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-httplib2/0.9.2 (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
```

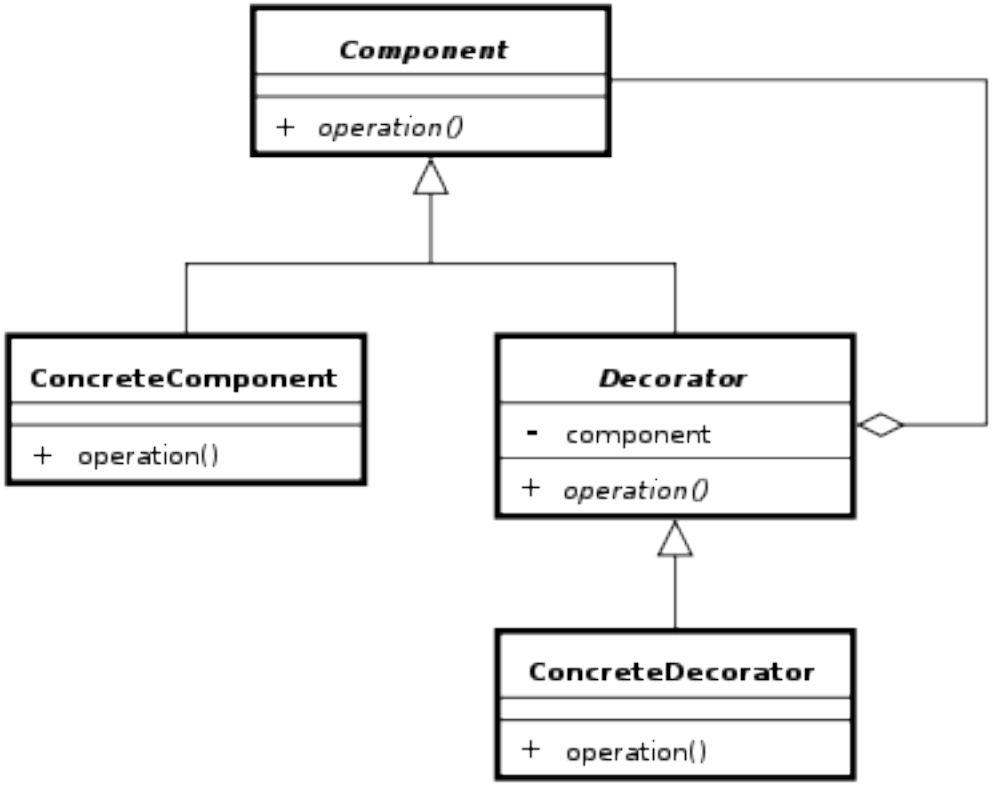
HTTP “Verbs”

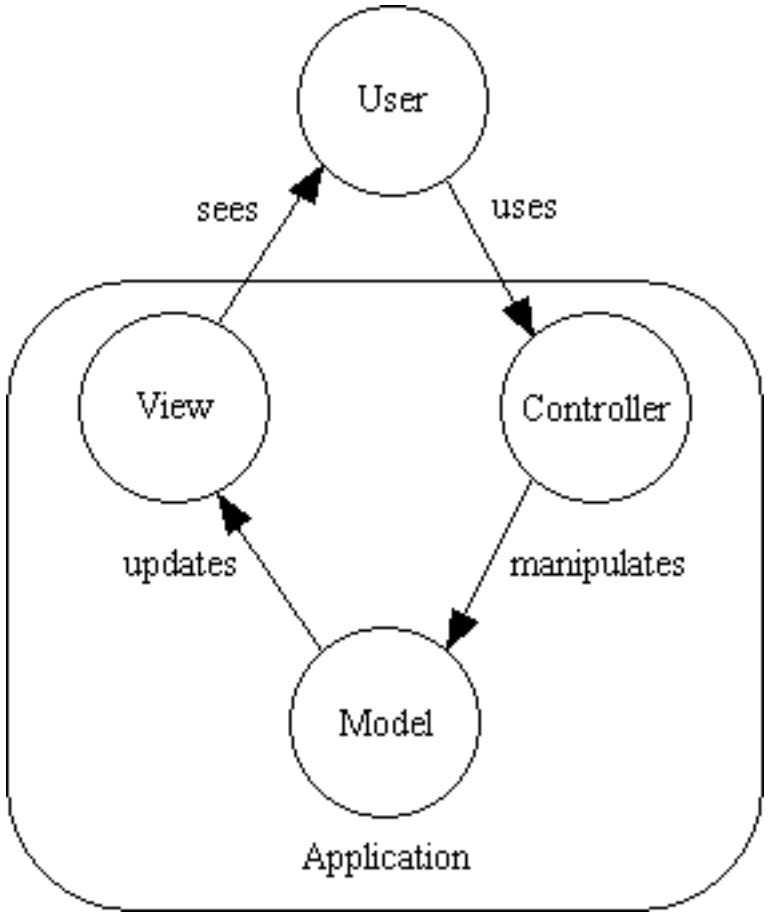
- GET uri
  - read a document; should be “safe”
- PUT uri, data
  - create or modify a resource; should be idempotent
- POST uri, data
  - create a subordinate resource
- DELETE uri
  - delete a resource; should be idempotent
- (also HEAD, TRACE, OPTIONS, CONNECT and now PATCH)

URIs, URNs, URLs

- uniform resource identifier (URI)
  - uniform resource locator (URL)
  - uniform resource name (URN)
- http://fremantle.org/hello
  - Is it a URI? URL? URN?

Examples of Design Patterns





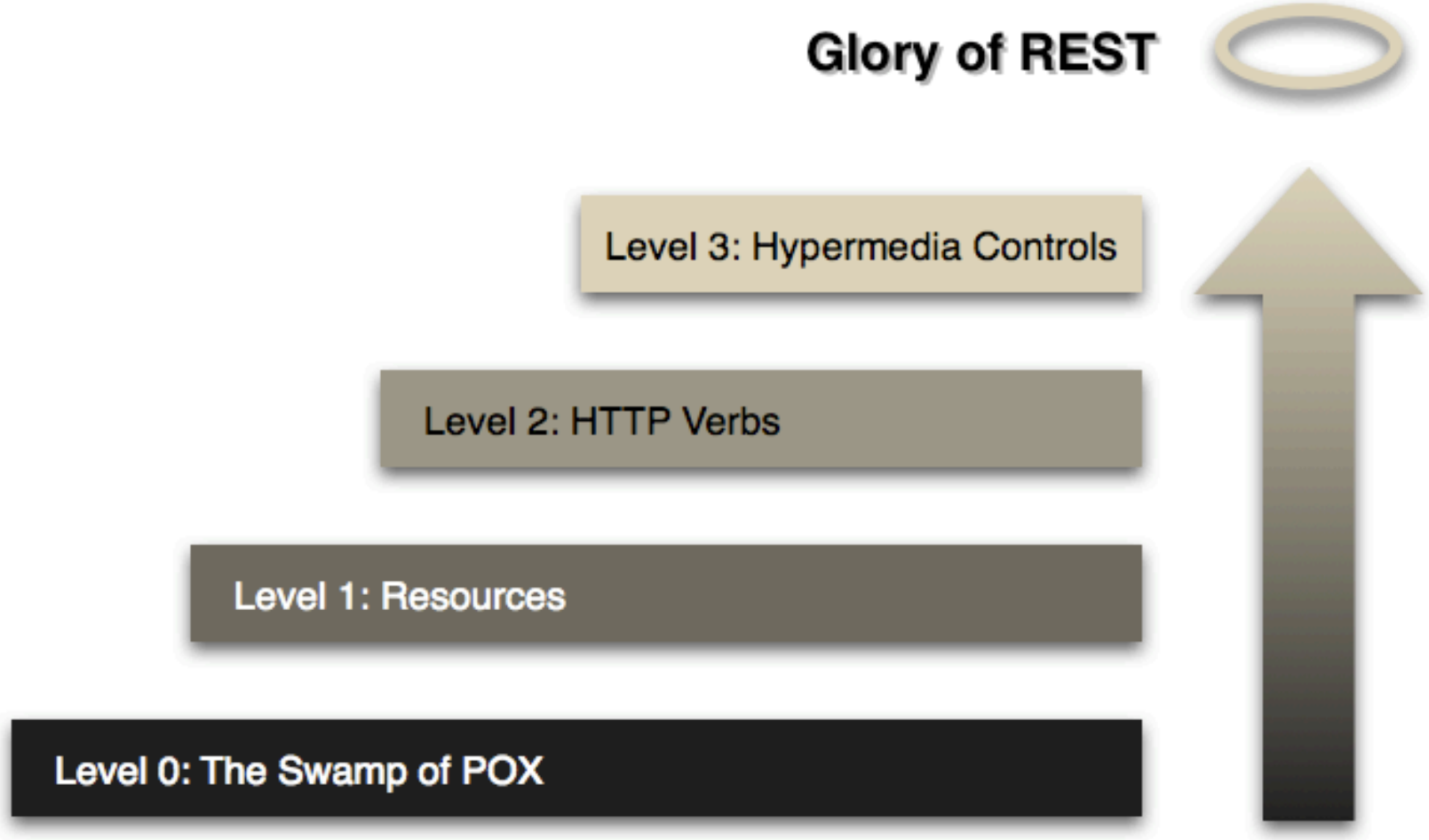
REST is a design pattern

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



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

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

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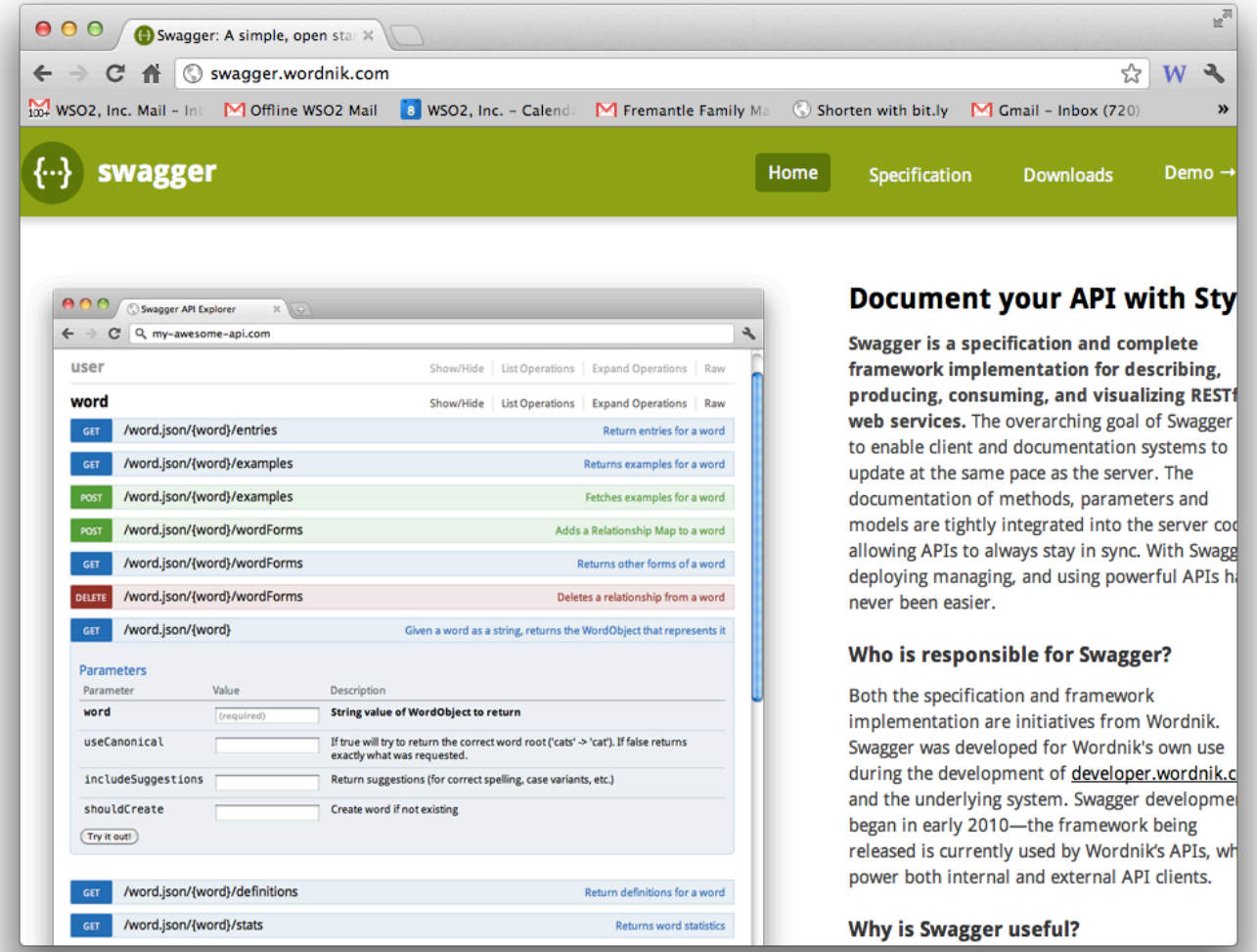
- Responses contain URIs that link to further resources

↓

Beginning

REST description



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

http://www.cheat-sheets.org/saved-copy/http-response-codes-1.pdf

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	Lengh Required	
	412	Precondition Failed	
	413	Reqeust Entity Too Large	
	415	Unsupported Media Type	
	416	Request Range Not Satisfiable	
	417	Expectation Failed	

Server Error Codes

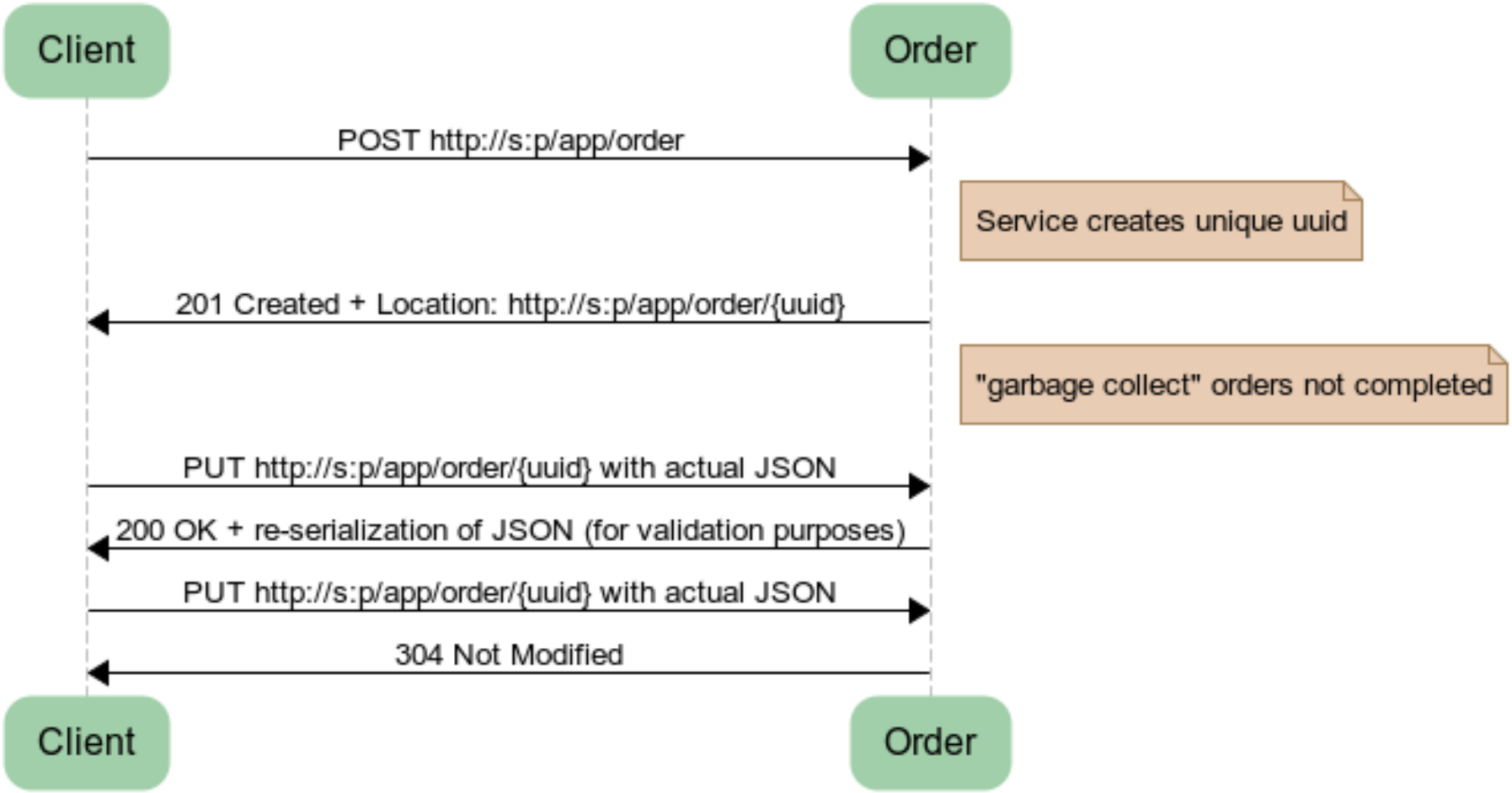
Server Error	500 Internal Server Error	Something on the server didn't work right.
	501 Not Implemented	
	502 Bad Gateway	
	503 Service Unavailable	Too busy to respond to a client
	504 Gateway Timeout	
	505 HTTP Version Not Supported	

Summary

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

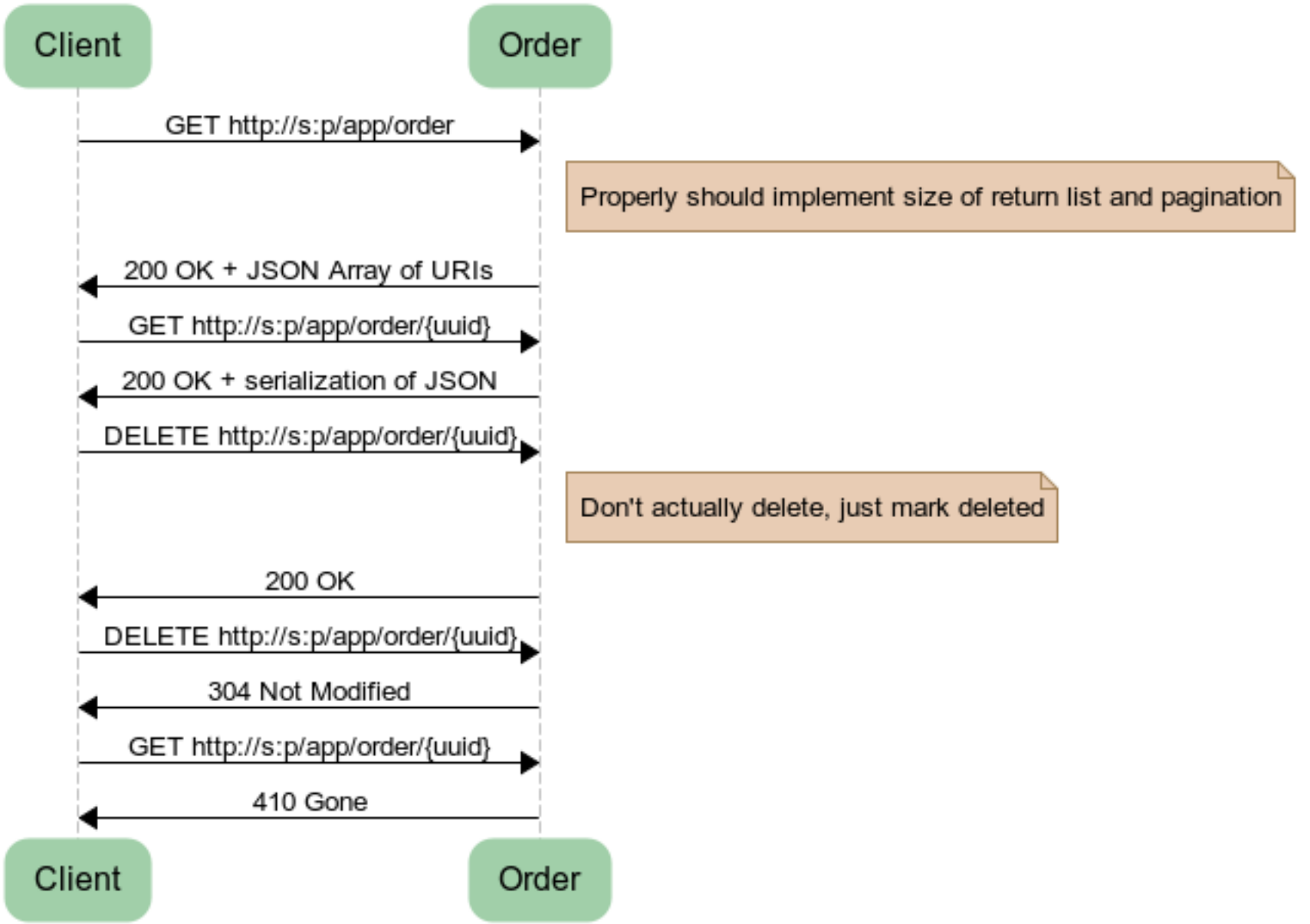
Our sample Purchase service

Order API - Create an Order



www.websequencediagrams.com

Order API - Deal with an Order



Questions?