```python
#!/usr/bin/env python
# -*- coding: utf-8 -*-
# Columbia EECS E6893 Big Data Analytics
"""
This module is the spark streaming analysis process.

Usage:
    If used with dataproc:
        gcloud dataproc jobs submit pyspark --cluster <Cluster Name> twitterHTTPClient.py

    Create a dataset in BigQurey first using
        bq mk bigdata_sparkStreaming

"""

from pyspark import SparkConf, SparkContext
from pyspark.streaming import StreamingContext
from pyspark.sql import Row, SQLContext
import sys
import requests
import time
import subprocess
import re
from google.cloud import bigquery

# global variables
bucket = "6893_course_data"
output_directory_hashtags = 'gs://{}/hadoop/tmp/bigquery/pyspark_output/hashtagsCount'.format(bucket)
output_directory_wordcount = 'gs://{}/hadoop/tmp/bigquery/pyspark_output/wordcount'.format(bucket)

# output table and columns name
output_dataset = 'twitter_data'
output_table_hashtags = 'hashtags'
columns_name_hashtags = ['hashtags', 'count']
output_table_wordcount = 'wordcount'
columns_name_wordcount = ['word', 'count', 'time']

# parameter
IP = 'localhost'      # ip port
PORT = 9001          # port

# time that the streaming process runs
STREAMTIME = 600

# the tags to track
tags = ['messi', 'bigdata', 'football', 'ai', 'nyc']
tags_regex = ["^#" + tag + "$" for tag in tags]
PATTERN = "|".join(tags_regex)

# the words you should filter and do word count
WORD = ['data', 'lol', 'ai', 'news', 'nyc']
```

```python
In [2]:  # Helper functions
         def saveToStorage(rdd, output_directory, columns_name, mode):
             """
             Save each RDD in this DStream to google storage
             Args:
                 rdd: input rdd
                 output_directory: output directory in google storage
                 columns_name: columns name of dataframe
                 mode: mode = "overwirte", overwirte the file
                       mode = "append", append data to the end of file
             """
             if not rdd.isEmpty():
                 (rdd.toDF(columns_name).write.save(output_directory, format="json", mode=mode))


         def saveToBigQuery(sc, output_dataset, output_table, directory):
             """
             Put temp streaming json files in google storage to google BigQuery
             and clean the output files in google storage
             """
             files = directory + '/part-*'
             subprocess.check_call(
                 'bq load --source_format NEWLINE_DELIMITED_JSON '
                 '--replace '
                 '--autodetect '
                 '{dataset}.{table} {files}'.format(
                     dataset=output_dataset, table=output_table, files=files
                 ).split())
             output_path = sc._jvm.org.apache.hadoop.fs.Path(directory)
             output_path.getFileSystem(sc._jsc.hadoopConfiguration()).delete(
                 output_path, True)


         def hashtagCount(words):
             """
             Calculate the accumulated hashtags count sum from the beginning of the stream
             and sort it by descending order of the count.
             Ignore case sensitivity when counting the hashtags:
                 "#Ab" and "#ab" is considered to be a same hashtag
             You have to:
             1. Filter out the word that is hashtags.
                Hashtag usually start with "#" and followed by a serious of alphanumeric
             2. map (hashtag) to (hashtag, 1)
             3. sum the count of current DStream state and previous state
             4. transform unordered DStream to a ordered Dstream

             Hints:
                 you may use regular expression to filter the words
                 You can take a look at updateStateByKey and transform transformations
             Args:
                 dstream(DStream): stream of real time tweets
             Returns:
                 DStream Object with inner structure (hashtag, count)
             """

             def update(newVal, runningCnt):
                 if runningCnt is None:
                     return sum(newVal)
                 return sum(newVal) + runningCnt

             hashtag = words.map(lambda w: w.lower())\
                            .filter(lambda w: True if re.match(PATTERN, w) else False)\
                            .map(lambda tag: (tag, 1))\
                            .reduceByKey(lambda v1, v2: v1 + v2)\
                            .updateStateByKey(update)\
                            .transform(lambda rdd: rdd.sortBy(lambda x: -x[1]))
             return hashtag


         def wordCount(words):
             """
             Calculte the count of 5 sepcial words for every 60 seconds (window no overlap)
             You can choose your own words.
             Your should:
             1. filter the words
             2. count the word during a special window size
             3. add a time related mark to the output of each window, ex: a datetime type
             Hints:
                 You can take a look at reduceByKeyAndWindow transformation
                 Dstream is a series of rdd, each RDD in a DStream contains data from a certain interval
                 You may want to take a look of transform transformation of DStream when trying to add a time
             Args:
                 dstream(DStream): stream of real time tweets
             Returns:
                 DStream Object with inner structure (word, count, time)
             """

             window_count = words.map(lambda w: w.lower())\
                                 .filter(lambda w: w in WORD)\
                                 .map(lambda w: (w, 1))\
                                 .reduceByKeyAndWindow(lambda x, y: x + y,
                                                       lambda x, y: x - y,
                                                       60,
                                                       60)\
                                 .transform(lambda time, rdd: rdd.map(lambda w: (w[0],
                                                                                 w[1],
                                                                                 time.strftime("%Y-%m-%d %H:%M:%S"))))
             window_count_time = window_count
             return window_count
```

```python
if __name__ == '__main__':
    # Spark settings
    /gateway/default/node/conf?host&port = SparkConf()
    /gateway/default/node/conf?host&port.setMaster('local[2]')
    /gateway/default/node/conf?host&port.setAppName("TwitterStreamApp")

    # create spark context with the above configuration
    sc = SparkContext(/gateway/default/node/conf?host&port=/gateway/default/node/conf?host&port)
    sc.setLogLevel("ERROR")

    # create sql context, used for saving rdd
    sql_context = SQLContext(sc)

    # create the Streaming Context from the above spark context with batch interval size 5 seconds
    ssc = StreamingContext(sc, 5)
    # setting a checkpoint to allow RDD recovery
    ssc.checkpoint("~/checkpoint_TwitterApp")

    # read data from port 9001
    dataStream = ssc.socketTextStream(IP, PORT)
    words = dataStream.flatMap(lambda line: line.split(" "))

    # calculate the accumulated hashtags count sum from the beginning of the stream
    topTags = hashtagCount(words)
    topTags.pprint()

    # Calculte the word count during each time period 60s
    wordCount = wordCount(words)
    wordCount.pprint()

    # save hashtags count and word count to google storage
    # used to save to google BigQuery
    # You should:
    #   1. topTags: only save the lastest rdd in DStream
    #   2. wordCount: save each rdd in DStream
    # Hints:
    #   1. You can take a look at foreachRDD transformation
    #   2. You may want to use helper function saveToStorage
    #   3. You should use save output to output_directory_hashtags, output_directory_wordcount,
    #       and have output columns name columns_name_hashtags and columns_name_wordcount.

    topTags.foreachRDD(lambda rdd: saveToStorage(rdd,
                                                 output_directory_hashtags,
                                                 columns_name_hashtags,
                                                 "overwrite"))
    wordCount.foreachRDD(lambda rdd: saveToStorage(rdd,
                                                  output_directory_wordcount,
                                                  columns_name_wordcount,
                                                  "append"))

    # start streaming process, wait for 600s and then stop.
    ssc.start()
    time.sleep(STREAMTIME)
    ssc.stop(stopSparkContext=False, stopGracefully=True)
    print("STREAMING END")

    # put the temp result in google storage to google BigQuery
    saveToBigQuery(sc, output_dataset, output_table_hashtags, output_directory_hashtags)
    saveToBigQuery(sc, output_dataset, output_table_wordcount, output_directory_wordcount)
    print("DONE SAVING")
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Time: 2022-10-22 01:07:25
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Time: 2022-10-22 01:07:30
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Time: 2022-10-22 01:07:35
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Time: 2022-10-22 01:07:40
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('#messi', 1)


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Time: 2022-10-22 01:07:45
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('#bigdata', 1)
('#ai', 1)


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Time: 2022-10-22 01:07:50
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('#bigdata', 1)
('#ai', 1)


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Time: 2022-10-22 01:07:55
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('#ai', 3)
('#bigdata', 1)


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('#ai', 3)
('#bigdata', 1)


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Time: 2022-10-22 01:08:05
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('#messi', 5)
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('#bigdata', 1)


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Time: 2022-10-22 01:08:20
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('#ai', 6)
('#bigdata', 2)


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Time: 2022-10-22 01:08:20
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('news', 1, '2022-10-22 01:08:20')
('lol', 3, '2022-10-22 01:08:20')


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Time: 2022-10-22 01:08:25
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('#ai', 7)
('#bigdata', 2)


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Time: 2022-10-22 01:08:30
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('#bigdata', 2)
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Time: 2022-10-22 01:08:40
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('#bigdata', 2)


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Time: 2022-10-22 01:08:45
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('#bigdata', 3)


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Time: 2022-10-22 01:08:50
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('#bigdata', 3)


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Time: 2022-10-22 01:08:55
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('#messi', 8)
('#bigdata', 3)


--------------------------------------------
Time: 2022-10-22 01:09:00
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('#football', 27)
('#ai', 22)
('#messi', 8)
('#bigdata', 3)


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Time: 2022-10-22 01:09:05
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('#football', 30)
('#ai', 22)
('#messi', 8)
('#bigdata', 3)


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Time: 2022-10-22 01:09:10
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Time: 2022-10-22 01:09:15
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Time: 2022-10-22 01:09:20
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('#bigdata', 5)


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Time: 2022-10-22 01:09:20
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('ai', 195, '2022-10-22 01:09:20')
('news', 2, '2022-10-22 01:09:20')
('data', 2, '2022-10-22 01:09:20')
('lol', 3, '2022-10-22 01:09:20')


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Time: 2022-10-22 01:09:25
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Time: 2022-10-22 01:09:30
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('#bigdata', 6)


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Time: 2022-10-22 01:09:35
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Time: 2022-10-22 01:09:45
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('#bigdata', 6)

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Time: 2022-10-22 01:09:50
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('#bigdata', 7)

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Time: 2022-10-22 01:09:55
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('#messi', 9)
('#bigdata', 7)

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Time: 2022-10-22 01:10:00
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Time: 2022-10-22 01:10:05
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('#messi', 9)
('#bigdata', 7)

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Time: 2022-10-22 01:10:10
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('#bigdata', 7)

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Time: 2022-10-22 01:10:15
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('#bigdata', 7)

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Time: 2022-10-22 01:10:20
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Time: 2022-10-22 01:10:20
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('lol', 5, '2022-10-22 01:10:20')

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Time: 2022-10-22 01:10:25
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('#bigdata', 7)

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Time: 2022-10-22 01:10:30
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('#messi', 9)
('#bigdata', 7)

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Time: 2022-10-22 01:10:35
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('#ai', 33)
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('#messi', 9)
('#bigdata', 7)


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Time: 2022-10-22 01:10:40
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('#bigdata', 7)


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Time: 2022-10-22 01:10:45
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('#football', 39)
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('#messi', 9)
('#bigdata', 7)


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Time: 2022-10-22 01:10:50
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('#football', 39)
('#ai', 34)
('#messi', 9)
('#bigdata', 7)


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Time: 2022-10-22 01:10:55
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('#football', 40)
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Time: 2022-10-22 01:11:00
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('#football', 40)
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('#bigdata', 7)


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Time: 2022-10-22 01:11:05
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Time: 2022-10-22 01:11:10
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('#football', 41)
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('#messi', 9)
('#bigdata', 7)


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Time: 2022-10-22 01:11:15
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('#football', 42)
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Time: 2022-10-22 01:11:20
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Time: 2022-10-22 01:11:20
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('nyc', 4, '2022-10-22 01:11:20')
('data', 3, '2022-10-22 01:11:20')
('lol', 1, '2022-10-22 01:11:20')


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Time: 2022-10-22 01:11:25
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('#football', 42)
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Time: 2022-10-22 01:11:30
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Time: 2022-10-22 01:11:35
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Time: 2022-10-22 01:11:45
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Time: 2022-10-22 01:11:55
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Time: 2022-10-22 01:12:00
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('#messi', 9)


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('#messi', 9)


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Time: 2022-10-22 01:12:10
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('#messi', 9)


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Time: 2022-10-22 01:12:20
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('lol', 8, '2022-10-22 01:12:20')
('data', 3, '2022-10-22 01:12:20')


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Time: 2022-10-22 01:12:25
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('#messi', 9)


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Time: 2022-10-22 01:12:35
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Time: 2022-10-22 01:13:20
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('#messi', 9)

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('nyc', 1, '2022-10-22 01:13:20')
('lol', 5, '2022-10-22 01:13:20')

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('#messi', 10)

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Time: 2022-10-22 01:13:45
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('news', 4, '2022-10-22 01:14:20')
('data', 2, '2022-10-22 01:14:20')


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Time: 2022-10-22 01:14:25
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Time: 2022-10-22 01:14:30
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Time: 2022-10-22 01:14:35
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('#ai', 79)
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Time: 2022-10-22 01:14:40
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('#ai', 80)
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Time: 2022-10-22 01:15:05
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Time: 2022-10-22 01:15:15
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Time: 2022-10-22 01:15:20
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('lol', 5, '2022-10-22 01:15:20')
('data', 1, '2022-10-22 01:15:20')


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Time: 2022-10-22 01:15:25
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Time: 2022-10-22 01:15:30
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('#bigdata', 19)
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STREAMING END
DONE SAVING
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In [ ]: