

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.** The solution to our problem is...

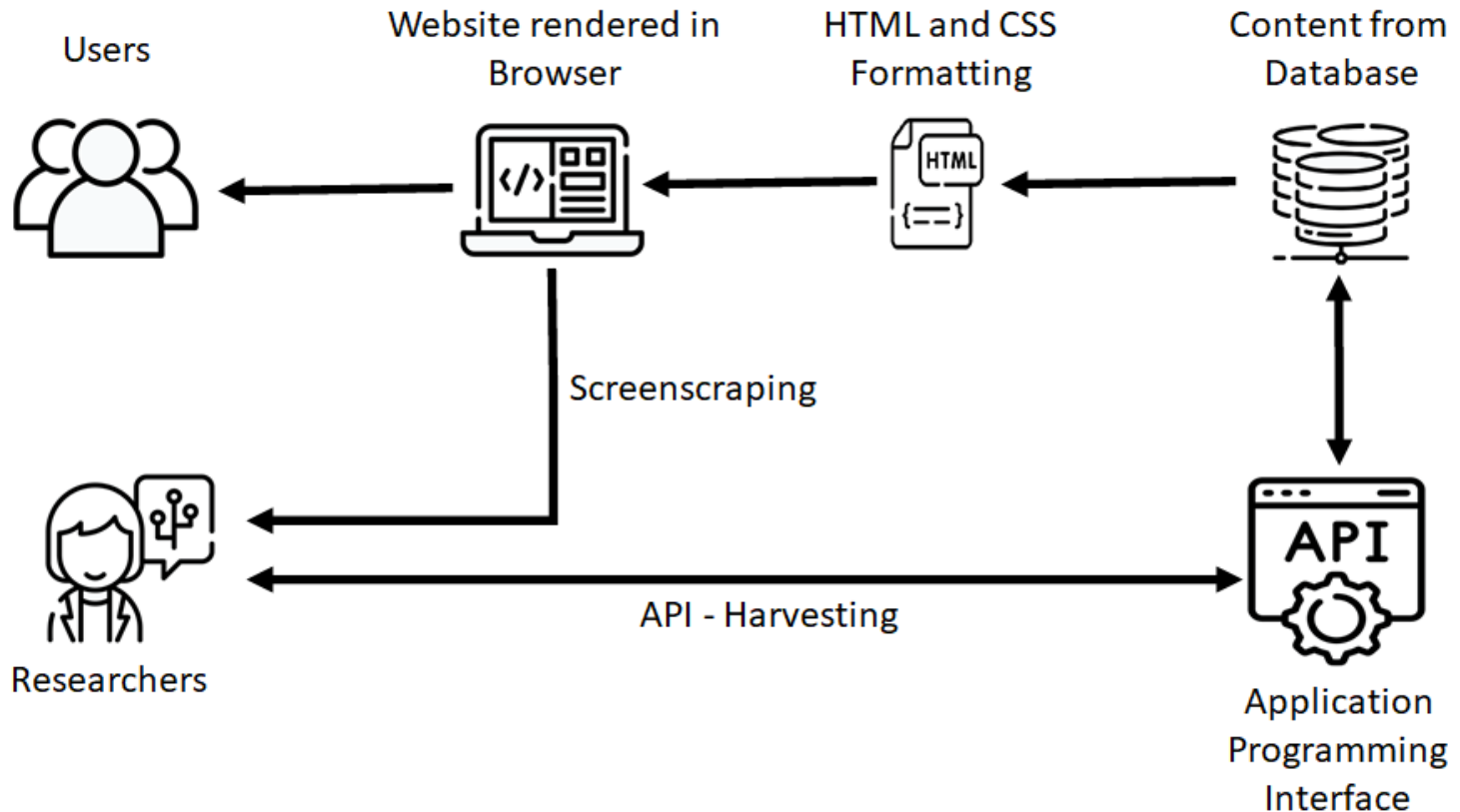
Web scraping. There are two different approaches:

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*

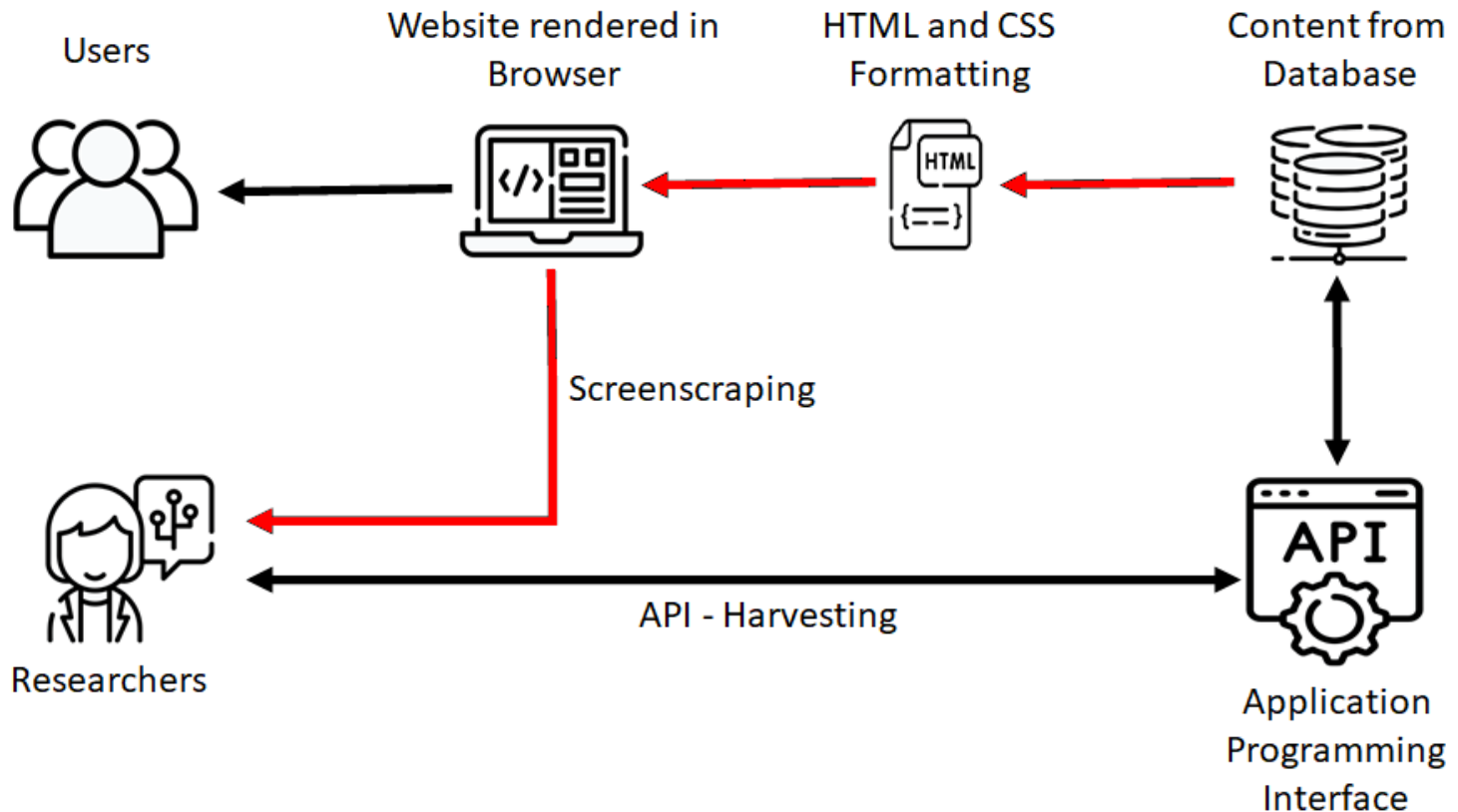
- All data on *YouTube* is stored in a **MySQL** database
- The website itself is an HTML page, which loads content from this database
- The HTML is rendered by a web browser so the user can interact with it
- Through interacting with the rendered website, we can either retrieve content from the database 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

The screenshot displays a web browser window with a YouTube video player and a list of recommended videos. The video player shows a man in a suit speaking. Below the video, the title "The Census: Last Week Tonight with John Oliver (HBO)" is visible, along with the view count "4,799,278 views" and the date "Nov 17, 2019". A "SUBSCRIBE" button is present. To the right, a list of recommended videos is shown, including "Filibuster: Last Week Tonight with John Oliver", "Robocalls: Last Week Tonight with John Oliver (HBO)", "Trump's Impeachment Lawyers Argue He Can Do Whatever He...", "Prosecutors: Last Week Tonight with John Oliver (HBO)", "Compounding Pharmacies: Last Week Tonight with John Oliver...", "Mike Pence: Last Week Tonight with John Oliver (HBO)", "Green New Deal: Last Week Tonight with John Oliver (HBO)", and "Medical Devices: Last Week Tonight with John Oliver (HBO)".

On the right side of the browser, the developer console is open, showing the "Elements" panel. The selected element is a `div` with the ID `content` and the class `style-scope ytd-expander`. The CSS styles for this element are listed in the "Styles" panel, including `margin`, `padding`, `border`, `background-color`, and `background-attachment`. The `padding` property is highlighted, showing a value of `812px 252px`.

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 Linux or MacOS (saves html to a file)

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

- **Online**, using the code from above

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

- 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

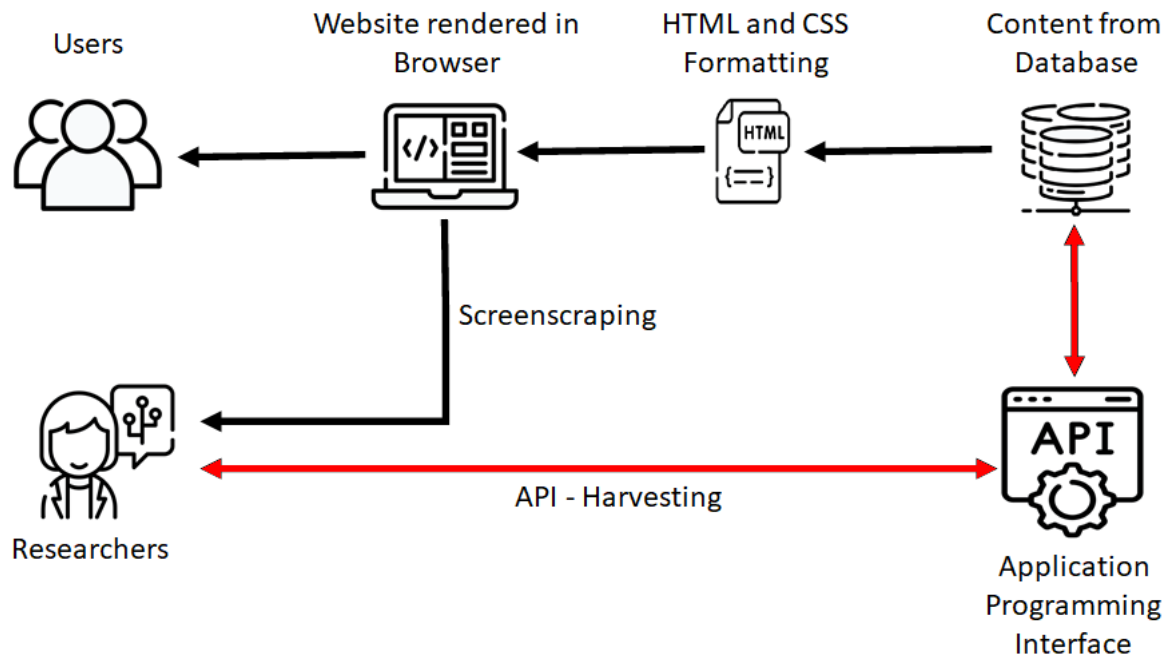
- You can access everything that you are able to access from your browser
- You are (theoretically) not restricted in how much data you can get
- (Theoretically) Independent from API-restrictions

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"
```

- **Online**, using code from above (API Key needs to be added before execution)
- 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

The YouTube API

Platform APIs

- To find an API for a given website, **Programmable Web** is a good starting point
- 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

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 authentication 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/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

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"  
}'
```

Important *YouTube* API Parameters

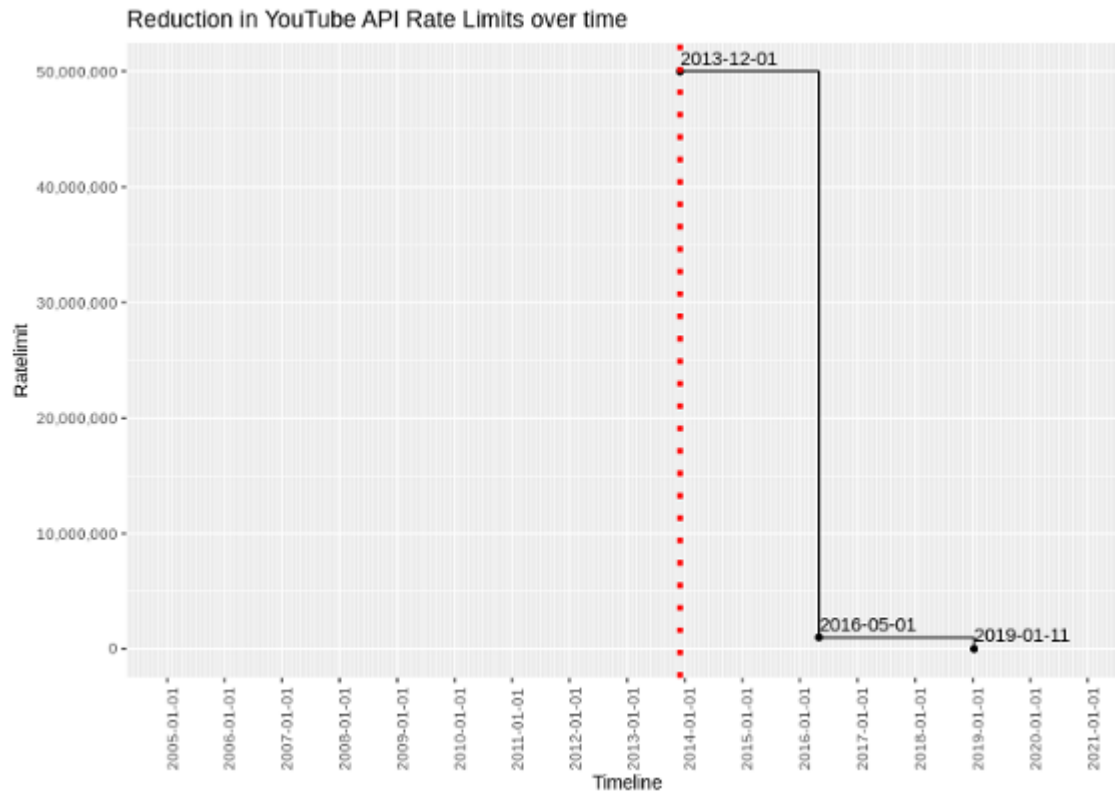
- All possible resources for the *YouTube* API are listed [here](#)
- For our workshop, the most important resources will be search, Comments, CommentThreads, and videos
- **NB:** Some information is only visible to owners of a channel or author of a video
- Not all information is necessarily available 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 (02.2022), 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*

Google Cloud Platform | YoutubeScrapper

Search Products, resources, docs (/)

IAM & Admin | Quotas for project "YoutubeScrapper" | EDIT QUOTAS

Near the limit
0
[View quotas](#)

Low usage
78
[View quotas](#)

All quotas
125

Filter Enter property name or value

Service	Quota	Dimensions (e.g. location)	Limit	Current usage percentage ↓	7 day peak usage percentage
<input type="checkbox"/> YouTube Data API v3	Queries per day		10,000	5.02%	5.02%
<input type="checkbox"/> YouTube Data API v3	Queries per minute		1,800,000	0.01%	0.01%
<input type="checkbox"/> BigQuery API	Cloud SQL federated query cross region bytes per day		1,099,511,627,776 B (1.1 TB)	0%	0%
<input type="checkbox"/> BigQuery API	Extract bytes per day		54,975,581,388,800 B (54.976 TB)	0%	0%
<input type="checkbox"/> BigQuery API	IamPolicy requests per minute		3,000	0%	0%

Methods

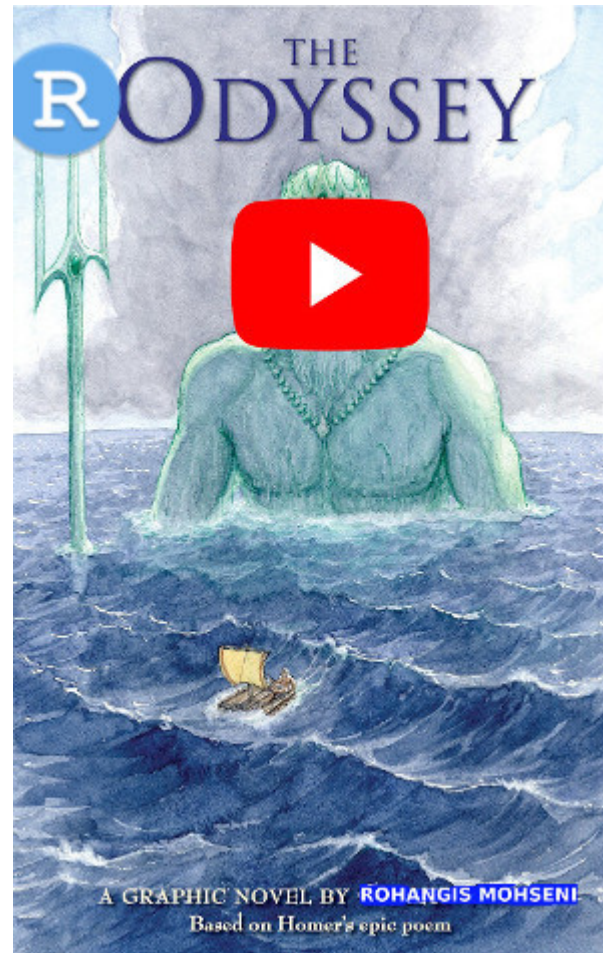
Method ↑	Requests	Errors
youtube.comments.list	4	0
youtube.commentThreads.list	292	0
youtube.videos.list	4	0

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 quota.",
    "errors": [
      {
        "message": "The request cannot be completed because you have exceeded your quota.",
        "domain": "youtube.quota",
        "reason": "quotaExceeded"
      }
    ]
  }
}
```

Can I Increase my Rate Limit? A "Short" Story



Trying to Raise the *YouTube* API Quota

- Study that needed large datasets in a short amount of time
- RQ: Is there a u-shaped relationship between success and number of uploads?
- Sample: 600 popular channels (identified via SocialBlade)
- Request for higher quota (October 11, 2019)
- Problem: Same application form for (web) apps and research
- Hard to figure what applies to research and what to write into the form
- Experience: Stuck in an infinite loop with e-mails from *Google* support on this issue

Any questions?

Exercise time 🏋️💪🏃🚴

Solutions