Developing Restful Services

Chapter1:

Building & Designing Restful Web Services

Chapter Objectives

In this chapter, we will discuss:

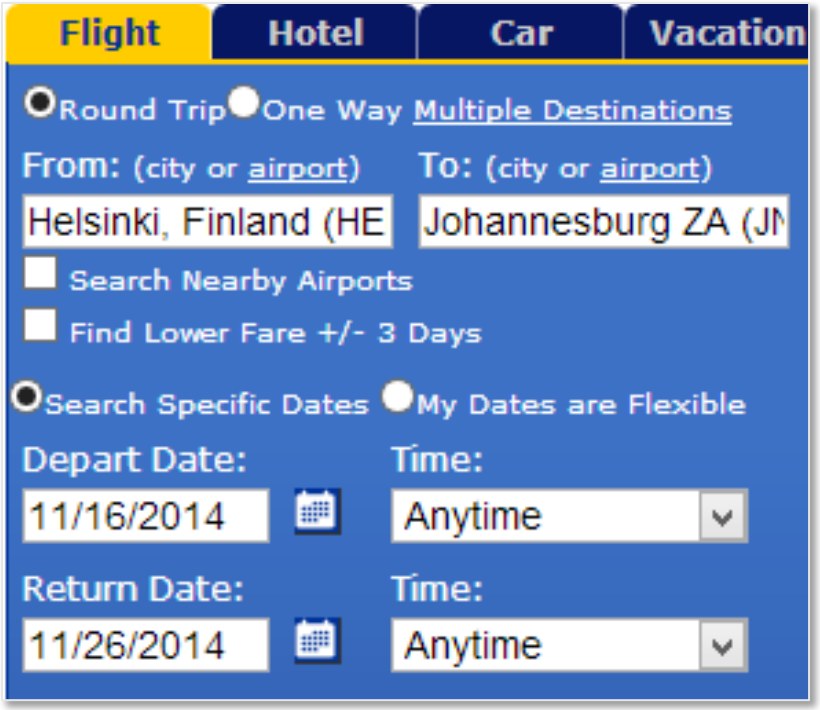
- Understanding what a RESTful web service is
- HTTP response codes
  - Status codes
  - What code to use
  - How to return a status code
- Designing an effective RESTful API
  - RESTful API guidelines
  - Services should be stateless
  - Return data in JSON format

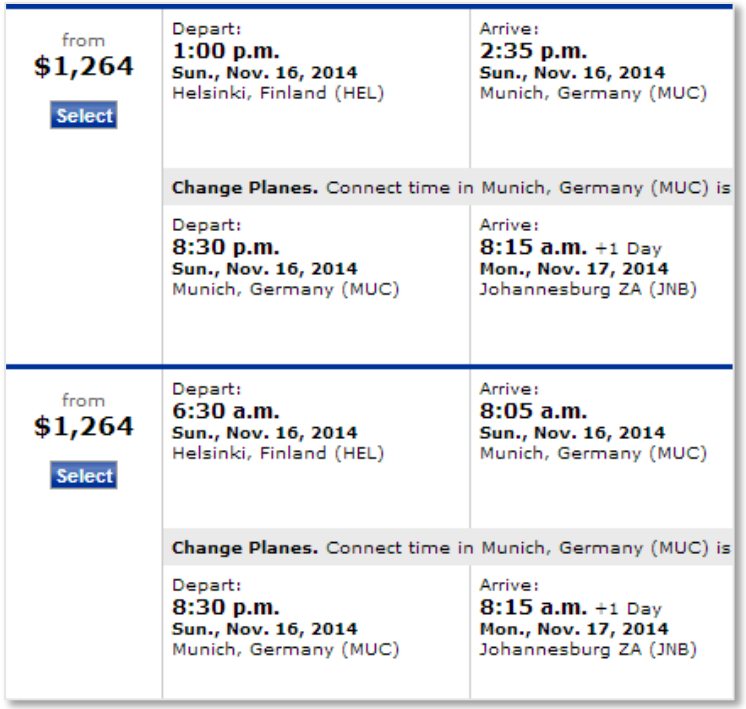
Chapter Concepts

- **RESTful Web Services**
- HTTP Response Codes
- Designing an Effective RESTful API
- Chapter Summary

Web Application vs. Web Service

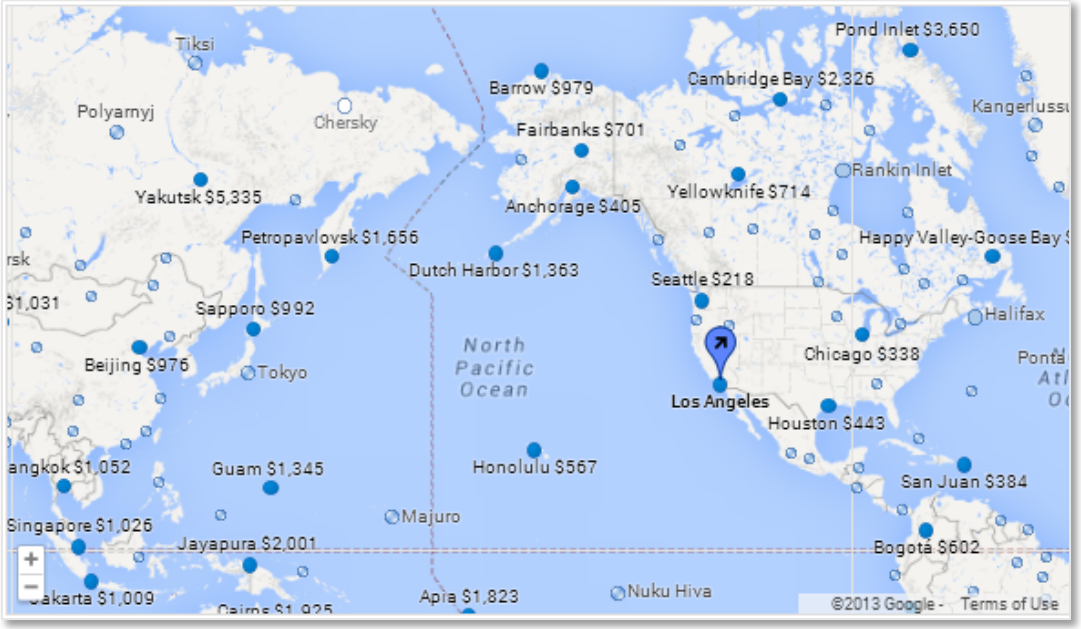
- Web applications are meant for use by human users
  - Visual representation of information, interactive
  - Multiple steps (often stateful)





Web Application vs. Web Service (continued)

- Web services are meant for use by automated applications
  - Machine-parseable representation of information
  - Often stateless
- Web services are “behind the scenes” and are not readily apparent
  - How do you think this “mashup” at https://www.google.com/flights is created?



SOAP Web Services

- A SOAP-based web service
  - Advertises a WSDL interface
  - Contains everything needed to communicate with that service
  - All the request and response messages are in XML
  - Interoperable
    - Many different clients can communicate with the service
  - The data is wrapped inside of an XML SOAP message
    - Requests
    - Responses
  - Not the most convenient format for many clients
    - Ajax
    - JavaScript

A Simpler Web Service

- REST-based web services
  - Communicate with a simpler format than SOAP-based web services
    - Simple XML
    - JavaScript Object Notation (JSON)
  - No Web Service Definition Language (WSDL) interface
    - Can provide a Web Application Definition Language (WADL) interface
  - Parameters often passed as part of the URL

REST-Based Web Services

Problem

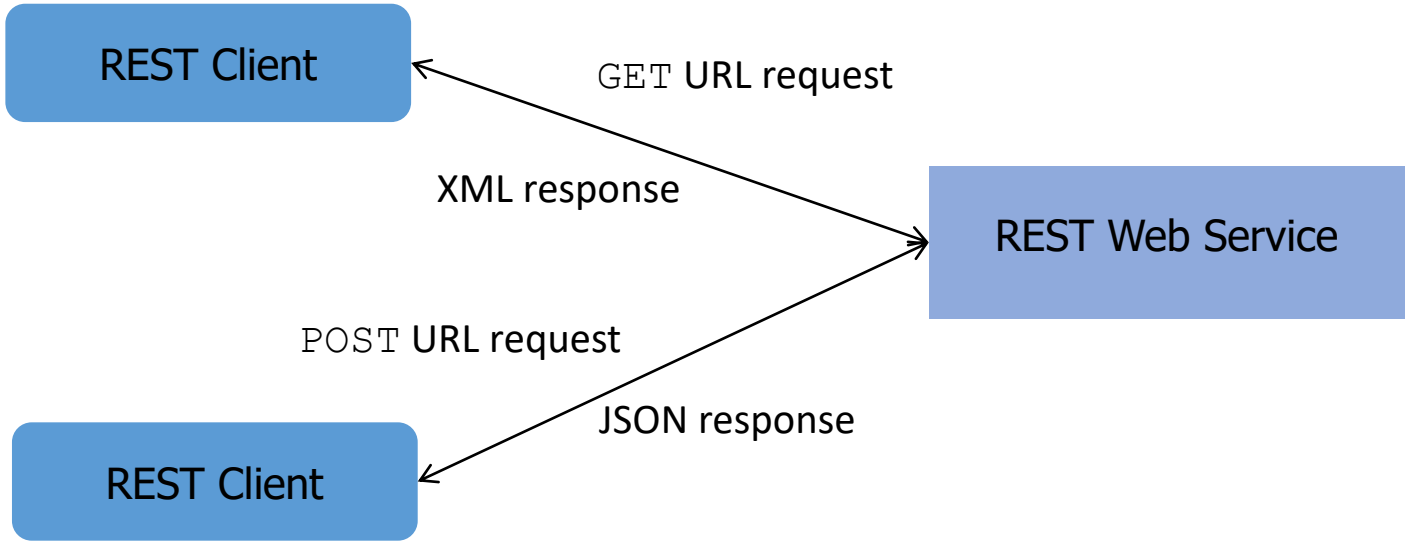
- Implementing a Service-Oriented Architecture requires:
  - Interoperable, loosely coupled ways of invoking services
    - Enterprise systems consist of many applications
    - Developed using many technologies
    - How to support communication between disparate systems?

Solution

- Use HTTP as base protocol
  - Mature, standard protocol supported by all languages and operating systems
  - HTTP traffic is allowed through most firewalls
- REST-based Web Services are a form of SOA that:
  - Use HTTP as base protocol
    - Use HTTP verbs to obtain and manipulate resources
      - `GET`, `POST`, `PUT`, `DELETE`
  - Exchange simple messages
    - In XML, JSON, etc.

REST-Based Web Services (continued)

- REST communication
  - Based on HTTP requests
  - Response can be in various formats
    - XML
    - JSON



XML and JSON

- JSON is the standard format used with REST services
- Clients are often Dynamic Web Applications using JavaScript
- Jax-RS handles both JSON and XML data
  - Will marshal data to/from Java classes based on type of data
- If a client requires data from a service in a particular format, they should set the HTTP header on the request
  - `Accept: application/json` or `Accept:application/xml`
  - Service will automatically send data in the correct format
    - With no change to code
- For a service to accept data, client should set HTTP header indicating type of data being sent
  - `Content-type: application/json` or `Content-type:application/xml`

Chapter Concepts

RESTful Web Services

HTTP Response Codes

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Chapter Summary

HTTP Status Codes

- The HTTP protocol defines meaningful status codes
  - Which can be returned from a RESTful service
- Using status codes can help service consumers
  - Determine how to understand the service response
  - Especially when errors occur
- What is status code 418?

https://en.wikipedia.org/wiki/List_of_HTTP_status_codes

HTTP Status Codes (continued)

- 200 OK — Response to a successful request
- 201 Created — Response to POST that results in a resource creation
- 204 No Content — Response to a successful request that does not return a body
- 400 Bad Request — The request was malformed
- 401 Unauthorized — Either invalid or missing authentication details in request
- 403 Forbidden — User does not have access to the requested resource
- 404 Not Found — We've all been here before
- 405 Method Not Allowed — The HTTP method is not allowed for this user
- 410 Gone — The resource is no longer available
- 418 ?

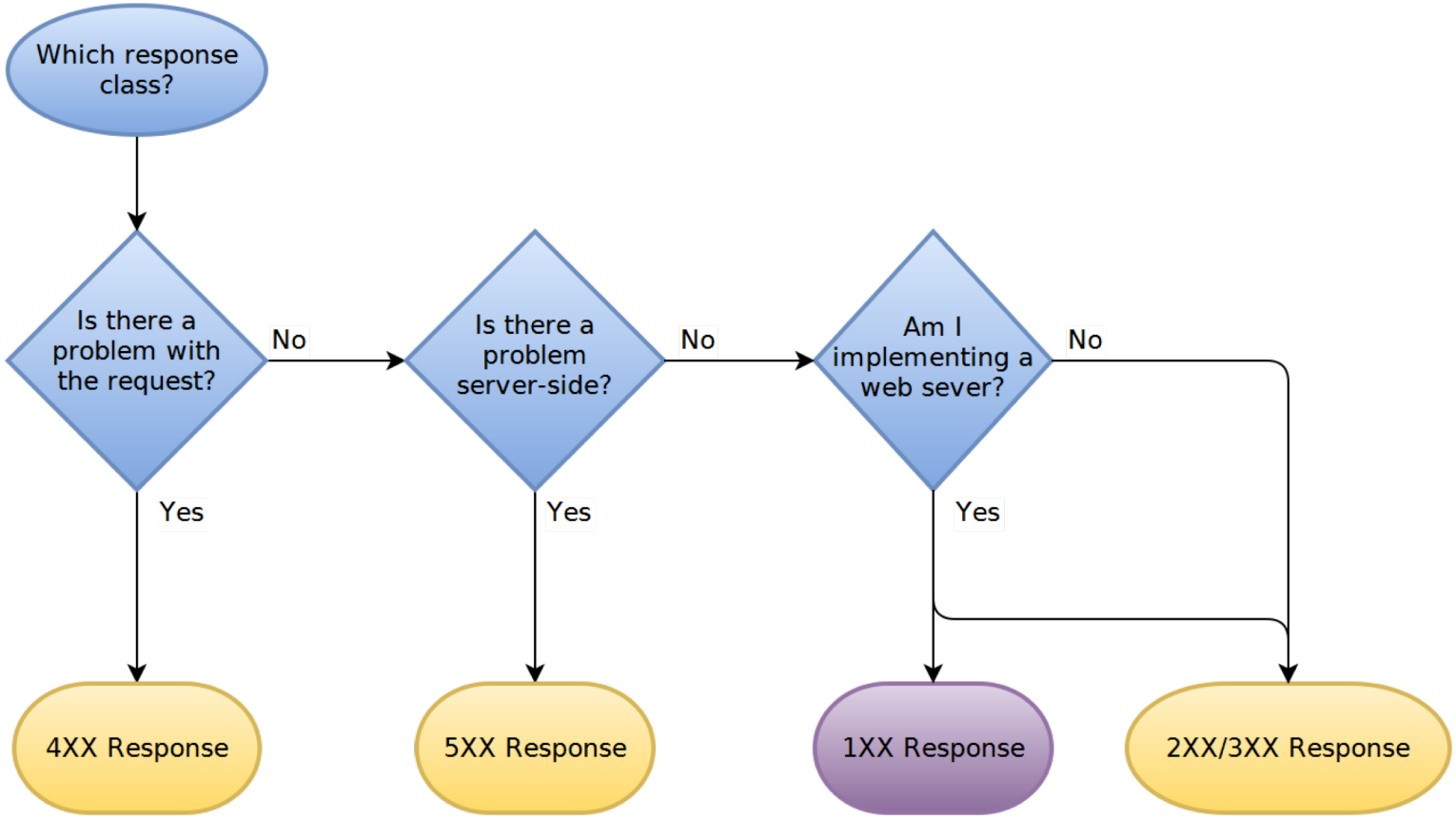
Why Should I Use a Status Code?

- They communicate to the RESTful client
  - When an exceptional event occurs
  - When some special behavior is required
- Many status codes represent situations that are worth handling with a special response
- Many widely used APIs are using them
  - A convention is being created
  - Following that convention makes it easier for users of your RESTful service
  - https://gist.github.com/vkostyukov/32c84c0c01789425c29a

What Status Should I Return?

- The following flowcharts answer this question
  - From http://racksburg.com/choosing-an-http-status-code/

- The flowcharts for each category of response are too big to fit on these slides
- Visit the above URL to see them



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RESTful API Guidelines

- RESTful services should be stateless
- Use RESTful URLs and actions
- Prefer returning JSON instead of XML
- Support versioning
- Use token-based authentication
- Include response headers that support caching
- Use HTTP Status codes effectively
- Consider using query parameters for filtering

RESTful Services Should Be Stateless

- A RESTful service API should be stateless
- Requests should not depend on cookies
  - Or sessions
- Services are much simpler
- Services are more efficient

User RESTful URLs

- RESTful principles were introduced in Roy Fielding's dissertation[1]
- Separate your API into conceptual resources
  - Describe as nouns (not verbs)
- Use HTTP verbs to manipulate resources

```
GET /employees/42/email              Retrieve the email for employee 42
POST /employees/42                   Create employee 42
PUT /employees/42/address            Update the address for employee 42
PATCH /employees/42/email            Partially update email for employee 42
DELETE /employees/42         Delete employee 42
```

1. Architectural Styles and the Design of Network-based Software Architectures, Roy Fielding
   http://www.ics.uci.edu/~fielding/pubs/dissertation/top.htm

Prefer JSON

- Problems with XML
  - Verbose
  - Difficult to parse
  - Difficult to use in a JavaScript client
- JSON is easy to use in JavaScript
  - It stands for JavaScript Object Notation right?
- The chart on the right indicates the trends of XML and JSON

https://trends.google.com/trends/explore?date=all&q=xml%20api,json%20api

Support Versioning

- Change is inevitable
  - So we have to deal with it
- Plan ahead for versioning support
  - Will save much time and effort later
- Where to include the version information
  - HTTP header
  - Request URL
- Can provide support for old versions
  - While offering new ones

Token-Based Authentication

- Request authentication should be stateless
  - No dependence on sessions or cookies
- Each request should contain its authentication credentials
- More on this in the Security section

Support Caching

- HTTP provides built-in caching
- Use additional outbound response headers
  - ETag
  - Last-Modified

ETag

- The ETag HTTP header
  - Contains a hash or checksum of the requested resource
  - This value should change whenever the resource changes
- If a request for the resource contains a If-None-Match header with a matching ETag value:
  - Then return a 304 Not Modified status code
  - Instead of the requested resource

Last-Modified

- Last-Modified works similarly to ETag
- Returns a timestamp as the value of the Last-Modified response header
- This is validated against the If-Modified-Since request header

Use HTTP Status Codes

- Use those status codes
  - As discussed in the Status Codes section

Filtering Resources

- Good idea to keep the RESTful URLs as lean as possible
- Filtering, sorting, and searching can be implemented with query parameters
  - Instead of many different URLs
- Consider using a unique query parameter
  - For each field that implements filtering
- This could also be done for sorting and searching

GET /tickets?state=open	– Retrieves only the tickets in the open state
GET /tickets?sort=-priority	– Retrieves a list of tickets in descending order of priority

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