)
- hypertext transfer protocol
- (HTTP)
- Tim Berners-Lee at CERN, 1989–1992



# HTTP

- two-way transmission of requests and responses
- layered over TCP
- essentially stateless (but. . . )
- standard extensions for security



```
127.0.0.1:40816: clientconnect
127.0.0.1 GET http://localhost:8080/
host: localhost:8000
accept-encoding: gzip, deflate
user-agent: Python-httpplib2/0.9.2 (gzip)
```

```
<< 200 OK 13B
```

```
X-Powered-By: Express
Content-Type: application/json; charset=utf-8
content-length: 13
ETag: W/"d-95lxyDUPrXs/bUPZHxxiWQ"
Date: Mon, 20 Jun 2016 09:19:05 GMT
Connection: keep-alive
```

```
{
  "random": 63
}
```

```
127.0.0.1:40816: clientdisconnect
```

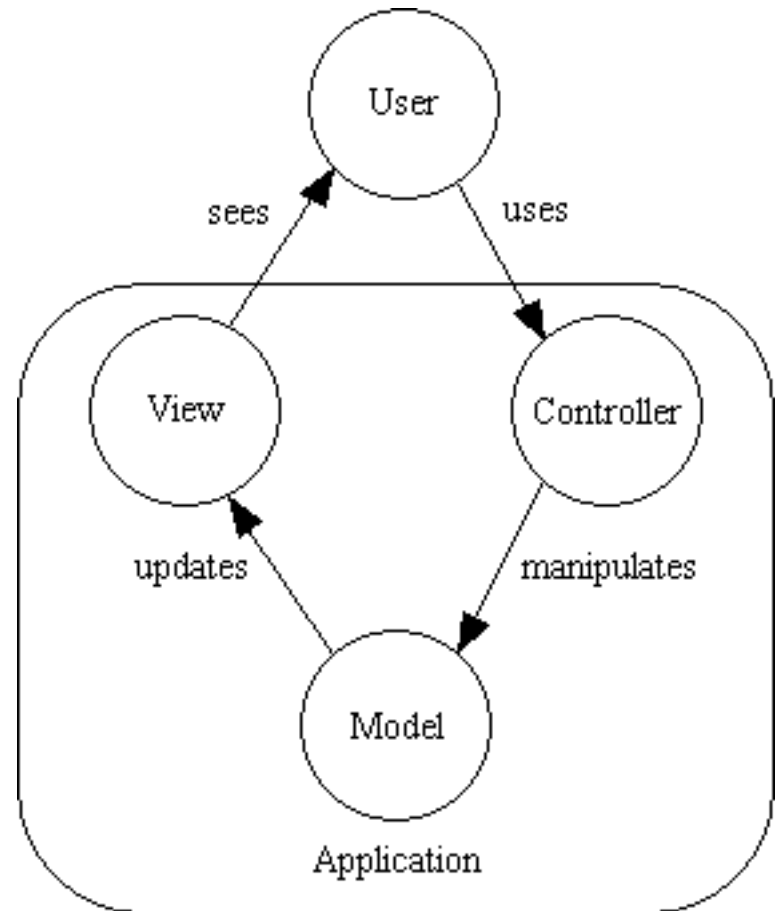
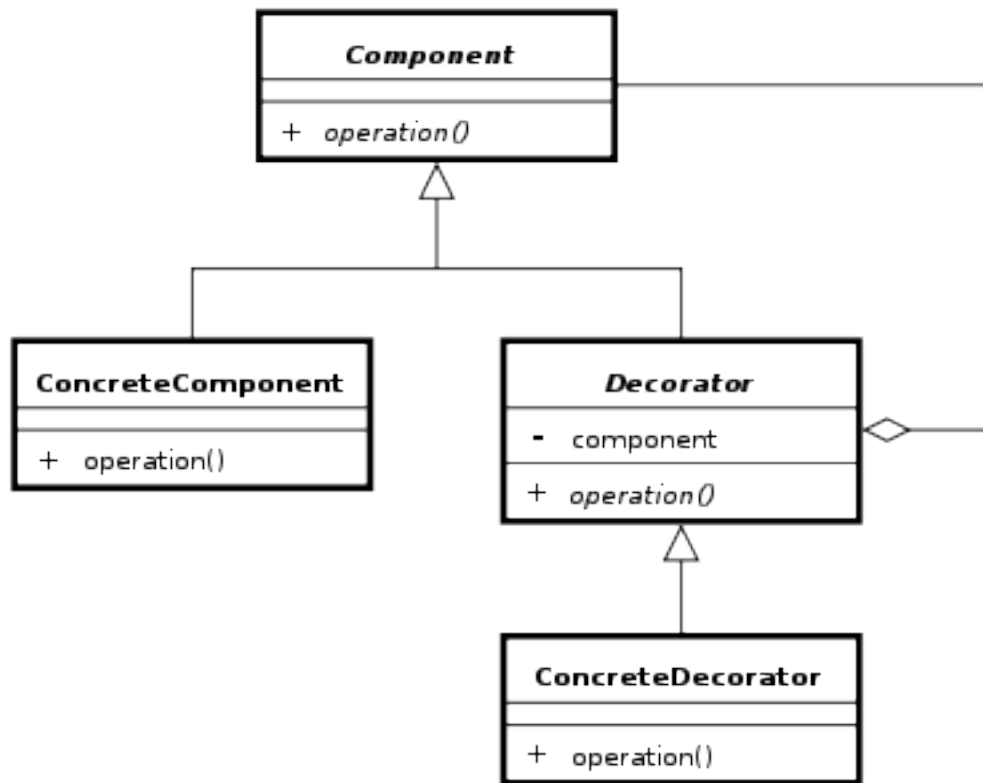


# HTTP “Verbs”

- GET uri
  - read a document; should be “safe”
- PUT uri, data
  - create or modify a resource; should be idempotent
- POST uri, data
  - create a subordinate resource
- DELETE uri
  - delete a resource; should be idempotent
- (also HEAD, TRACE, OPTIONS, CONNECT and now PATCH)



# Examples of Design Patterns



# REST is a design pattern

Also characterized as an ***Architectural Style*** (aka an architecture design pattern)



# Resource Oriented Architecture

- Resource-oriented architecture
  - after Richardson & Ruby, RESTful WS
  - action identified in HTTP method, not in payload
  - scoping information in URI





# Richardson's Maturity Model

Glory of REST



Level 3: Hypermedia Controls

Level 2: HTTP Verbs

Level 1: Resources

Level 0: The Swamp of POX



# HTTP good bad and ugly

- Good
  - GET reports/open-bugs HTTP/1.1
    - in contrast to RPC-style interaction
- Bad
  - POST /rpc HTTP/1.1  
Host: www.upcdatabase.com  
<?xml version="1.0">  
  <methodCall>  
    <methodName>lookupUPC</methodName> ...  
  </methodCall>
- Ugly
  - http://www.flickr.com/services/rest?method=search&tags=cat



# PUT vs POST

- PUT vs POST
  - creation by either PUT to new URI or POST to existing URI
  - typically, create a subordinate resource with a POST to its parent
- use PUT when client chooses URI; use POST when server chooses
- successful POST returns code 201 'Created' with Location header
- (POST also sometimes used for form submission, but this can be non-uniform)



# Resource Representations and States

- Interact with services using representations of resources.
  - An XML representation
  - A JSON representation
- An object referenced by one URI can have different formats available. Different platforms need different formats.
  - A mobile application may need JSON
  - A Java application may need XML.
- Utilize the Content-Type header
  - And the Accept: header
- Communicate in a stateless manner
  - Stateless applications are far more scaleable



# Hypertext as the Engine of Application State

- Resources are identified by URIs



- Clients communicate with resources via requests using a
  - standard set of methods



- Requests and responses contain resource representations
  - in formats identified by media types



- Responses contain URIs that link to further resources



Beginning



# REST description

The image shows a browser window displaying the Swagger website (swagger.wordnik.com) and an embedded Swagger API Explorer for a service named 'my-awesome-api.com'.

**Swagger Website Header:**

- Logo: { } swagger
- Navigation: Home, Specification, Downloads, Demo

**Swagger API Explorer (my-awesome-api.com):**

**word**

| Method | Endpoint                    | Description                                                         |
|--------|-----------------------------|---------------------------------------------------------------------|
| GET    | /word.json/{word}/entries   | Return entries for a word                                           |
| GET    | /word.json/{word}/examples  | Returns examples for a word                                         |
| POST   | /word.json/{word}/examples  | Fetches examples for a word                                         |
| POST   | /word.json/{word}/wordForms | Adds a Relationship Map to a word                                   |
| GET    | /word.json/{word}/wordForms | Returns other forms of a word                                       |
| DELETE | /word.json/{word}/wordForms | Deletes a relationship from a word                                  |
| GET    | /word.json/{word}           | Given a word as a string, returns the WordObject that represents it |

**Parameters**

| Parameter          | Value                                   | Description                                                                                                      |
|--------------------|-----------------------------------------|------------------------------------------------------------------------------------------------------------------|
| word               | <input type="text" value="(required)"/> | String value of WordObject to return                                                                             |
| useCanonical       | <input type="text"/>                    | If true will try to return the correct word root ('cats' -> 'cat'). If false returns exactly what was requested. |
| includeSuggestions | <input type="text"/>                    | Return suggestions (for correct spelling, case variants, etc.)                                                   |
| shouldCreate       | <input type="text"/>                    | Create word if not existing                                                                                      |

**Additional Endpoints:**

- GET /word.json/{word}/definitions: Return definitions for a word
- GET /word.json/{word}/stats: Returns word statistics

**Document your API with Style**

Swagger is a specification and complete framework implementation for describing, producing, consuming, and visualizing REST web services. The overarching goal of Swagger is to enable client and documentation systems to update at the same pace as the server. The documentation of methods, parameters and models are tightly integrated into the server code, allowing APIs to always stay in sync. With Swagger, deploying, managing, and using powerful APIs has never been easier.

**Who is responsible for Swagger?**

Both the specification and framework implementation are initiatives from Wordnik. Swagger was developed for Wordnik's own use during the development of [developer.wordnik.com](http://developer.wordnik.com) and the underlying system. Swagger development began in early 2010—the framework being released is currently used by Wordnik's APIs, which power both internal and external API clients.

**Why is Swagger useful?**



# JSON

- A simple notation that originated in JavaScript

```
var x = {a:1, b:2, c:3}
```

- equivalent to:

```
x.a = 1; x.b = 2; x.c = 3
```

- Can be done “dynamically”

```
var x = “{a:1, b:2, c:3}”
```

```
// imagine this actually
```

```
// comes from a webserver
```

```
var z = eval(‘(‘+x+’)’)
```

```
assert(z.a == 1)
```

# Return codes

- Good RESTful design means proper use of return codes...
  - Why?





# HTTP return codes

|             |                                   |                                                         |
|-------------|-----------------------------------|---------------------------------------------------------|
|             | 100 Continue                      |                                                         |
|             | 101 Switching Protocols           |                                                         |
| Successful  | 200 OK                            | Everything is normal                                    |
|             | 201 Created                       |                                                         |
|             | 202 Accepted                      |                                                         |
|             | 203 Non-Authoritative Information |                                                         |
|             | 204 No Content                    |                                                         |
|             | 205 Reset Content                 |                                                         |
|             | 206 Partial Content               |                                                         |
| Redirection | 300 Multiple Choices              | Update your URL, this has moved for good.               |
|             | 301 Moved Permanently             |                                                         |
|             | 302 Found                         |                                                         |
|             | 303 See Other                     |                                                         |
|             | 304 Not Modified                  |                                                         |
|             | 305 Use Proxy                     |                                                         |
|             | 306 Unused                        |                                                         |
|             | 307 Temporary Redirect            | This is temporarily moved, don't update your bookmarks. |

# Client Error Codes

## Client Error

|                                   |                                                              |
|-----------------------------------|--------------------------------------------------------------|
| 400 Bad Request                   | Server didn't understand the URL you gave it.                |
| 401 Unauthorized                  | Must be authenticated                                        |
| 402 Payment Required              | Not used really                                              |
| 403 Forbidden                     | Server refuses to give you a file, authentication won't help |
| 404 Not Found                     | A file doesn't exist at that address                         |
| 405 Method Not Allowed            |                                                              |
| 406 Not Acceptable                |                                                              |
| 407 Proxy Authentication Required |                                                              |
| 408 Request Timeout               | Browser took too long to request something                   |
| 409 Conflict                      |                                                              |
| 410 Gone                          |                                                              |
| 411 Length Required               |                                                              |
| 412 Precondition Failed           |                                                              |
| 413 Request Entity Too Large      |                                                              |
| 415 Unsupported Media Type        |                                                              |
| 416 Request Range Not Satisfiable |                                                              |
| 417 Expectation Failed            |                                                              |

# Server Error Codes

## Server Error

500 Internal Server Error

Something on the server didn't work right.

501 Not Implemented

502 Bad Gateway

503 Service Unavailable

Too busy to respond to a client

504 Gateway Timeout

505 HTTP Version Not Supported



# Summary

- Basic REST concepts:
  - Use the right VERB
  - Use the right return code
  - Use well defined media types
    - Resource representation
  - Use hyperlinks for HATEOAS

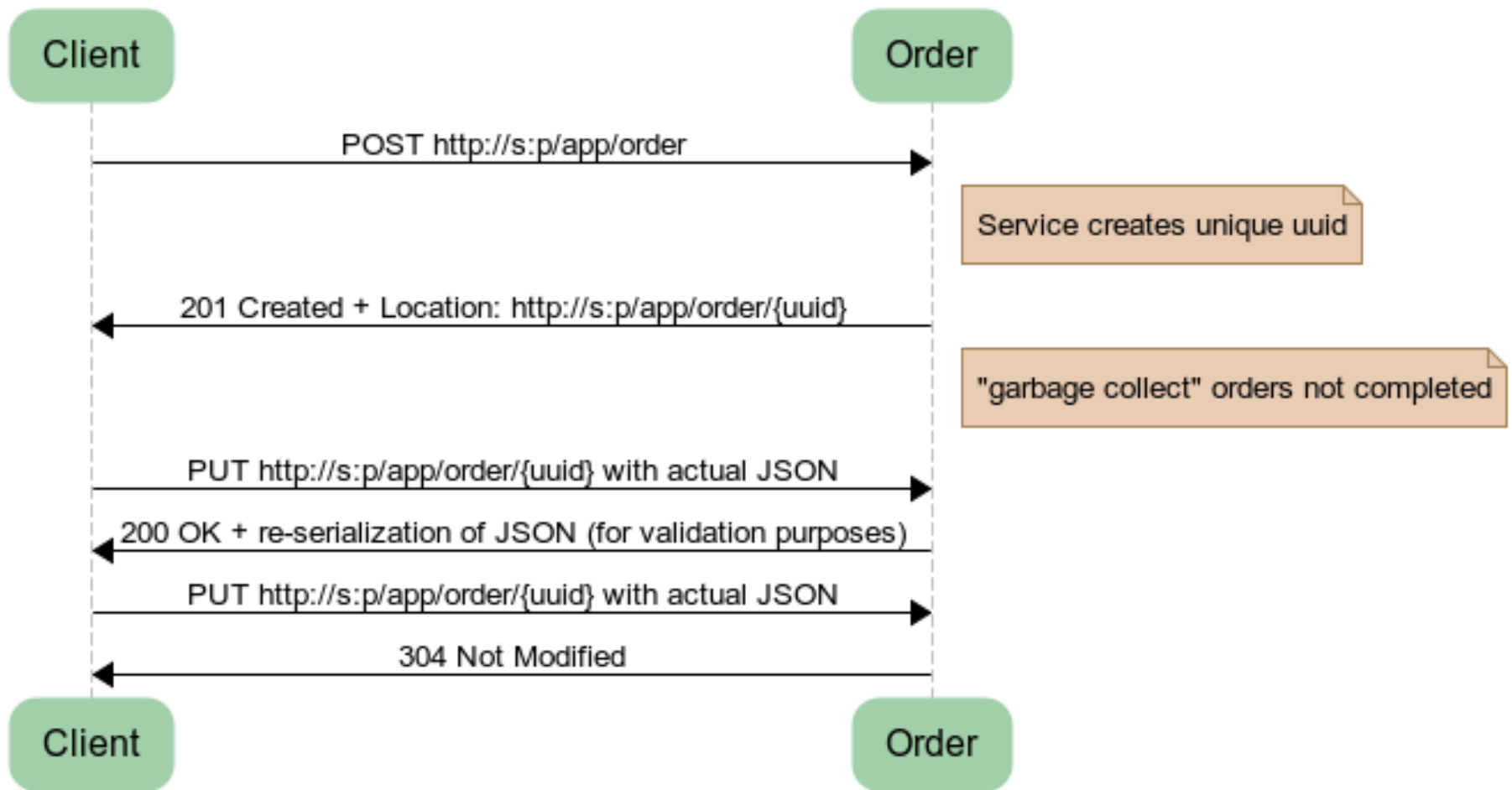


# Our sample Purchase service



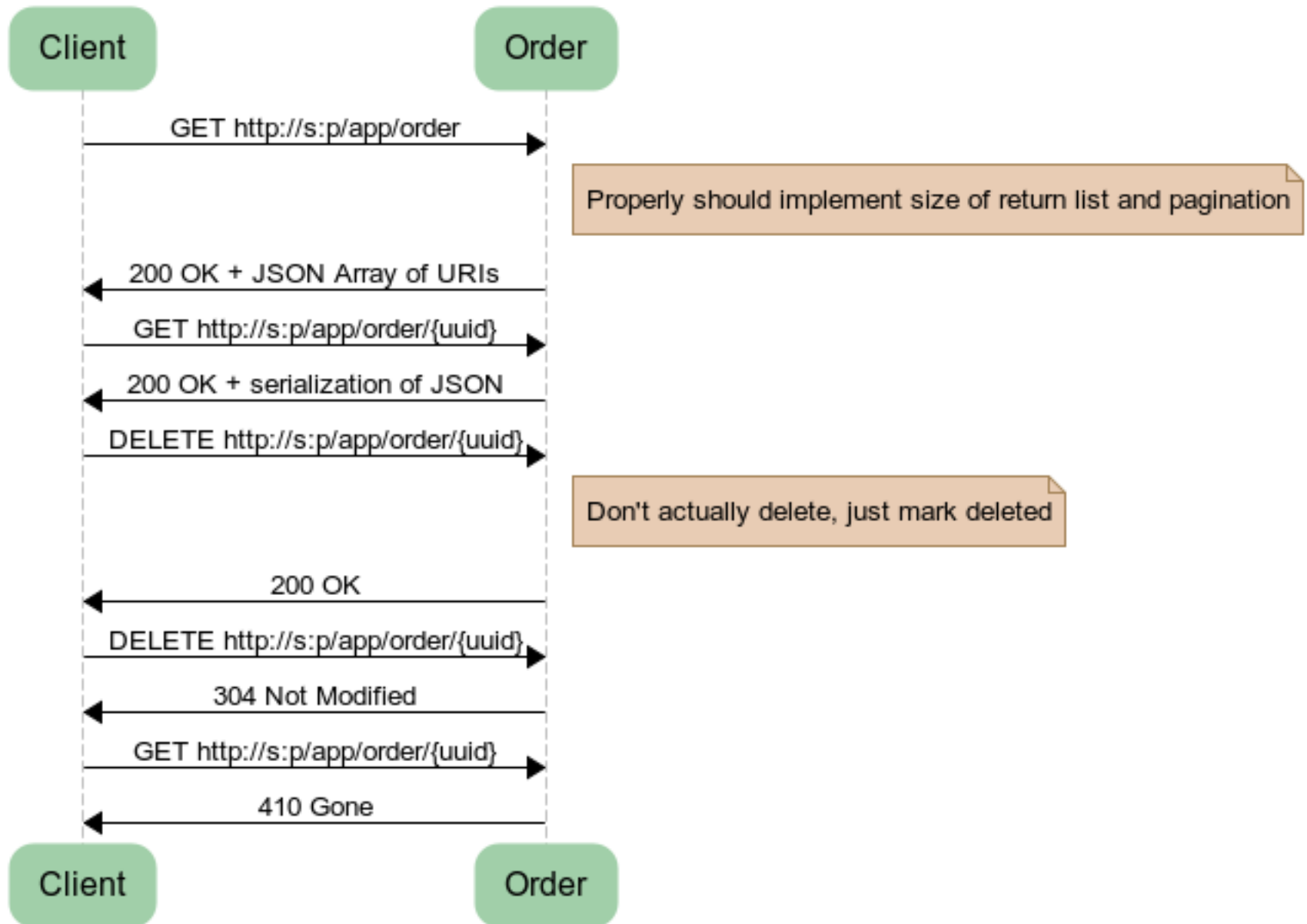
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## Order API - Create an Order



www.websequencediagrams.com

## Order API - Deal with an Order



# Questions?



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