

## Assignment 3

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Due Date: Mentioned on eLearning

### Instructions

- This assignment requires you to write code using Structured Streaming and GraphFrames libraries. To be able to run your code, you would need Apache Spark and other libraries mentioned installed in your environment. If you choose to run it on your local machine, all paths should be inputted as parameters. You cannot hardcode paths to your local computer.
- All instructions for compiling and running your code must be placed in the README file.
- You should use a cover sheet, which can be downloaded from [http://www.utdallas.edu/~axn112530/cs6350/CS6350\\_CoverPage.docx](http://www.utdallas.edu/~axn112530/cs6350/CS6350_CoverPage.docx)
- You are allowed to work in pairs i.e. a group of two students is allowed. Please write the names of the group members on the cover page.
- **You have a total of 4 free late days for the entire semester. You can use at most 2 days for any one assignment. After four days have been used up, there will be a penalty of 10% for each late day. The submission for this assignment will be closed 2 days after the due date.**
- Please ask all questions on Piazza, not via email.

# 1 Spark Streaming with Twitter and Kafka

In this part, you will create a Spark Streaming application that will continuously read data from Twitter, analyze them for their sentiment, and send the values to Apache Kafka. A pipeline using Elasticsearch and Kibana will read the data from Kafka and analyze it visually.

## Setting up your development environment

You can set up everything on your local machine or host them on the cloud. Following are the resources that you will need:

- You will need to create a Twitter app and get credentials. It can be done at <https://apps.twitter.com/>
- You will need a working Spark cluster. It can be setup locally or you can use a cloud based server.
- Download Apache Kafka and go through the quickstart steps: <https://kafka.apache.org/quickstart>
- Windows users might want to consider WSL, which gives a Unix-like environment on Windows: <https://docs.microsoft.com/en-us/windows/wsl/install-win10>
- I have attached a simple project showing how to pass data between Kafka and a Spark Structured Streaming application that performs word count. Instructions for running are also attached.
- Later, you will also need to set up Elasticsearch and Kibana environment to visualize data. You will need to download Elasticsearch, Kibana, and Logstash from <https://www.elastic.co/downloads/>

## Project Steps

For this project, you will need to perform the following steps:

- Create a PySpark application that continuously reads tweets from Twitter relating to a search term. For example, you can retrieve tweets relating to the search term *Covid-19*.
- Analyze the gathered tweets for their individual sentiment. You may be able to use part of the code that you wrote for assignment 2. The sentiment evaluation should happen continuously using a stream approach. At the end of every window, a message containing the **sentiment** should be sent to Kafka through the topic created in the previous step.
- Start Apache Kafka and create a topic for data exchange. The Spark Structured Streaming application should send data to Kafka.
- Configure Logstash, Elasticsearch, and Kibana to read from the Kafka topic and set up visualization of sentiment.

## Visualizing the data using Elasticsearch and Kibana

You will need Elasticsearch and Kibana installed to get the data from Kafka and visualize it. Details are available at:

<https://www.elastic.co/downloads>

<https://www.elastic.co/start>

You will need to visualize sentiment of your Twitter search term plotted against time. You can view this using Kibana.

## What to Submit

You are required to submit the following:

- Your project code file.
- A graphical plot showing how the sentiment for your topic varied over a time interval. You are free to choose the time interval - but it should be at least a few hours. You can submit a single plot or series of plots showing sentiment variation with time.
- A brief summary of how the sentiment varied over the time frame, and what insights does it give you.
- A README file indicating how to run your code. Please do not use any hard coded paths - all paths should be specified as arguments.

## 2 Analyzing Social Networks using GraphX/GraphFrame

In this part, you will use Spark GraphX/GraphFrame to analyze social network data. You are free to choose any one of the Social network datasets available from the [SNAP repository](#).

You will use this dataset to construct a GraphX/GraphFrame graph and run some queries and algorithms on the graph. You will need to perform the following steps:

### 2.1 Loading Data

Load the data into a GraphFrame or RDD using Spark. Define a parser so that you can identify and extract relevant fields. Note that edges are directed, so if your dataset has undirected relationships, you might need to convert those into 2 directed relationships. That is, if your dataset contains an undirected friendship relationship between X and Y, then you might need to create 2 edges one from X to Y and the other from Y to X.

### 2.2 Create Graphs

Define edge and vertex structure and create property graphs.

### 2.3 Running Queries

Run the following queries using the GraphX/GraphFrame API and write your output to a file specified by the output parameter.

- a. Find the top 5 nodes with the highest outdegree and find the count of the number of outgoing edges in each
- b. Find the top 5 nodes with the highest indegree and find the count of the number of incoming edges in each
- c. Calculate PageRank for each of the nodes and output the top 5 nodes with the highest PageRank values. You are free to define any suitable parameters.
- d. Run the connected components algorithm on it and find the top 5 components with the largest number of nodes.
- e. Run the triangle counts algorithm on each of the vertices and output the top 5 vertices with the largest triangle count. In case of ties, you can randomly select the top 5 vertices.

## 2.4 What to submit

You are required to submit the following:

- Your project code file. There should be two arguments: input dataset path, and output dataset path.
- Output file with the results of the queries
- A brief summary indicating whether your results make sense and what insights you get by this analysis.
- A README file indicating how to run your code. Please do not use any hard coded paths - all paths should be specified as arguments.