ISA 414 – Managing Big Data

Lecture 9 – Data Collection

APIs (Part I)

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Lecture Objectives

- Quick review of Assignment 1
- Learn about APIs and how they are used during data collection
- Understand the data exchange format called JSON

Lecture Instructions

- Download the notebook "*Lecture 9.ipynb*" available on Canvas
  - Open the above file with VS Code

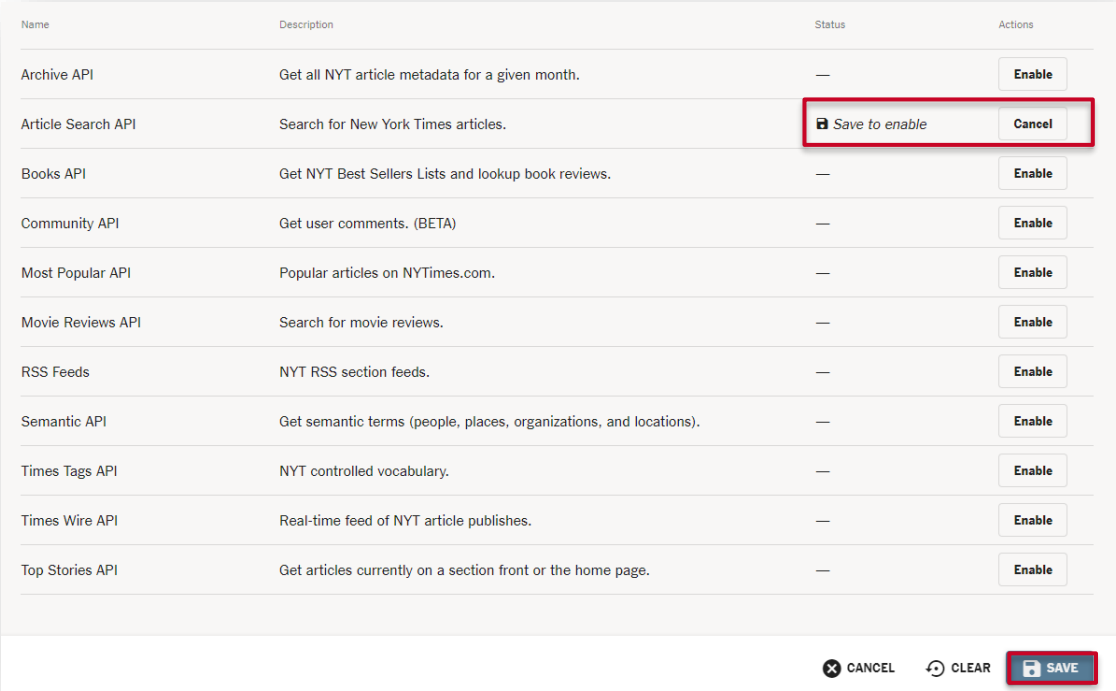
- Download the file NYTimes.json (optional)

Lecture Instructions

- Go to https://developer.nytimes.com/
  - Click on "*Get Started*" -> "*Create account*"
  - Fill in the text fields
  - Check your email and verify your identity
  - Click on "*Sign in,*" and use your email and password to sign in

Lecture Instructions

- Continuing …
  - Click on your email address (top right) -> "*Apps*"
  - Click on "*+ NEW APP*"
    - Pick an app name (e.g., ISA414)
    - Enable the "*Article Search API*" option
  - Click on *Save*

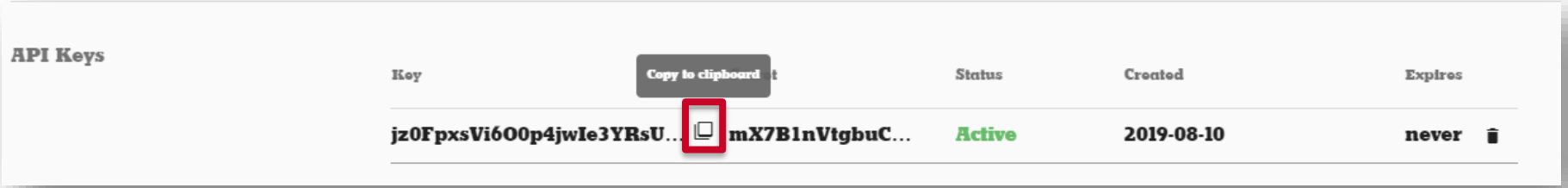


Name	Description	Status	Actions
Archive API	Get all NYT article metadata for a given month.	—	Enable
Article Search API	Search for New York Times articles.	*Save to enable*	Cancel
Books API	Get NYT Best Sellers Lists and lookup book reviews.	—	Enable
Community API	Get user comments. (BETA)	—	Enable
Most Popular API	Popular articles on NYTimes.com.	—	Enable
Movie Reviews API	Search for movie reviews.	—	Enable
RSS Feeds	NYT RSS section feeds.	—	Enable
Semantic API	Get semantic terms (people, places, organizations, and locations).	—	Enable
Times Tags API	NYT controlled vocabulary.	—	Enable
Times Wire API	Real-time feed of NYT article publishes.	—	Enable
Top Stories API	Get articles currently on a section front or the home page.	—	Enable

CANCEL CLEAR SAVE

Lecture Instructions

- Copy your API Key and save it somewhere



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Data Collection

- Can one scrap all the data on the web? No!!!
  - Legal issues
    - Copyright


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  - Website owners can:
    - Block an IP address that is requesting too many webpages in a short period of time
    - Use captchas
    - Make small/random changes to HTML code
  - Controlled access to data is often done via API
    - Today's lecture

Data Collection

- Data are assets
  - Not all relevant data are freely available on the web
  - Many companies make money by directly or indirectly selling data, *e.g.*, Twitter, Google, Facebook
    - How can we access these companies' data?
      - Which protocol should we follow?
    - What is the format of the provided data?
      - Unlikely to be CSV
    - We will address the above questions in this lecture

API

- API: Application Programming Interface
  - Set of protocols that allow two+ software to communicate with each other
    - *E.g.*, to exchange data
  - Example:
    - When you write a script that formally requests data from the NY Times, that script must follow a certain protocol
      - Set of rules

API

- There are different types of APIs
  - Operating Systems (OS) APIs
    - Software/apps can access functionalities of the underlying OS
    - *E.g.*, an app can request Android to access a phone's camera
      - The request must follow a certain pre-defined protocol
      - The OS can approve or deny the request
  - Web APIs
    - Sometimes referred to as *web services*
    - Requests are often made via a protocol called REST
    - Responses are typically expressed in JSON or XML

API

- When using or developing web APIs, one must consider both:
  1. The protocol required when requesting data
  2. The format of the resulting responses

- We will learn how to use web APIs to request data, but not how to program/create APIs
  - Beyond the scope of this course

API

- Protocols
  - There are different ways of specifying an API protocol
  - Our focus in this course: **REST** or **RESTful** systems
    - Currently, the most popular method to create web APIs
    - Every resource (*e.g.*, data) is represented uniquely
      - For example, *via* URLs
    - Standard HTTP methods are very often used for retrieving, replacing, uploading, or deleting data
      - For example, <u>one can request data similarly to requesting a web page via URLs</u>

API

- **HTTP-based REST** operations

Uniform Resource Locator (URL)	GET	PUT	POST	DELETE
Collection of files, such as http://api.example.com/resources/	**List** the URLs	**Replace** the entire collection of files with another collection	**Create** a new entry in the collection of files	**Delete** the entire collection
Element, such as http://api.example.com/resources/item10	**Retrieve** an element of the collection	**Replace** an element of the collection	**Create** a new resource to an existent element	**Delete** an element of the collection

API

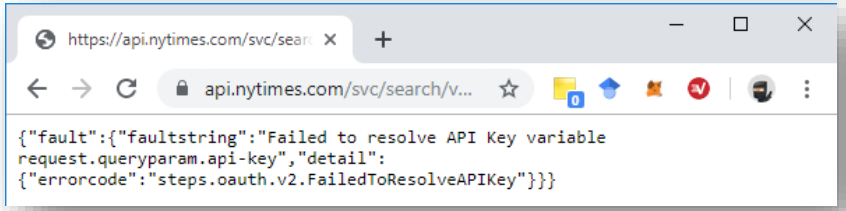
- We will focus primarily on request (GET) operations
  - We shall work with POST operations in the second half of the course
- Let's make some GET requests
  - Background story
    - Suppose you work for Microsoft
    - Your job: monitor social media and news outlets
      - Goal: quickly react to bad/good news
    - Let's find out what the NY Times is writing about Microsoft

API

- Let's make some GET requests
  - First, via a web browser to build intuition, then via Python
  - Base URL of NY Times API:

https://api.nytimes.com/svc/search/v2/articlesearch.json

  - After requesting data via the above URL, we get the following response
    - Some sort of an error



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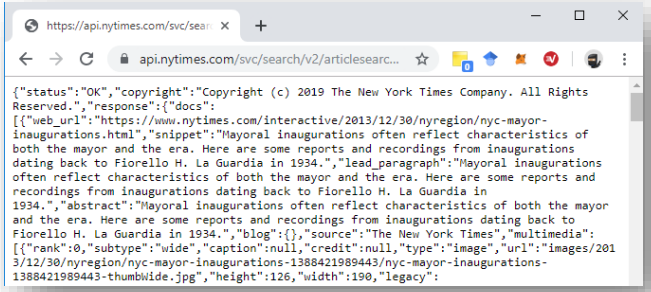
API

- The previous message says that the API Key is missing
  - That is, we are not authorized to request data
- API authorization is often tackled via login/pass and/or a token
  - Data access control
  - NY Times requires a token you obtained in the beginning of the lecture
    - Not always free
  - Let's try another URL: https://api.nytimes.com/svc/search/v2/articlesearch.json?api-key=add –your-token-here
    - The question mark '?' in the URL means that what comes next is a series of key-value pairs that will be used by the API to provide the right answer to the request

API

- It seems we get something
  - Data in a weird format (more on that soon)



- Let’s get data (articles) about Microsoft
  - Key = *q*, value = 'Microsoft'

https://api.nytimes.com/svc/search/v2/articlesearch.json?api-key=add –your-token-here&q='Microsoft'

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API

- Once again, we get some data in a weird format, but this time about Microsoft


```
{"status":"OK","copyright":"Copyright (c) 2018 The New York Times Company. All Rights Reserved.","response":{"docs":[{"web_url":"https://topics.nytimes.com/top/news/business/companies/microsoft_corporation/index.html","snippet":"News about Microsoft Corporatio
including commentary and archival articles published in The New York Times.","blog":{},"multimedia":[],"headline":{"main":"Microsoft Corporation","kicker":null,"content_kicker":null,"print_headline":null,"name":null,"seo":null,"sub":null},"keywords":
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```


- Note the use of '&' in the previous URL
  - Implies that another key-value term is coming
- How does one know the key-value pairs to use in a request?
  - *E.g., api-key* and *q*
  - Answer: read the API documentation: https://developer.nytimes.com/docs/articlesearch-product/1/overview

API

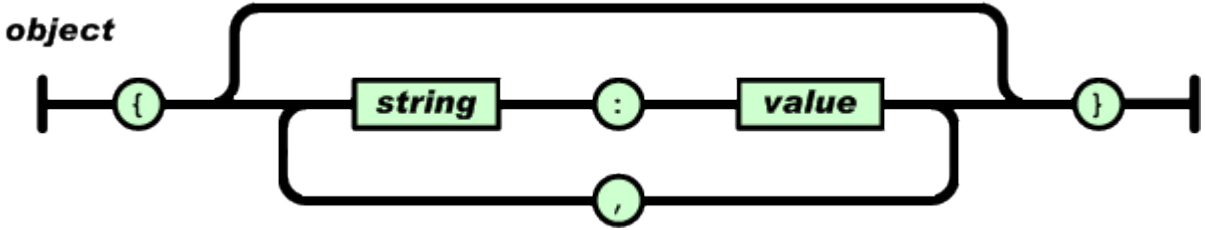
- To summarize
  - REST protocol to request data
    - GET, PUT, POST, DELETE operations
      - GET operations is similar to requesting a webpage, *i.e.,* one needs a URL
    - Common URL format: www.baseurl.com/somepage**?**key1=value1**&**key2=value2...
      - Example: https://api.nytimes.com/svc/search/v2/articlesearch.json**?**api-key=jz0FpxsVi6O0p4jwIe3YRsUcQHPFdDhx**&**q='Microsoft'

JSON

- Let's understand the retrieved data now
  - It is in a format called JSON (JavaScript Object Notation)
    - Data-interchange language
      - Widely used to communicate and store unstructured data
    - Textual (like CSV)
      - Format is completely language independent
    - Two key structures
      - A collection of key/value pairs, also known as *objects*
      - An ordered list of values, also known as *vector/array*

JSON

- Object
  - An unordered set of key-value pairs
  - Begins with { and ends with }
  - Each key is followed by : and the key-value pairs are separated by ,



JSON

- Object
  - Example: Professor (3 key-value pairs)

```
{"name":"Arthur",
 "dept":"ISA",
"position":“Paliwal Innov. Chair",
"position 2":"Assistant Professor"}
```

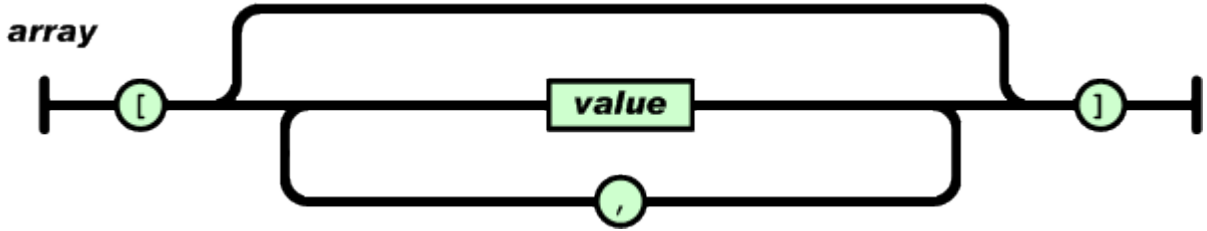
```
{ "name":"Skip",
  "dept":"ISA",
  "position":“Dept. Chair“ }
```

name	dept	position	position 2
Arthur	ISA	Assistant Professor	Paliwal Innov. Chair
Skip	ISA	Dept. Chair	

The above data could also be stored as a table. So why using JSON? Answer: flexibility

JSON

- Array/vector
  - Ordered collection of values
  - Begins with [and ends with] (*i.e.*, square brackets)
  - Values are separated by comma



JSON

- Array/vector
  - Example:

```
{ "TWD characters" : ["Rick", "Michonne", "Negan"] }
```

JSON

- We can always combine objects and vectors

```
{
 "menu": {
      "id": "night",
      "menuitem": [
                {"Item": "Rice", "Price": 3},
                {"Item": "Beef", "Price": 10},
                {"Item": "Chicken", "Price": 9}
      ]
 }
}
```

- Main object: menu
- Value associated with menu: an object containing 2 key-value pairs
  - Key-value pair #1: "id":"night"
  - Key-value pair #2: "menuitem":*array containing 3 objects*
    - Item: Rice, Price: 3
    - Item: Beef, Price: 10
    - Item: Chicken, Price:9

JSON

- Let's look at the JSON file you got from the NY Times
  - Open the file *NYTimes.json* (File -> Open File …) with VS Code

```
{
"response": {
    "meta": {
        "hits": [29997],
        "time": [9],
        "offset": [0]
     }
     "docs":[…],
  }
 "status": ["OK“],
  "copyright": ["Copyright (c) …"]
}
```

Line 1: the '{' indicates that the whole response is an object

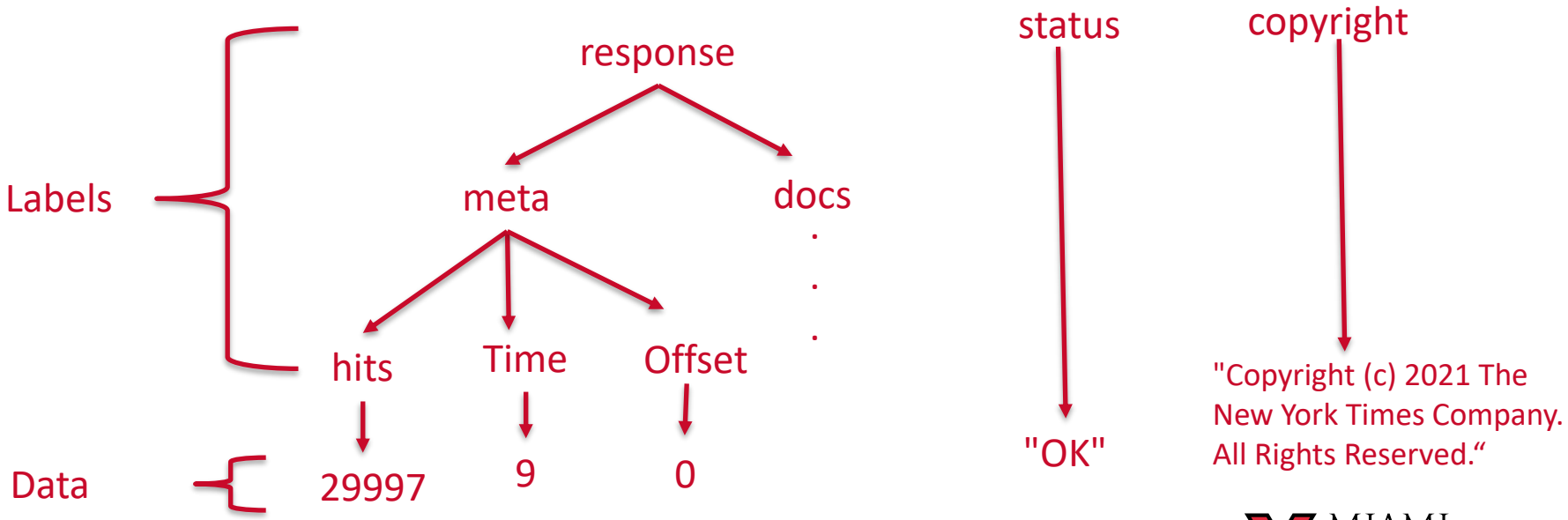
Black lines: the key *response* is associated with an object. That object in turn has two key-value pairs: *meta* and *docs*

Green line: 2nd key-value pair

Blue line: 3rd key-value pair

JSON

- The best way of interpreting JSON files is by means of a hierarchical tree



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JSON

- Let's process JSON files with Python
  - Install the required modules: pip install requests
  - Request the JSON file

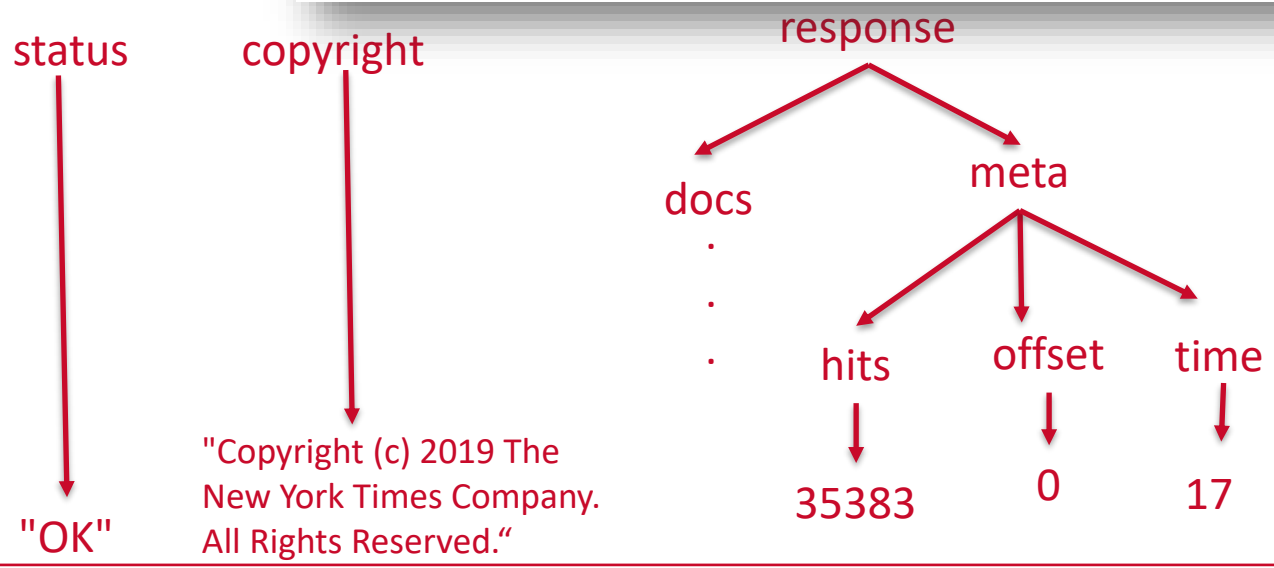
```
import requests

response = requests.get("https://api.nytimes.com/svc/search/v2/articlesearch.json?api-key=ADD YOUR TOKE HERE&q='Microsoft'")

json_data = response.json()
```

  - Python has a data structure called dictionary that handles the JSON format
    - We used that format before when creating data frames

JSON

- Let's navigate through the JSON file
  - With the help of VS Code, we can see that json_data is a **dictionary**

Name	▲ Type	Size	Value
json_data	dict	3	{'status': 'OK', 'copyright': 'Copyright (c) 2021 T



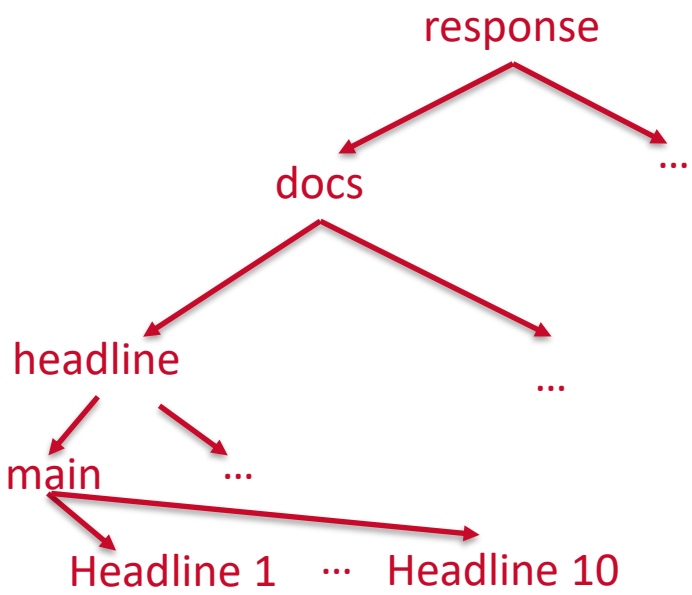
JSON

- The data we are looking for are inside/below *response* and *docs*
  - Let’s see what is inside response

```
response_data = json_data['response’]
response_data.keys()
```

JSON

- Obtaining the headlines

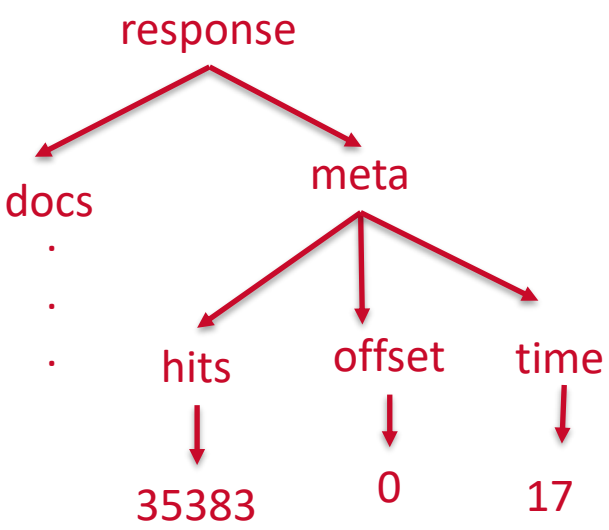



```
docs = response_data['docs']

headlines = []
for i in range(len(docs)):
    headlines.append(docs[i]['headline']['main'])
```

JSON

- Let's obtain the number of hits (articles about Microsoft)

```
meta = response_data['meta']
meta['hits']
```



API

- Final note
  - APIs make data collection very easy
  - Think about how cumbersome it would be to collect Microsoft-related articles from the NY Times via web scrapping (assuming this is allowed)
    - Download all articles
    - Filter the articles related to Microsoft
  - Can one get the content of a NYT article?
    - No (at the time of writing)

API

- Final note
  - There are a number of APIs out there
    - **YouTube**: https://developers.google.com/youtube/
    - **Google Maps**: https://developers.google.com/maps/
    - **Flicker**: https://www.flickr.com/services/api/
    - **Facebook**: https://developers.facebook.com/docs/graph-api
    - **Amazon Product Advertising**: https://affiliate-program.amazon.com/gp/advertising/api/detail/main.html
    - **Fitbit**: https://dev.fitbit.com/
    - **Twitter**: https://developer.twitter.com/en/docs.html
    - **KDnuggets 52 useful APIs**: http://www.kdnuggets.com/2017/02/machine-learning-data-science-apis-updated.html

Summary

- We learned about the concept of APIs
  - Request: REST protocol
  - Response: JSON file
- Next lecture
  - Introduction to APIs – Part II
    - Response: XML