israel_hamas_2023

November 6, 2023

1 Exploration of Media Sentiment Pre and Post Israel-Hamas Escalation

1.1 In this report, we conduct a methodical examination of public sentiment as expressed in YouTube comments concerning the topic of "Israel", with a specific focus on the period preceding and following the events of the October 2023 Hamas-Israel conflict.

Our analysis is extensively facilitated by the use of **Google Cloud Platform** services (therefore, it is also preferable if this notebook is run from Google Colab).

OUTLINE:

1. Data Collection: Our initial phase involves the systematic extraction of YouTube comments using the term "Israel". This data collection spans two critical time frames: prior to and subsequent to October 7, 2023 (the day that Hamas initiated the attacks). For this purpose, we employ the **YouTube API**.

2. Data Preprocessing and Feature Engineering: In the subsequent phase, we utilize the **Pandas** library to pre-process and transform the collected data. This process includes cleansing and the construction of relevant features to enhance the analytical value of the dataset. The refined data is then meticulously formatted into a **CSV** file, optimizing it for subsequent SQL queries (via Google Cloud **BigQuery**).

3. Exploratory Analysis with SQL: With the data already in the right format, we transition to Google Cloud BigQuery for an in-depth exploratory analysis. The **SQL** language, facilitated by **BigQuery magic**, serves as our tool for mining insights from the dataset. The culmination of this stage is the synthesis of our findings into a dashboard utilizing **Looker Studio**. This tool not only integrates seamlessly with Google Cloud services but also streamlines the extraction of insights from BigQuery.

4. Sentiment Analysis of Comments: To explore public sentiment in the comments, we utilize the Natural Language Toolkit (**NLTK**) library for sentiment analysis. This exploration includes both qualitative visualizations, such as **wordclouds**, and a quantitative sentiment assessment.

5. Conclusion: We find obvious differences in the public's attitudes towards the term "Israel" before and after the attack, with what appears to be a major sudden shift from positive to negative sentiment. We will discuss how to interpret the results.

Disclaimer: we should approach the findings of this exploration with caution. It is

critical to avoid hasty generalizations or the formulation of biases based on this singular dataset, the tools we employed and the interpretation we may make of the results.

Let us begin by importing most the required libraries.

[ ]:
```python
from googleapiclient.discovery import build
import datetime
import numpy as np
import pandas as pd
import nltk
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
nltk.download('stopwords')
nltk.download('punkt')
from wordcloud import WordCloud
import matplotlib.pyplot as plt
from datetime import date, datetime, timedelta
from nltk.sentiment import SentimentIntensityAnalyzer
nltk.download('vader_lexicon')
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data…
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package punkt to /root/nltk_data…
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package vader_lexicon to /root/nltk_data…
[nltk_data]   Package vader_lexicon is already up-to-date!
```

You must have a Google account and have your YouTube API credentials ready. Learn more at: https://developers.google.com/youtube/v3

[ ]:
```python
# Use your YouTube API key
api_key = '<Your YouTube API key>'
```

[ ]:
```python
# Set up the YouTube Data API service
youtube = build('youtube', 'v3', developerKey=api_key)
```

2 1. DATA EXTRACTION

The following functions help us extract video related data from public YouTube videos.

In the end, we will obtain Pandas dataframes where each row represents a YouTube video and some data associated to it, including people's comments.

[ ]:
```python
def get_video_ids(response):
    """
    Returns all video id's from a search dictionary object. The API returns a␣
 ↪maximum of 50 id's per search.
    We use this function inside other functions.
    """
    video_ids = []
    for item in response['items']:
        video_ids.append(item['id']['videoId'])
    print(f'{len(video_ids)} video ids' )

    return video_ids
```

```
[ ]: def all_info(youtube, video_ids):
         """
         Returns a Pandas dataframe from video id's.
         """
         all_comments = []
         all_video_info = []

         ## VIDEO INFO ##
         for i in range(0, len(video_ids), 50):
             request_videos = youtube.videos().list(
                 part="snippet,contentDetails,statistics",
                 id=','.join(video_ids[i:i+50])
             )
             response_videos = request_videos.execute()
             # There is a lot of information we can extract from the videos. We are␣
      ↪interested only in the following:
             for video in response_videos['items']:
                 stats_to_keep = {'snippet': ['channelTitle', 'title',␣
      ↪'description', 'publishedAt'],
                                  'statistics': ['viewCount', 'likeCount',␣
      ↪'commentCount']                                }
                 video_info = {}
                 video_info['video_id'] = video['id']
                 for k in stats_to_keep.keys():
                     for v in stats_to_keep[k]:
                         try:
                             video_info[v] = video[k][v]
                         except:
                             video_info[v] = None
                 all_video_info.append(video_info)

         ## COMMENTS INFO ##
         for video_id in video_ids:
             try:
                 request_comments = youtube.commentThreads().list(
                     part="snippet,replies",
                     videoId=video_id,
                     maxResults=100,
                     order="time"
                 )
```

```
            response_comments = request_comments.execute()
            comments_in_video =␣
 ↪[comment['snippet']['topLevelComment']['snippet']['textOriginal'] for␣
 ↪comment in response_comments['items']]
            comments_in_video_info = {'comments': comments_in_video}
            all_comments.append(comments_in_video_info)
        except:
            # When error occurs, most likely because comments are disabled on a␣
 ↪video
            print('Could not get comments for video ' + video_id)

    video_info_df = pd.DataFrame(all_video_info)
    comments_info_df = pd.DataFrame(all_comments)
    videos_and_comments_df = pd.concat([video_info_df, comments_info_df],␣
 ↪axis=1)

    return pd.DataFrame(videos_and_comments_df)
```

[ ]:

```
# This function integrates the other two above.
# By default, YouTube API will give us only 50 search results per query.
# Then, to get more data, we conduct and stack the results of several queries␣
 ↪(one per day).
def allinfo_df(yt_object, keyword, after_date, before_date):
    """
    Returns a response object based on keyword term, and starting and finishing␣
 ↪timepoints for the search.
    It performs a new query per day, between the first and the last dates␣
 ↪provided.
    """
    start_date = after_date
    end_date = before_date
    dates_list = []
    current_date = start_date
    next_date = current_date
    vids_and_comments_df = pd.DataFrame()
    while current_date < end_date:
        # Make list of intermediate dates in RFC 3339 format
        dates_list.append(current_date.strftime("%Y-%m-%dT%H:%M:%SZ"))
        next_date = current_date + timedelta(days=1)
        search_query = keyword
        request = yt_object.search().list(
            part="snippet",
            q=search_query,
            publishedAfter=current_date.strftime("%Y-%m-%dT%H:%M:%SZ"),
            publishedBefore=next_date.strftime("%Y-%m-%dT%H:%M:%SZ"),
            type='video',
            maxResults = 1000,
            relevanceLanguage="en"  ###
        )
        print("current_date: ", current_date)
        print("next_date: ", next_date)
        current_date += timedelta(days=1)
        response = request.execute()
        video_ids = get_video_ids(response)
        vids_and_comments_df = pd.concat([vids_and_comments_df,␣
 ↪all_info(youtube, video_ids)])

    return vids_and_comments_df
```

We could focus on any major event that may cause a shift in public sentiment towards a specific term; so, we could easily reuse this notebook for other explorations.

In any case, here we are focusing on the Hamas-Israel escalation that began on the 7th of October, 2023. Thus, we are going to collect YouTube video data from before and after that specific date, encompassing the two weeks before and the two weeks after the event, correspondingly.

```
[ ]: # # Comment out if dataframe is directly loaded from CSV file
     # Specify the beginnings and ends of the two periods we are interested in␣
      ↪(before the event, and after the event)
     startdate_before_event = date(2023, 9, 22)
     enddate_before_event = date(2023, 10, 6)
     startdate_after_event = date(2023, 10, 8)
     enddate_after_event = date(2023, 10, 22)

     # Collect the data and save them as Pandas dataframes. This might take some␣
      ↪time.
     before_event_df = allinfo_df(youtube, "Israel", startdate_before_event,␣
      ↪enddate_before_event)
     after_event_df = allinfo_df(youtube, "Israel", startdate_after_event,␣
      ↪enddate_after_event)
```

```
current_date:  2023-09-22
next_date:  2023-09-23
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video kNH85jgzJOY

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video CnGEDzaDcZI
current_date:  2023-09-23
```

```
next_date:  2023-09-24
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video gbhi4z5jloQ
Could not get comments for video Cj7H0w7q8ZU
current_date:  2023-09-24
next_date:  2023-09-25
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 0qkhsC5C9x4

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video WUSirGxWh-U
current_date:  2023-09-25
next_date:  2023-09-26
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video cxH9ItshHSI

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video FIHPEAKNp-A
current_date:  2023-09-26
next_date:  2023-09-27
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video WDuRQ3pFbh4
current_date:  2023-09-27
next_date:  2023-09-28
50 video ids
current_date:  2023-09-28
next_date:  2023-09-29
50 video ids
current_date:  2023-09-29
next_date:  2023-09-30
50 video ids
current_date:  2023-09-30
```

```
next_date:  2023-10-01
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video nd__Rp780zo

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video QIGUhlmkRZI

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video ho_N8qlW5xY
current_date:  2023-10-01
next_date:  2023-10-02
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 6OYB2I0ORNA
Could not get comments for video aIe8lt4QoUI
Could not get comments for video akk8sM9KV2g

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 8v_ToU_pfL0

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video cb12KmMMDJA
Could not get comments for video OyQKThz41wg
current_date:  2023-10-02
next_date:  2023-10-03
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video kfgHPj3E9QQ

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
```

```
Could not get comments for video 1E-z28HdbzM
current_date:  2023-10-03
next_date:  2023-10-04
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video j_LlMCNgjqA

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video YwwOGYgEIpQ
current_date:  2023-10-04
next_date:  2023-10-05
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video fUkmqzrcuW4

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 1BTsX2WBg8Q
current_date:  2023-10-05
next_date:  2023-10-06
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video xUMn6uq8a70

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 9iWRUQufGbc

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video we6AEoX2mj8
Could not get comments for video YDxnQEqP9f8

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video iXs5cpg3TwQ

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
```

```
Could not get comments for video 1e7ncomHgoA
current_date:  2023-10-08
next_date:  2023-10-09
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video jVRO2Q1LCcc

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 9AJLac4iDFg
Could not get comments for video -5GUjb_3V5A
Could not get comments for video it_nHNPEfd8
Could not get comments for video gKjFcCydeGs

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 6zRp0VaaMDA

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video cZ83Q7tM4A0
current_date:  2023-10-09
next_date:  2023-10-10
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video zsNj8DiJv-A

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video f2fvHp2tbzE

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video NybU9LlDf8g

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
```

```
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video vK79VDAc2hw
Could not get comments for video OOKkDcwzlAE

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video Uw-MEeRvBNg

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video uFYc1PeOFCA

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video B3_yQ4mgOks
Could not get comments for video b-rMTOjOTRE
current_date:  2023-10-10
next_date:  2023-10-11
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 4yXR_Q_sScY

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video tPfQe6MtzDE

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video OnWgOWWYkQI

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video rDdAWRWRiMs
current_date:  2023-10-11
next_date:  2023-10-12
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video LVsvU6cqzRo

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
```

```
Could not get comments for video 9oCOCvLTQNI

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video ZDHyGrbWXZU

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video K_U8PFXaFVU

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video NPoyd9l3lJI

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 8fiuudd432Y

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 4hYkgGMpe2g

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video diV4hF930Eg
Could not get comments for video aaBqNG8fkWo
current_date:  2023-10-12
next_date:  2023-10-13
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video Ar_9UCZaJHw

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video bW8gY_5Kzcw

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video vHaHzr5M7gk

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
```

```
Could not get comments for video qenkS-YMubI
current_date:  2023-10-13
next_date:  2023-10-14
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video VAh1cKtEc8M

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video qFb2XCnQMB4

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video QMbQ1aZ7PRg

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video LFGmGPVtFNc

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video ny51G4XUfp8

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video Ydq9-Da9ilI
current_date:  2023-10-14
next_date:  2023-10-15
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video NeFuOIUM1qc

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video yID-vH2RLRQ

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 9apcmWZOGFc

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video vX6HSBwfIO8
```

```
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video kecYngYSy04
current_date:  2023-10-15
next_date:  2023-10-16
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video bEF8fxGnTtc

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video fzWJGxGZ2FI
current_date:  2023-10-16
next_date:  2023-10-17
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video GkNYB0DayKo

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video AlxjtVcN5mQ

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 7IE9eDvG_Tw
Could not get comments for video MtbvY1j82gc
current_date:  2023-10-17
next_date:  2023-10-18
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video QVw-uymnaYk

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video uKupoNutUSA

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video vJvhg4Gxk6E
```

```
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video GG7ss3jYKYk

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video EVff6mq9-pg

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video JMcI1ZiQfWQ
Could not get comments for video vBpNUVC0dSU

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video BusNb2jt1NU
current_date:  2023-10-18
next_date:  2023-10-19
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video ESzCGAMgTcg

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video CeddkAb8Ub0

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 6ZZg2_yzMII

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video kDXSZKkgk4E

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video U4zX8RbEkIU
current_date:  2023-10-19
next_date:  2023-10-20
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"
```

```
Could not get comments for video Bug_O699_yQ

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video jeNpmUb4Lak

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video ocEKcEqDQww
current_date:  2023-10-20
next_date:  2023-10-21
50 video ids

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video OYJFHtTYc0g

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 6Jpoy6L-VKU

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video kGlMutroZBA

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video hH_Kcj5Ikqs

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 5pkapvWfTsw

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video PqR1IFz5da8

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 9kCdnhAMtMO

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video RcpzXWJYsxY
current_date:  2023-10-21
next_date:  2023-10-22
50 video ids
```

```
WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video eeQDv8QlHZk

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video 9Fg2iDKl04o

WARNING:googleapiclient.http:Encountered 403 Forbidden with reason
"commentsDisabled"

Could not get comments for video NAvVIXVwK1w
```

3 2. PREPROCESSING & FEATURE ENGINEERING

Let us take a quick look at the data we just extracted, starting with the data before the event.

```
[ ]: before_event_df.describe()
```

```
[ ]:            video_id    channelTitle  \
     count            700             700
     unique           700             490
     top      IJUXKq2bgQ8  Dilyara Shorts
     freq               1              18

                                                         title description  \
     count                                                 700         700
     unique                                                681         434
     top     ISRAEL - HOLY LAND - CATHOLIC PILGRIMAGES - GL…
     freq                                                   10         244

                      publishedAt viewCount likeCount commentCount comments
     count                    700       700       662          688      670
     unique                   700       622       355          226      480
     top     2023-09-22T19:01:51Z         0         2            0       []
     freq                       1         6        36          208      191
```

```
[ ]: before_event_df.head()
```

```
[ ]:       video_id        channelTitle  \
     0  IJUXKq2bgQ8  Al Jazeera English
     1  kNH85jgzJOY        PBS NewsHour
     2  ZYTehyVodwo    Associated Press
     3  7xgclIzo0qo           The Bayit
     4  OeGxTuck5ms            CBN News

                                                title  \
     0  Netanyahu touts peace with Saudi Arabia, issue…
```

```
1  WATCH: Israeli Prime Minister Benjamin Netanya…
2  Benjamin Netanyahu tells UN that Israel is 'at…
3  Rav Avi Message from outside the Israel Missio…
4  Israeli-Saudi Relations on the Horizon | Jerus…

                                       description           publishedAt  \
0  Israeli Prime Minister Benjamin Netanyahu has …  2023-09-22T19:01:51Z
1  Stream your PBS favorites with the PBS app: ht…  2023-09-22T13:45:38Z
2  Israeli Prime Minister Benjamin Netanyahu says…  2023-09-22T14:55:18Z
3                                                     2023-09-22T13:41:45Z
4  Netanyahu highlights threats facing Israel and…  2023-09-22T22:00:25Z

  viewCount likeCount commentCount  \
0    682767      2204         2828
1    253402      2916         None
2     29417       252          150
3       191        11            0
4     55961      1086          292

                                          comments
0  [Great presentation skills. He just divided th…
1  [This Mega Corridor look like a Coy, now Why N…
2                                               []
3  [This did not age well, Well, scrap that.,  …
4  [One person's  hero  is another ones terrorist…
```

[ ]:
```
before_event_df.isna().sum()
```

[ ]:
```
video_id         0
channelTitle     0
title            0
description      0
publishedAt      0
viewCount        0
likeCount       38
commentCount    12
comments        30
dtype: int64
```

Everything seems OK thus far. We have some null entries in likeCount, commentCount and comments. Also, we receive the comments as nested lists, which we will need to address later. Now, the data after the event:

[ ]:
```
after_event_df.describe()
```

[ ]:
```
           video_id channelTitle  \
count           700          700
```

```
     unique          700          151
     top     FXrVtabZggI     Sky News
     freq                1           43

                                                         title description  \
     count                                                 700         700
     unique                                                696         693
     top     Israel warns citizens to leave Egypt, Jordan a…
     freq                                                    2           4

                      publishedAt viewCount likeCount commentCount comments
     count                    700       700       699          625      623
     unique                   699       700       677          567      617
     top     2023-10-18T12:09:22Z   5165203       653            0       []
     freq                       2         1         3            8        7
```

```
[ ]: after_event_df.head()
```

```
[ ]:       video_id    channelTitle  \
     0  FXrVtabZggI        BBC News
     1  jVR02Q1LCcc         DW News
     2  0XiW6hhC6Bs  Task & Purpose
     3  _45HVw5pEA8        Sky News
     4  F6_p78k43NY           MSNBC

                                                    title  \
     0  700 dead in Israel as it "declares war" on Ham…
     1  Is Israel planning a ground incursion into Gaz…
     2                                   Israel is at War
     3  Israel-Hamas war: Many killed in Sderot follow…
     4  Palestinian Americans in Chicago's 'Little Pal…

                                              description           publishedAt  \
     0  Israeli has formally declared war on the Hamas…  2023-10-08T22:46:23Z
     1  Israel has declared a state of war after a mas…  2023-10-08T15:10:42Z
     2  I'll be posting updates here: https://www.inst…  2023-10-08T02:07:43Z
     3  The Israeli city of Sderot is waking up to the…  2023-10-08T21:36:52Z
     4  NBC News' Maggie Vespa reports from the "Littl…  2023-10-08T20:00:02Z

       viewCount likeCount commentCount  \
     0   5165203     46293        23295
     1   1436150     11901         None
     2   7068331    144959        22880
     3   1131062      7683         3463
     4    242832      1242         2084

                                                 comments
```

```
0  [Israel = Apartheid, Hamas = terrorists!. Pala…
1  [I'll be posting updates the Israeli Palestini…
2  [Wtf?!!where are israel attact palestine?,   …
3  [Anti zionism is antisemitism as over half the…
4  [BILLIONS OF TAXPEYES MONEY IN WARS KILLINGS S…
```

```
[ ]: after_event_df.isna().sum()
```

```
[ ]: video_id         0
     channelTitle     0
     title            0
     description      0
     publishedAt      0
     viewCount        0
     likeCount        1
     commentCount    75
     comments        77
     dtype: int64
```

Same kind of dataset as one before the event.

For the sake of simplicity, we are going to merge the two datasets into one. We will also create a new column referring to whether the data entry is from before or after the event.

```
[ ]: before_event_df.insert(0, "from_event", 'before')
     after_event_df.insert(0, "from_event", 'after')
```

```
[ ]: israel_attack_df = pd.concat([before_event_df, after_event_df])
```

```
[ ]: # Check the first rows of the new dataframe
     israel_attack_df.head()
```

```
[ ]:   from_event     video_id        channelTitle  \
     0     before  IJUXKq2bgQ8  Al Jazeera English
     1     before  kNH85jgzJOY        PBS NewsHour
     2     before  ZYTehyVodwo    Associated Press
     3     before  7xgclIzo0qo           The Bayit
     4     before  OeGxTuck5ms            CBN News

                                                 title  \
     0  Netanyahu touts peace with Saudi Arabia, issue…
     1  WATCH: Israeli Prime Minister Benjamin Netanya…
     2  Benjamin Netanyahu tells UN that Israel is 'at…
     3  Rav Avi Message from outside the Israel Missio…
     4  Israeli-Saudi Relations on the Horizon | Jerus…

                                           description           publishedAt  \
     0  Israeli Prime Minister Benjamin Netanyahu has …  2023-09-22T19:01:51Z
```

```
1  Stream your PBS favorites with the PBS app: ht…  2023-09-22T13:45:38Z
2  Israeli Prime Minister Benjamin Netanyahu says…  2023-09-22T14:55:18Z
3                                                     2023-09-22T13:41:45Z
4  Netanyahu highlights threats facing Israel and…  2023-09-22T22:00:25Z

  viewCount likeCount commentCount  \
0    682767      2204         2828
1    253402      2916         None
2     29417       252          150
3       191        11            0
4     55961      1086          292

                                            comments
0  [Great presentation skills. He just divided th…
1  [This Mega Corridor look like a Coy, now Why N…
2                                                 []
3  [This did not age well, Well, scrap that.,  …
4  [One person's  hero  is another ones terrorist…
```

```
[ ]: # Check the last rows
israel_attack_df.tail()
```

```
[ ]:   from_event     video_id          channelTitle  \
    45      after  lCMT-T2Y7OY                  WION
    46      after  ExmMG2Ttnws  Pastor Mark Driscoll
    47      after  wIWs1h-Zqf8             Firstpost
    48      after  32Qp8hVg9X0             TRT World
    49      after  -YuYeQ0CnpU       Middle East Eye

                                                  title  \
    45  Hezbollah says it launched missiles at Israel,…
    46                       A History of Hamas & Israel
    47  LIVE: Biden's Israel Visit, Hamas' Hypocrisy, …
    48  Israel's narrative of Al Ahli Arab Hospital at…
    49  Over 300,000 gather in central London to prote…

                                            description           publishedAt  \
    45  Israel warned civilians to stay out of the Leb…  2023-10-21T06:27:33Z
    46  A history of Hamas & Israel.\n\nThis is a clip…  2023-10-21T16:24:33Z
    47  LIVE: Biden's Israel Visit, Hamas' Hypocrisy, …  2023-10-21T16:18:24Z
    48  In this in-depth video, we delve into the Al A…  2023-10-21T07:04:06Z
    49  In a massive show of solidarity, over 300,000 …  2023-10-21T16:42:34Z

       viewCount likeCount commentCount  \
    45    134721       731          199
    46     12403       549           80
    47    637343      8326         1683
```

```
48    51729     3406          478
49   610181    49752         3680

                                                   comments
45  [Thank you, Tell Hamas to quit hiding under ho…
46  [Nuke em all, Que estas protestas no sean en v…
47                                                      NaN
48                                                      NaN
49                                                      NaN
```

Check the data types and adress the empty entries.

[ ]:

```
israel_attack_df.dtypes
```

[ ]:

```
from_event      object
video_id        object
channelTitle    object
title           object
description     object
publishedAt     object
viewCount       object
likeCount       object
commentCount    object
comments        object
dtype: object
```

[ ]:

```
# Change the types of columns 'likeCount' and 'commentCount' to int. Before␣
↪that, "None" values are replaced with 0.
israel_attack_df['likeCount'] = israel_attack_df['likeCount'].fillna(0).
↪astype(int)
israel_attack_df['commentCount'] = israel_attack_df['commentCount'].fillna(0).
↪astype(int)
```

[ ]:

```
# Replace empty entries with mean values, except for the 'comments' column
israel_attack_df['likeCount'].fillna(israel_attack_df['likeCount'].mean(),␣
↪inplace=True)
israel_attack_df['commentCount'].fillna(israel_attack_df['commentCount'].
↪mean(), inplace=True)
```

Transform comments from nested lists to strings. This will be convenient to store the data as CSV files and for the later processing.

[ ]:

```
def nested_list_to_string(lst):
    result = []
    if not isinstance(lst, list):
        lst = ["Nan"]
    for item in lst:
        if isinstance(item, list):
            result.append(nested_list_to_string(item))
        elif not isinstance(item, float):
            result.append(item)
    return " #@# ".join(result) # " #@# " is used as an arbitrary separator␣
↪between comments
```

[ ]:

```
israel_attack_df['comments'] = israel_attack_df['comments'].
↪apply(nested_list_to_string)
```

[ ]:

```
# Show a random sample of comments to see if they look alright
israel_attack_df['comments'].sample(10)
```

[ ]:

```
9     Harari is dangerous and part of this  terrible…
22    The woman talks like she knows everything exce…
16    Hamas je pun…awk pakai jet pakai meriam pn t…
25    Give Palestine back to the Palestinians!!!!!!!…
30     spider vs fly #@#     #@# If wasn't for re…
0     This is the kind of of people Christian world …
45    Israel nhi Palestine. #@# Israel nahi, occupie…
41    The world police strikes again, meanwhile our …
47                                          #@#
4     Please like and share with your friends so mor…
Name: comments, dtype: object
```

So far, we have our date entries in RFC 3339 format, which is what the YouTube API returns. It looks like this:

[ ]:

```
israel_attack_df['publishedAt'].head(2)
```

[ ]:

```
0    2023-09-22T19:01:51Z
1    2023-09-22T13:45:38Z
Name: publishedAt, dtype: object
```

We will transform the date data format to ISO 8601 standard (YYYY-MM-DD), which will be more convenient and is widely used in SQL databases.

[ ]:

```
def rfc3339_to_iso8601(date_str):
    return date_str.split('T')[0]
```

[ ]:

```
israel_attack_df['publishedAt'] = israel_attack_df['publishedAt'].
↪apply(rfc3339_to_iso8601)
```

Save the dataset as a CSV file.

[ ]:

```
# Save the dataset as a CSV file, which might be convenient to save time when␣
↪exploring the data.
israel_attack_df.to_csv('israel_attack.csv')
```

4 3. EXPLORATORY ANALYSIS (SQL-queried, excluding analysis of comments)

We will carry out this first part of the exploratory analysis using Google Cloud BigQuery and SQL queries. **We are doing it this way for demonstrations purposes**; we could reach the same goals if we just continued with Pandas.

[ ]:
```
# Create a new dataframe to upload to BigQuery, dropping several columns that␣
 ↪are not needed for now
israel_bq = israel_attack_df.drop(columns=['comments', 'description'])
```

Connecting to BigQuery. You must at least have a project already set up; we will add a dataset and table to it.

[ ]:
```
# Running this, we are asked for permission to access our Google credentials
from google.colab import auth
auth.authenticate_user()
```

[ ]:
```
from google.cloud import bigquery
client = bigquery.Client(project='<your project ID>') # Enter your project ID
```

Create a dataset in BigQuery called "event_analysis".

[ ]:
```
dataset_id = 'event_analysis'
dataset_ref = client.dataset(dataset_id)
dataset = bigquery.Dataset(dataset_ref)
dataset.location = 'asia-east1' # The location should ideally be the closest to␣
 ↪you. Check the BigQuery documentation
dataset = client.create_dataset(dataset)
```

Create and fill a table inside our dataset, based on the dataset from the Pandas DataFrame that we prepared.

[ ]:
```
table_id = "<your project ID>.event_analysis.israel_attack" # Enter your␣
 ↪project ID at the beginning of the string
job_config = bigquery.LoadJobConfig(
    schema=[
    ],
    write_disposition="WRITE_TRUNCATE",
)
job = client.load_table_from_dataframe(
    israel_bq, table_id, job_config=job_config
)
job.result()  # Wait for the job to complete.
```

Let us run a simple SQL command with BigQuery magic, just to see if it works. Enter your own project ID always with the BigQuery magic commands.

[ ]:

```
%%bigquery --project <your project ID>
SELECT * FROM `<your project ID>.event_analysis.israel_attack`
WHERE viewCount > 800000
LIMIT 5;
```

```
Executing query with job ID: b8d2e2c2-31f6-4435-942a-5fda66ac10e3
Query executing: 1.02s


ERROR:
 400 No matching signature for operator > for argument types: STRING, INT64.
Supported signature: ANY > ANY at [2:7]

Location: asia-east1
Job ID: b8d2e2c2-31f6-4435-942a-5fda66ac10e3
```

"Oops, it seems we had forgotten to change the data type of viewCount to Integer". No problem, we will fix it with SQL. But first, let us check the data types of all columns to make sure we don't make more mistakes.

[ ]:

```
%%bigquery --project <your project ID>
SELECT
    column_name,
    data_type
FROM
    `event_analysis`.INFORMATION_SCHEMA.COLUMNS
WHERE
    table_name = 'israel_attack';
```

```
Query is running:   0%|          |

Downloading:   0%|          |
```

[ ]:

```
    column_name data_type
0    from_event    STRING
1      video_id    STRING
2  channelTitle    STRING
3         title    STRING
4   publishedAt      DATE
5     viewCount     INT64
6     likeCount     INT64
7  commentCount     INT64
```

Not only should viewCount be Integer, but also publishedAt should be of Date type.

[ ]:

```
%%bigquery --project <your project ID>
CREATE OR REPLACE TABLE `event_analysis.israel_attack` AS
SELECT
    from_event,
    video_id,
    channelTitle,
    title,
    CAST(publishedAt AS DATE) as publishedAt,
    CAST(viewCount AS INT64) as viewCount,
    likeCount,
    commentCount
FROM
    `event_analysis.israel_attack`;
```

```
Query is running:   0%|          |
```

```
[ ]: Empty DataFrame
     Columns: []
     Index: []
```

```
[ ]: %%bigquery --project <your project ID>
     SELECT
         column_name,
         data_type
     FROM
         `event_analysis`.INFORMATION_SCHEMA.COLUMNS
     WHERE
         table_name = 'israel_attack';
```

```
Query is running:   0%|          |

Downloading:   0%|          |
```

```
[ ]:     column_name data_type
     0    from_event    STRING
     1      video_id    STRING
     2  channelTitle    STRING
     3         title    STRING
     4   publishedAt      DATE
     5     viewCount     INT64
     6     likeCount     INT64
     7  commentCount     INT64
```

Now the data types are alright. Let us start the exploratory analysis as such.

4.1 Basic counts before and after the event

```
[ ]: %%bigquery --project <your project ID>
     SELECT
         from_event,
         COUNT(*) as video_count
     FROM
```

```
    `event_analysis.israel_attack`
GROUP BY
    from_event;
```

```
Query is running:   0%|          |
```

```
Downloading:   0%|          |
```

```
[ ]:   from_event  video_count
     0     before          700
     1      after          700
```

(We know this already from the Pandas DataFrames).

4.2 Public interest in the topic before and after the event

We can look at the counts of video views, likes and comments to get an impression of how interested people were in "Israel" before and after the terrorist attack.

```
[ ]: %%bigquery --project <your project ID>
     SELECT
         from_event,
         SUM(viewCount) as total_views,
         SUM(likeCount) as total_likes,
         SUM(commentCount) as total_comments
     FROM
         `event_analysis.israel_attack`
     GROUP BY
         from_event;
```

```
Query is running:   0%|          |
```

```
Downloading:   0%|          |
```

```
[ ]:   from_event  total_views  total_likes  total_comments
     0     before    168854688      2570991          252176
     1      after    568771042      7898677         2196651
```

We see how the three measures reach far greater levels after the event compared to before, which we might have expected.

It might be more correct to show the averages per video:

```
[ ]: %%bigquery --project <your project ID>
     SELECT
         from_event,
         AVG(viewCount) as avg_views_per_video,
         AVG(likeCount) as avg_likes_per_video,
         AVG(commentCount) as avg_comments_per_video
     FROM
```

```
    `event_analysis.israel_attack`
GROUP BY
    from_event;
```

```
Query is running:   0%|          |

Downloading:   0%|          |
```

```
[ ]:  from_event  avg_views_per_video  avg_likes_per_video  avg_comments_per_video
    0     before        241220.982857          3672.844286              360.251429
    1      after        812530.060000         11283.824286             3138.072857
```

4.3 Channel coverage on the topic

What channels referred to the term “Israel” most often? It seems likely that this changed with the attack.

Before the attack:

```
[ ]: %%bigquery --project <your project ID>
     SELECT
         from_event,
         channelTitle as channel,
         COUNT(*) as video_count,
         SUM(viewCount) as total_views
     FROM
         `event_analysis.israel_attack`
     WHERE
         from_event='before'
     GROUP BY
         from_event, channelTitle
     ORDER BY
         total_views DESC
     LIMIT 10;
```

```
Query is running:   0%|          |

Downloading:   0%|          |
```

```
[ ]:  from_event            channel  video_count  total_views
    0     before      Todo Noticias            1     35820550
    1     before                UFC            2     18763163
    2     before    Middle East Eye            3     14156289
    3     before           ESPN MMA            1      9271760
    4     before       Visit Israel            2      9240857
    5     before           Sky News            2      6737734
    6     before  Israel & Rodolffo            1      5777482
    7     before       News18 India            8      4875411
    8     before           KOMPASTV            1      3937770
```

```
9     before        War Stories             1      3684174
```

After the attack:

```
[ ]: %%bigquery --project <your project ID>
     SELECT
         from_event,
         channelTitle as channel,
         COUNT(*) as video_count,
         SUM(viewCount) as total_views
     FROM
         `event_analysis.israel_attack`
     WHERE
         from_event='after'
     GROUP BY
         from_event, channelTitle
     ORDER BY
         total_views DESC
     LIMIT 10;
```

```
Query is running:   0%|          |

Downloading:   0%|          |
```

```
[ ]:   from_event                  channel  video_count  total_views
     0      after                 BBC News           29     47015044
     1      after            The Telegraph            9     41522046
     2      after  Piers Morgan Uncensored            4     38669084
     3      after            Channel 4 News           13     36901712
     4      after                 NBC News           40     29541906
     5      after                 Sky News           49     21271962
     6      after                Firstpost           11     18176847
     7      after          Hindustan Times           17     18088277
     8      after                      CNN           32     17692771
     9      after                     WION           24     12157531
```

We can compare the most popular channels, in terms of total video views, before and after the attack.

Interestingly, the popular channels before the attack appear to be a heterogeneous mix in terms of the countries of the channels and the contents (e.g., we see channels from India and Spain, and another channel about tourism). However, after the attack, as we might expect, the most popular channels focus on news and are mainstream news channels (e.g. BBC News and The Telegraph).

4.4 Temporal trend of video views

Immediately after the attack, the public may have shown the greatest interest (which we will measure as the number of views per day). This interest may have declined over time since the first attacks.

```
[ ]: %%bigquery --project <your project ID>
     SELECT
         publishedAt,
         SUM(viewCount) as total_views
     FROM
         `event_analysis.israel_attack`
     WHERE
         from_event = 'after'
     GROUP BY
         publishedAt
     ORDER BY
         publishedAt;
```

```
Query is running:   0%|          |

Downloading:   0%|          |
```

```
[ ]:    publishedAt  total_views
     0   2023-10-08    100861864
     1   2023-10-09     72605852
     2   2023-10-10     56031383
     3   2023-10-11     50424924
     4   2023-10-12     50487255
     5   2023-10-13     29374210
     6   2023-10-14     38214303
     7   2023-10-15     26788806
     8   2023-10-16     35471887
     9   2023-10-17     39961874
     10  2023-10-18     15137466
     11  2023-10-19     23665431
     12  2023-10-20     12042648
     13  2023-10-21     17703139
```

We find some evidence that supports our assumption: in the days that followed the attack, there appears to be a descending trend in the interest regarding the term “Israel”.

4.5 Looker Studio dashboard

Using Google’s BigQuery, it is quite straightforward to create a dashboard in Looker Studio. With the results from the previous SQL queries we can create the following dashboard, which offers a more intuitive look on the data we analyzed so far:

5 4. EXPLORATORY ANALYSIS (analysis of comments)

Here, we will explore the content of the comments, which will allow us to glance into people’s sentiment more directly.

We are going to create wordclouds to visualize the most common words from the comments; later, we will measure the public's sentiment quantitatively.

[ ]:
```
# # Uncomment this cell if you saved the CSV file in Google Colab and you lost␣
 ↪contact with the dataframe due to disconnection
# israel_attack_df = pd.read_csv('/content/israel_attack.csv')
```

[ ]:
```
# We create a set of stopwords (words that are not relevant in terms of␣
 ↪emotional value) to be removed from the comments
# Even though YouTube API searched for videos that are supposed to relate␣
 ↪mostly to English, there are still some foreign words that "leaked through"
stop_words = set(stopwords.words('english'))
more_stopwords = {"israel", "israeli", "el", "se", "de", "del", "la", "las",␣
 ↪"que", "en", "di", "su", "con", "ya", "su", "video", "não",
                  "por", "para", "one", "un", "una", "si", "u", "tu", "è",␣
 ↪"che", "ja", "pero", "https", "also", "et", "al", "da", "é",
                  "e", "lo", "ko", "ka", "os", "ye", "ki", "I'm", "em", "ni",␣
 ↪"te", "como", "get","got", "le", "es", "let", "still", "yet",
                  "los", "dont"}
stop_words.update(more_stopwords)
```

[ ]:
```
# The column 'comments' from the dataframe event_df contains comments separated␣
 ↪by the string " #@# ".
# This function returns a list of all the words from the comments in the␣
 ↪dataframe.
# It also removes the stopwords and punctuation.
def comments_to_words(df):
    comments = df['comments'].str.cat(sep=' #@# ')
    tokens = word_tokenize(comments)
    # Convert to lowercase
    tokens = [w.lower() for w in tokens]
    # Remove punctuation
    import string
    table = str.maketrans('', '', string.punctuation)
    stripped = [w.translate(table) for w in tokens]
    # Remove non-alphabetic tokens
    words = [word for word in stripped if word.isalpha()]
    # Remove stopwords
    words = [w for w in words if not w in stop_words]
    return words
```

[ ]:
```
# Apply the function comments_to_words to the dataframe israel_attack_df, but␣
 ↪only to the comments before the event
words_before =␣
 ↪comments_to_words(israel_attack_df[israel_attack_df['from_event'] ==␣
 ↪'before'])
# Same, but only to the comments after the event
```

```
words_after = comments_to_words(israel_attack_df[israel_attack_df['from_event']␣
 ↪== 'after'])
```

[ ]:
```
# Function that removes stopwords from a list of words
def remove_stopwords(word_list):
    return [w for w in word_list if not w in stop_words]
```

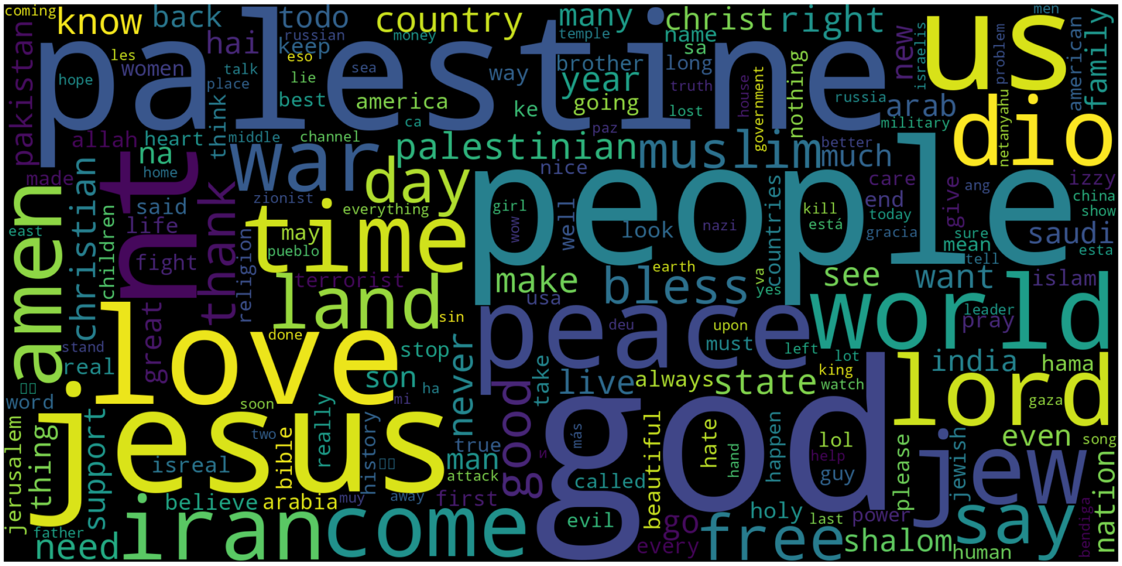
[ ]:
```
words_before_filtered = remove_stopwords(words_before)
words_after_filtered = remove_stopwords(words_after)
```

5.1 Wordclouds

Let us begin with a wordcloud that corresponds to the YouTube comments before the attack.

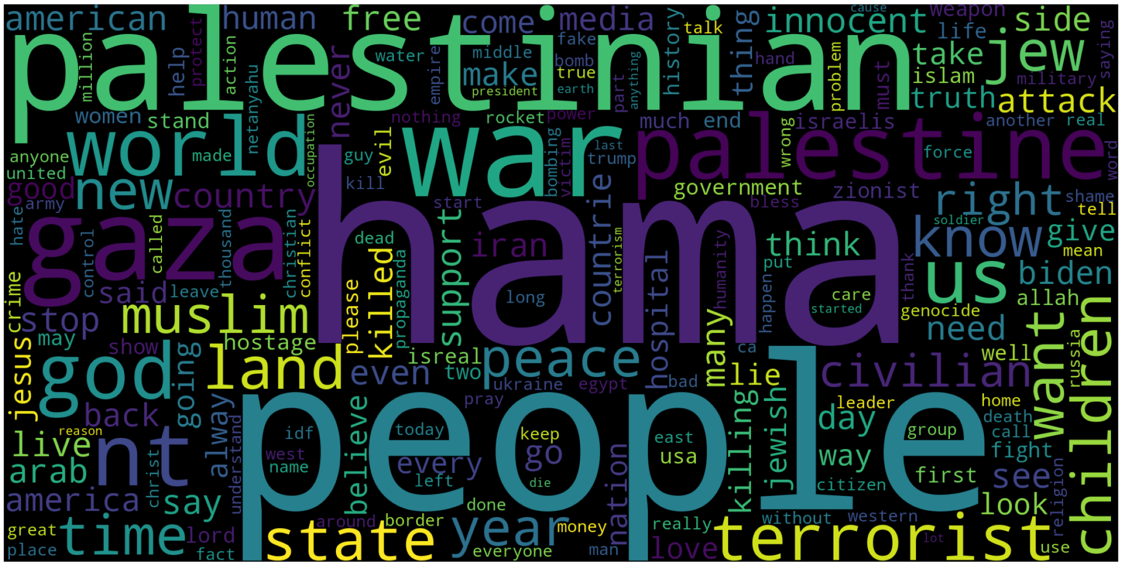
[ ]:
```
def plot_cloud(wordcloud):
    plt.figure(figsize=(30, 20))
    plt.imshow(wordcloud)
    plt.axis("off")
```

[ ]:
```
## Wordcloud BEFORE attack ##
wordcloud = WordCloud(width = 2000, height = 1000, random_state=1,␣
 ↪background_color='black',
                      colormap='viridis', collocations=False).generate(" ".
 ↪join(words_before_filtered))
plot_cloud(wordcloud)
```



Now, a wordcloud from the comments *after* the attack.

```
[ ]: ## Wordcloud AFTER event ##
     wordcloud = WordCloud(width = 2000, height = 1000, random_state=1,␣
      ↪background_color='black',
                              colormap='viridis', collocations=False).generate(" ".
      ↪join(words_after_filtered))
     plot_cloud(wordcloud)
```



We can find a lot of interesting cues in the wordclouds:

- Prevalence of Specific Words: In both word clouds, terms related to the Israel-Palestine conflict are prevalent, such as “Palestine,” “Gaza,” and “Hamas.” This suggests that discussions around this topic were consistent both before and after the incident.
- Shift in Emotion and Sentiment: After the terrorist attack, terms like “terrorist,” “attack,” “kill,” and “war” seem to be more pronounced, indicating a potential shift in the tone of discussions, with an increase in negative sentiments and emotions. (We will carry out a sentiment analysis after this, to obtain some quantitave measures).
- Religious Undertones: Words like “God,” “Jesus,” “Muslim,” and “Jew” are visible in both word clouds. This suggests that the discourse around the topic may often intertwine with religious discussions or sentiments.
- Global Perspective: There are mentions of other countries and regions, such as “USA,” “Russia,” “Iran,” and “world,” indicating that people are discussing the Israel-Palestine issue in a broader geopolitical context.
- Concern for Civilians: Terms like “children,” “civilian,” and “innocent” are more visible after the terrorist attack, possibly reflecting concerns for non-combatants affected by the conflict.
- Concern about war and peace: The presence of words like “peace,” “love,” and “support” alongside terms like “fight,” “conflict,” and “war” indicates that the search word “Israel” is

commonly associated with conflict and peace attempts.

5.2 Quantitative Sentiment Analysis

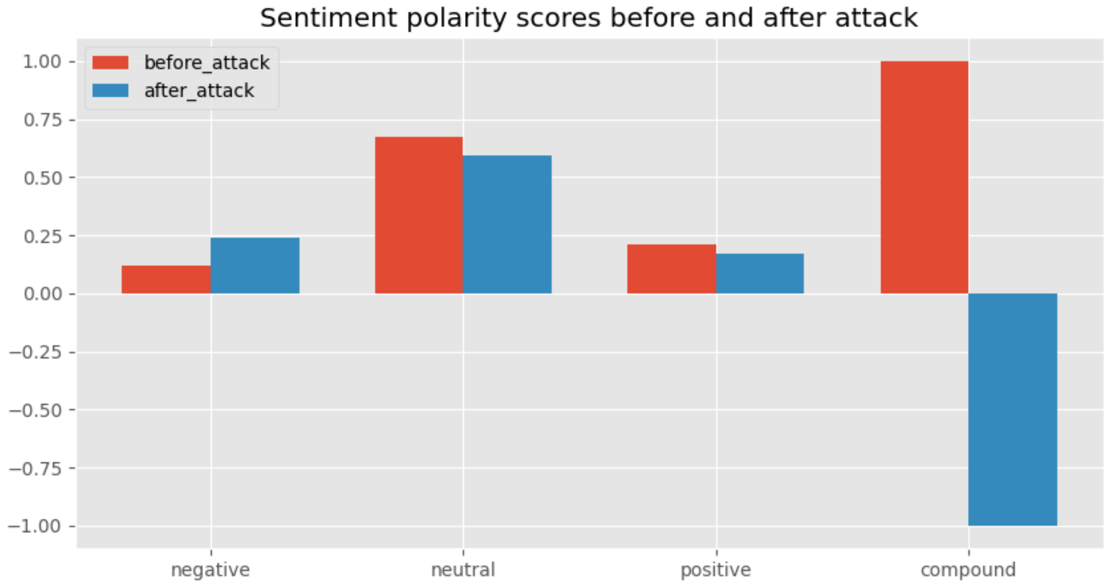
Fortunately, there are available tools to measure sentiment in a text. We will use one from the popular NLTK library.

[ ]:
```
# Now we will conduct sentiment analysis on the comments before and after the␣
  ↪event.
# We will use nltk.sentiment.vader
# The function sentiment_scores() returns a dictionary with the polarity scores␣
  ↪for each comment.
def sentiment_scores(text):
    sid_obj = SentimentIntensityAnalyzer()
    sentiment_dict = sid_obj.polarity_scores(text)
    return sentiment_dict
```

[ ]:
```
sentiment_before = sentiment_scores(" ".join(words_before_filtered))
sentiment_after = sentiment_scores(" ".join(words_after_filtered))
```

The objects we just obtained above are dictionaries that contain information about the comments' sentiment. But it will be more intuitive if we visualize these results as a bar chart.

[ ]:
```
# Bar chart of the polarity scores from comments before and after the attack
plt.style.use('ggplot')
plt.figure(figsize=(10, 5))
labels = ['negative', 'neutral', 'positive', 'compound']
x = np.arange(len(labels))
width = 0.35
plt.bar(x - width/2, list(sentiment_before.values()), width,␣
  ↪label='before_attack')
plt.bar(x + width/2, list(sentiment_after.values()), width,␣
  ↪label='after_attack')
plt.xticks(x, labels)
plt.legend()
plt.title("Sentiment polarity scores before and after attack")
plt.show()
```



The **negative sentiment score increases** significantly after the attack, suggesting that people were expressing more negative emotions or opinions in their comments regarding the event.

The **neutral sentiment score decreases** slightly after the attack, which may imply that people felt more strongly (either positive or negative) about the situation and were less inclined to be neutral.

We find also find **a decrease in the positive score** after the attack, indicating that there were fewer positive comments or feelings being expressed in relation to the event.

Most importantly, the compound score, which is an aggregate metric that combines the positive, negative, and neutral scores, became more negative after the attack. This signifies that, **on balance, the overall sentiment shifted to a more negative stance following the terrorist attack**.

6 5. CONCLUSION

We extracted YouTube video data, including comments, that contained the search term "Israel" in the video title. The dataset comprised 700 videos uploaded 2 weeks prior to the October 2023 Israel-Hamas confrontation, and another 700 videos that followed the Hamas attack. Our goal was to explore quantitatively and qualitatively the public's interest and sentiment with regards to the term "Israel".

As we might expect, the confrontation changed the public's level of interest in the topic, both in terms of quantity (e.g., almost 10 times as many video views after the attack compared to before) as well in terms of content (before the attack, "Israel" was associated with a varied mix of topics, for example related to religion and tourism; after the attack, "Israel" appeared almost exclusively associated with war and politics).

We conducted sentiment analysis pre and post event (the attack by Hamas), which revealed a very strong shift from “very positive” sentiment to “very negative” with respect to the keyword “Israel”.

6.1 Limitations

Can we conclude that the public (or, at least, the part of the public that is active on YouTube) used to like Israel, and now they dislike the country? We do not have enough evidence to make such a strong claim, for several reasons: 1. Striking news about any topic will overflood the media, eclipsing all previous views and comments on that topic just by the sheer amount of new information. If this new and abundant information is negative (which tends to be the case, unfortunately, with striking news), then the new average sentiment **associated** with this topic will also tend to be negative. But this negative association does not imply that people dislike the topic in question, it only implies that most of the times that people discussed the topic, there was something negative in the narrative. We might expect to encounter a similar sentiment shift if, for example, a huge earthquake devastated a certain country. Even if the corresponding average sentiment that we could extract from comments was positive before the earthquake, after such catastrophe the media would be deluged with sad and negative news, which would turn the new **associated** sentiment score into a negative one. 2. People tend more to express their opinions online about something if they have strong feelings, especially when these are negative. We can see this happening in Amazon reviews: even if a product is almost reaching the 5 stars, we might still find many reviews with extremely negative comments. Thus, a lot of negative comments does not imply that the whole population shares negative feelings; it could also be the case that a small part is very prolific at negative comments. 3. We do not know how well the active users of YouTube can represent the whole population. Even if active YouTube users tended now to dislike anything that has to do with Israel, we simply do not know if this could generalize to the whole population.
4. This exploration is, of course, limited in many ways. For example, we gathered data from only one media platform, YouTube. Another limitation regards the sentiment analysis tool that we employed (based on NLTK’s VADER). Namely, critics highlight its “bag of words” approach, which can miss the complexities of context and language nuances such as sarcasm or domain-specific jargon, potentially leading to inaccuracies in sentiment classification.

These limitations illustrate the need for good judgment when it comes to drawing conclusions from any analysis of the data. Knowing how to use our tools is not enough. Common sense is irreplaceable.

[ ]: