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Data Integration: The *REST* of the Story

RESTful Interface Design for Data Integration

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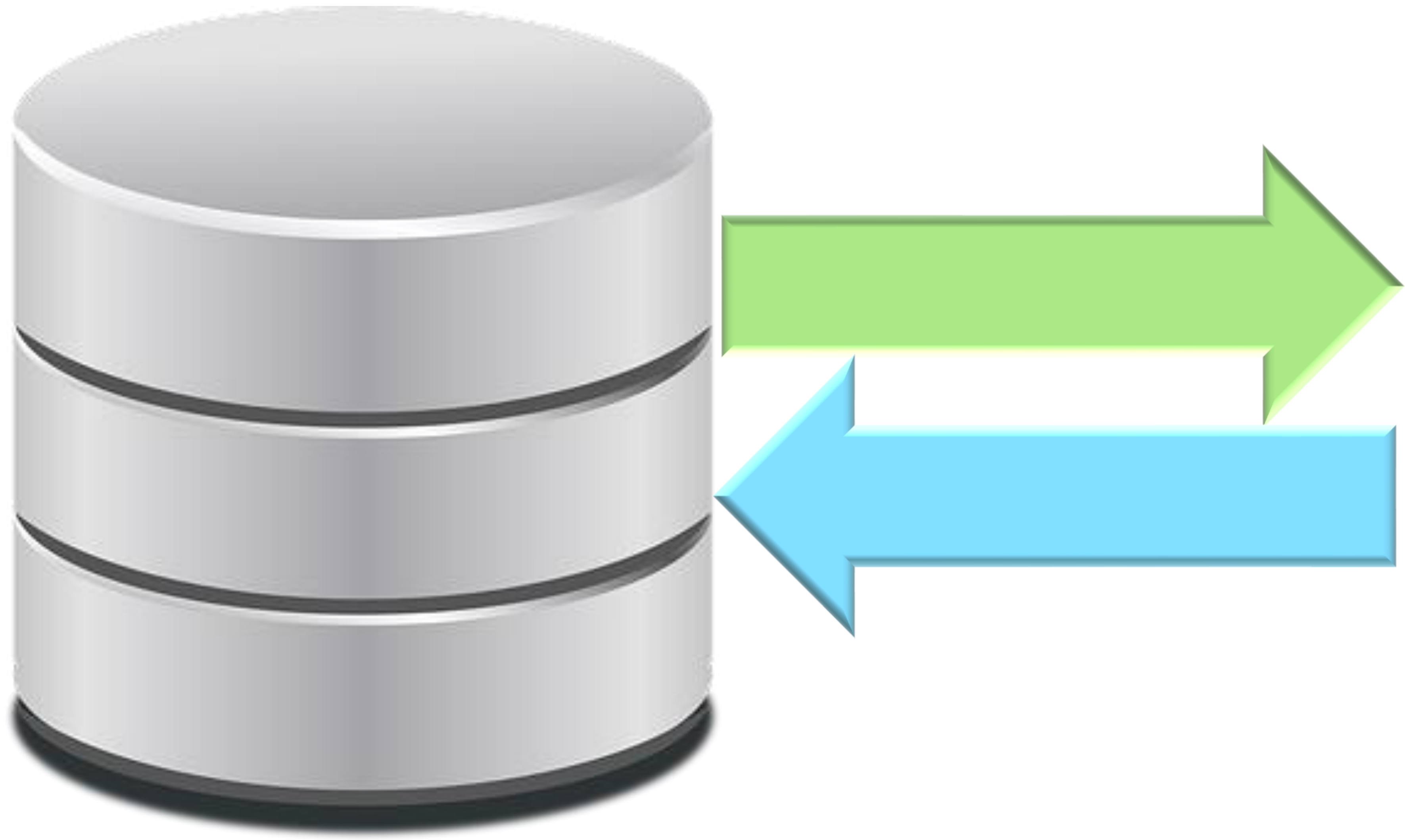
What are we doing here?!

- Why are we talking about REST?
  - You are providing data! (or want to)
  - You are consuming data! (or want to)
- APIs are everywhere!
  - External APIs
  - Internal APIs



"Use the API" sounds easy – but sometimes it's harder than it has to be.
What can *you* do to be successful?

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The Story Arc*

Background	*REST Basics.*
Internal APIs vs. Documented APIs	*Dealing with incomplete informa…*
Tools & Debugging	*Postman, Fiddler, AutoREST*
Complex Data & Relationships	*Nested & repeating structures. Joins.*
Designing for Change	*Schema evolution.*
Designing for Performance	*Paging, Filtering, Caching.*
Authentication & Security	*Basic, OAuth2, etc.*
Error Handling	*Bad JSON. HTTP Status.*

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Background

Why Choose REST?

- Fast infrastructure available
  - It leverages browser technologies
  - Compression/Caching
- Simple enough for an intern to implement
  - Protocol simple
  - Incremental value
- All the cool kids are doing it
  - Almost every application has a REST-in or REST-out option
  - Tools widely available and free

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REST Basics

- Protocol: **HTTP** *or* **HTTPS**
- Actions: **Verbs**
    - GET
    - POST
    - PUT
    - PATCH
    - DELETE
- Payload: **JSON**
    - Less often, **XML**

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REST Basics – GET

- GET
  - FIND or FOR EACH (ABL)　　　SELECT (SQL)
- GET /customer
  - FOR EACH customer:　　　SELECT * FROM customer;
- GET /customer/key
  - FIND customer WHERE id = key.　　　SELECT customer WHERE id = key;
- GET /customer?name=UFO%20Frisbee
  - FOR EACH customer
    WHERE name = "UFO Frisbee":　　　SELECT customer
    WHERE name = 'UFO Frisbee';

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REST Basics – POST

- POST
  - CREATE (ABL) INSERT (SQL)
  - Requires a JSON payload, like
    { "id":27, "name":"UFO Frisbee", "salesrep":"DKP" }
- POST /customer
  - CREATE customer INSERT INTO customer

```
CREATE customer
ASSIGN
    id = 27
    name = "UFO Frisbee"
    salesrep = "DKP".
```

```
INSERT INTO customer
    (id, name, salesrep)
    VALUES
    (27, 'UFO Frisbee', 'DKP');
```

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REST Basics – PUT and PATCH

- PUT and PATCH
  - Technically, PUT should reset any unspecified fields to their default
    - A lot like deleting and recreating, with just the values specified
  - Most sites mean PATCH when they implement PUT
    - So we'll pretend PUT means PATCH for the rest of this slide
  - Assignments (ABL) UPDATE (SQL)
  - Requires a JSON payload, like
    { "salesrep":"SLS" }
- PUT /customer/27
  - ABL:

    ```
    FIND customer
        WHERE id = 27.
    customer.salesrep = "SLS".
    ```

    SQL:

    ```
    UPDATE customer
        SET salesrep = 'SLS'
        WHERE id = 27;
    ```

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REST Basics – DELETE

- DELETE
  - DELETE (ABL) DELETE (SQL)
- DELETE /customer/27
  - FIND customer WHERE id = 27. DELETE customer. DELETE customer WHERE id = 27;

```
FIND customer                         DELETE customer
    WHERE id = 27.                        WHERE id = 27;
DELETE customer.
```

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Internal APIs vs. Documented APIs

What’s what

- Some applications do a really good job of documenting their APIs
- Some tell a good story, but the docs don’t match reality
- Some endpoints, especially those built on internal systems, have no reference material at all, other than “Ask Rita; I think she wrote that.”

```
/** @author Rita */
public class Result
  /**
   * @return
   */
  public Object getValue() {
   return object.calc();
  }

  /**
   * @param object
   */
  public void setValue(Object o) {
   object = o.clone();
  }
}
```

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Strategies

- Reading documentation
  - And hoping it’s accurate

```
This sentence is false.
```

- Reading source code
  - If it’s available, and if it’s not written in APL

```
{ω /⍨ ~{ω∨≠\ω}ω∊'<>'} txt
```

- Finding Rita
  - “Oh, She resigned last week.”
    “Um, Anyone know if IT has wiped her computer yet?”
- Poking it with a stick
  - Hitting the endpoint with `POSTMAN` and seeing what comes out
- Sampling
  - Using ARC to sample and analyze the structure

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Things to look for in documentation

- Authentication
- Paging
- Parameter semantics
- JSON response format (results aren't always at the root)

```
[
   {"id":8, "name":"Butternut Squash"},
   {"id":23, "name":"Sub Par Golf"},
   {"id":27, "name":"UFO Frisbee"}
]
```

```
{
   "customers":[
      {"id":8, "name":"Butternut Squash"},
      {"id":23, "name":"Sub Par Golf"},
      {"id":27, "name":"UFO Frisbee"}
   ]
}
```

```
{
   "offset":0,
   "count":3,
   "total":3,
   "page":1,
   "pages":1,
   "results":[
      {"id":8, "name":"Butternut Squash"},
      {"id":23, "name":"Sub Par Golf"},
      {"id":27, "name":"UFO Frisbee"}
   ]
}
```

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Tools & Debugging

Browser

- Quick way to test GET requests when no special headers or authentication is required
  - But that’s about it

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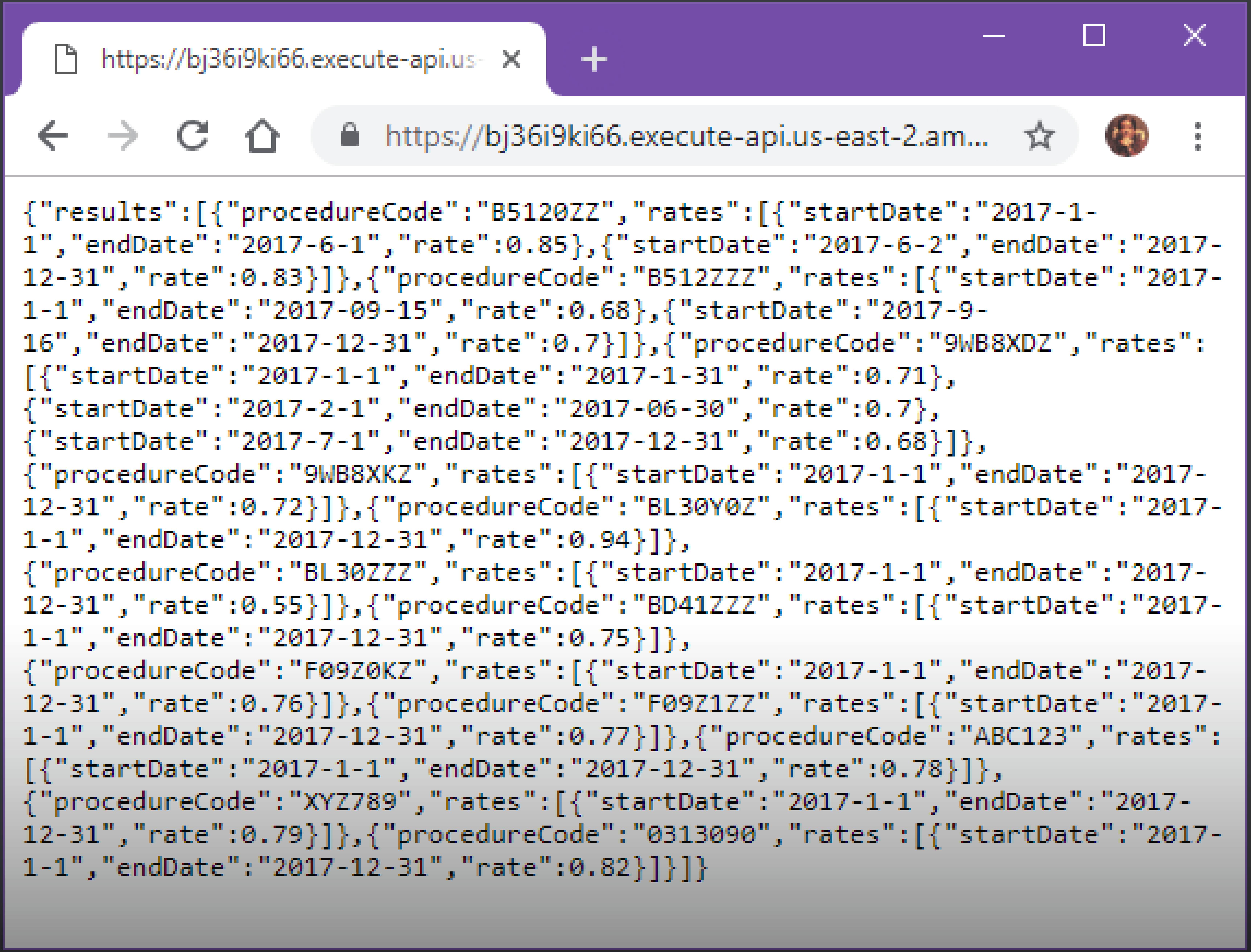
Inspecting with a Browser (Chrome)


https://bj36i9ki66.execute-api.us-
https://bj36i9ki66.execute-api.us-east-2.am...

```
{"results":[{"procedureCode":"B5120ZZ","rates":[{"startDate":"2017-1-1","endDate":"2017-6-1","rate":0.85},{"startDate":"2017-6-2","endDate":"2017-12-31","rate":0.83}]},{"procedureCode":"B512ZZZ","rates":[{"startDate":"2017-1-1","endDate":"2017-09-15","rate":0.68},{"startDate":"2017-9-16","endDate":"2017-12-31","rate":0.7}]},{"procedureCode":"9WB8XDZ","rates":[{"startDate":"2017-1-1","endDate":"2017-1-31","rate":0.71},{"startDate":"2017-2-1","endDate":"2017-06-30","rate":0.7},{"startDate":"2017-7-1","endDate":"2017-12-31","rate":0.68}]},{"procedureCode":"9WB8XKZ","rates":[{"startDate":"2017-1-1","endDate":"2017-12-31","rate":0.72}]},{"procedureCode":"BL30Y0Z","rates":[{"startDate":"2017-1-1","endDate":"2017-12-31","rate":0.94}]},{"procedureCode":"BL30ZZZ","rates":[{"startDate":"2017-1-1","endDate":"2017-12-31","rate":0.55}]},{"procedureCode":"BD41ZZZ","rates":[{"startDate":"2017-1-1","endDate":"2017-12-31","rate":0.75}]},{"procedureCode":"F09Z0KZ","rates":[{"startDate":"2017-1-1","endDate":"2017-12-31","rate":0.76}]},{"procedureCode":"F09Z1ZZ","rates":[{"startDate":"2017-1-1","endDate":"2017-12-31","rate":0.77}]},{"procedureCode":"ABC123","rates":[{"startDate":"2017-1-1","endDate":"2017-12-31","rate":0.78}]},{"procedureCode":"XYZ789","rates":[{"startDate":"2017-1-1","endDate":"2017-12-31","rate":0.79}]},{"procedureCode":"0313090","rates":[{"startDate":"2017-1-1","endDate":"2017-12-31","rate":0.82}]}]}
```

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Postman

- Issue request
- Inspect results
- Modify headers
- Experiment with authentication

POSTMAN

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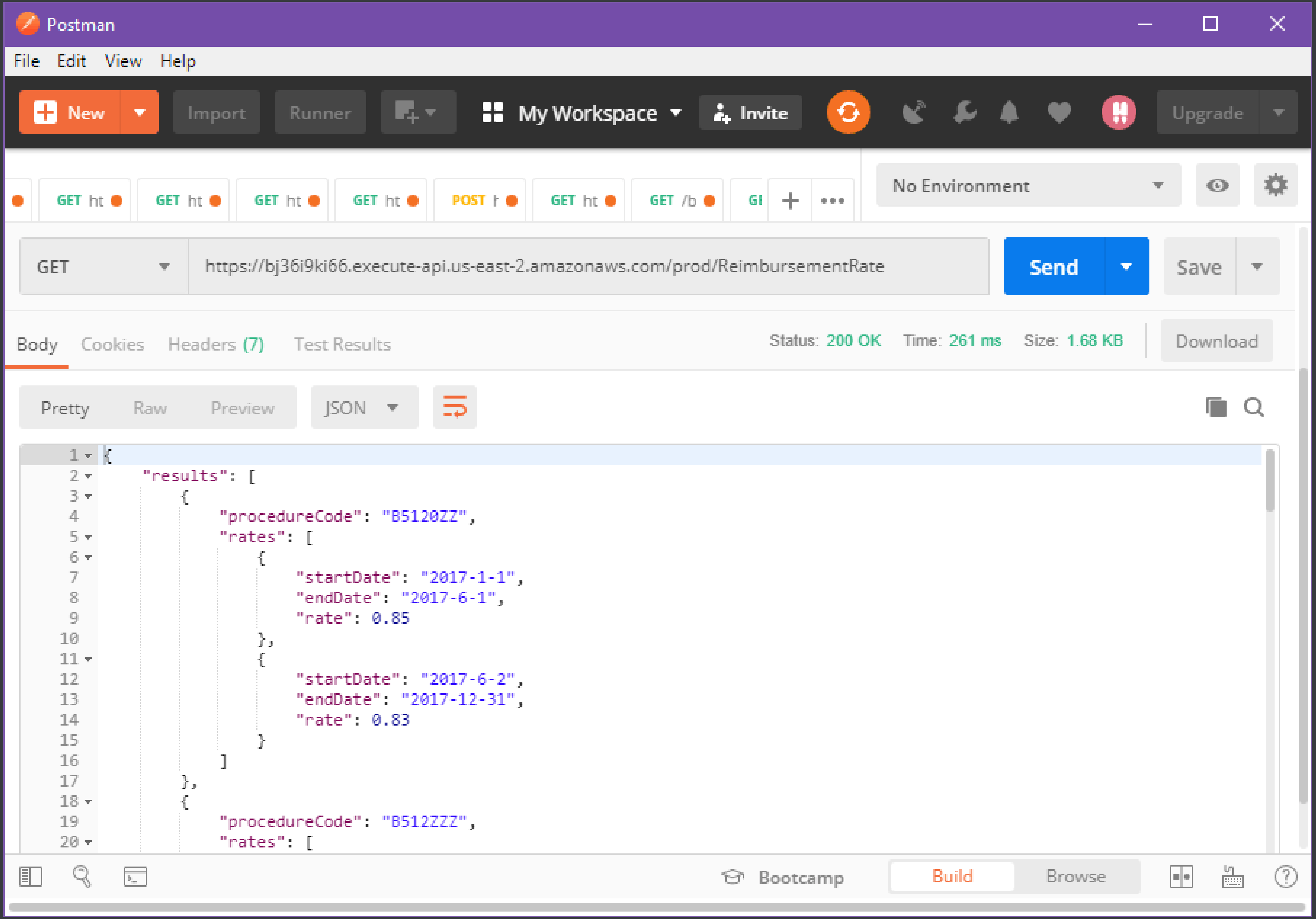
Inspecting with Postman (showing body)



GET https://bj36i9ki66.execute-api.us-east-2.amazonaws.com/prod/ReimbursementRate

Status: 200 OK Time: 261 ms Size: 1.68 KB

```
{
    "results": [
        {
            "procedureCode": "B5120ZZ",
            "rates": [
                {
                    "startDate": "2017-1-1",
                    "endDate": "2017-6-1",
                    "rate": 0.85
                },
                {
                    "startDate": "2017-6-2",
                    "endDate": "2017-12-31",
                    "rate": 0.83
                }
            ]
        },
        {
            "procedureCode": "B512ZZZ",
            "rates": [
```

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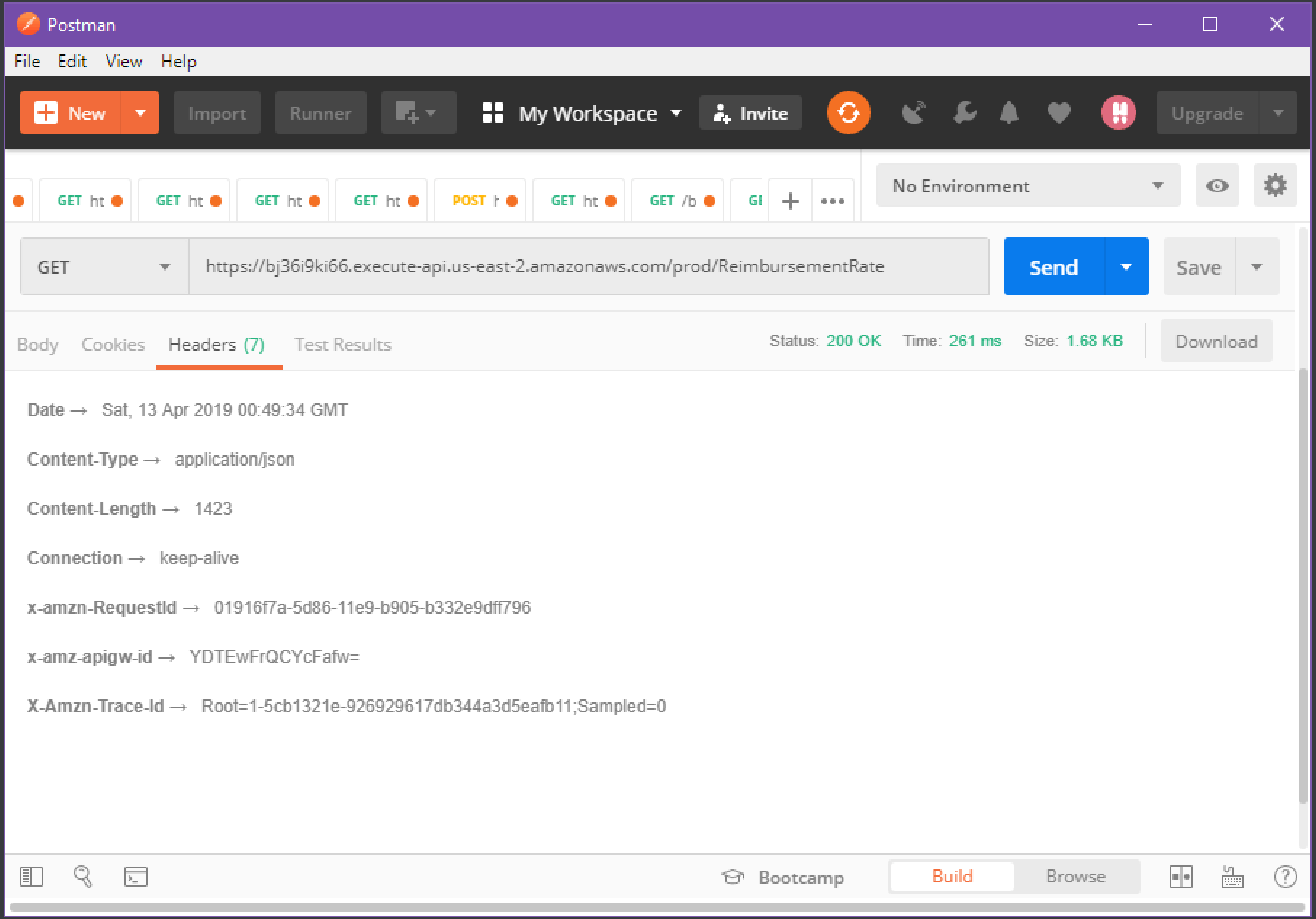
Inspecting with Postman (showing headers)



GET https://bj36i9ki66.execute-api.us-east-2.amazonaws.com/prod/ReimbursementRate

Status: 200 OK Time: 261 ms Size: 1.68 KB

```
Date → Sat, 13 Apr 2019 00:49:34 GMT
Content-Type → application/json
Content-Length → 1423
Connection → keep-alive
x-amzn-RequestId → 01916f7a-5d86-11e9-b905-b332e9dff796
x-amz-apigw-id → YDTEwFrQCYcFafw=
X-Amzn-Trace-Id → Root=1-5cb1321e-926929617db344a3d5eafb11;Sampled=0
```

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Fiddler

Fiddler

- Use as a proxy to watch stuff happen
  - Even **HTTPS** interception
- Intercept (and tweak) data in stream

https://www.telerik.com/download/fiddler

https://docs.telerik.com/fiddler/Configure-Fiddler/Tasks/ConfigureFiddler

https://docs.telerik.com/fiddler/Configure-Fiddler/Tasks/ConfigureJavaApp

- If using HTTPS, here's how to configure:
  https://stackoverflow.com/questions/8549749/how-to-capture-https-with-fiddler-in-java

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Import certificate from Fiddler; Inform JVM

- <*java*>\bin\keytool.exe -importcert -trustcacerts
  -file **<*desktop*>\FiddlerRoot.cer**
  -keystore **<*directory*>/FiddlerKeystore** -alias **Fiddler**
- Enter keystore password: **password**
- Trust this certificate? [no] **yes**

- -Dhttps.proxyHost=**127.0.0.1**
- -Dhttps.proxyPort=**8888**
- -Djavax.net.ssl.trustStore=**<*directory*>/FiddlerKeystore**
- -Djavax.net.ssl.trustStorePassword=**password**

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Fiddler Screenshot

Fiddler on the Roof, 1971—8 Academy Awards,
4 Golden Globes, 3 BAFTAs, etc. Not software.

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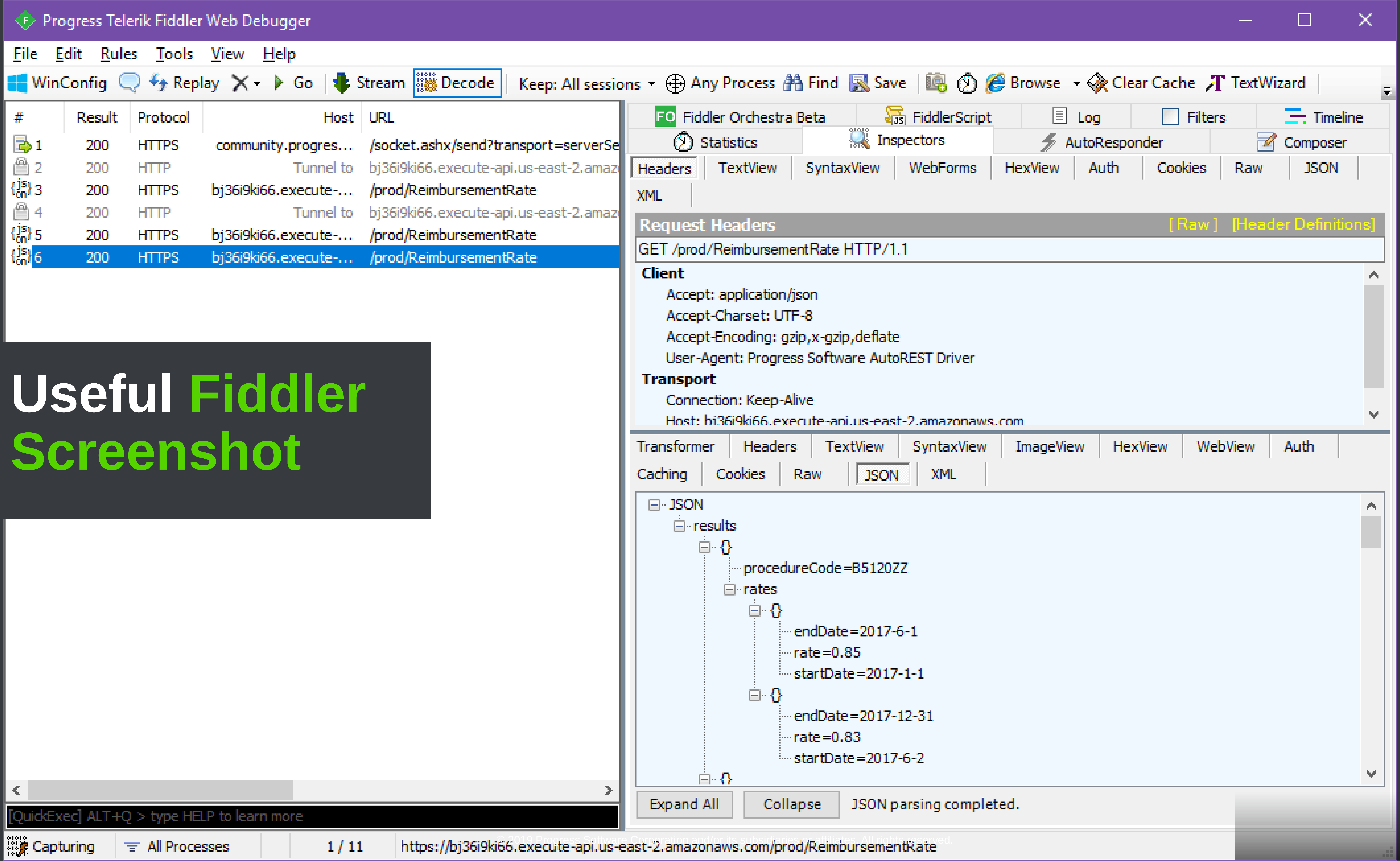
Useful Fiddler Screenshot


Progress Telerik Fiddler Web Debugger
File Edit Rules Tools View Help
WinConfig Replay Go Stream Decode Keep: All sessions Any Process Find Save Browse Clear Cache TextWizard
Fiddler Orchestra Beta FiddlerScript Log Filters Timeline
Statistics Inspectors AutoResponder Composer
Headers TextView SyntaxView WebForms HexView Auth Cookies Raw JSON XML
Transformer Headers TextView SyntaxView ImageView HexView WebView Auth
Caching Cookies Raw JSON XML
Expand All Collapse

#	Result	Protocol	Host	URL
1	200	HTTPS	community.progres…	/socket.ashx/send?transport=serverSe
2	200	HTTP	Tunnel to	bj36i9ki66.execute-api.us-east-2.amaz
3	200	HTTPS	bj36i9ki66.execute-…	/prod/ReimbursementRate
4	200	HTTP	Tunnel to	bj36i9ki66.execute-api.us-east-2.amaz
5	200	HTTPS	bj36i9ki66.execute-…	/prod/ReimbursementRate
6	200	HTTPS	bj36i9ki66.execute-…	/prod/ReimbursementRate

```
Request Headers                                [ Raw ]  [Header Definitions]
GET /prod/ReimbursementRate HTTP/1.1
Client
    Accept: application/json
    Accept-Charset: UTF-8
    Accept-Encoding: gzip,x-gzip,deflate
    User-Agent: Progress Software AutoREST Driver
Transport
    Connection: Keep-Alive
    Host: bj36i9ki66.execute-api.us-east-2.amazonaws.com
```

```
JSON
  results
    {}
      procedureCode=B5120ZZ
      rates
        {}
          endDate=2017-6-1
          rate=0.85
          startDate=2017-1-1
        {}
          endDate=2017-12-31
          rate=0.83
          startDate=2017-6-2
    {}
```

JSON parsing completed.

[QuickExec] ALT+Q > type HELP to learn more

Capturing   All Processes   1 / 11   https://bj36i9ki66.execute-api.us-east-2.amazonaws.com/prod/ReimbursementRate

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Complex Data & Relationships

One of these things is not like the others

Surface	Length	Width	Legs
Oak	42"	72"	5
Maple	36"	60"	4
Teak	30"	54"	2
Ebony	80cm	160cm	2

Muppet	Voice	Image
Grover	Frank Oz	
Kermit	Jim Henson	

Team	Zone	Standing
Brazil	CONMEBOL	3
Chile	CONMEBOL	14
Colombia	CONMEBOL	8
Germany	UEFA	2
Mexico	CONCACAF	20
USA	CONCACAF	13

```
{
  _id: 1,
  tournament: "world cup",
  years:[
    {
      year: 2014,
      location: "Brazil",
      teams:[
        "Brazil", "Chile", "Colombia",
        "Germany", "Mexico", "USA"
      ]
    },
    …
  ]
}
```

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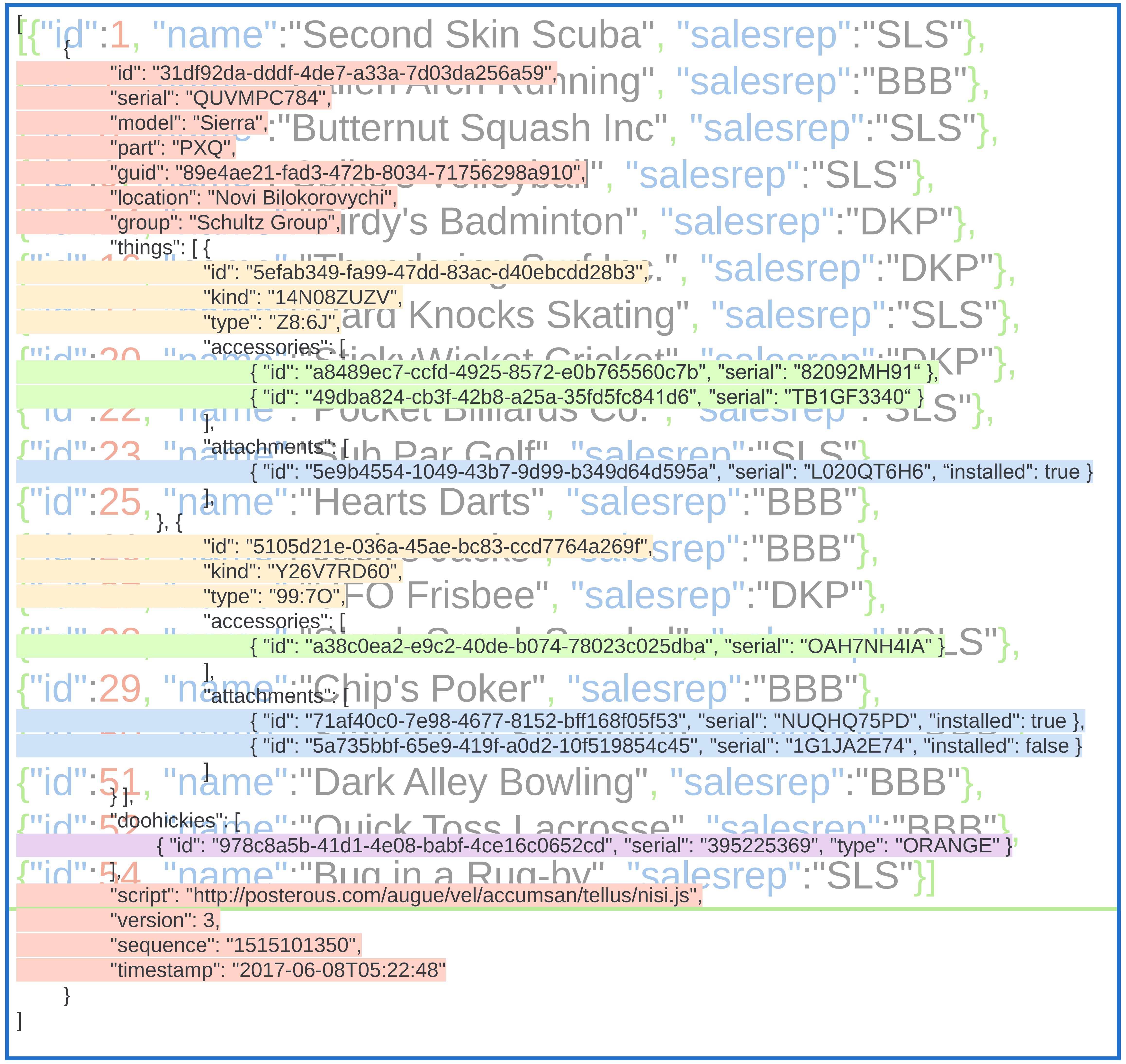
For many APIs, you’ll get back rectangles of data

- Often for APIs that simply front some other reporting engine

But for other APIs, you’ll get really complex structures



```
[{"id":1, "name":"Second Skin Scuba", "salesrep":"SLS"},
[illegible]nning", "salesrep":"BBB"},
[illegible]:"Butternut Squash Inc", "salesrep":"SLS"},
[illegible]", "salesrep":"SLS"},
[illegible]rdy's Badminton", "salesrep":"DKP"},
[illegible]", "salesrep":"DKP"},
[illegible]ard Knocks Skating", "salesrep":"SLS"},
{"id":20, "name":"Sticky Wicket Cricket", "salesrep":"DKP"},
{"id":22, "name":"Pocket Billiards Co.", "salesrep":"SLS"},
{"id":23, "name":"[illegible]b Par Golf", "salesrep":"SLS"},
{"id":25, "name":"Hearts Darts", "salesrep":"BBB"},
[illegible]srep":"BBB"},
[illegible]FO Frisbee", "salesrep":"DKP"},
[illegible]"SLS"},
{"id":29, "name":"Chip's Poker", "salesrep":"BBB"},
{"id":51, "name":"Dark Alley Bowling", "salesrep":"BBB"},
{"id":52, "name":"Quick Toss Lacrosse", "salesrep":"BBB"},
{"id":54, "name":"Bug in a Rug-by", "salesrep":"SLS"}]
```

```
[
    {
        "id": "31df92da-dddf-4de7-a33a-7d03da256a59",
        "serial": "QUVMPC784",
        "model": "Sierra",
        "part": "PXQ",
        "guid": "89e4ae21-fad3-472b-8034-71756298a910",
        "location": "Novi Bilokorovychi",
        "group": "Schultz Group",
        "things": [ {
            "id": "5efab349-fa99-47dd-83ac-d40ebcdd28b3",
            "kind": "14N08ZUZV",
            "type": "Z8:6J",
            "accessories": [
                { "id": "a8489ec7-ccfd-4925-8572-e0b765560c7b", "serial": "82092MH91“ },
                { "id": "49dba824-cb3f-42b8-a25a-35fd5fc841d6", "serial": "TB1GF3340“ }
            ],
            "attachments": [
                { "id": "5e9b4554-1049-43b7-9d99-b349d64d595a", "serial": "L020QT6H6", “installed": true }
            ]
        }, {
            "id": "5105d21e-036a-45ae-bc83-ccd7764a269f",
            "kind": "Y26V7RD60",
            "type": "99:7O",
            "accessories": [
                { "id": "a38c0ea2-e9c2-40de-b074-78023c025dba", "serial": "OAH7NH4IA" }
            ],
            "attachments": [
                { "id": "71af40c0-7e98-4677-8152-bff168f05f53", "serial": "NUQHQ75PD", "installed": true },
                { "id": "5a735bbf-65e9-419f-a0d2-10f519854c45", "serial": "1G1JA2E74", "installed": false }
            ]
        } ],
        "doohickies": [
            { "id": "978c8a5b-41d1-4e08-babf-4ce16c0652cd", "serial": "395225369", "type": "ORANGE" }
        ],
        "script": "http://posterous.com/augue/vel/accumsan/tellus/nisi.js",
        "version": 3,
        "sequence": "1515101350",
        "timestamp": "2017-06-08T05:22:48"
    }
]
```

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Complex Data Models – The Why

- Model relationship semantics
  - An order has items, after all
- Keep related data together
  - Prevents multiple round trips
  - Helps data consistency
- Report on query/execution metadata
  - Did the query succeed?
  - Is this a partial result?

```
{    "meta":{
         "Status":"success",
         "exectime":873,
         "records":5937984
     },
     "pagenumber":4,
     "morePages" :true,
     "results": [
          {
               "Address":"11 Perkins St",
               "City":"Boston",
               "Cust-num":4,
               "Order-num":2,
               "Name":"Pedal Power Cycles",
               "items": [{
                         "Item-num":3,
                         "Price":2.55,
                         "Qty":4,
                    }, {
                         "Item-num":9,
                         "Price":75,
                         "Qty":2,
                    }
               ]
          }
     ]
}
```

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Normalization

```
https://myservice/orders/2
{
    "Order-num":2,
    "Odate":"1990-09-06",
    "customer": {
        "Cust-num":4,
        "Name":"Pedal Power Cycles",
        "Address":"11 Perkins St",
        "City":"Boston"
    },
    "orderlines": [
        {
            "Item-num":3,
            "Price":2.55,
            "Qty":4
        }, {
            "Item-num":9,
            "Price":75,
            "Qty":2
        }, {
            "Item-num":19,
            "Price":19.95,
            "Qty":17
        }
    ]
}
```

```
TABLE: orders
Order-num: integer, key
Odate: Date
```

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Normalization→Flattening (Objects)

```
https://myservice/orders/2
{
    "Order-num":2,
    "Odate":"1990-09-06",
    "customer": {
        "Cust-num":4,
        "Name":"Pedal Power Cycles",
        "Address":"11 Perkins St",
        "City":"Boston"
    },
    "orderlines": [
        {
            "Item-num":3,
            "Price":2.55,
            "Qty":4
        }, {
            "Item-num":9,
            "Price":75,
            "Qty":2
        }, {
            "Item-num":19,
            "Price":19.95,
            "Qty":17
        }
    ]
}
```

```
TABLE: orders
Order-num: integer, key
Odate: Date
Cust-num: integer
Name: varchar(64)
Address: varchar(64)
City: varchar(64)
```

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Normalization→Arrays (Lists)

```
https://myservice/orders/2
{
    "Order-num":2,
    "Odate":"1990-09-06",
    "customer": {
        "Cust-num":4,
        "Name":"Pedal Power Cycles",
        "Address":"11 Perkins St",
        "City":"Boston"
    },
    "orderlines": [
        {
            "Item-num":3,
            "Price":2.55,
            "Qty":4
        }, {
            "Item-num":9,
            "Price":75,
            "Qty":2
        }, {
            "Item-num":19,
            "Price":19.95,
            "Qty":17
        }
    ]
}
```

TABLE: orders

Order-num (KEY)	Odate	Cust-num	Name	Address	City
2	1990-09-06	4	Pedal Power Cycles	11 Perkins St	Boston

TABLE: orderlines

Order-num (KEY)	Position (KEY)	Item-num	Price	Qty
2	1	3	2.55	4
2	2	9	75.00	2
2	3	19	19.95	17

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Relationships – JOIN in a single endpoint

```
https://myservice/orders/
{
    "Order-num":2,
    "Odate":"1990-09-06",
    "customer": {
        "Cust-num":4,
        "Name":"Pedal Power Cycles",
        "Address":"11 Perkins St",
        "City":"Boston"
    },
    "orderlines": [
        {
            "Item-num":3,
            "Price":2.55,
            "Qty":4
        }, {
            "Item-num":9,
            "Price":75,
            "Qty":2
        }, {
            "Item-num":19,
            "Price":19.95,
            "Qty":17
        }
    ]
}
```

TABLE: orders

Order-num (KEY)	Odate	Cust-num	Name	Address	City
2	1990-09-06	4	Pedal Power Cycles	11 Perkins St	Boston

TABLE: orderlines

Order-num (KEY)	Position (KEY)	Item-num	Price	Qty
2	1	3	2.55	4
2	2	9	75.00	2
2	3	19	19.95	17

SELECT orders.Name, orderlines.Price, orderlines.Qty

FROM orders INNER JOIN orderlines

ON orders.Order-num = orderlines.order-num

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Relationships – JOIN across endpoints

```
https://myservice/orders/
{
    "Order-num":2,
    "Odate":"1990-09-06",
    "customer": {
        "Cust-num":4,
        "Name":"Pedal Power Cycles",
        "Address":"11 Perkins St",
        "City":"Boston"
    },
    "orderlines": [
        {
            "Item-num":3,
            "Price":2.55,
            "Qty":4
        }, {
            "Item-num":9,
            "Price":75,
            "Qty":2
        }, {
            "Item-num":19,
            "Price":19.95,
            "Qty":17
        }
    ]
}
```

```
https://myservice/customers

{
    "Contact":"Alicia Primes",
    "Curr-bal":520.77,
    "Cust-num":4,
    "Discount":2,
    "Max-credit":416,
    "Name":"Pedal Power Cycles",
    "Phone":"6172456969",
    "Sales-rep":"BBB",
    "St":"MA",
    "Ytd-sls":4713.87
}, …
```

What can we do?

- Pull everything back (is next week okay?)
- Optimizations
  - Algorithms
  - Filters

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Designing Your Data Model for Integration

- Domain specific design is okay
- Consider future reporting needs
  - Either augment existing data…
  - …or provide an alternative endpoint
- Avoid limitless and over-generalized nesting

```
{
    "DATA" : {
        "RECORDS" : {},
        "ArrayIndex" : 1
    },
    "PEOPLE" : {
        "PERSON" : [
            {
                "DATA" : {
                    "RECORDS" : {},
                    "ArrayIndex" : 1
                },
                "PARTY" : {
                    "APPLICANT" : {
                        "BACKGROUND" : {
                            "CREDIT_HISTORY" : [
                                {
                                    "DATA" : {
                                        "HISTORY" : {
                                            "GOOD_STUFF" : [
                                                {
                                                    "YEAR" : 2007,
                                                    "SCORE" : "1"
                                                }
                                            ],
                                            "BAD_STUFF" : [
                                                {
                                                    "YEAR" : 2009,
                                                    "SCORE" : 37
                                                }
                                            ]
                                        },
                                        "ArrayIndex" : 1
                                    },
                                    "RULES_APPLIED" : "1",
                                    "DESCRIPTION" : "Success!"
                                },
                                {
                                    "DATA" : {
                                        "HISTORY" : {
                                            "GOOD_STUFF" : [
                                                {
                                                    "YEAR" : 2007,
                                                    "SCORE" : "1"
```

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Designing for Change

Schema Evolution – as a Sender

- If you're sending the payload, how do you protect clients from future changes?

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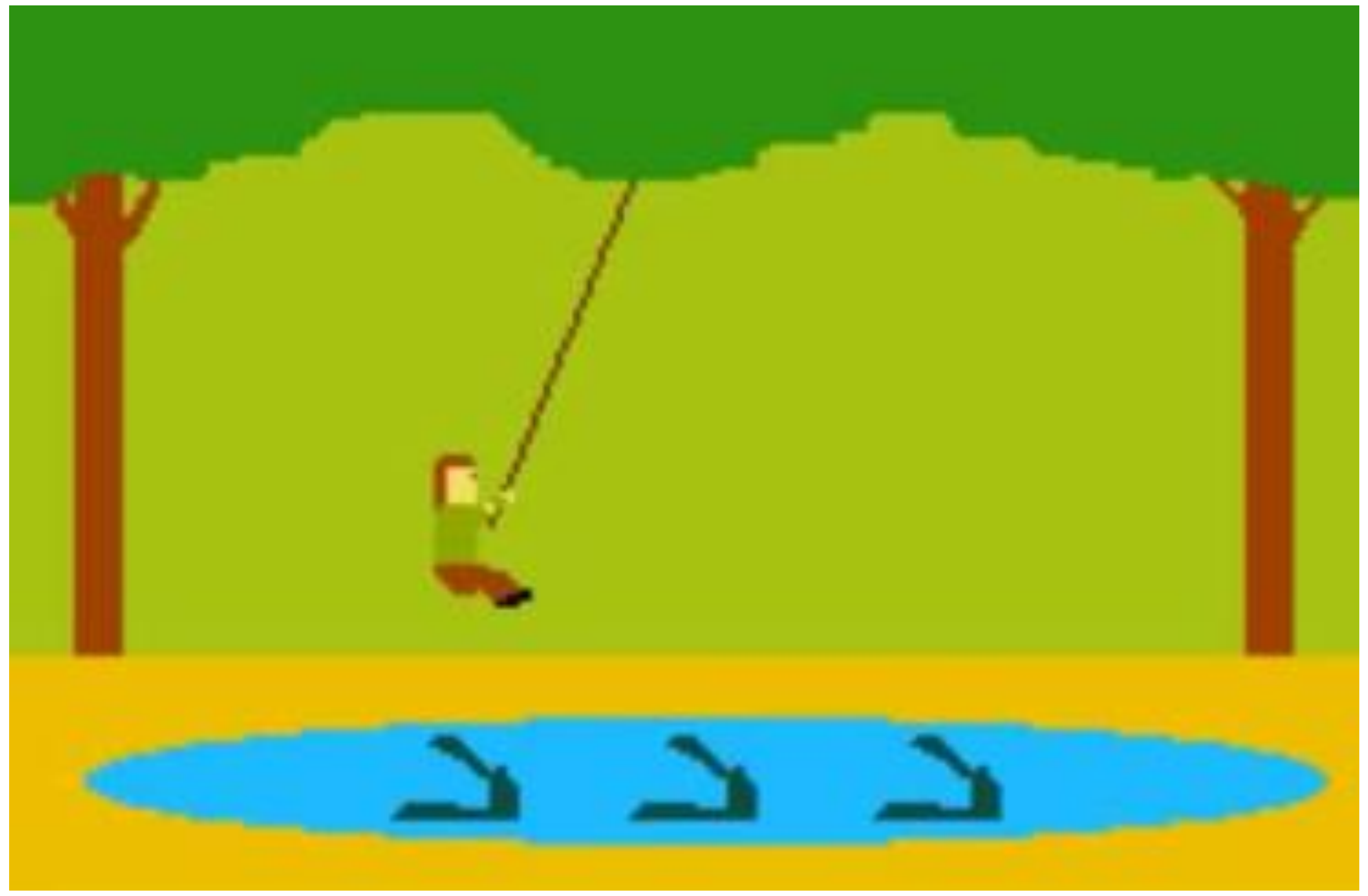
Schema Evolution – Beware the following changes

- Changing from scalar to array instances
- Using the same name for a field when changing its type
  - Especially simple to complex types
  - Tools' implementations will lag behind your API
- Big structural changes will cause problems for integrators
- Date and time representations
  - Yes: ISO. Yes: epoch. No: MMDDYY
- Floats/Numerics – some JSON systems put everything into a double.
  - Often see numbers quoted for this reason
  - What looks like an `int` may be a `long`
- **Hint: Version your APIs!**



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Designing for Performance

Large Result Sets

- The good news:
  Your entire database can now be queried with REST
- The bad news:
  All 15TB comes back

Like drinking from a firehose

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Paging

- Common pattern is **paging**
  - Page size/Row offset
  - Page size/Page number
  - Cursor-driven

  - Example from SpaceX →

GET All Rockets

https://api.spacexdata.com/v3/rockets

Returns all rockets

Param	Type	Description
limit	integer	Limit results returned, defaults to all documents returned
offset	integer	Offset or skip results from the beginning of the query

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Paging and Stability

- Common problem is **stability**
  - REST ain't ACID
    - No "consistent read" mode
  - If the source is active, inserted or deleted rows can leave "holes"

Tony

```
> GET Offset 0, Limit 1000
…returns Keys 0-999


> GET Offset 1000, Limit 1000
…returns keys 1001-2000 (!)
```

Key	Data
0	
…	
~~999~~	🟥
1000	
1001	
…	
1999	
2000	

Phil

```
> Delete where key = 999
```

(laughs maniacally)

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Filtering

- How to design filtering so that it’s easy for others to use
- The simpler, the better
  - Everybody wants to introduce their own query language
  - Resist the urge!
  - Do you really need all those operators?
  - If so, consider **OData**. *Why reinvent the wheel?*
    - .Net → NuGet Install-Package Microsoft.AspNet.Odata
    - Java → https://olingo.apache.org/
    - Standard → https://www.odata.org/ “OData – the best way to REST”

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80/20 Rule Filtering

- Most of the time, people just want to use some simple filters
- Query parameters
  - Get all data
    `https://server/endpoint`
  - Use one filter: Get all data on “little” items
    `https://server/endpoint?size=little`
  - Use a different filter: Get all data on “green” items
    `https://server/endpoint?color=green`
  - Combine filters: Get all data on Martians
    `https://server/endpoint?size=little&color=green&object=men`

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Caching

- Congratulations!
- Because you used REST and not GraphQL or RPC, you can take advantage of *caching*
- HTTP Caching only works for HTTP GET requests

- HTTP Caching Headers:
  - **Cache-Control**
  - **Expires**
  - **ETag** and **If-None-Match**
  - **Apache**, **nginx**, **IIS**, **Tomcat**, etc.—most web servers support caching

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Compression – Just Do It

- “gzip” response compression
  - Alternatives?
    - “deflate” subsumed by “gzip”
    - “brotli” slightly better; not as well supported, source at https://github.com/google/brotli
    - “identity” for small payloads? Nah, best to just gzip everything
  - Easy to implement
    - GZipInputStream/GZipOutputStream (Java)
    - GZipStream (.Net)
    - zlib (C/C++)
  - Minimal performance impact (<5%)
  - Transparent to user

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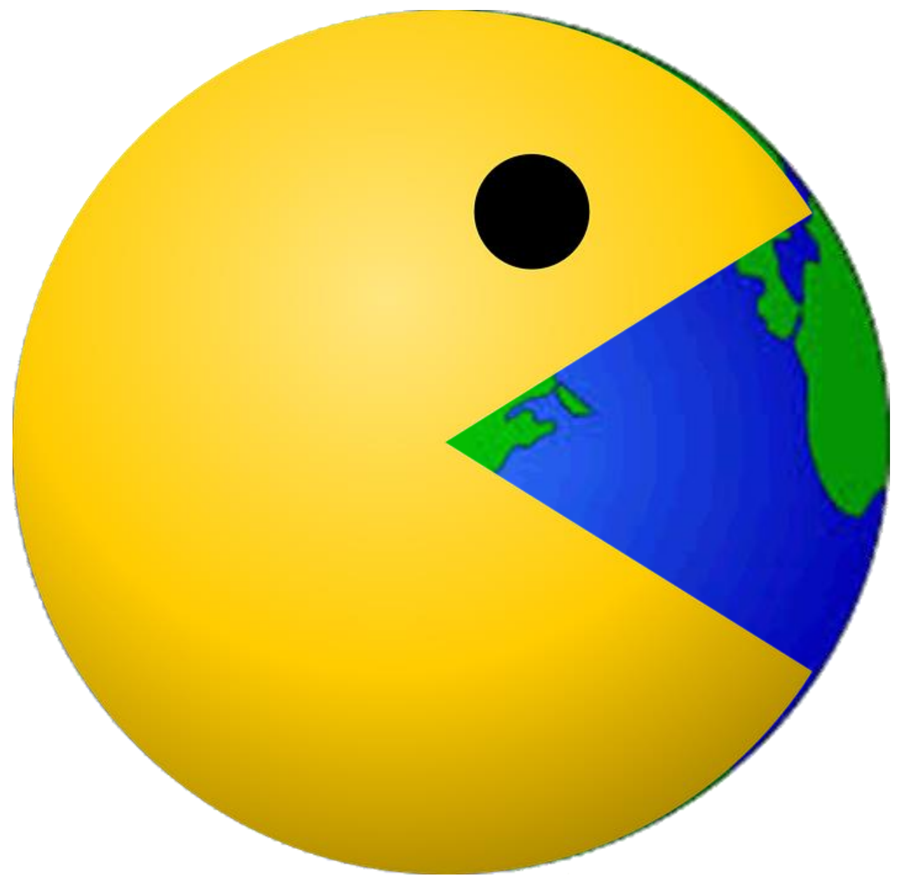
Authentication & Security

Authentication

- *The good news:*
  You've put on a REST interface, so now the whole world can see your data
- *The bad news:*
  The whole world can see your data



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Recommended Authentication

- None
- Basic
- ~~Digest~~
- ~~OAuth 1~~
- OAuth 2
- SSO
  - Kerberos
  - Active Directory
- ~~Other~~

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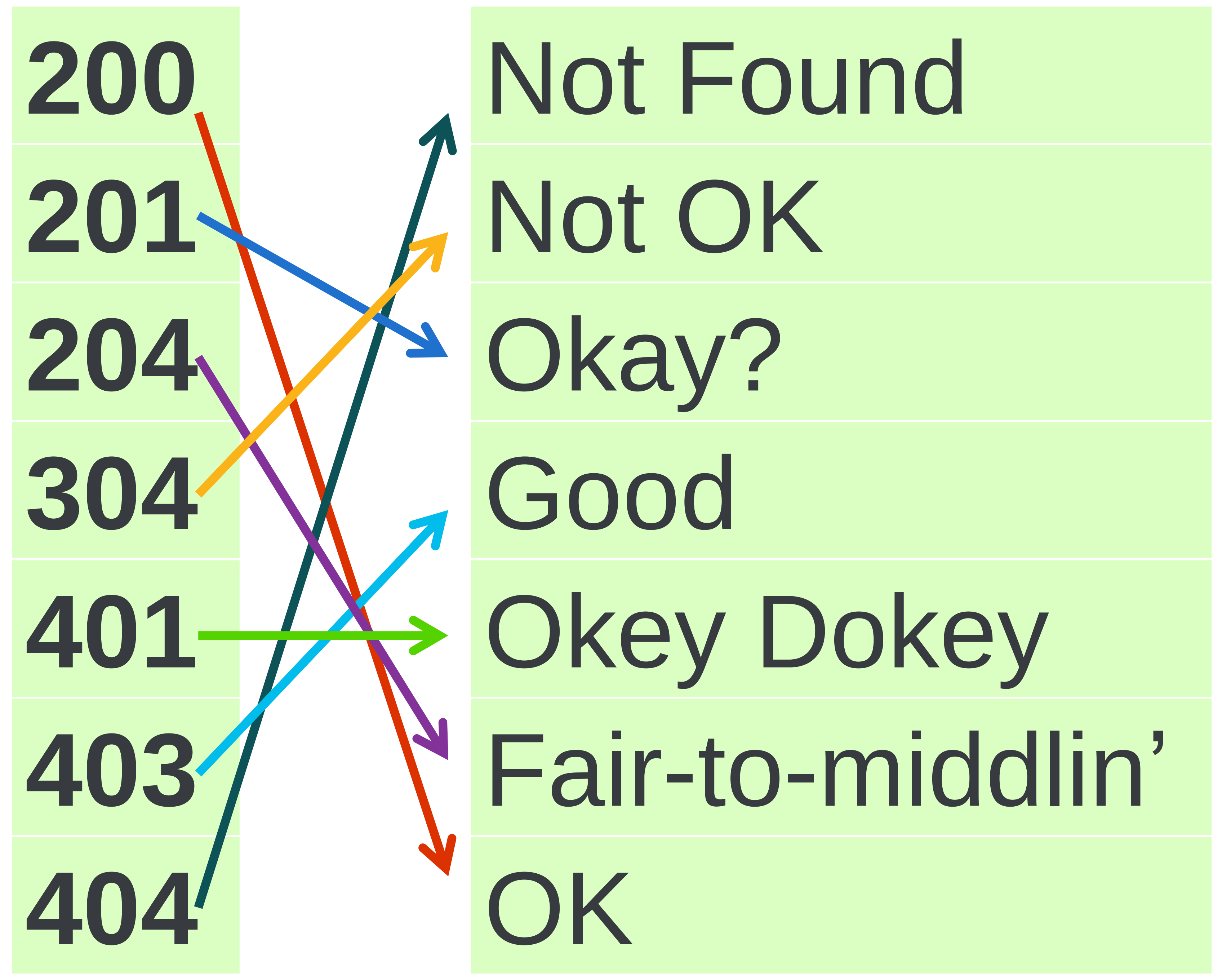
Error Handling

HTTP Status Codes

- Everything is not OK
  (and that's okay!)
  - Use the HTTP status codes they way they are meant to be used
- Retries
  - WSRetry
- As a client, what do you do with errors when you get them (and how do you decide?)



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Say What You Mean, and Mean What You Say

- 200 and friends – Everything is fine
  - `200 OK` – okay, and something is in payload
  - `204 No Content` – okay, but no payload
    - Often used for DELETE
- 300 and friends – Who moved my cheese?
  - `301 Moved Permanently` – I've moved over there
  - `304 Not Modified`
    - Used in caching to mean "I already sent you this"
- 400 and friends – caller did something wrong
  - `401 Unauthorized` – need to authenticate (perhaps token expired)
  - `403 Forbidden` – don't touch that
  - `404 Not Found` – it's not there (not necessarily an error!)
  - `429 Too Many Requests` – you're going too fast for me
- 500 and friends – server is busted
  - It's not your fault, it's theirs
  - If at first you don't succeed, give up and come back later – retrying won't help

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404 Is Tricky

- /service/custoxer/4
  - Since we don't have custoxers in our database; this is properly a `404 Not Found` error

- /service/customer/4
  - We have customers, but not a customer 4, so this also is a `404 Not Found`, but a 404 meaning 'you're in the right place, but nobody is home'

- /service/customer?id=4
  - If there is no customer 4, then the query will succeed in returning an set of zero rows, so the result should be a `200 OK`

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Bad JSON

- Missing commas

```
[
    {"id":8, "name":"Butternut Squash Inc"}
    {"id":23, "name":"Sub Par Golf"}
    {"id":27, "name":"UFO Frisbee"}
]
```

- Missing escapes

```
[
    {"id":26, "name":"Jack's  "Jumpin' " Jacks"},
]
```

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In conclusion,
Get all the REST you can.

—the Progress database driver developers ;)

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