MY472 – Week 5: APIs

Friedrich Geiecke

MY 472: Data for Data Scientists

26 October 2020

Course website: lse-my472.github.io

Course outline

1. Introduction to data
2. The shape of data
3. Introduction to scraping
4. Advanced scraping
5. Working with APIs
6. (Reading week)
7. Textual data
8. Data visualization
9. Creating and managing databases
10. Interacting with online databases
11. Cloud computing

Plan for today

- JSON
- APIs
- API Examples
    - New York Times
    - Twitter
- Guided coding session

Outline

- JSON
- APIs
- API Examples
  - New York Times
  - Twitter
- Guided coding session

JSON

- API responses are very often in JSON format (JavaScript Object Notation)
- JSON is a lightweight and flexible format to store and transmit data
- JSON data can e.g. be read/parsed into R with the ‘fromJSON‘ function from the `jsonlite` package
- Yet, many packages have their own functions to read data in JSON format into R, e.g. the ‘content(r, ...)‘ function from the `httr` package which we will use for querying APIs

JSON

- JSON objects are key-value pairs: { “someKey”: 42 }
- Keys have to be strings with double quotes
- Values can be one of the following types:
  - JSON object ({})
  - String (“hello”)
  - Number (42, 3.141)
  - Array ([])
  - Boolean (true, false)
  - null
- Nested structure

Reference:
`https://www.w3schools.com/js/js_json_syntax.asp`

Example (1/3)

```
{
    "name": "Bob",
    "courseWork": [
        "Assignment",
        "Final"
    ],
    "grades": [
        65,
        73
    ],
    "supervisor": {
        "name": "Alice",
        "department": "Mathematics"
    },
    "currentlyEnrolled": false
}
```

Example (2/3)

```
{
    "date": [
        "2020-10-01",
        "2020-10-17",
        "2020-10-24"
    ],
    "section": [
        "Economics",
        "Politics",
        "Sports"
    ],
    "headline": [
        "Covid recession",
        "New polls",
        "Liverpool wins"
    ],
    "lead_paragraph": [
        "The recession triggered by the pandemic ...",
        null,
        "In their game on Saturday, Liverpool FC ..."
    ]
}
```

Example (3/3)

```
{
    "MT": [
        {
            "code": "MY472",
            "title": "Data for Data Scientists",
            "description": "A course about collecting, processing, and storing data.",
            "units": 0.5,
            "offeredThisYear": true,
            "registeredStudents": []
        },
        {
            "code": "MY470",
            "title": "Computer Programming",
            "description": "An introduction to programming.",
            "units": 0.5,
            "offeredThisYear": true,
            "registeredStudents": []
        }
    ],
    "LT": [
        {
            "code": "MY459",
            "title": "Special Topics in Quantitative Analysis: Quantitative Text Analysis",
            "description": "A course about text analysis.",
            "units": 0.5,
            "offeredThisYear": true,
            "registeredStudents": []
        }
    ]
}
```

Outline

- JSON
- APIs
- API Examples
  - New York Times
  - Twitter
- Guided coding session

APIs

- API: Application Programming Interface
- In web APIs, a set of structured HTTP requests can return data in a lightweight format e.g. JSON or XML
- The API user sends a request to the API (e.g. with a software such as R) and the API returns data from the API provider's database
- APIs are widely used to communicate between applications

See also e.g. Munzert et al., 2014, Chapter 9

APIs

Types of APIs

1. RESTful APIs: Queries for static information at current moment (e.g. user profiles, posts, etc.)
2. Streaming APIs: Changes in users' data in real time (e.g. new tweets, weather alerts...)

APIs generally have extensive documentation

- Written for developers, so must be understandable for humans
- What to look for: Endpoints and parameters

Most APIs are rate-limited

- Restrictions on number of API calls by user/IP address and period of time
- Commercial APIs may impose a monthly fee

An example: Google Maps API

Constructing an API call

- Baseline URL endpoint:
  `https://maps.googleapis.com/maps/api/geocode/json`
- Parameters: `?address=london`
- Authentication token: `&key=XXXXX`

From R, use `httr` package to make `GET` request:

```
library(httr)
r <- GET(
"https://maps.googleapis.com/maps/api/geocode/json",
query=list(address="london", key="XXXXX))
```

If request was successful, returned code will be 200, where `4xx` indicates client errors and `5xx` indicates server errors.
If you need to attach data, use `POST` request.

```
{
   "results" : [
      {
         "address_components" : [
            {
               "long_name" : "London",
               "short_name" : "London",
               "types" : [ "locality", "political" ]
            },
            {
               "long_name" : "London",
               "short_name" : "London",
               "types" : [ "postal_town" ]
            }
         ],
         "formatted_address" : "London, UK",
         "geometry" : {
            "bounds" : {
               "northeast" : {
                  "lat" : 51.6723432,
                  "lng" : 0.148271
               },
               "southwest" : {
                  "lat" : 51.38494009999999,
                  "lng" : -0.3514683
               }
            },
            "location" : {
               "lat" : 51.5073509,
               "lng" : -0.1277583
            },
...
}
{
...
            "location_type" : "APPROXIMATE",
            "viewport" : {
               "northeast" : {
                  "lat" : 51.6723432,
                  "lng" : 0.148271
               },
               "southwest" : {
                  "lat" : 51.38494009999999,
                  "lng" : -0.3514683
               }
            }
         },
         "place_id" : "ChIJdd4hrwug2EcRmSrV3Vo6llI",
         "types" : [ "locality", "political" ]
      }
   ],
   "status" : "OK"
}
```

Authentication

- Many APIs require an access key or token
- This is also the case for both examples in this lecture, the New York Times and Twitter APIs

R packages

Before starting a new project, it is worth checking whether there is already an R package specifically for this API, or whether to use e.g. `httr`. Where to look?

- **CRAN Web Technologies Task View** (yet, only packages released in CRAN)
- GitHub (including unreleased packages and most recent versions of packages)
- **rOpenSci Consortium**

Also see this **great list of APIs** in case you need inspiration

Why APIs?

Advantages

- Cleaner data collection: Avoid malformed HTML, no legal issues, clear data structures, more trust in data collection…
- Standardized data access procedures: Transparency, replicability
- Robustness: Benefits from “wisdom of the crowds”

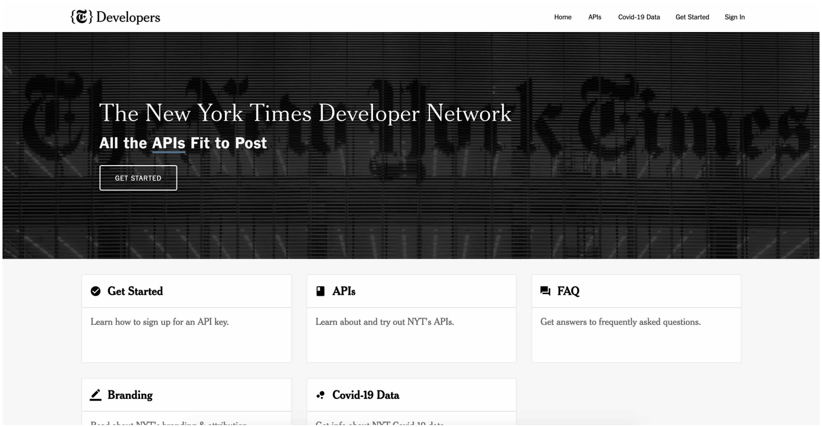
Disadvantages

- Not always available
- Dependency on API providers
- Rate limits

Outline

- JSON
- APIs
- API Examples
  - New York Times
  - Twitter
- Guided coding session

New York Times API



{𝕿} Developers

Home APIs Covid-19 Data Get Started Sign In

The New York Times Developer Network

All the APIs Fit to Post

GET STARTED

Get Started

Learn how to sign up for an API key.

APIs

Learn about and try out NYT's APIs.

FAQ

Get answers to frequently asked questions.

Branding

Read about NYT's branding & attribution

Covid-19 Data

Get info about NYT Covid-19 data

Website: `https://developer.nytimes.com/`

New York Times API

- The New York Times (NYT) offers a range of APIs
- We will use:
  - The Article Search API to search for keywords in articles
  - The Archive API to download the full data for a given month
- While we cannot download full articles in the public version of the Archive API, we can obtain headlines, abstracts, snippets, and/or lead paragraphs since 1851

New York Times API

- To obtain a key, pause the video and follow the instructions here: `https://developer.nytimes.com/get-started`
- When specifying your key during this application, make sure to tick the boxes for Article Search and Archive API
- If you are interested in the topic, check out other APIs such as e.g. the RSS Feed API (not covered here)

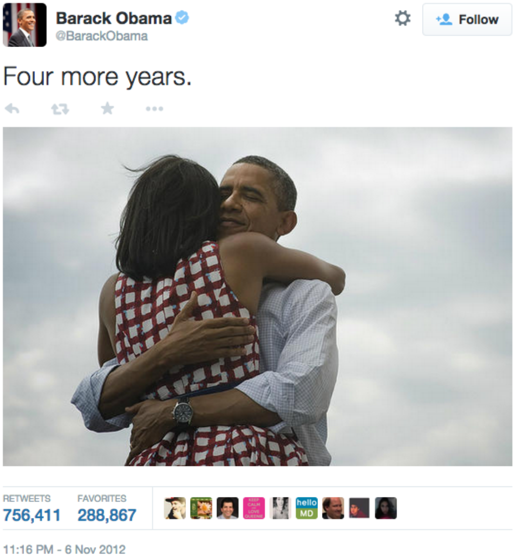
Outline

- JSON
- APIs
- API Examples
  - New York Times
  - Twitter
- Guided coding session

Preliminaries

- To obtain access to the API, pause the video and apply for a developer account, this can take a few day to be processed (we use the Twitter API in the lab and in the assignment)
- Application can be done via https://developer.twitter.com/en/apps
- After your application is approved, you can create an app within a project or a standalone app
- This will create 1) a key and 2) a key secret
- Afterwards you can create 3) an access token and 4) an access token secret
- These four strings/characters will be used to access the API e.g. via the package `rtweet`
- Any problems? Post them into #twitterapi on Slack

Anatomy of a tweet



Barack Obama
@BaracKObama

Four more years.

RETWEETS 756,411
FAVORITES 288,867

11:16 PM - 6 Nov 2012

Anatomy of a tweet

Tweets are stored in JSON format:

```
{ "created_at": "Wed Nov 07 04:16:18 +0000 2012",
  "id": 266031293945503744,
  "text": "Four more years. http://t.co/bAJE6Vom",
  "source": "web",
  "user": {
    "id": 813286,
    "name": "Barack Obama",
    "screen_name": "BarackObama",
    "location": "Washington, DC",
    "description": "This account is run by Organizing for Action staff.
        Tweets from the President are signed -bo.",
    "url": "http://t.co/8aJ56Jcemr",
    "protected": false,
    "followers_count": 54873124,
    "friends_count": 654580,
    "listed_count": 202495,
    "created_at": "Mon Mar 05 22:08:25 +0000 2007",
    "time_zone": "Eastern Time (US & Canada)",
    "statuses_count": 10687,
    "lang": "en" },
  "coordinates": null,
  "retweet_count": 756411,
  "favorite_count": 288867,
  "lang": "en"
}
```

Twitter APIs

Two different methods to collect Twitter data

1. REST API
   - Queries for specific information about users and tweets
   - Search recent tweets
   - Examples: User profile, list of followers and friends, tweets generated by a given user ("timeline"), users lists, etc.
2. Streaming API
   - Connect to the "stream" of tweets as they are being published
   - Three streaming APIs:
     - 2.1 Sample stream: 1% random sample of tweets
     - 2.2 Filter stream: tweets filtered by keywords (when volume reaches 1% of all tweets, it will also return a random sample)
     - 2.3 Geo stream: tweets filtered by location

Important limitation: Tweets can only be downloaded in real time (exceptions: last seven days or user timelines, where $\sim$ 3,200 most recent tweets are available)

Can the sampling be biased?

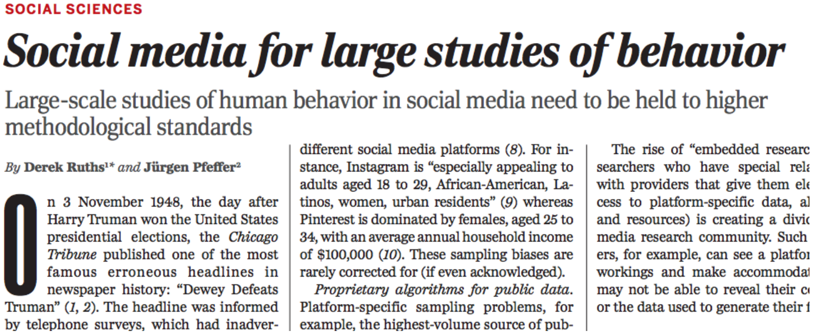
Morstatter et al, 2013, *ICWSM*, "Is the Sample Good Enough? Comparing Data from Twitter's Streaming API with Twitter's Firehose":

- 1% random sample from Streaming API is not truly random
- Less popular hashtags, users, topics... less likely to be sampled
- But for keyword-based samples, bias is not as important

González-Bailón et al, 2014, *Social Networks*, "Assessing the bias in samples of large online networks":

- Small samples collected by filtering with a subset of relevant hashtags can be biased
- Central, most active users are more likely to be sampled
- Data collected via search (REST) API more biased than those collected with Streaming API

More biases in social media data



SOCIAL SCIENCES

Social media for large studies of behavior

Large-scale studies of human behavior in social media need to be held to higher methodological standards

By **Derek Ruths**[1*] and **Jürgen Pfeffer**[2]

On 3 November 1948, the day after Harry Truman won the United States presidential elections, the *Chicago Tribune* published one of the most famous erroneous headlines in newspaper history: “Dewey Defeats Truman” (*1*, *2*). The headline was informed by telephone surveys, which had inadver-

different social media platforms (*8*). For instance, Instagram is “especially appealing to adults aged 18 to 29, African-American, Latinos, women, urban residents” (*9*) whereas Pinterest is dominated by females, aged 25 to 34, with an average annual household income of $100,000 (*10*). These sampling biases are rarely corrected for (if even acknowledged).

Proprietary algorithms for public data. Platform-specific sampling problems, for example, the highest-volume source of pub-

The rise of “embedded researc
searchers who have special rela
with providers that give them ele
cess to platform-specific data, al
and resources) is creating a divid
media research community. Such
ers, for example, can see a platfor
workings and make accommodat
may not be able to reveal their co
or the data used to generate their f

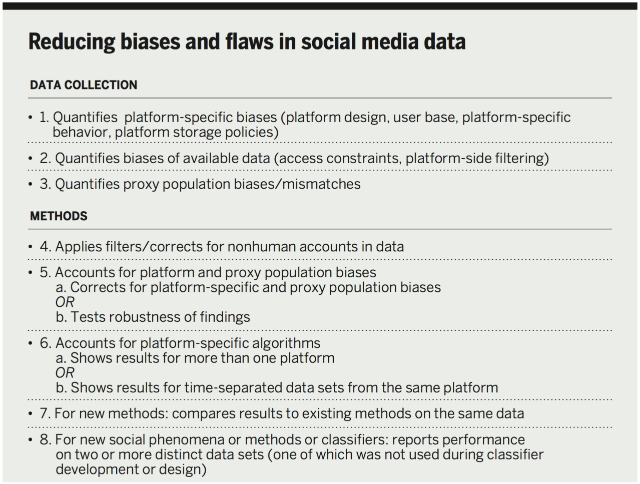
Ruths and Pfeffer, 2015, “Social media for large studies of behavior”, *Science*

More biases in social media data

Sources of bias (Ruths and Pfeffer, 2015; Lazer et al, 2017)

- Population bias
  - Sociodemographic characteristics are correlated with presence on social media
- Self-selection within samples
  - Partisans more likely to post about politics (Barberá & Rivero, 2014)
- Proprietary algorithms for public data
  - Twitter API does not always return 100% of publicly available tweets (Morstatter et al, 2014)
- Human behavior and online platform design
  - e.g. *Google Flu* (Lazer et al, 2014)

More biases in social media data



Reducing biases and flaws in social media data

DATA COLLECTION

- 1. Quantifies platform-specific biases (platform design, user base, platform-specific behavior, platform storage policies)
- 2. Quantifies biases of available data (access constraints, platform-side filtering)
- 3. Quantifies proxy population biases/mismatches

METHODS

- 4. Applies filters/corrects for nonhuman accounts in data
- 5. Accounts for platform and proxy population biases
  a. Corrects for platform-specific and proxy population biases
  OR
  b. Tests robustness of findings
- 6. Accounts for platform-specific algorithms
  a. Shows results for more than one platform
  OR
  b. Shows results for time-separated data sets from the same platform
- 7. For new methods: compares results to existing methods on the same data
- 8. For new social phenomena or methods or classifiers: reports performance on two or more distinct data sets (one of which was not used during classifier development or design)

Issues in evaluating data from social media. Large-scale social media studies of human behavior should i address issues listed and discussed herein (further discussion in supplementary materials).

Ruths and Pfeffer, 2015, "Social media for large studies of behavior", *Science*

Outline

- JSON
- APIs
- API Examples
    - New York Times
    - Twitter
- Guided coding session

Guided coding sessions

```
01-json-in-r.Rmd
02-nytimes-api.Rmd
03-twitter-rest-api.Rmd
```