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Leibniz Institute
for the Social Sciences

Automatic Sampling and Analysis of YouTube Data

The YouTube API

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How Can We Get Data From Websites?

Theoretically, we could gather all the information manually by clicking on the things that are interesting to us and copy/pasting them. However, this is tedious and time-consuming. **We want a way of automatizing this task**. There are two different approaches:

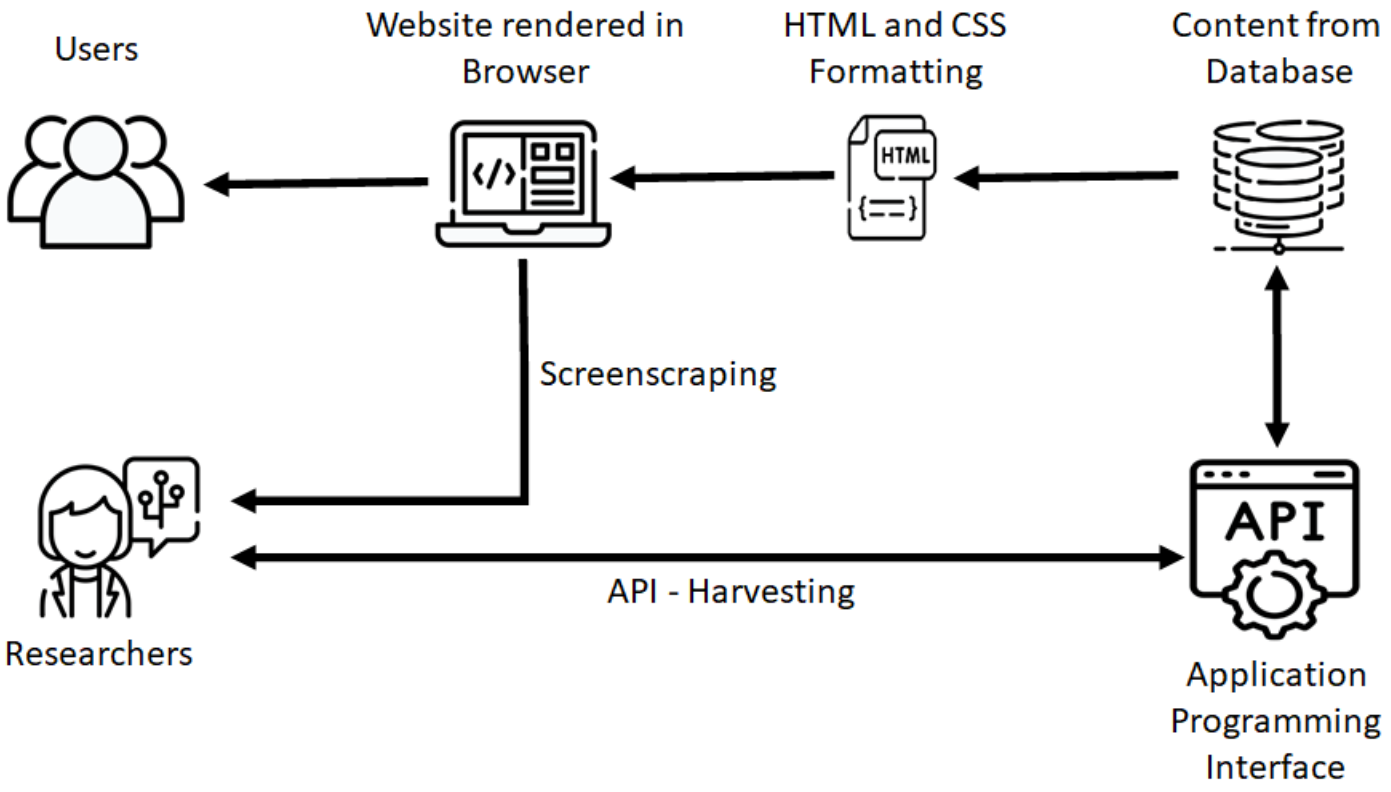
1. **Screen scraping:** Getting the HTML-code out of your browser, parsing & formatting it, then analyzing the data

2. **API harvesting:** Sending requests directly to the database and only getting back the information that you want and need

The Structure of Data on *YouTube*

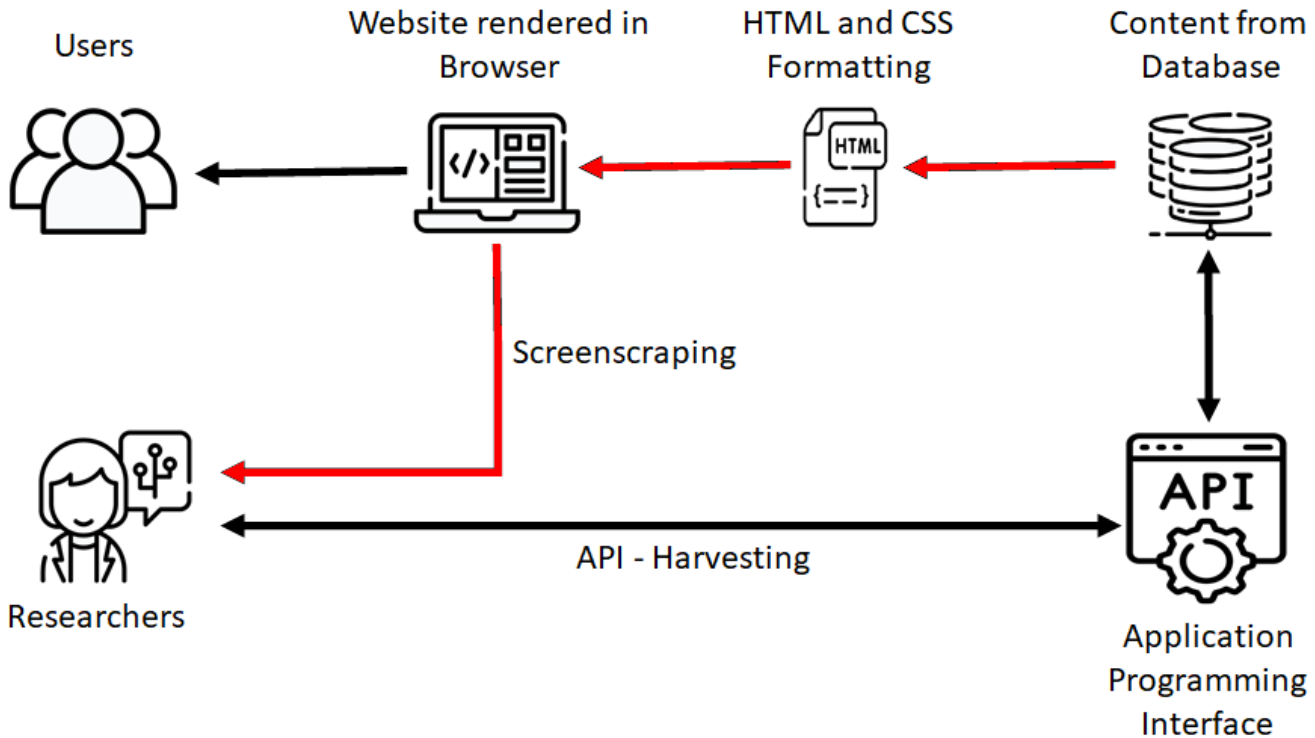
- All data on *YouTube* is stored in a MySQL database
- The website itself is an HTML page, which loads content from this database
- The HTML is rendered by a web browser so the user can interact with it
- Through interacting with the rendered website, we can either retrieve content from the database or send information to the database
- The YouTube website is
  - built in HTML
  - uses CSS for the "styling"
  - dynamically loads content using Ajax from the database

Interaction with the Data



Screen Scraping

- Screen scraping means that we download the HTML text file, which contains the content we are interested in but also a lot of unnecessary clutter that describes how the website should be rendered by the browser



Screen Scraping

Screen Scraping

- To automatically obtain data, we can use a so-called GET request
- A GET request is an HTTP method for asking a server to send a specific resource (usually an HTML page) back to your local machine. It is implemented in many different libraries, such as curl.
- This is the basic principle that all the scraping packages are built on
- We will not use this directly and will let the higher-level applications handle this under the hood

Screen Scraping - Examples

- Via the console in Windows, Linux or MacOS (saves html to a file)

```
curl "https://www.youtube.com/watch?
v=1aheRpmurAo/" > YT.html
```

- In R

```
# Warning about incomplete final line can (usually) be ignored
library(curl)
html_text <-
readLines(curl("https://www.youtube.com/watch?v=1aheRpmurAo/"))
```

Screen Scraping: Advantages

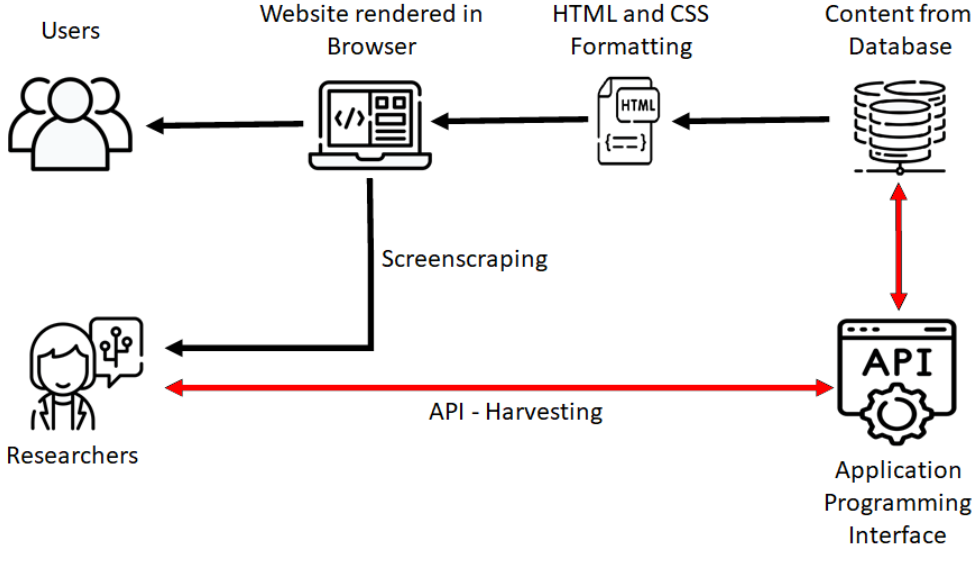
- You can access everything that you are able to access from your browser
- You are (theoretically) not restricted in how much data you can get
- (Theoretically) Independent from API-restrictions

Screen Scraping: Disadvantages

- Extremely tedious to get information out of HTML-pages
- You have to manually look up the Xpaths/CSS/HTML containers to get specific information
- Reproducibility: The website might be tailored to stuff in your cache, cookies, accounts etc.
- There is no guarantee that even pages that look the same have the same underlying HTML structure
- You have to manually check the website and your data to make sure that you get what you want
- If the website changes anything in their styling, your scripts probably won't work anymore
- Legality depends on country

API Harvesting

- An Application Programming Interface...
  - is a system built for developers
  - directly communicates with the underlying database(s)
  - is a voluntary service provided by the platform
  - controls what information is accessible, to whom, how, and in which quantities



Using APIs

- APIs can be used to/for:
  - embed content in other applications
  - create bots that do something automatically
  - scheduling/moderation for content creators
  - collect data for (market) research purposes
- Not every website has their own API. However, most large social media services do, e.g.:
  - Facebook
  - Twitter
  - Instagram
  - Wikipedia
  - Google Maps

API Harvesting - Examples

- From the console
  (API Key needs to be added before execution)

```
curl https://www.googleapis.com
    /youtube/v3/search?
    part=snippet&q=Brexit&
    key=INSERT-API-KEY-HERE
```

- In R (API Key needs to be added before execution, data needs to be converted to JSON format)

```
library(curl)
library(jsonlite)
api_response <- fromJSON(curl("https://www.googleapis.com/
                              youtube/v3/search?
                              part=snippet&q=Brexit&
                              key=INSERT-API-KEY-HERE"))
```

Advantages of API Harvesting

- No need to interact with HTML files, you only get the information you asked for
- The data you get is already nicely formatted (usually JSON files)
- You can be confident that what you do is legal (if you adhere to the Terms of Service and respect data privacy and copyright regulations)

Disadvantages of API Harvesting

- Not every website/service has an API
- You can only get what the API allows you to get
- There are often restricting quotas (e.g., daily limits)
- Terms of Service can restrict how you may use the data (e.g., with regard to sharing or publishing it)
- There is no standard language to make queries, you have to check the documentation
- Not every API has a (good) documentation

Screen Scraping vs. API-Harvesting

If you can, use an API, if you must, use screen scraping instead.

YouTube API

- Fortunately, *YouTube* has its own, well-documented APIs that developers can use to interact with their database (most *Google* services do)
- We will use the YouTube Data API in this workshop

Let's Check Out the *YouTube* API!

- Google provides a sandbox for their API that we can use to get a grasp of how it operates
- We can, for example, use our credentials to search for videos with the keyword "Brexit"
- Example
- Keep in mind: We have to log in with the *Google* account we used to create the app for accessing the API
- What we get back is a JSON-formatted response with the information we requested in the API sandbox

Excursus: What is JSON?

- Java Script Object Notation
- Language-independent data format (like .csv)
- Like a nested List of Key:Value pairs
- Standard data format for many APIs and web applications
- Better than tabular formats (.csv / .tsv) for storing large quantities of data by not declaring missing data
- Represented in R as a list of lists that typically needs to be transformed into a regular dataframe (this can be tedious but, luckily, there are packages and functions for handling this, such as `jsonlite`)

Excursus: What is JSON?

```
'{
  "first name": "John",
  "last name": "Smith",
  "age": 25,
  "address": {
    "street address": "21 2nd Street",
    "city": "New York",
    "postal code": "10021"
  },
  "phone numbers": [
    {
      "type": "home",
      "number": "212 555-1234"
    },
    {
      "type": "mobile",
      "number": "646 555-4567"
    }
  ],
  "sex": "male"
}'
```

API Key vs. OAuth2.0

- There are two different ways to authenticate with the YouTube API
  - API Key: Text string identifying the app and user, grants access to public data
  - OAuth2.0: Token created from Client secret and Client ID, grants access to everything the user can access
- For most API calls, the API key is enough
- the `tuber` package for `R`, however, uses OAuth2.0 authentification because you can also use it to, e.g., change your account information from `R`

Constructing API calls

We can construct all calls to the API according to the following logic

YouTube Data API v3 – Call Construction

https://youtube.googleapis.com/youtube/v3/search?maxResults=10&pageToken=2&q=Omicron&key=[YOUR_API_KEY]

https://youtube.googleapis.com/youtube/v3/	API Address, this is always constant
search	Type of resource to retrieve
?	Separator to distinguish resources from parameters
maxResults=10 pageToken=2 q=Omicron	Parameters for specifying format and content of resource
&	Separator to distinguish parameters from each other
key=[YOUR_API_KEY]	Your API key

Important *YouTube* API Parameters

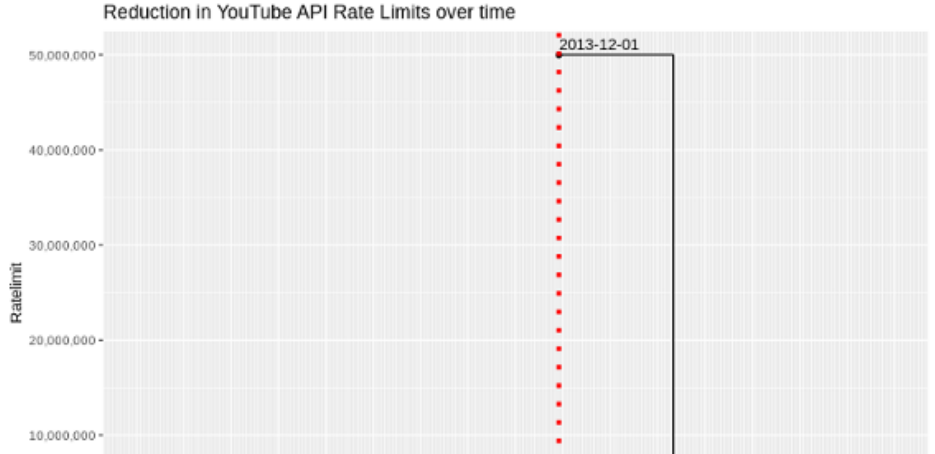
- All possible resources for the *YouTube* API are listed here
- For our workshop, the most important resources will be `search`, `Comments`, `CommentThreads`, and `videos`
- **NB**: Some information is only visible to owners of a channel or author of a video
- Not all information is necessarily available for all videos (e.g., live videos)
- Public data requires an API key, getting user data requires OAuth2.0 authentication

Using the API from R

- We can simplify the process of interacting with the YouTube API by using a dedicated R package
- The package handles the authentication with our credentials and translates R commands into API calls
- It also simplifies the JSON response to a standard dataframe automatically for many requests
- In essence, we can run R commands and get nicely formatted API results back
- For this workshop, we will mostly use the tuber package, and also briefly explore the vosonSML package

API Rate Limits

- With the API, you have a limit of how much data you can get
- The daily quota limit has constantly decreased significantly over the last decade



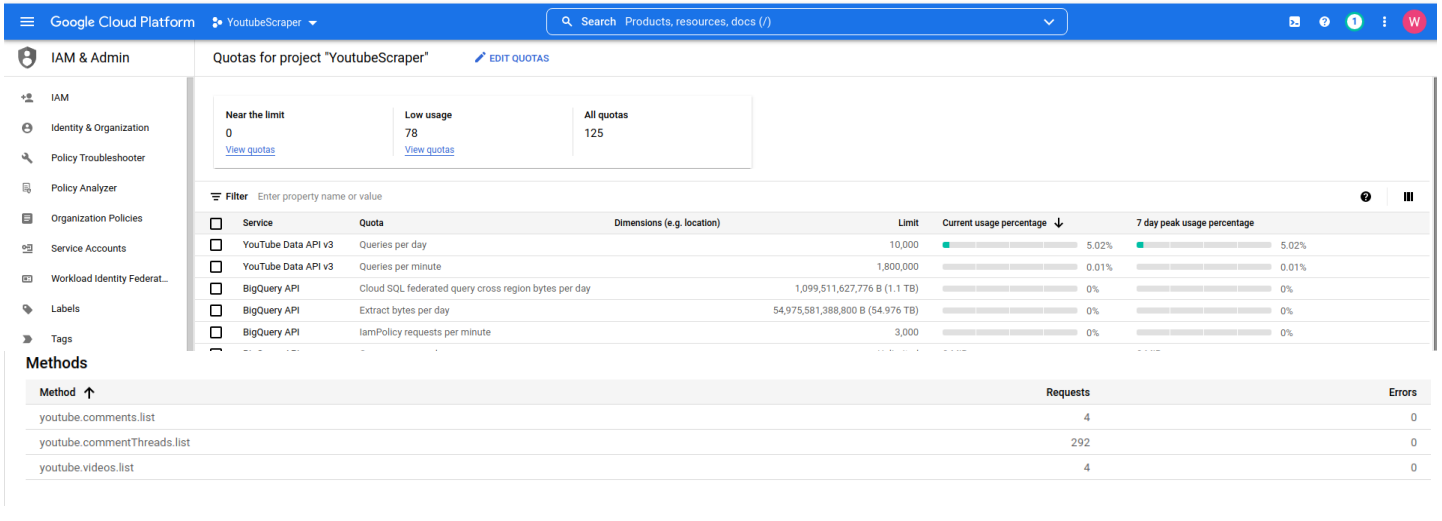
API Rate Limits

- Currently (02.2023), you have a quota of **10.000** units per day
- Each request (even invalid ones) costs a certain amount of units
- There are two factors influencing the quota cost of each request:
  - different types of requests (e.g., write operation: 50 units; video upload: 1600 units)
  - how many parts the requested resource has (playlist:2 ; channel:6 ; video:10)
- **You should only request parts that you absolutely need to make the most of your units. We will talk about this in more detail in the data collection session.**

NB: Sending incorrect requests can also deplete your daily quota

API Rate Limits

- You can check the rate limits in the *YouTube* API Documentation
- You can see how much of your quota you have already used up in the *Google* Developer Console



Exceeding the API Rate Limit

Once you reach your rate limit, the API will start to send back the following response until your rate limit is reset


```
{
  "error": {
    "code": 403,
    "message": "The request cannot be completed because you
    have exceeded your \u003ca href=\"/youtube/v3/getting-started#quota\"
    \u003equota\u003c/a\u003e.",
    "errors": [
      {
        "message": "The request cannot be completed because
        you have exceeded your \u003ca href=\"/youtube/v3/
        getting-started#quota\
        "\u003equota\u003c/a\u003e.",
        "domain": "youtube.quota",
        "reason": "quotaExceeded"
      }
    ]
  }
}
```

How to Increase the Quota

- You can pay for quota, but you need a credit card
- There is a form for researchers to apply for a higher quota, but until 2022, this practically did not work
- The form was improved for research, but it still contains questions regarding the API that are hard to answer (e.g., "How long do you store YouTube API Data?")
- Nevertheless, it is now worthwhile to give it a try. We were able to increase our daily quota from 10k to 500k.

Any questions?

Exercise time 

Solutions