Big Data Analytics

Report

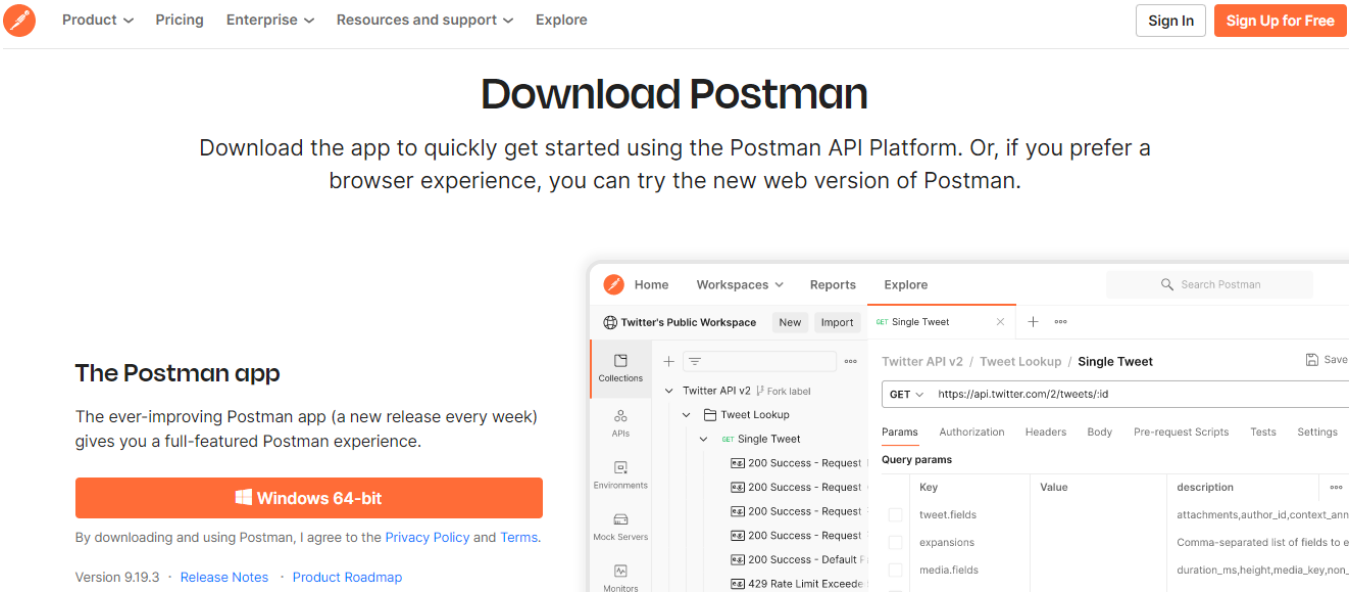
Project 1: Real-time Spark Processing: (Kappa): Set up an Apache Kafka + Spark Streaming + Hadoop + Docker pipeline (use PySpark if needed) and demonstrate a variety of real-time analytical queries. You can also use SparkSql for SQL-based queries. Requires Front-End.

By Abeera Tariq – 13170 (2nd June 2022)

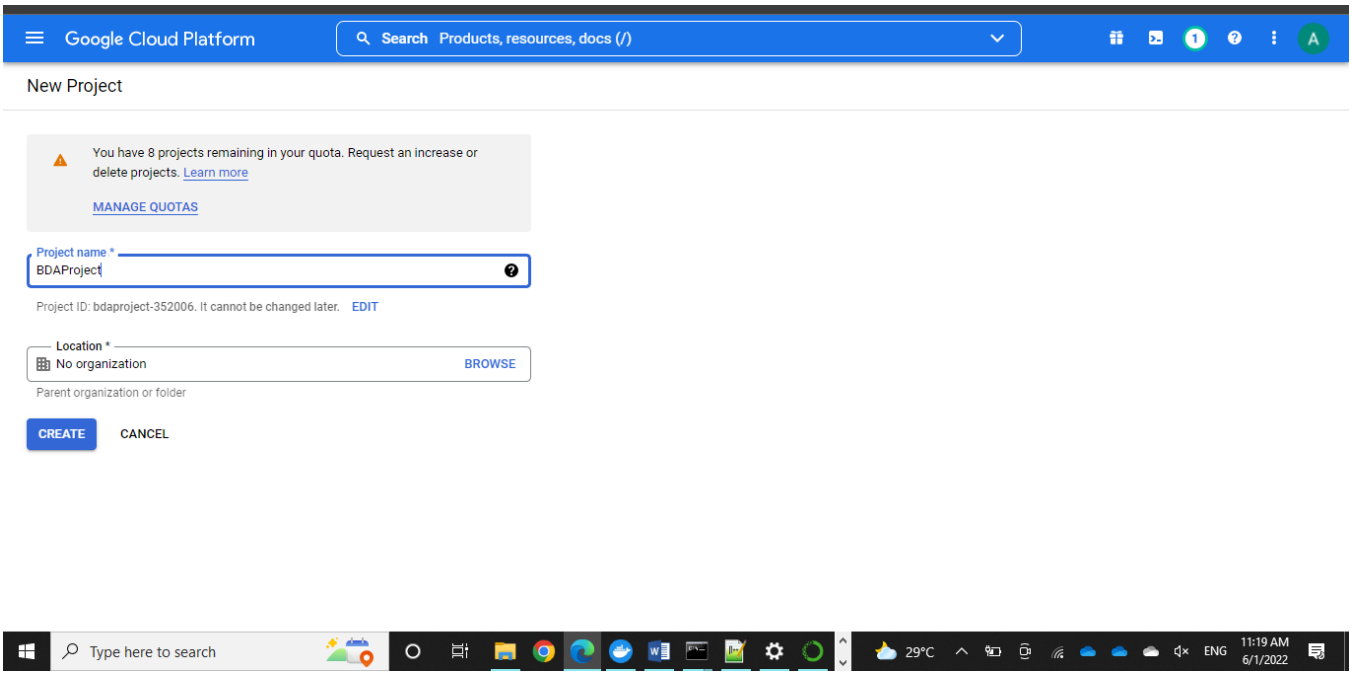
DATA PREPARATION

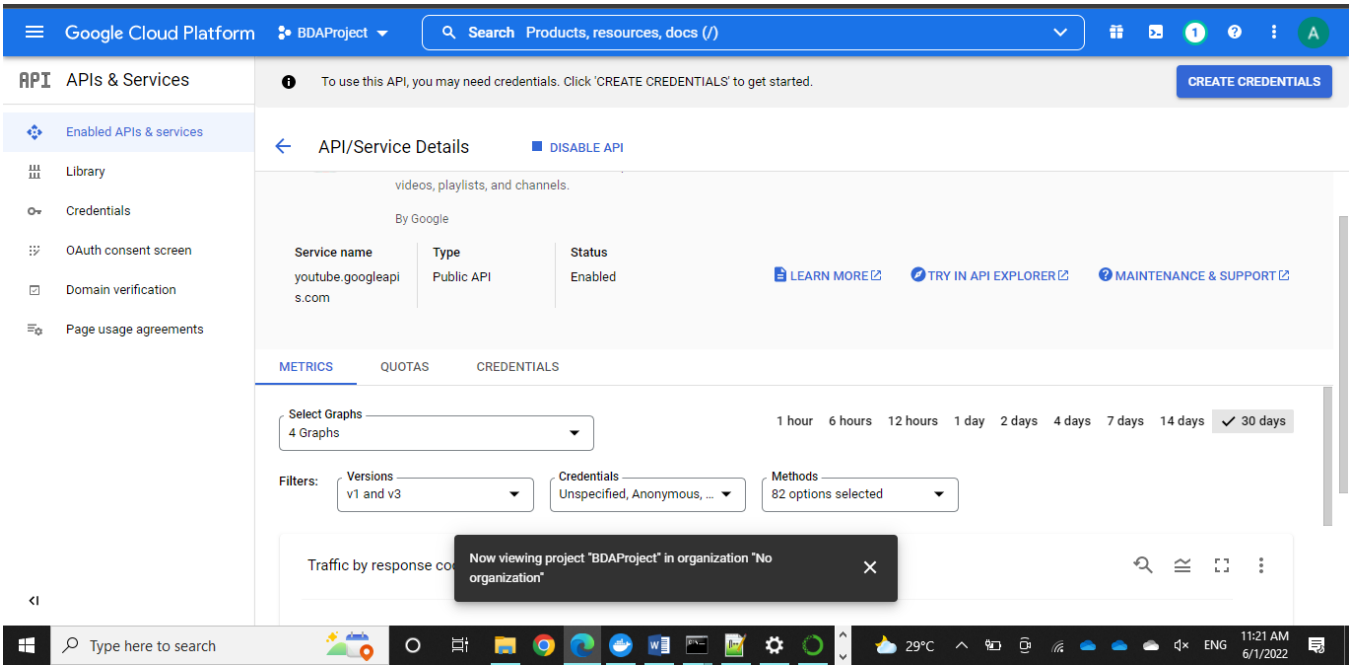
SET UP POSTMAN

This will allow testing of API.



GET API KEY





API key: AI**********

(hidden from the project)

To create your own Youtube Data API key, follow the steps as in [YouTube Data API Overview | Google Developers]().

Once you have the key, create a file named api_key.txt containing the key and follow the steps as below.

Scrapped data from Youtube using API.

```
(bda) E:\IBA - MBA 2022\MBA - IV Spring 2022\Big Data Analytics\Project\my-document-streaming-project-main\my-document-streaming-project-main\client>python get-data.py
Writing US data to file...

(bda) E:\IBA - MBA 2022\MBA - IV Spring 2022\Big Data Analytics\Project\my-document-streaming-project-main\my-document-streaming-project-main\client>python transformer.
py

(bda) E:\IBA - MBA 2022\MBA - IV Spring 2022\Big Data Analytics\Project\my-document-streaming-project-main\my-document-streaming-project-main\client>_
```

From the conda environment, execute the script get-data.py to fetch datafeeds from Youtube and run transformer.py to get the data as a text file in json format.

Here on, client/output.txt contains a json of Youtube trending videos data of US. This can be modified to have more countries with changes in the country_codes file.

DATASET

<u>Use Case:</u> Social Media Analysis – YOUTUBE Trending videos

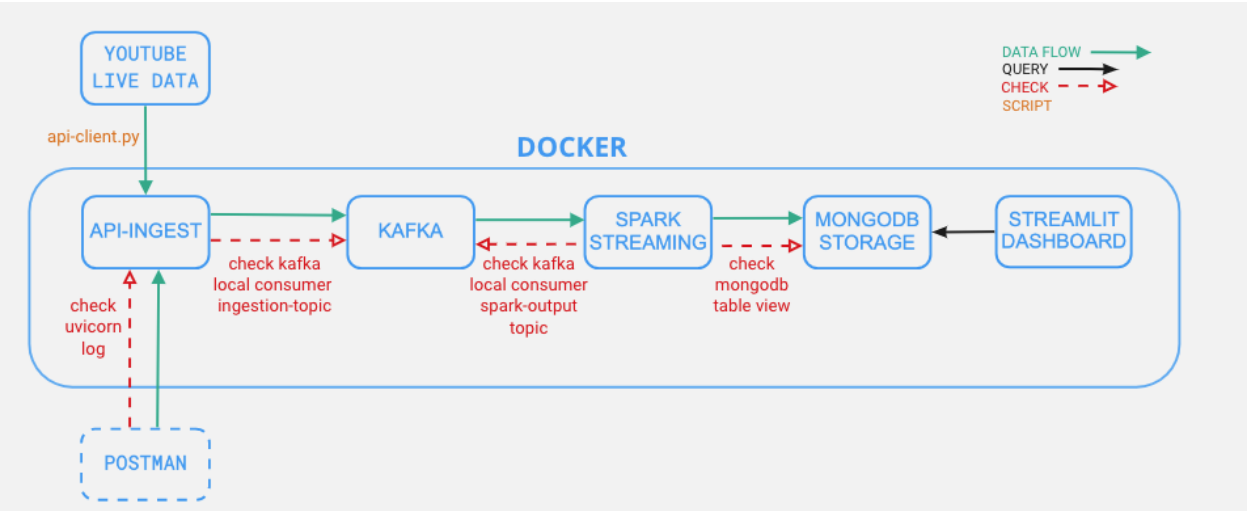
<u>Sample Data:</u>

{"video_id": "5XWEVoI40sE",
"title": "THE INSIDE OUTTAKES - Bo Burnham (4K)",
"publish_time": "2022-05- 31T00:55:11Z",
"channel_title": "UC81hVmI5eEBIt3s3HQpJd_w",
"channelTitle": "boburnham",
"category_id": 23,
"trending_date":"22.01.06",
"views": 2235673,
"likes": 0,
"dislikes": 0,
"comment_count":14033}

<u>Column Names and Data types:</u>

video_id: str
trending_date: str
title: str
channel_title: str
category_id: int
publish_time: str
views: int
likes: int
dislikes: int
comment_count: int

Pipeline Schema



The application uses simple API to ingest YouTube trending video data, then use Kafka, Apache Spark and MongoDB for storage to create a streaming pipeline and Streamlit is utilized for viewing and creating dashboards.

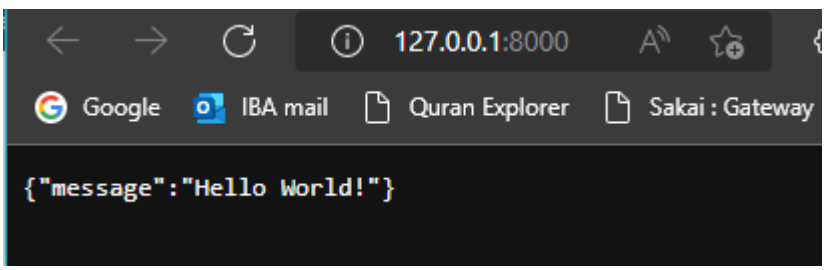
API Preparation

- Import the conda yaml file to have the required environment needed for this application.
- 2 methods are created.
    - GET: display message to ensure API is running
    - POST: convert trending data column to a standard date and post the record as a json string to Kafka

  Go to my-document-streaming-project-main\API-Ingest\app
- In the conda terminal, run
  `uvicorn main:app --reload`

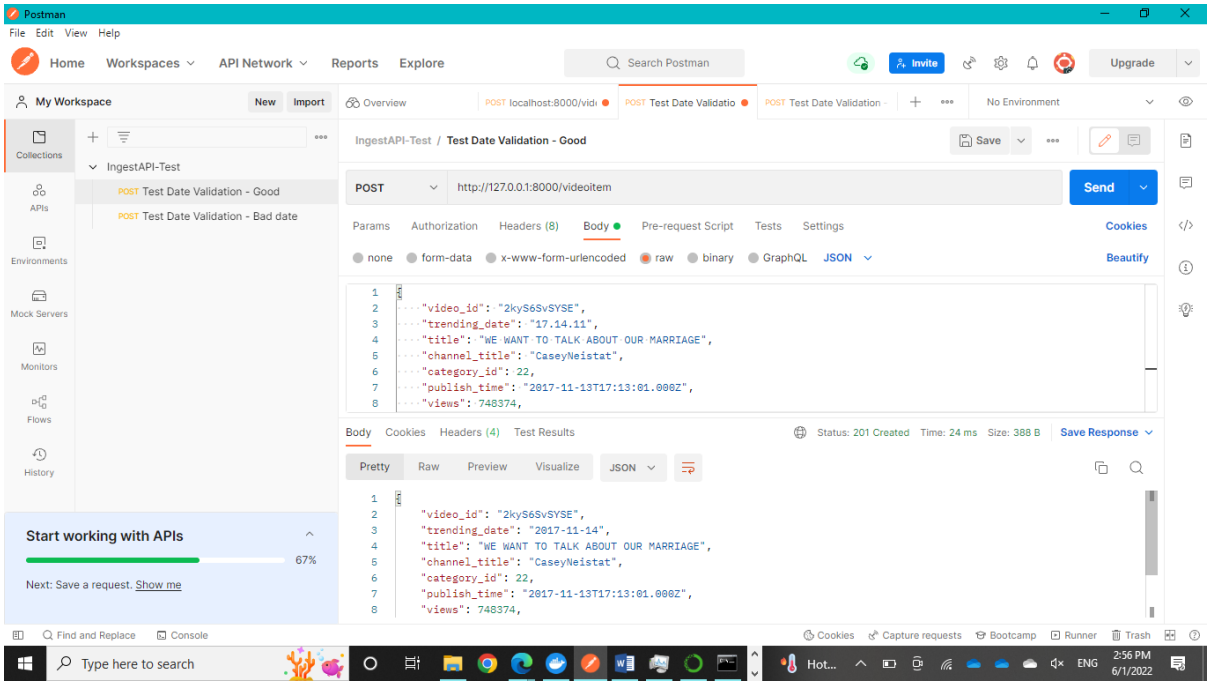
```
(bda) E:\IBA - MBA 2022\MBA - IV Spring 2022\Big Data Analytics\Project\my-document-streaming-project-main\my-document-s
treaming-project-main\API-Ingest\app>uvicorn main:app --reload
←[32mINFO←[0m:     Will watch for changes in these directories: ['E:\\IBA - MBA 2022\\MBA - IV Spring 2022\\Big Data Ana
lytics\\Project\\my-document-streaming-project-main\\my-document-streaming-project-main\\API-Ingest\\app']
←[32mINFO←[0m:     Uvicorn running on ←[1mhttp://127.0.0.1:8000←[0m (Press CTRL+C to quit)
←[32mINFO←[0m:     Started reloader process [←[36m←[1m36084←[0m] using ←[36m←[1mwatchgod←[0m
←[33mWARNING←[0m:  The --reload flag should not be used in production on Windows.
←[32mINFO←[0m:     Started server process [←[36m36044←[0m]
←[32mINFO←[0m:     Waiting for application startup.
←[32mINFO←[0m:     Application startup complete.
```

At http://127.0.0.1:8000 , the following page should be visible.



Testing with Postman

- Launch Postman
- Import my-document-streaming-project/API-Ingest/Postman/IngestAPI-Test.postman_collection.json



- Ensure that line 64 in \API-Ingest\app\main.py is commented out for testing with test data. The request should be received.

```
Message received
Found the first timestamp:  2017-11-14 00:00:00
New trending date: 2017-11-14
{"video_id": "2kyS6SvSYSE", "trending_date": "2017-11-14", "title": "WE WANT TO TALK ABOUT OUR MARRIAGE", "channel_title": "CaseyNeistat", "category_id": 22, "publish_t
ime": "2017-11-13T17:13:01.000Z", "views": 748374, "likes": 57527, "dislikes": 2966, "comment_count": 15954}
←[32mINFO←[0m:     127.0.0.1:54276 - "←[1mPOST /videoitem HTTP/1.1←[0m" ←[32m201 Created←[0m
```

Kafka Container

RUN in a terminal

```
docker-compose -f docker-compose-kafka.yml up
```

Setting Kafka Topics

In the kafka terminal, execute

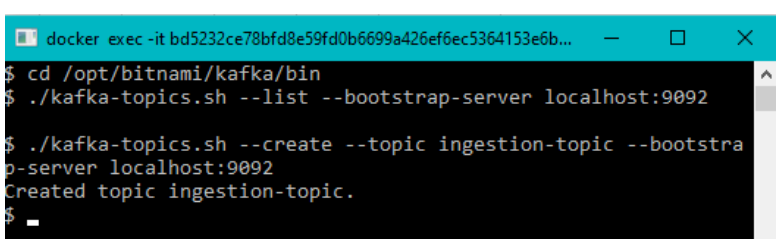
```
cd /opt/bitnami/kafka/bin
```

look for existing topics

```
./kafka-topics.sh --list --bootstrap-server localhost:9092
```

Create the ingestion topic

```
./kafka-topics.sh --create --topic ingestion-topic --bootstrap-server
localhost:9092
```



Local Consumer

Create Local Consumer

In the kafka terminal:

```
./kafka-console-consumer.sh --topic ingestion-topic --bootstrap-server
localhost:9092
```

Meanwhile, uncomment line 64 in main.py and switch `boostrap_servers='localhost:9093'`

Test with Postman: send the same record and see if both Postman and local consumer receive it successfully

```
docker exec -it bd5232ce78bfd8e59fd0b6699a426ef6ec5364153e6b3798b9f628e376a1738d /bin/sh
$ cd /opt/bitnami/kafka/bin
$ ./kafka-topics.sh --list --bootstrap-server localhost:9092

$ ./kafka-topics.sh --create --topic ingestion-topic --bootstrap-server localhost:9092
Created topic ingestion-topic.
$ ./kafka-console-consumer.sh --topic ingestion-topic --bootstrap-server localhost:9092
{"video_id": "2kyS6SvSYSE", "trending_date": "2017-11-14", "title": "WE WANT TO TALK ABOUT OUR MARRIAGE", "channel_title": "CaseyNeistat", "category_id": 22, "publish_t
ime": "2017-11-13T17:13:01.000Z", "views": 748374, "likes": 57527, "dislikes": 2966, "comment_count": 15954}
```

Connecting with Kafka

With test passed, change bootstrap_servers='kafka:9092' in main.py as we are moving from external to client

Create an image for API app, use dockerfile and requirements, run

```
docker build -t api-ingest .
```

```
E:\IBA - MBA 2022\MBA - IV Spring 2022\Big Data Analytics\Proje
ngest .
[+] Building 20.0s (9/9) FINISHED
 => [internal] load .dockerignore                          2.1s
 => => transferring context: 2B                            0.3s
 => [internal] load build definition from Dockerf          2.5s
 => => transferring dockerfile: 32B                        0.3s
 => [internal] load metadata for docker.io/tiango          9.0s
 => [internal] load build context                          0.5s
 => => transferring context: 4.85kB                        0.1s
 => [1/4] FROM docker.io/tiangolo/uvicorn-gunicor          0.0s
 => CACHED [2/4] COPY requirements.txt /tmp/               0.0s
 => CACHED [3/4] RUN pip install --no-cache-dir -          0.0s
 => [4/4] COPY ./app /app                                  2.6s
 => exporting to image                                     4.5s
 => => exporting layers                                    1.9s
 => => writing image sha256:cd1a0677ecf0c94f3340d          0.1s
 => => naming to docker.io/library/api-ingest              0.2s
```

Deploy API

Start Kafka, find the name of network with the container

```
docker run --rm --network my-document-streaming-project-main_default -
-name my-api-ingest -p 81:80 api-ingest
```

```
#! /usr/bin/env bash

# Let the DB start
sleep 10;
# Run migrations
alembic upgrade head

[2022-06-01 10:26:39 +0000] [1] [INFO] Starting gunicorn 20.1.0
[2022-06-01 10:26:39 +0000] [1] [INFO] Listening at: http://0.0.0.0:80 (1)
[2022-06-01 10:26:39 +0000] [1] [INFO] Using worker: uvicorn.workers.Uvico
rnWorker
[2022-06-01 10:26:39 +0000] [9] [INFO] Booting worker with pid: 9
[2022-06-01 10:26:39 +0000] [10] [INFO] Booting worker with pid: 10
[2022-06-01 10:26:39 +0000] [11] [INFO] Booting worker with pid: 11
[2022-06-01 10:26:39 +0000] [12] [INFO] Booting worker with pid: 12
[2022-06-01 10:26:45 +0000] [11] [INFO] Started server process [11]
[2022-06-01 10:26:45 +0000] [10] [INFO] Started server process [10]
[2022-06-01 10:26:45 +0000] [12] [INFO] Started server process [12]
[2022-06-01 10:26:45 +0000] [10] [INFO] Waiting for application startup.
[2022-06-01 10:26:45 +0000] [12] [INFO] Waiting for application startup.
[2022-06-01 10:26:45 +0000] [11] [INFO] Waiting for application startup.
[2022-06-01 10:26:45 +0000] [9] [INFO] Started server process [9]
[2022-06-01 10:26:45 +0000] [9] [INFO] Waiting for application startup.
[2022-06-01 10:26:45 +0000] [9] [INFO] Application startup complete.
[2022-06-01 10:26:45 +0000] [11] [INFO] Application startup complete.
[2022-06-01 10:26:45 +0000] [12] [INFO] Application startup complete.
[2022-06-01 10:26:45 +0000] [10] [INFO] Application startup complete.
```

<u>Test API container with Kafka</u>

Start Local Consumer again

```
./kafka-console-consumer.sh --topic ingestion-topic --bootstrap-server
localhost:9092
```

Change port number to 81, and send record

IngestAPI-Test / **Test Date Validation - Good**

POST http://127.0.0.1:81/videoitem

Params Authorization Headers (8) Body Pre-request Script Tests Settings

none form-data x-www-form-urlencoded raw binary GraphQL JSON

```
{
    "video_id": "2kyS6SvSYSE",
    "trending_date": "17.14.11",
    "title": "WE WANT TO TALK ABOUT OUR MARRIAGE",
    "channel_title": "CaseyNeistat",
    "category_id": 22,
    "publish_time": "2017-11-13T17:13:01.000Z",
    "views": 748374,
```

Body Cookies Headers (4) Test Results Status: 201 Created Tir

Pretty Raw Preview Visualize JSON

```
{
    "video_id": "2kyS6SvSYSE",
    "trending_date": "2017-11-14",
    "title": "WE WANT TO TALK ABOUT OUR MARRIAGE",
    "channel_title": "CaseyNeistat",
    "category_id": 22,
    "publish_time": "2017-11-13T17:13:01.000Z",
    "views": 748374,
```

```
Message received
Found the first timestamp:  2017-11-14 00:00:00
New trending date: 2017-11-14
{"video_id": "2kyS6SvSYSE", "trending_date": "2017-11-14", "title": "WE WA
NT TO TALK ABOUT OUR MARRIAGE", "channel_title": "CaseyNeistat", "category
_id": 22, "publish_time": "2017-11-13T17:13:01.000Z", "views": 748374, "li
kes": 57527, "dislikes": 2966, "comment_count": 15954}
172.18.0.1:57356 - "POST /videoitem HTTP/1.1" 201
```

```
$ ./kafka-console-consumer.sh --topic ingestion-topic --bootstrap-server localhost:9092
{"video_id": "2kyS6SvSYSE", "trending_date": "2017-11-14", "title": "WE WANT TO TALK ABOUT OUR MARRIAGE", "channel_title": "CaseyNeistat", "category_id": 22, "publish_t
ime": "2017-11-13T17:13:01.000Z", "views": 748374, "likes": 57527, "dislikes": 2966, "comment_count": 15954}
```

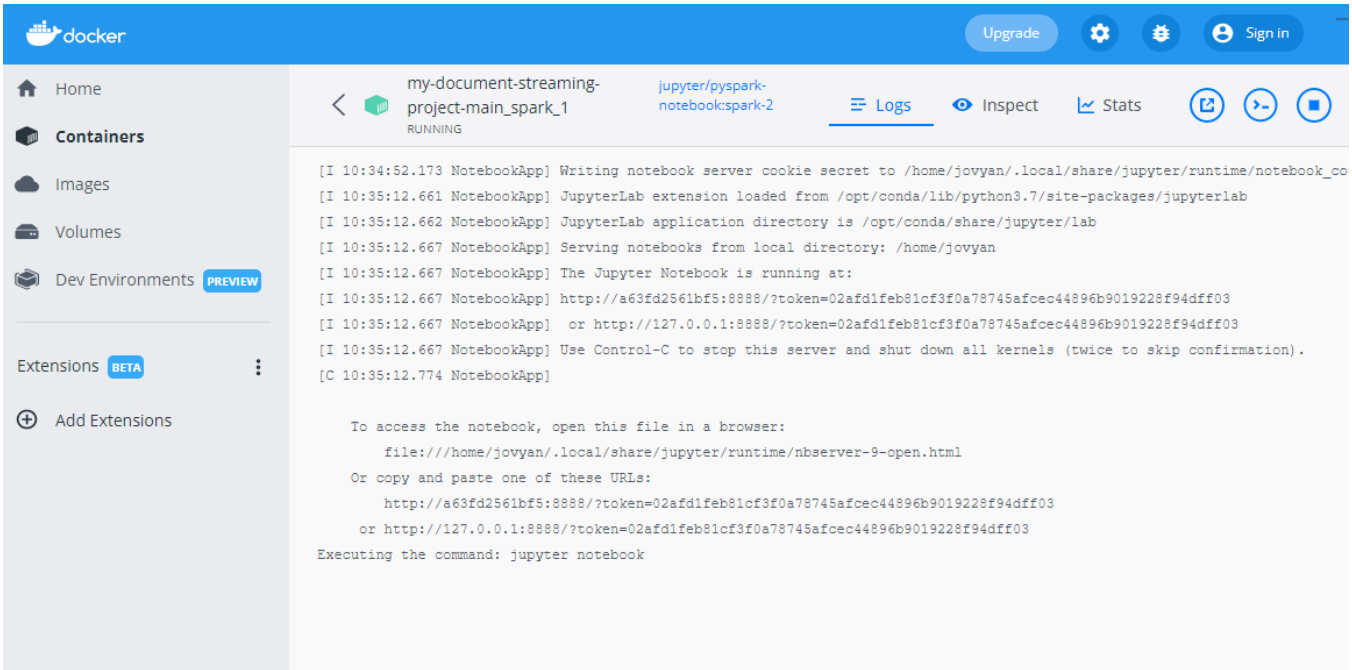
Both consumer and postman receive same message successfully.

Stop Container.

Apache Spark

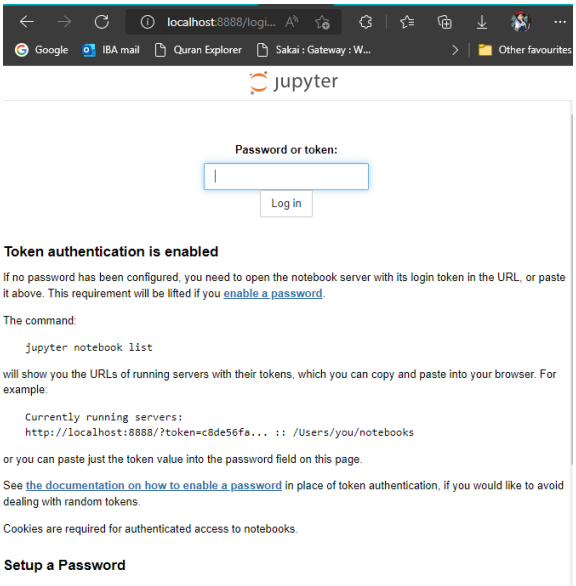
```
docker-compose -f docker-compose-kafka-spark.yml up
```

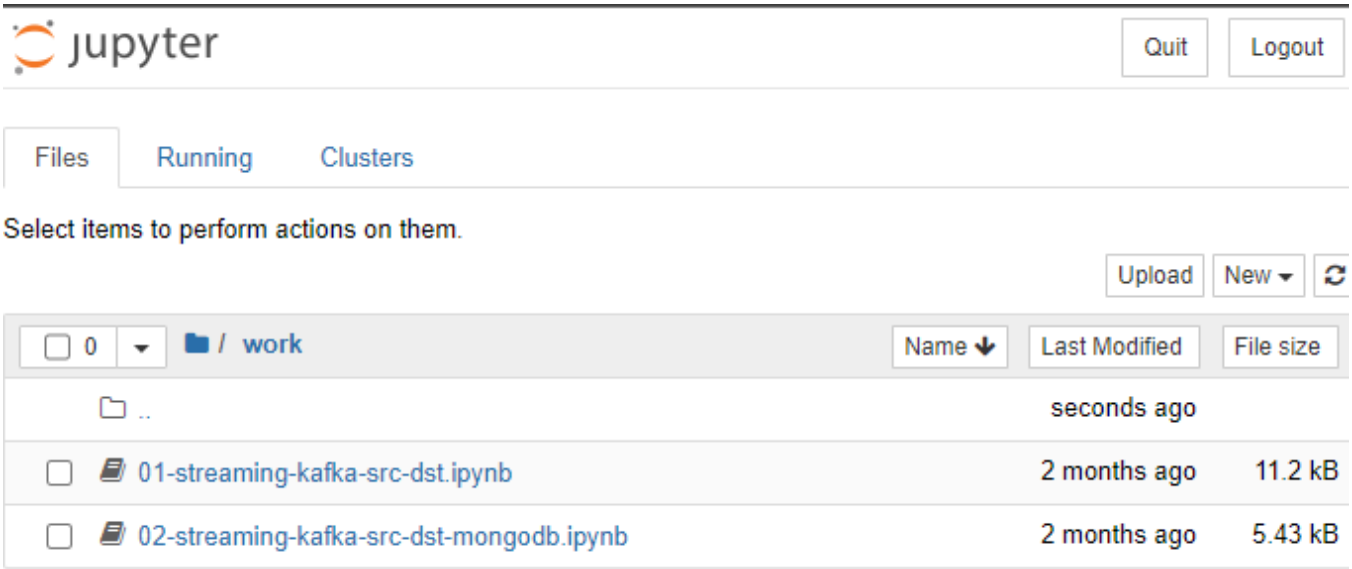
Once the container is running, go to *view logs* to get the token



token=02afd1feb81cf3f0a78745afcec44896b9019228f94dff03

Go to *localhost:8888* to enter the token and open jupyter notebook (this was configured in the docker compose yaml file), you should see 2 notebooks there already





Spark Streaming

Using python notebooks, a spark session will be set which will listen to messages from Kafka on one topic and receive it then send back to Kafka using a second topic – spark-output for testing.

- Create a new topic *spark-output*: `./kafka-topics.sh --create --topic spark-output --bootstrap-server localhost:9092`
- Check to see if both topics are there: `./kafka-topics.sh --list --bootstrap-server localhost:9092`

  Create a local consumer: `./kafka-console-consumer.sh --topic spark-output --bootstrap-server localhost:9092`

```
$ cd /opt/bitnami/kafka/bin
$ ./kafka-topics.sh --create --topic spark-output --bootstrap-server loc
alhost:9092
Created topic spark-output.
$ ./kafka-topics.sh --list --bootstrap-server localhost:9092
spark-output
$ ./kafka-topics.sh --create --topic ingestion-topic --bootstrap-server
localhost:9092
Created topic ingestion-topic.
$ ./kafka-topics.sh --list --bootstrap-server localhost:9092
ingestion-topic
spark-output
$
```

- Execute the notebook then go to Postman and send the same record again
- The message should appear in local consumer and you should see the confirmation in the terminal

```
$ ./kafka-console-consumer.sh --topic spark-output --bootstrap-server localhost:9092
{"video_id": "2kyS6SvSYSE", "trending_date": "2017-11-14", "title": "WE WANT TO TALK ABOUT OUR MARRIAGE", "channel_title": "CaseyNeistat", "category_id": 22, "publish_time": "2017-11-13T17:13:01.000Z", "views": 748374, "likes": 57527, "dislikes": 2966, "comment_count": 15954}
```

POST http://127.0.0.1:81/videoitem

Params Authorization Headers (8) Body Pre-request Script Tests Settir

none form-data x-www-form-urlencoded raw binary GraphQL J

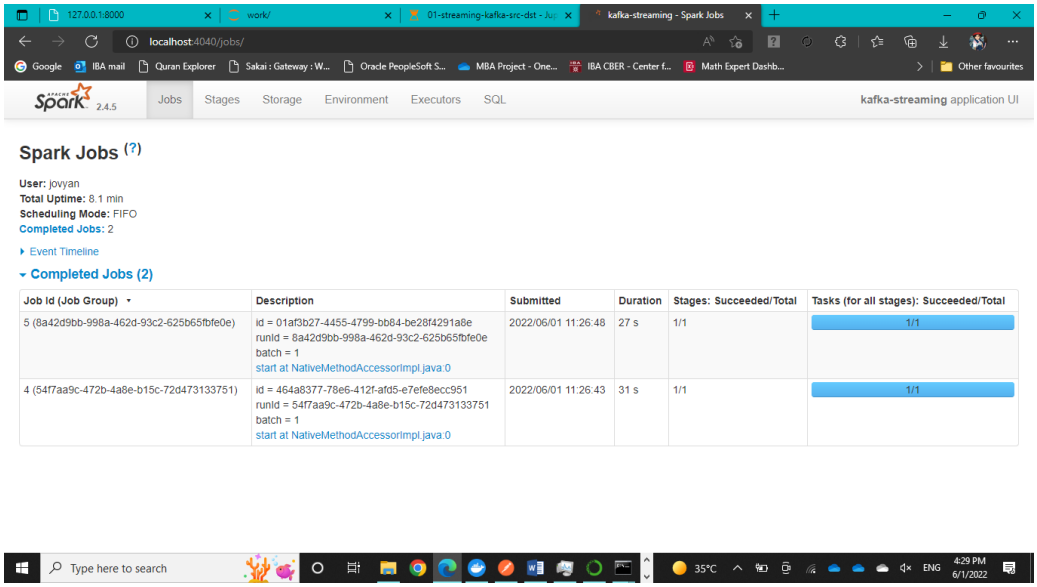
```
1 {
2     "video_id": "2kyS6SvSYSE",
3     "trending_date": "17.14.11",
4     "title": "WE WANT TO TALK ABOUT OUR MARRIAGE",
5     "channel_title": "CaseyNeistat",
6     "category_id": 22,
7     "publish_time": "2017-11-13T17:13:01.000Z",
8     "views": 748374,
```

Body Cookies Headers (4) Test Results St

Pretty Raw Preview Visualize JSON

```
1 {
2     "video_id": "2kyS6SvSYSE",
3     "trending_date": "2017-11-14",
4     "title": "WE WANT TO TALK ABOUT OUR MARRIAGE",
5     "channel_title": "CaseyNeistat",
6     "category_id": 22,
7     "publish_time": "2017-11-13T17:13:01.000Z",
8     "views": 748374,
```

- You can also check out the Spark cluster interface at *localhost:4040*

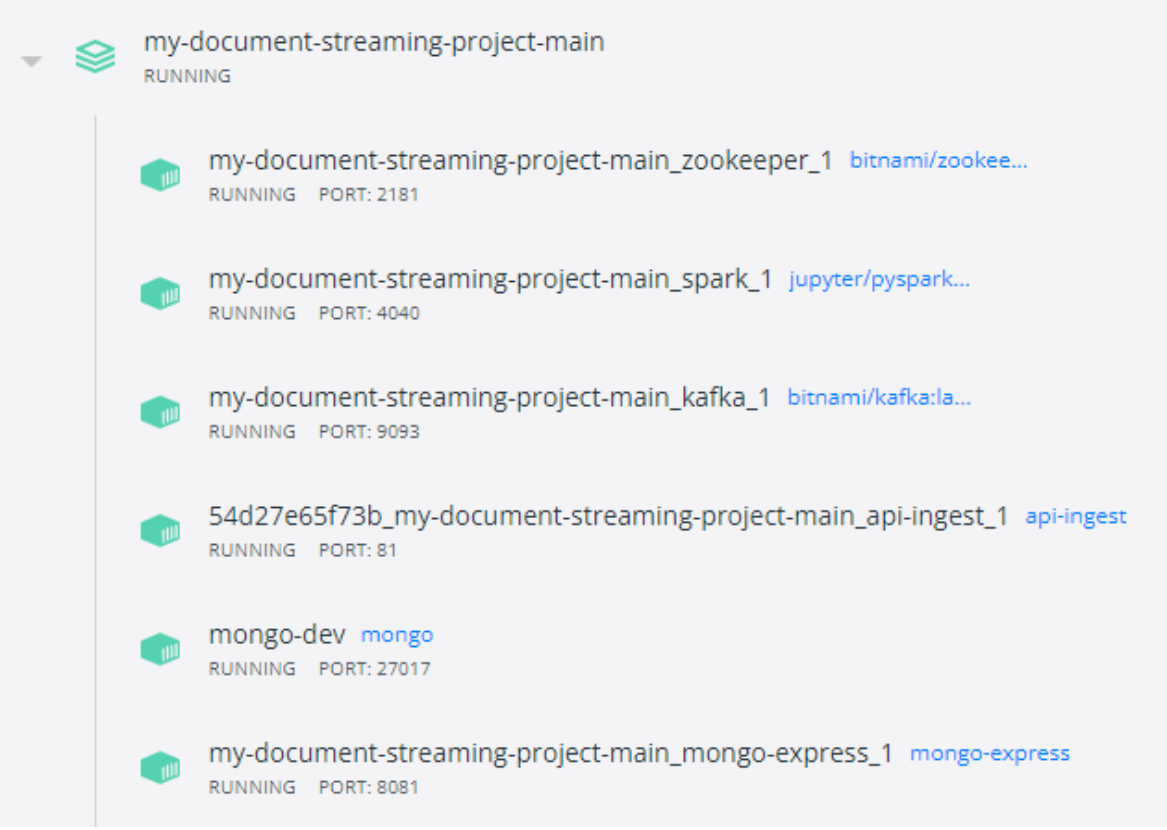


- Stop the container

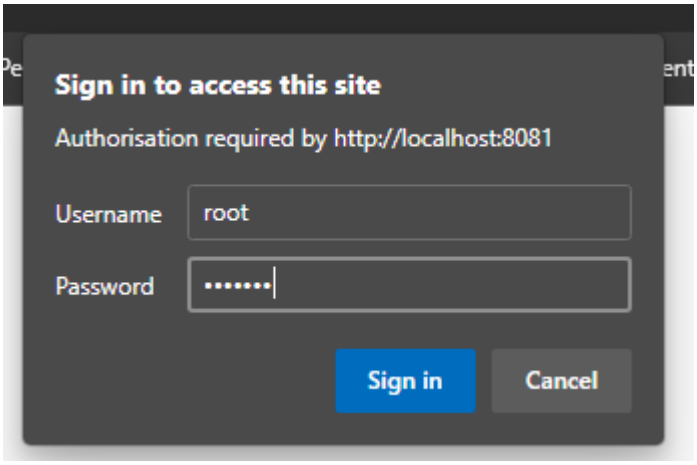
MongoDB

It is essential to store the data and query it. For this project, I have chosen MongoDB.

```
docker-compose -f docker-compose-kafka-spark-mongodb.yml up
```

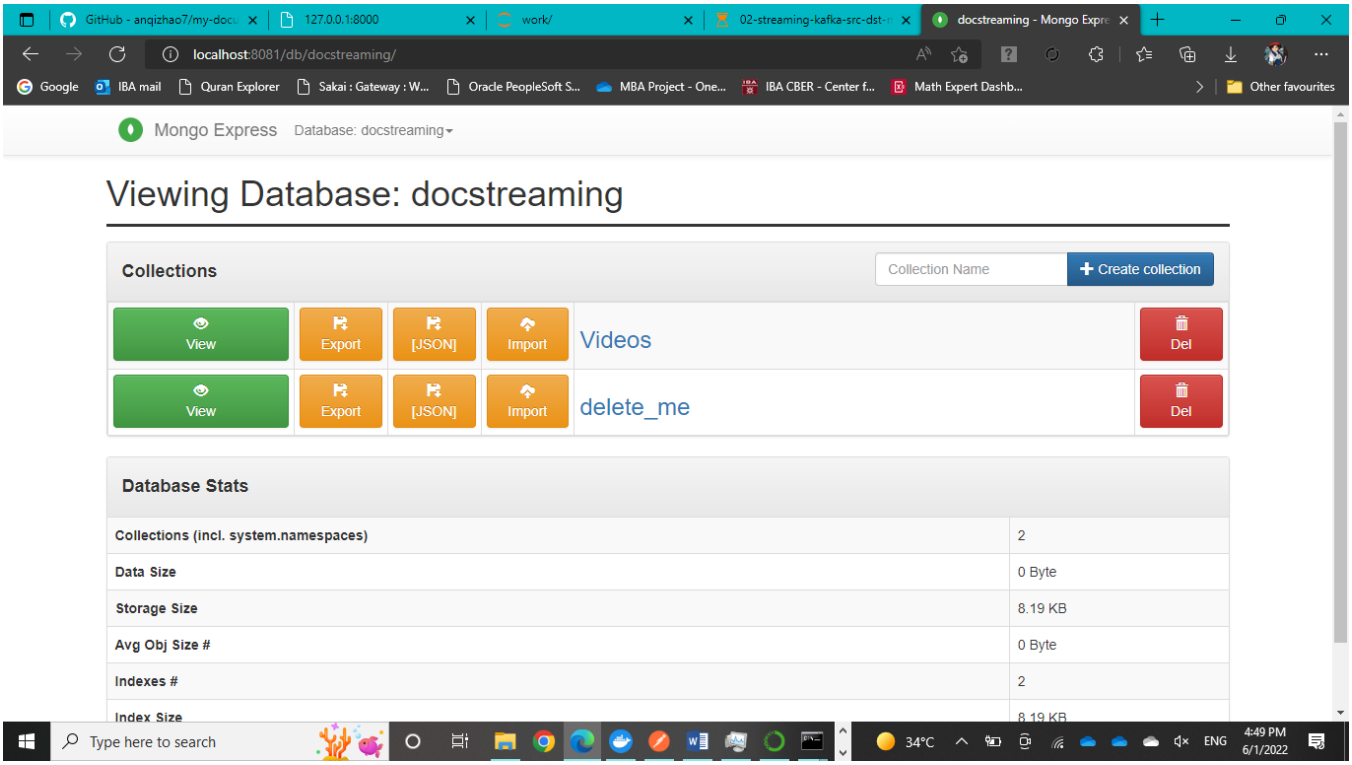


Go to localhost:8081



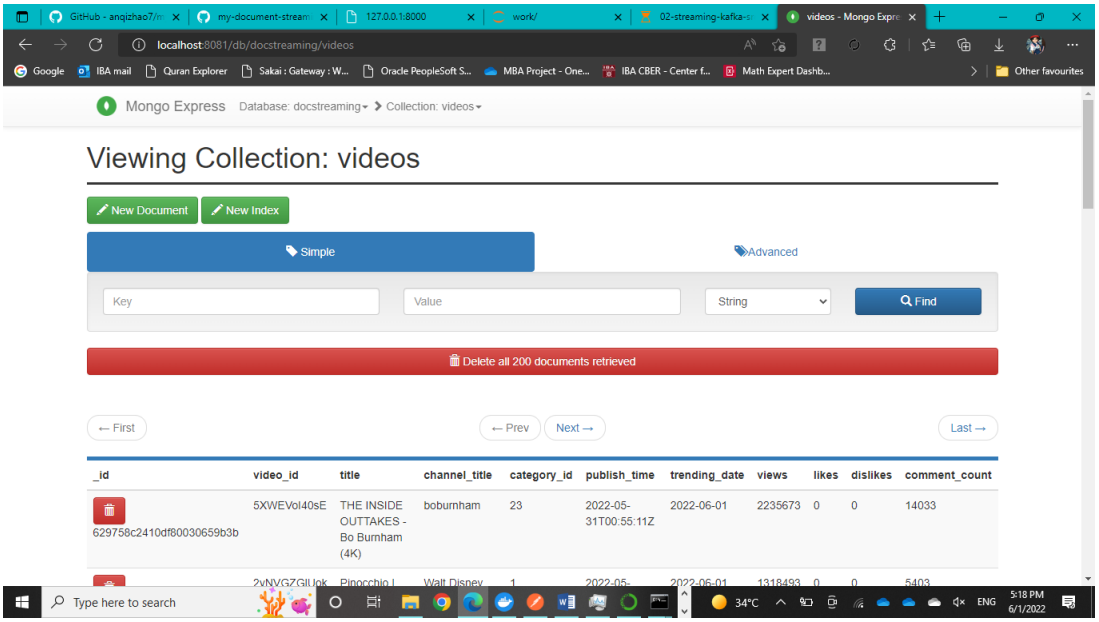
Username: admin P/w: tribes

Create a DB called docstreaming and create a collection *videos* to store all the records from Spark streaming



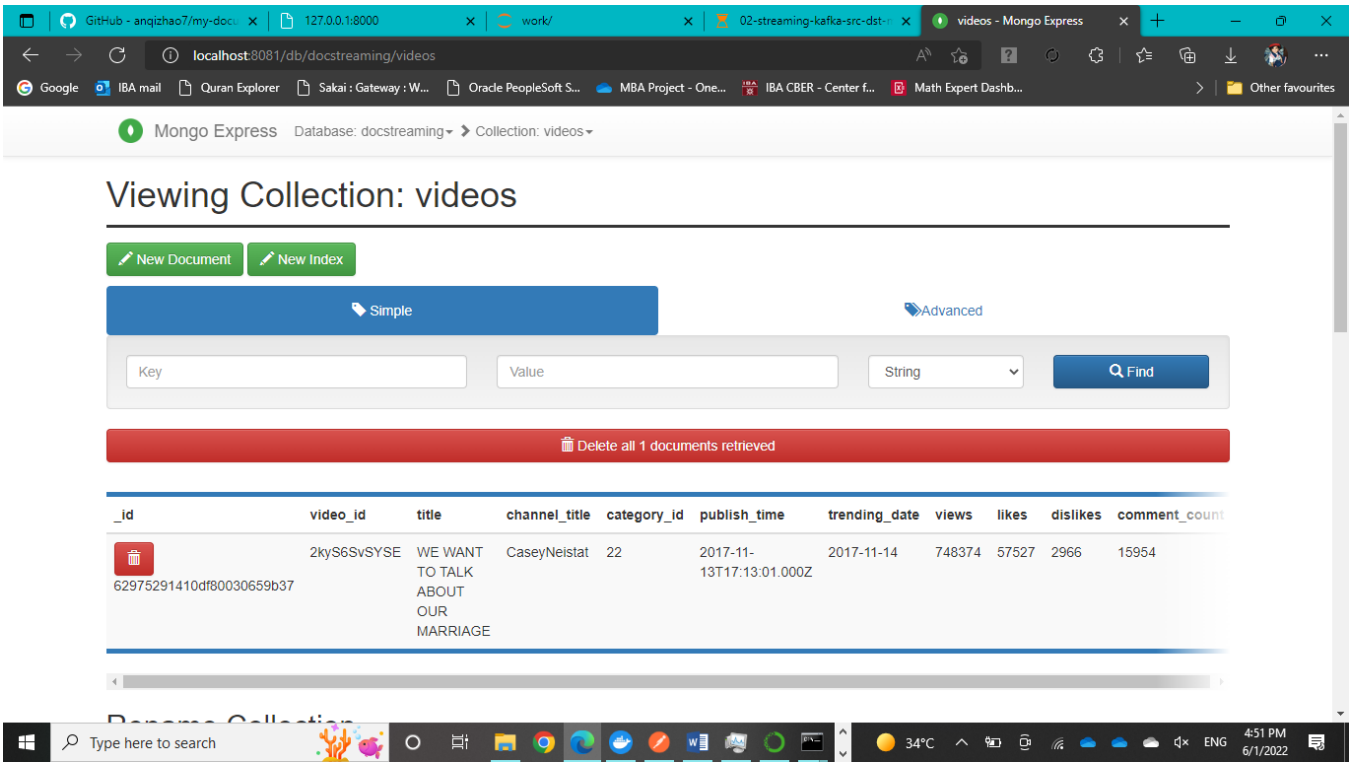
Connect Spark to MongoDB

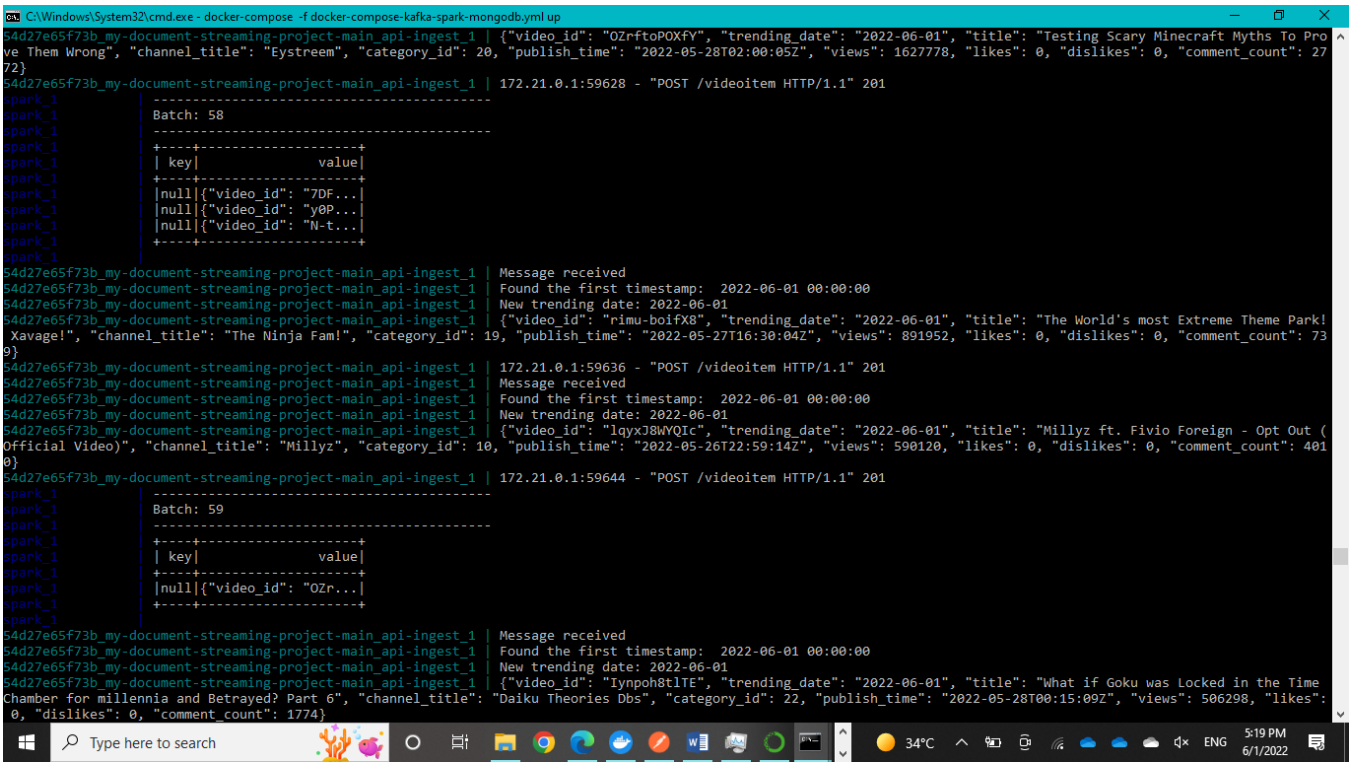
- Go to 02-streaming-kafka-src-dst-mongodb.ipynb
- Note code block 6 adds a dataframe transformation to set the output table in MongoDB
- Execute the notebook then go to Postman and post a record. Check to see that it appeared in the MongoDB collection properly

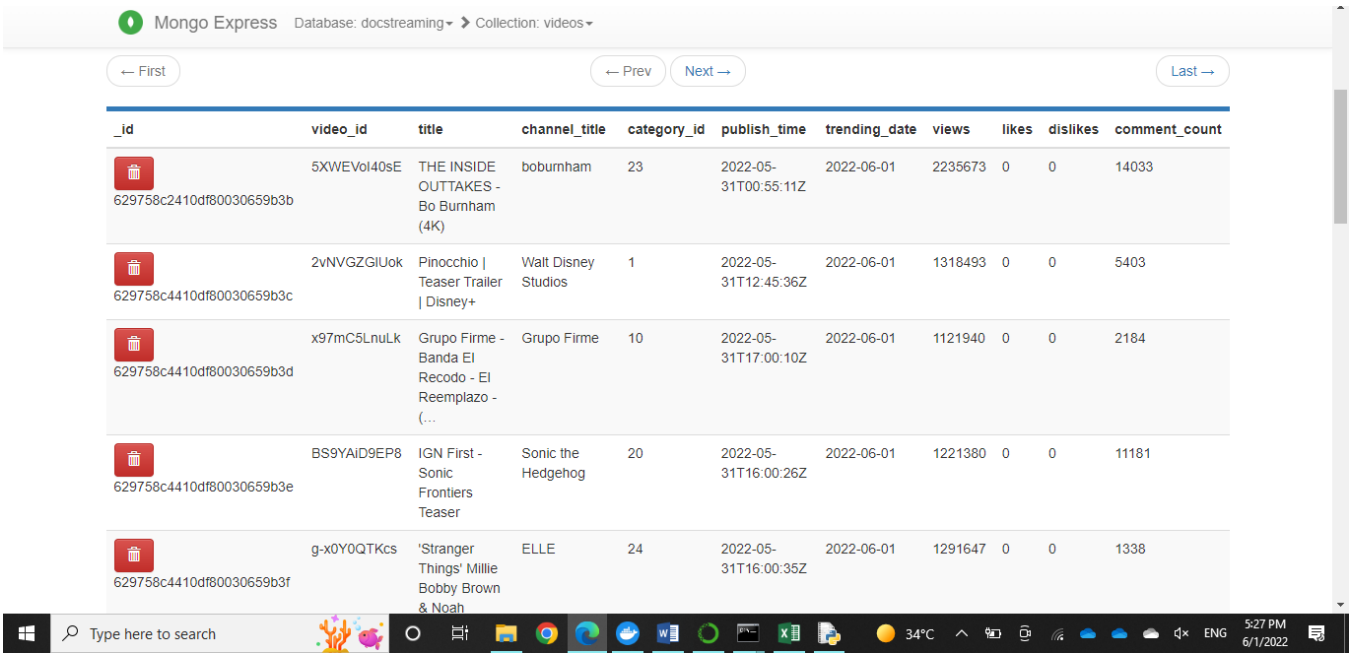


API Client Writes Data

- Clean up MongoDB table if you sent test record earlier
- Use api-client.py to send the most recent trending video records
- Multiple batches with all the records are stored in MongoDB



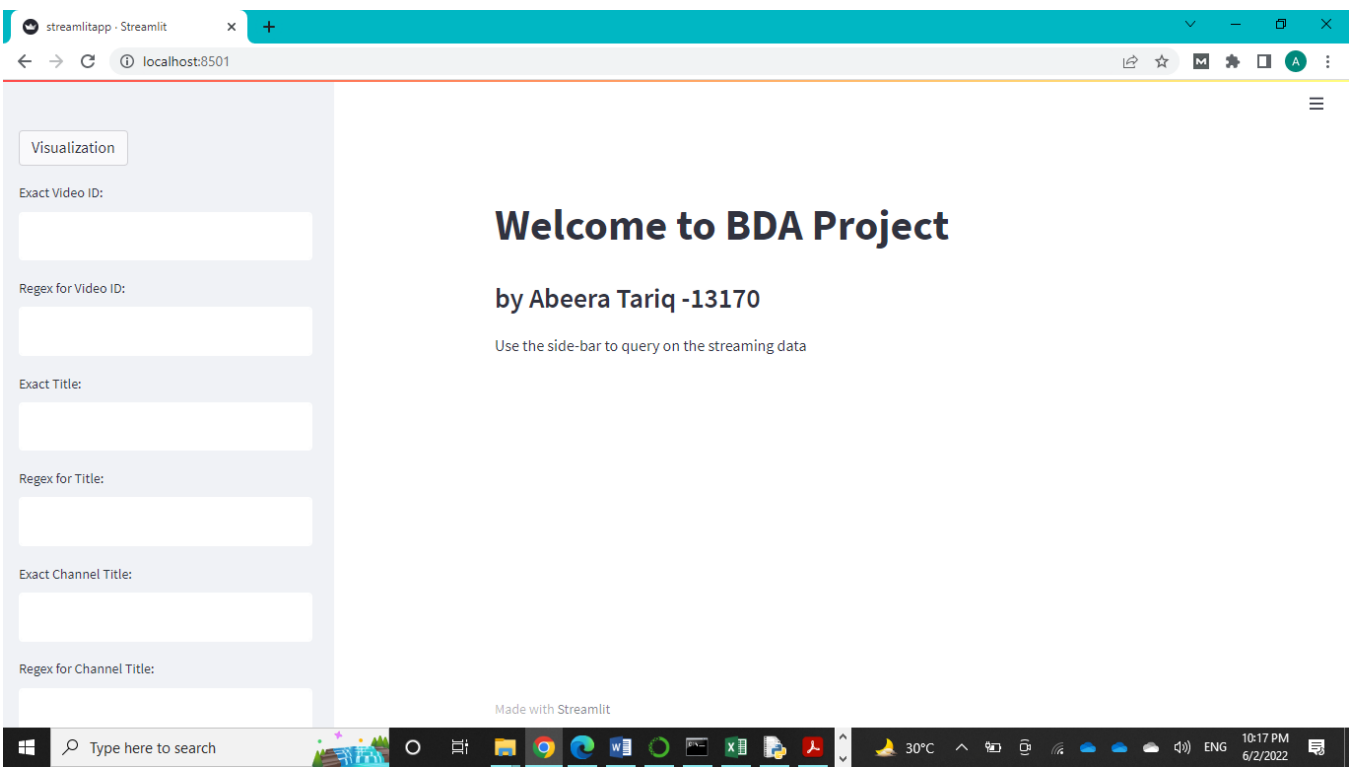




_id	video_id	title	channel_title	category_id	publish_time	trending_date	views	likes	dislikes	comment_count
629758c2410df80030659b3b	5XWEVol40sE	THE INSIDE OUTTAKES - Bo Burnham (4K)	boburnham	23	2022-05-31T00:55:11Z	2022-06-01	2235673	0	0	14033
629758c4410df80030659b3c	2vNVGZGIUok	Pinocchio | Teaser Trailer | Disney+	Walt Disney Studios	1	2022-05-31T12:45:36Z	2022-06-01	1318493	0	0	5403
629758c4410df80030659b3d	x97mC5LnuLk	Grupo Firme - Banda El Recodo - El Reemplazo - (...	Grupo Firme	10	2022-05-31T17:00:10Z	2022-06-01	1121940	0	0	2184
629758c4410df80030659b3e	BS9YAiD9EP8	IGN First - Sonic Frontiers Teaser	Sonic the Hedgehog	20	2022-05-31T16:00:26Z	2022-06-01	1221380	0	0	11181
629758c4410df80030659b3f	g-x0Y0QTKcs	'Stranger Things' Millie Bobby Brown & Noah	ELLE	24	2022-05-31T16:00:35Z	2022-06-01	1291647	0	0	1338

Interface with Streamlit

To visualize the data output in table view and perform real-time analytics.

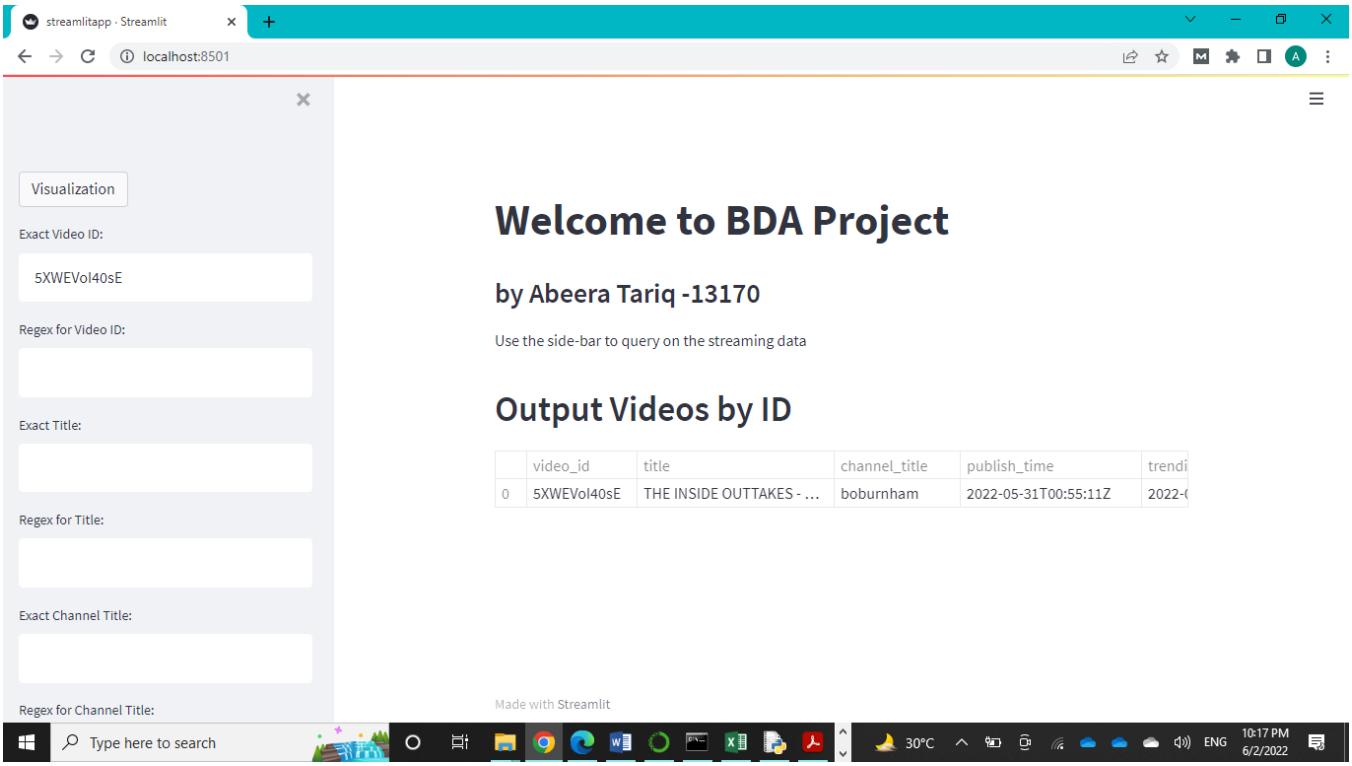


The streamlit app was modified to accept more queries.

Analytical queries were run and executed as follows.

Query by exact Video ID:

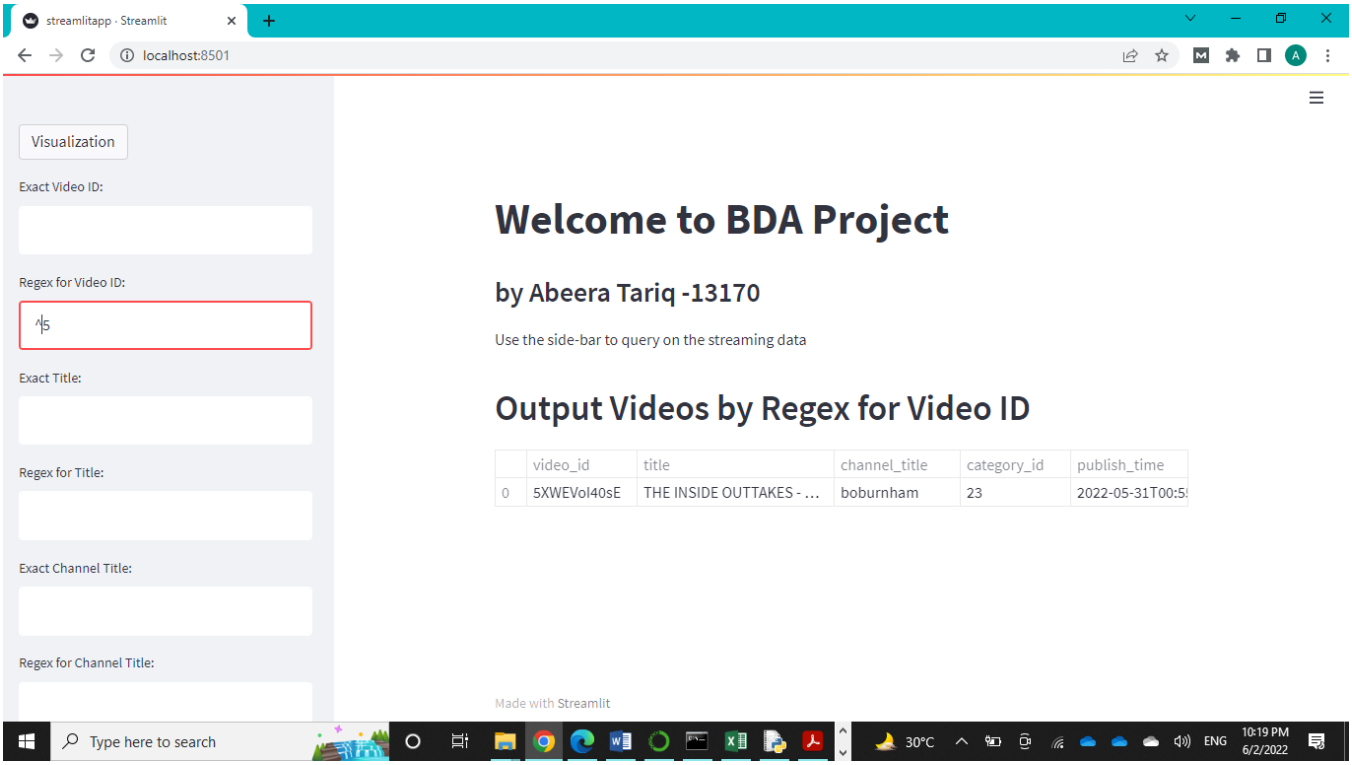
```
if video_id:

    myquery = {"video_id": video_id}
    # only includes or excludes
    mydoc = mycol.find( myquery , { "category_id": 0, "_id": 0})

    # create dataframe from resulting documents to use drop_duplicates
    df = DataFrame(mydoc)

    # drop duplicates, but keep the first one
    df.drop_duplicates(subset ="channel_title", keep = 'first', inplace = True)

    # Add the table with a headline
    st.header("Output Videos by ID")
    table2 = st.dataframe(data=df)
```



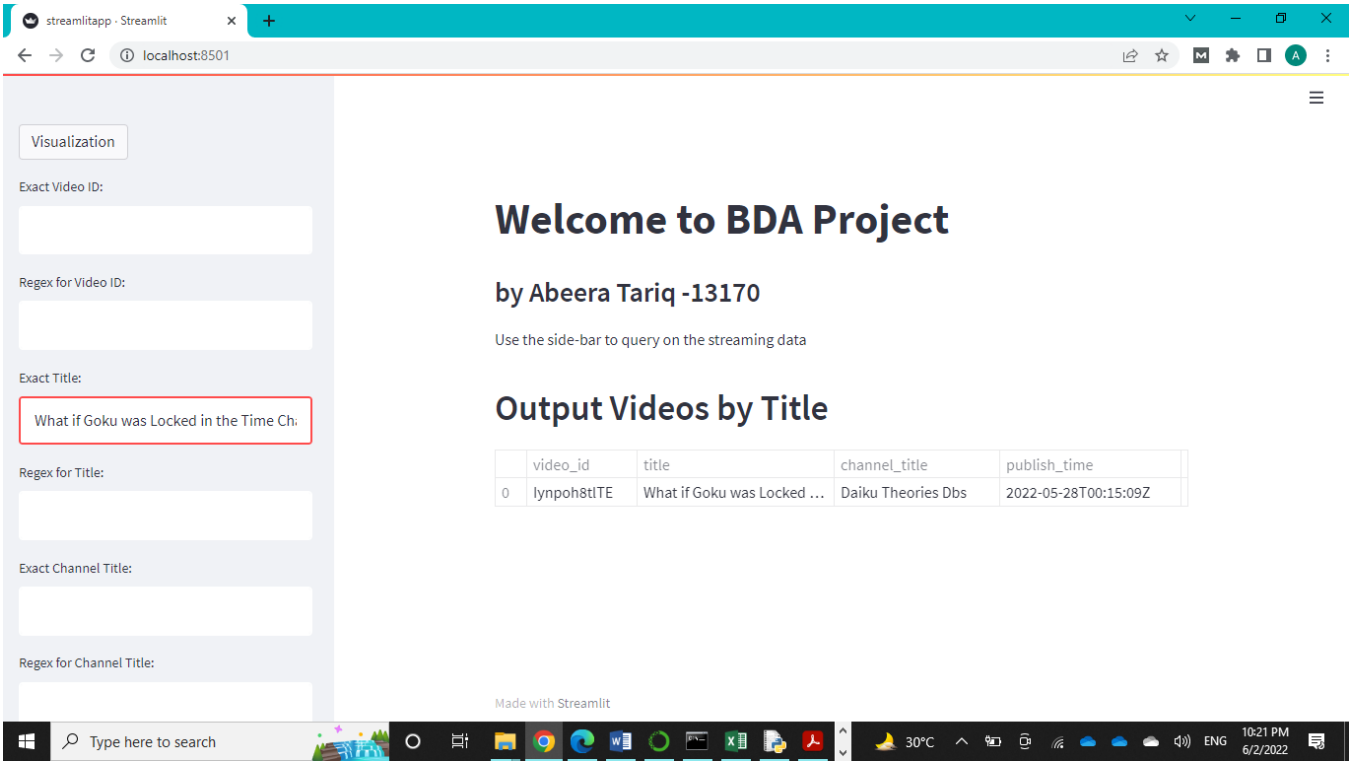
Query by regex:

```
if regex_id:

    myquery = {"video_id": {"$regex": regex_id}}
    # only includes or excludes
    mydoc = mycol.find(myquery, { "_id": 0, "trending_date": 0, "views": 0, "likes": 0, "dislikes": 0, "comment_count": 0 })

    # create dataframe from resulting documents to use drop_duplicates
    df = DataFrame(mydoc)
    print(df)
    # drop duplicates, but keep the first one
    df.drop_duplicates(subset ="video_id", keep = 'first', inplace = True)

    # Add the table with a headline
    st.header("Output Videos by Regex for Video ID")
    table3 = st.dataframe(data=df)
```

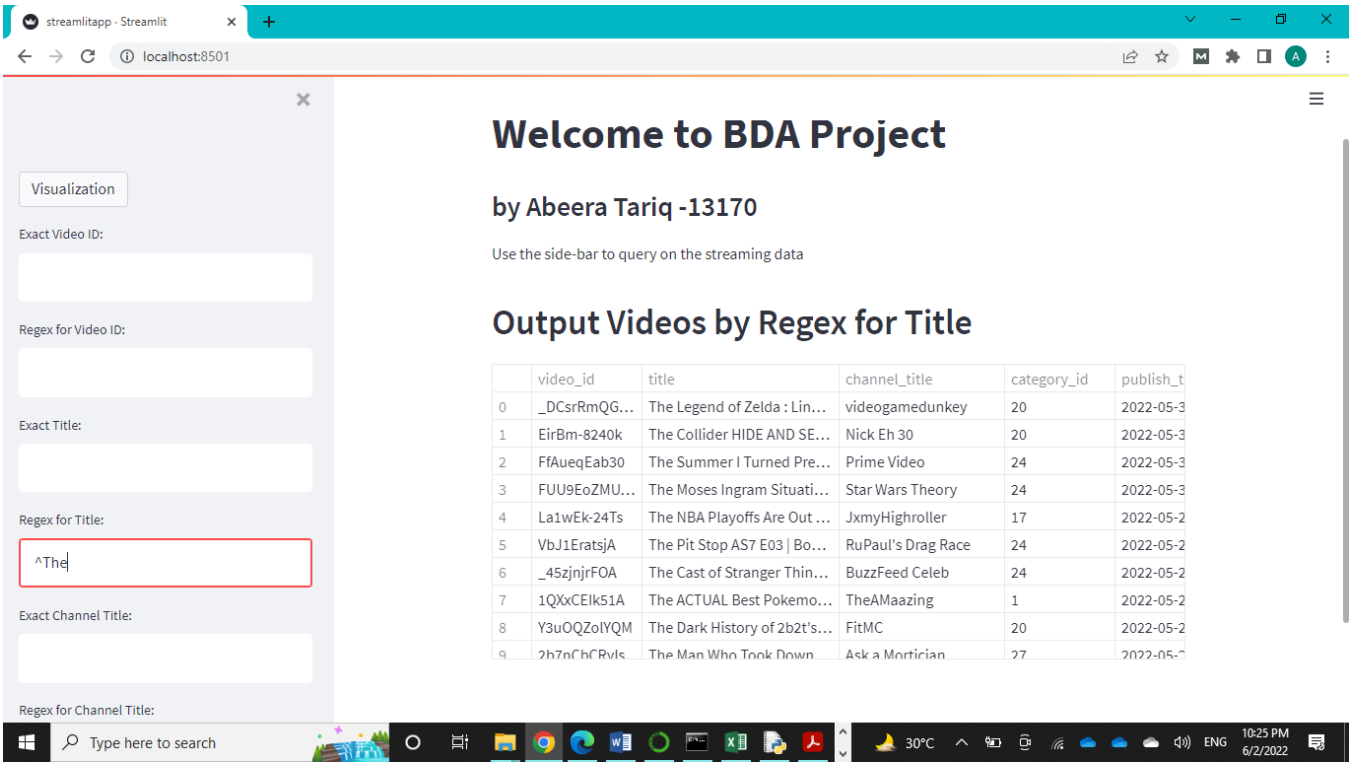
All videos whose id start with 5



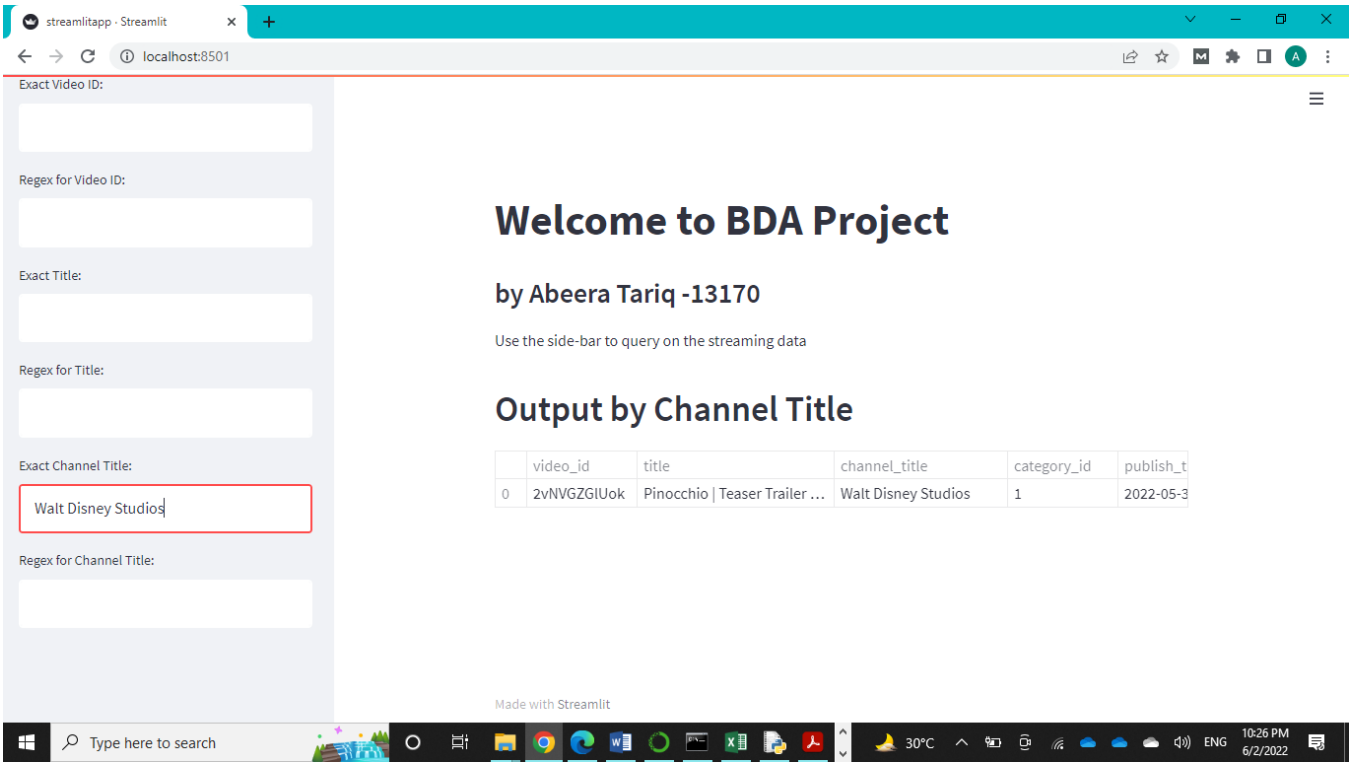
Query by exact title:



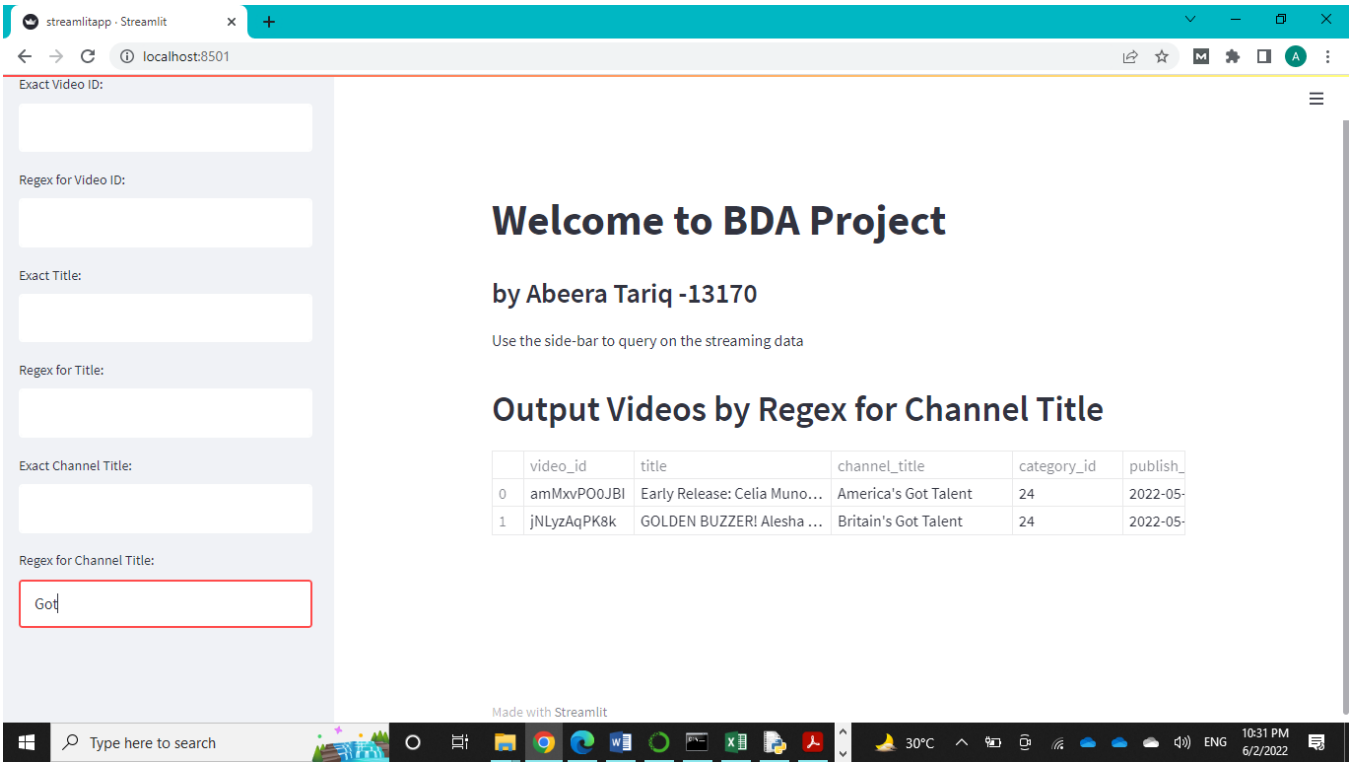
Query by regex for title:



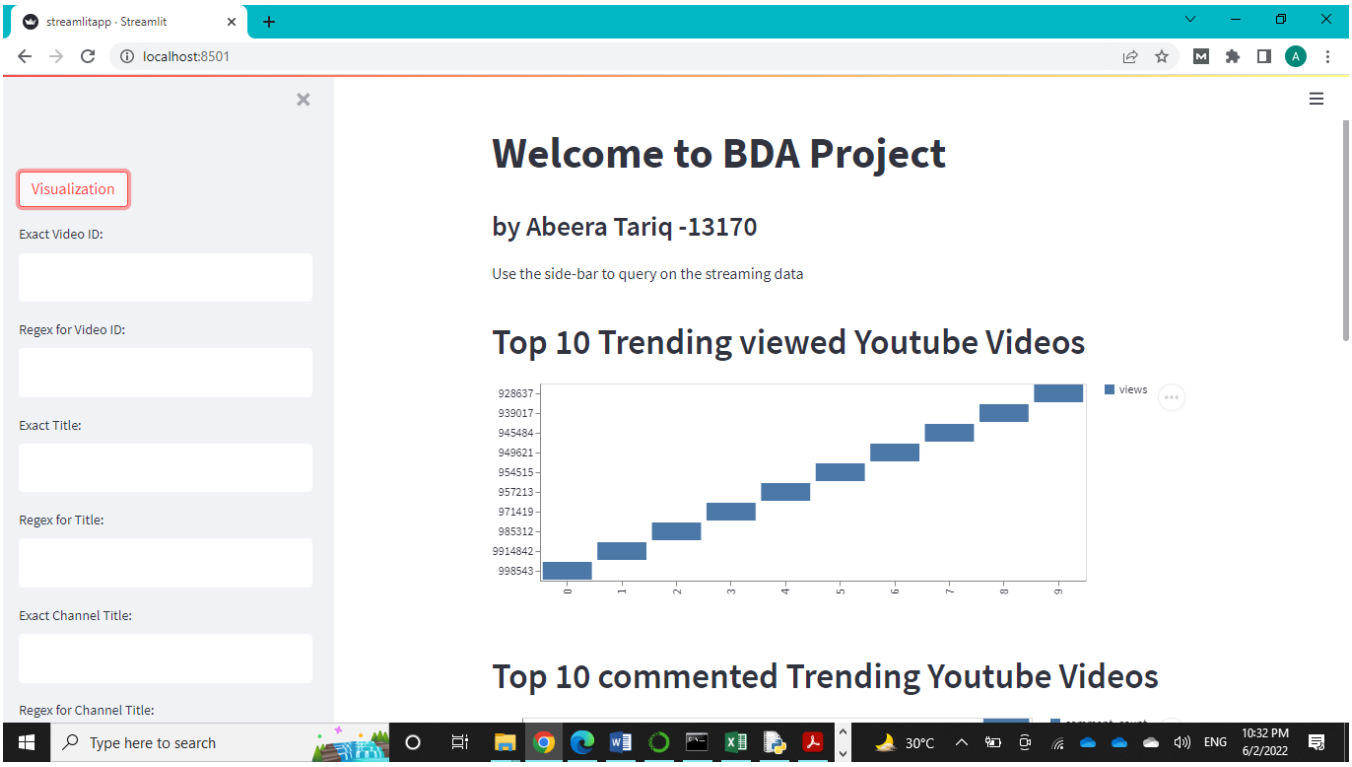
Query by exact Channel:

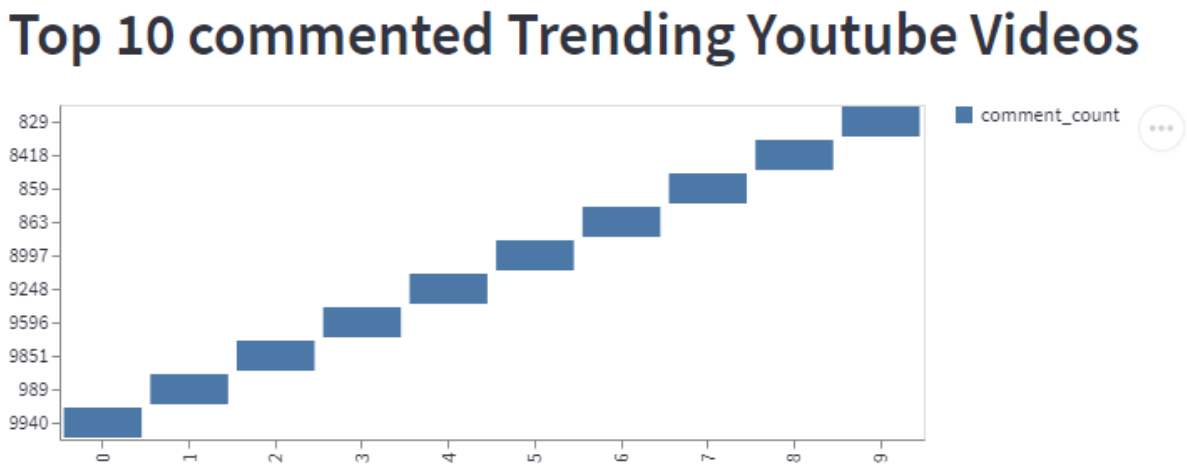


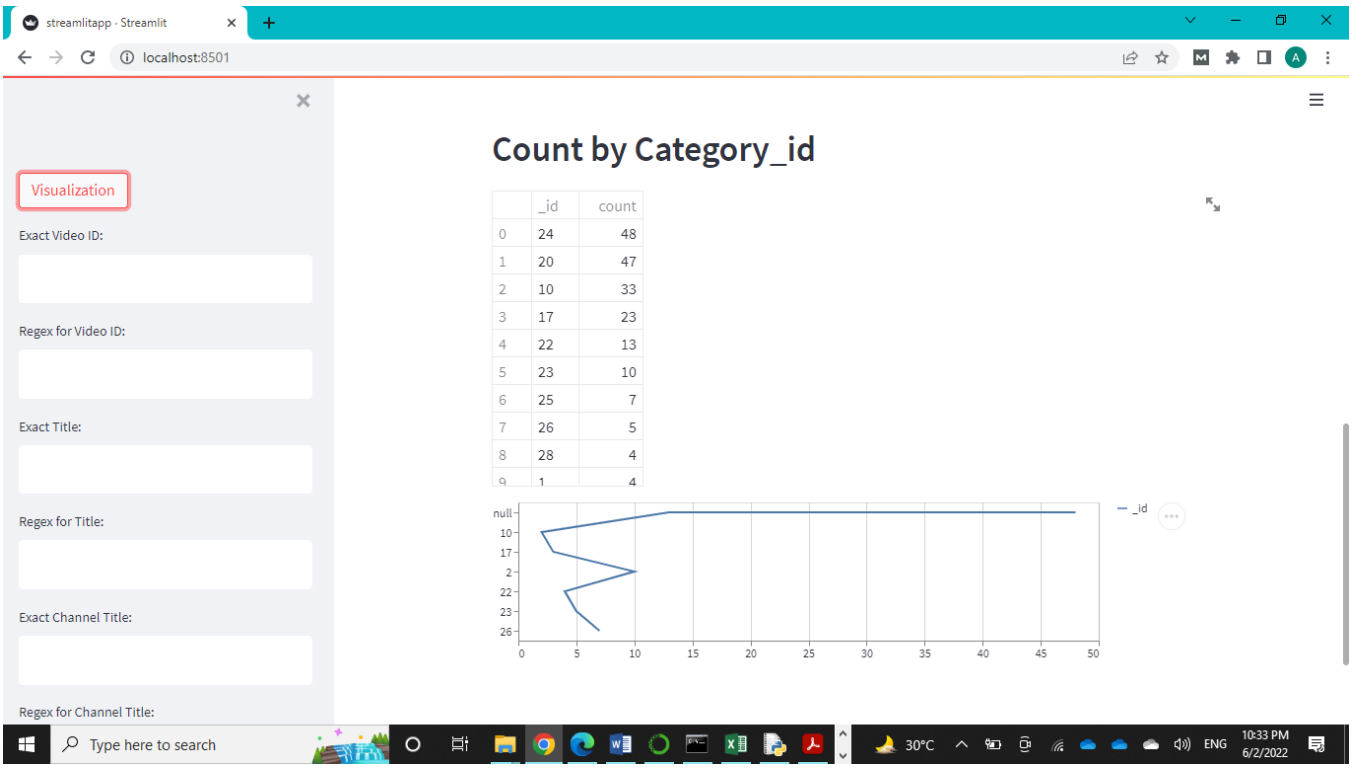
Query by channel regex:



Visualizations for Dashboard:







Acknowledgement:

Special thanks to 2 GitHub repositories that served as great guidance to execute this project

[GitHub - anqizhao7/my-document-streaming-project]

[GitHub - mitchelljy/Trending-YouTube-Scraper: Python script that scrapes the currently trending YouTube videos in a variety of countries]