

REST

Exploring REST API's

April 30, 2021



Agenda

What is a API?

- What is an API?
- What isn't necessarily an API?
- Types of APIs

What is a REST API?

- Message vs Transport protocol
- Commands vs Resources
- What is REST?
- The six constraints of REST
- Exercise

Doctors and Patients

- Problem statement
- REST Implementation
- Potential pitfalls of REST
- Documentation with Swagger
- Swagger editors
- Exercise



What is an API?

What is an API?

API ?

- Interface = The portion of an application that is exposed to the **outside world** for users to interact with
- UI = User **Interface**
 - Audience: **Users**
- API = Application Programming **Interface**
 - Audience: Developers, other application
 - A collections of functions or methods with known signatures and data models

What is an API?

Different types of API's

- Libraries and Frameworks
 - A software library
 - Ex. Java/JDK API, React API
- Operation Systems (OS)
 - Specifies the interface between an application and the operating system
 - Ex. WinAPI, POSIX
- Web Services
 - The interface for one application to exchange data with another over the web
 - Ex. SOAP, REST

What is an API?

Web Services / Web API

- For the remainder of this course, we'll be focused on web services / web API's



<https://towardsdatascience.com/api-management-platform-data-science-projects-43120558a000>

What is a REST API?

What is a REST API?

Message Protocol vs Transport Protocol

Message Protocol

- Structure and format of messages
- Ex. SOAP (Simple Object Access Protocol)

```
<?xml version="1.0"?>
<soap:Envelope
  xmlns:soap="http://www.w3.org/2003/05/soap-envelope/"
  soap:encodingStyle="http://www.w3.org/2003/05/soap-encoding">

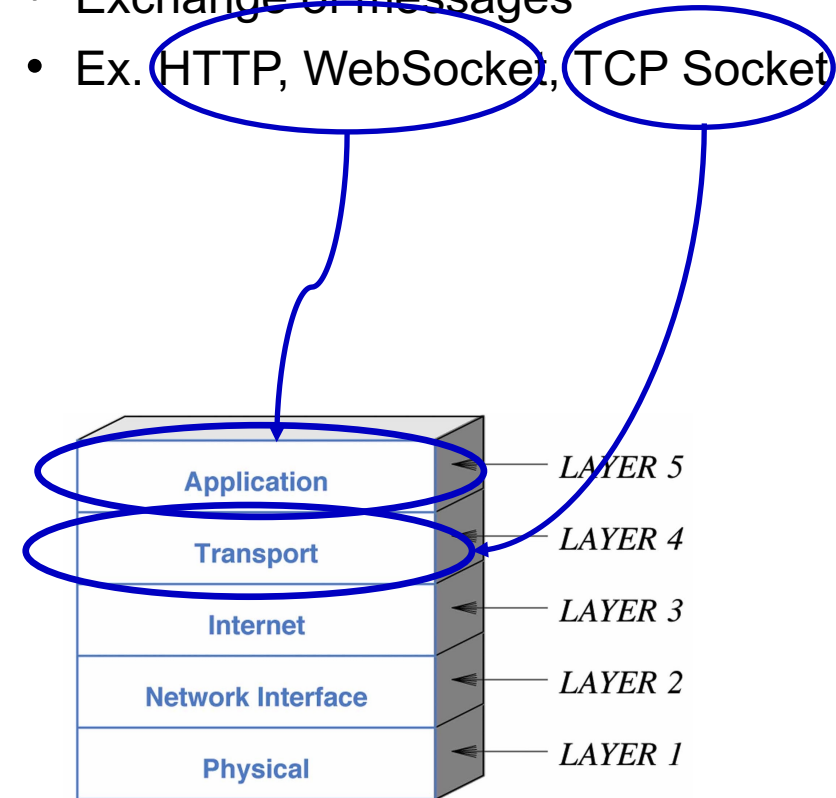
  <soap:Header>
    <m:Trans xmlns:m="https://www.w3schools.com/transaction/"
      soap:actor="https://www.w3schools.com/code/">234
    </m:Trans>
  </soap:Header>

  <soap:Body>
    <m:GetPriceResponse xmlns:m="https://www.w3schools.com/prices">
      <m:Price>1.90</m:Price>
    </m:GetPriceResponse>
  </soap:Body>

</soap:Envelope>
```

Transport Protocol

- Exchange of messages
- Ex. HTTP, WebSocket, TCP Socket



What is a REST API?

What is REST?

- **R**epresentational **S**tate **T**ransfer
- An architectural style for sharing data between applications
- Comprised of 6 architectural constraints
- Implemented over HTTP

REST was defined by Roy Fielding, a computer scientist. He presented the REST principles in his PhD dissertation in 2000.

What is a REST API?

What is REST?



Representational
state transfer

REST is comprised of the following:

- Services
- Resources
- Representations
- Verbs

Example

- Service: Doctor Profile
- Resource: Doctor
- Representation: {Id: 123, Name: 'Dr. Phil'}
- Verb: GET

What is a REST API?

The 6 architectural constraints of REST



Uniform Interface

- Define the interface between the client and the server
- Simplifies and decouples architecture
- Restful design
 - HTTP verbs (e.g. GET, PUT, POST, DELETE)



Stateless

- The server does not remember anything about the user using the API
- Each individual request contains all the information the server needs to perform the request and return a response, regardless of other requests made by the same API user

What is a REST API?

The 6 architectural constraints of REST



Client-Server Separation

- The client and server act independently, each on its own
- Interaction between them is only in the form of requests, initiated by the client only
- The server only responds in reaction to a request from a client



Cacheable

- Server response contains information about whether or not the data is cacheable
- Client can avoid requesting the same data again and again
- Client should know when the current version of the data expires

What is a REST API?

The 6 architectural constraints of REST



Layered System

- Between the client who requests a resource and the server who responds, there might be a number of servers in the middle
- These servers might provide a security layer, caching layer, load-balancing layer or other functionality
- Additional layers should not affect request or response



Code-on-demand (optional)

- Client can request code from the server, usually in the form of a script
- The client can then execute that code

What is a REST API?

Exercise

- Make a REST API with Express
- GET /home → { response: "Hello World!" }

Doctors and Patients

Doctors and Patients

Problem Statement

- You are web developer building a healthcare product
- You need to retrieve patient data from the server
- What are some of the typical ways to retrieve data in this scenario?

Potential Solutions



Custom protocol implementation

- Full control over implementation
- Security can be integrated into existing systems



Direct database access

- SQL is easy & ubiquitously known
- Flexibility of a query engine



SOAP

- Very descriptive API (WSDL)
- Utilizes secured authentication



REST APIs & similar implementations

- More detailed discussion to follow

Avantages

Inconvénients

- Considerable time spend
- Potential for security breaches

- Tight coupling between client & database
- Potential for security breaches

- Tight coupling between client & database
- Lack of supported data formats

Doctors and Patients

REST Implementation

- Supports any hypertext format (JSON, XML etc.)
- CRUD Operations (GET, PUT, POST, DELETE)
- APIs are independent of the client
- Fewer resources in transport as well as description
- Caching utilizes less network resources

Doctors and Patients

API path naming conventions



Verbs

- /getDoctors



Nouns

- More specifically, plurals
- /doctors



Filter

- Use ?
- GET /doctors?lastname=smith&city=waterloo

Doctors and Patients

HTTP Verbs

GET

Retrieve a representation of a resource

PUT

Update an existing entity

DELETE

Delete an entry (could be async)

POST

Create a new entity

Doctors and Patients

HTTP Status Codes

1XX – Information

- Ex. 101 Switching Protocols (HTTP → WebSocket)

2XX – Success

- Ex. 200 OK, 201 Created, 204 No Content

3XX – Redirect

- Ex. 301 Moved Permanently

4XX – Client Error

- Ex. 400 Bad Request, 401 Unauthorized, 404 Not Found

5XX – Server Error

- Ex. 500 Internal Server Error

Doctors and Patients

Patients

- ID
- Name

Visits

- Patient ID
- Doctor ID
- Completed

Doctors

- ID
- Name

Simplified REST API

```
var express = require("express");
var app = express();
var router = express.Router();

router.route("/patients/:id").get(function(req, res) {
  var patient = db.getPatient(req.body.id);
  res.json(patient);
});

router.route("/doctors/:id").get(function(req, res) {
  var doctor = db.getDoctor(req.body.id);
  res.json(doctor);
});

router.route("/visits/:patientId").get(function(req, res) {
  var visits = db.getVisits(req.body.patientId);
  res.json(visits);
});
```

...but where might
our solution struggle?

Doctors and Patients

Potential pitfalls of REST



- REST APIs are synchronous & hence resource intensive
- REST offers fewer verbs to operate on (e.g. no upsert functionality)



- Loses relationships between entities



- Often misused losing scalability

The wrong approach

Popular “REST” API

```
router.route("/patientsWithDoctors/:patientId").get(function(req, res) {  
  var result = {  
    patient: {},  
    doctors: []  
  };  
  result['patient'] = db.getPatient(req.body.patientId);  
  var visits = db.getVisits(req.body.patientId);  
  visits.forEach(function(visit) {  
    result.doctors.push(db.getDoctor(visit.doctor_id));  
  });  
  res.json(result);  
});
```

- Does not conform to standard
- Increases implementation complexity
- Endpoints tailored to specific use case – restricts reuse
- Any new feature requires editing an endpoint, resulting in potential breaking changes



Doctors and Patients

Documentation with Swagger

- Swagger is a framework for describing an API using a common language everyone can understand
 - Think of it like a blueprint for a house
- Comprehensible for developers and non-developers
- Both human readable and machine readable
- Easily adjustable

Sample Swagger file

Header

```
1  swagger: '2.0'
2  info:
3    title: polaris-demo1-service
4    description: Polaris Demo 1 Service
5    version: 1.0.0
6  schemes:
7    - https
8  basePath: /
9  produces:
10   - application/json
```

API Paths

```
11 paths:
12   '/demo1/v1/{name}':
13     post:
14       operationId: sayHello
15       parameters:
16         - name: name
17           in: path
18           description: name to say hello
19           required: true
20           type: string
21         - in: body
22           name: echoMessage
23           required: false
24           description: data for query
25           schema:
26             $ref: '#/definitions/EchoData'
27       responses:
28         200:
29           description: "OK"
30           schema:
31             $ref: '#/definitions/DemoResponse'
32         404:
33           description: "Resource Not Found"
```

Definitions

```
34 definitions:
35   EchoData:
36     type: object
37     properties:
38       message:
39         type: string
40         example: "Hello, how are you?"
41   DemoResponse:
42     type: object
43     properties:
44       result:
45         type: string
46       errors:
47         $ref: '#/definitions/Errors'
48   Errors:
49     type: object
50     description: error model for exception
51     properties:
52       errorList:
53         type: array
54         items:
55           type: string
```

Swagger Editor

Swagger Codegen

Code Generator
(client or server)

Swagger Editor

Editor for
designing and API

SwaggerUI

Interactive API
documentation

Doctors and Patients

Two approaches to Swagger

1) Top-Down

- Design-first
- Swagger Editor → Swagger/OpenAPI Spec → Swagger Codegen

2) Bottom-Up

- Generate Swagger documentation for an existing API

Doctors and Patients

Exercise



Manulife