Social Networks: The Tracking of COVID-19 Misinformation Using NLP and Graph-based Approaches

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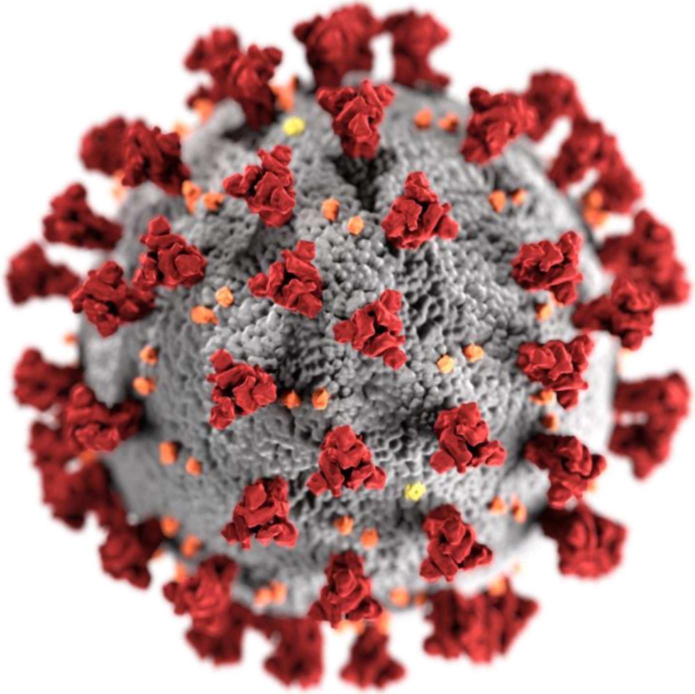
Motivation

- The Covid-19 pandemic has brought about millions of death globally
- Misinformation plays a big role through **vaccine hesitancy** and undermining of the virus's impact
- Social media has been used to spread **misinformation** at unprecedented rates, primarily through bots and influencers



Research Questions

1. What kinds of users participate in the dissemination of misinformation?

2. What Natural Language Processing (NLP) based patterns can be drawn from malicious users and their tweets/posts?

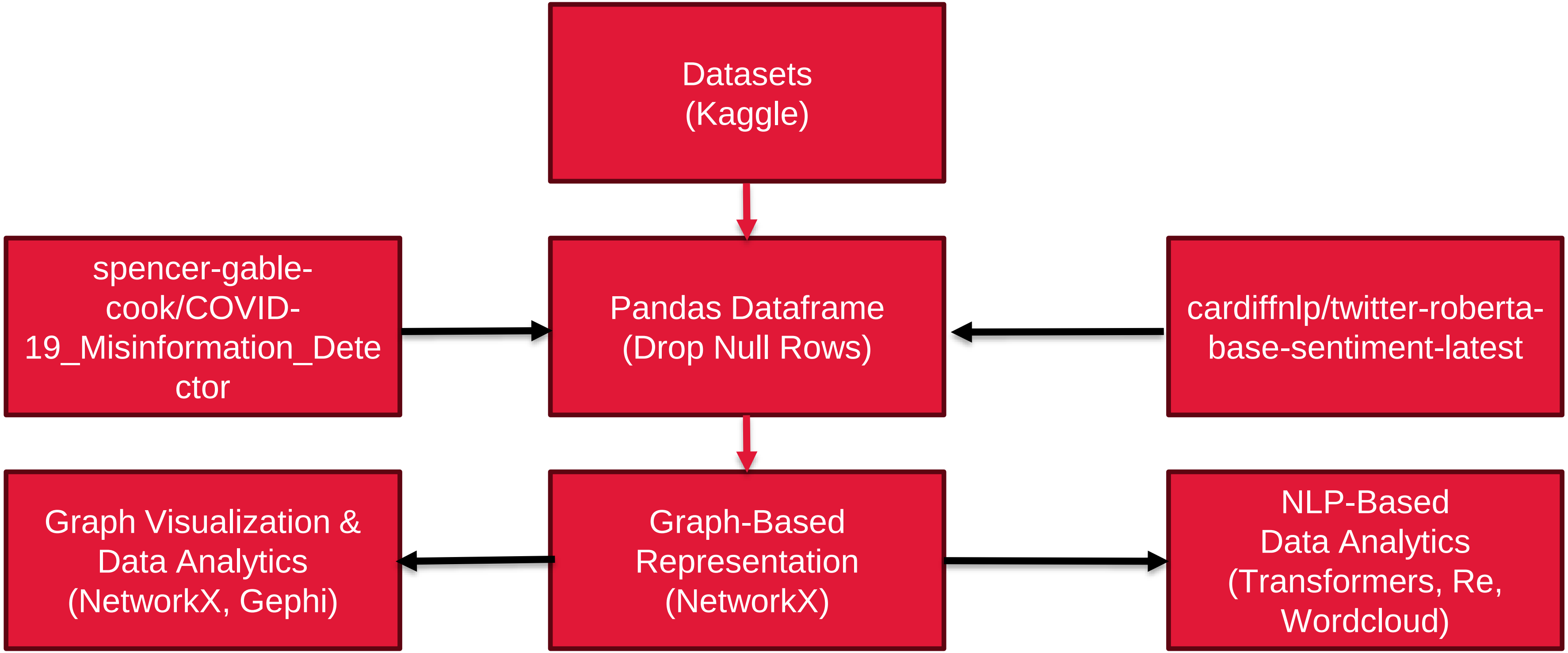
3. How is misinformation propagated in terms of a longitudinal time frame?

4. What are noticeable differences and similarities in how misinformation spreads between Reddit and Twitter?

Recap: What We Did Last Time

1. Twitter & Reddit Pipeline
2. Graph-based Analysis
   - Community Detection
   - PageRank
   - HITS
   - Null Model (Barabasi-Albert)
3. Data Visualization
   - Wordclouds
   - Timeseries
   - Graphs (Gephi: Yifan Lu Layout)

Recap: Methodology (Twitter)



Datasets (Kaggle)

spencer-gable-cook/COVID-19_Misinformation_Detector

Pandas Dataframe (Drop Null Rows)

cardiffnlp/twitter-roberta-base-sentiment-latest

Graph Visualization & Data Analytics (NetworkX, Gephi)

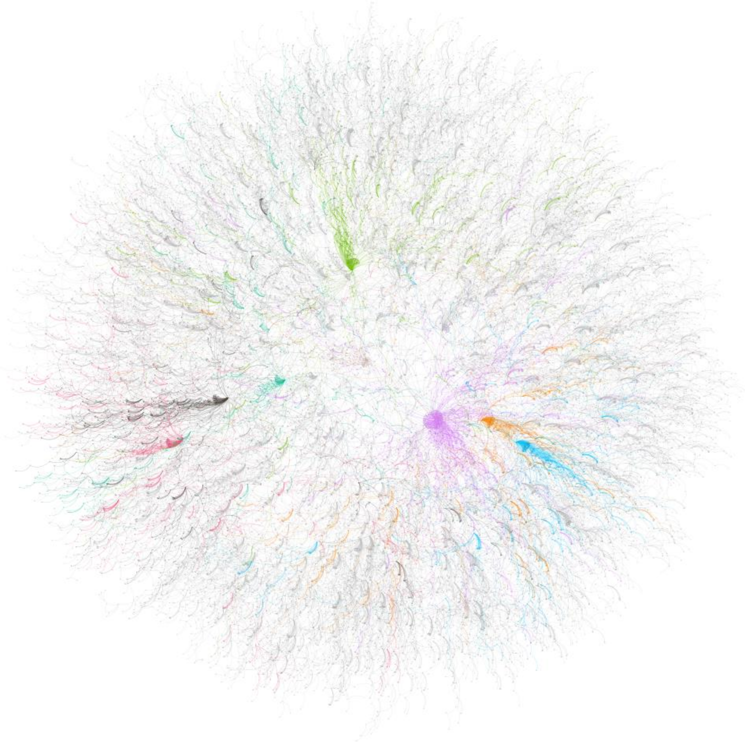
Graph-Based Representation (NetworkX)

NLP-Based Data Analytics (Transformers, Re, Wordcloud)

Recap: Problem Definition

- Our aim is to create a **directed** social network graph **G = (V, E)** where:
  - **V** represents users who are participating in the spread of misinformation
  - **E** represents the relationships between users who share, view, or distribute misinformation

Results and Analysis (Twitter) - 2

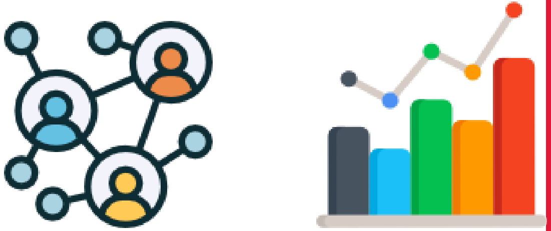


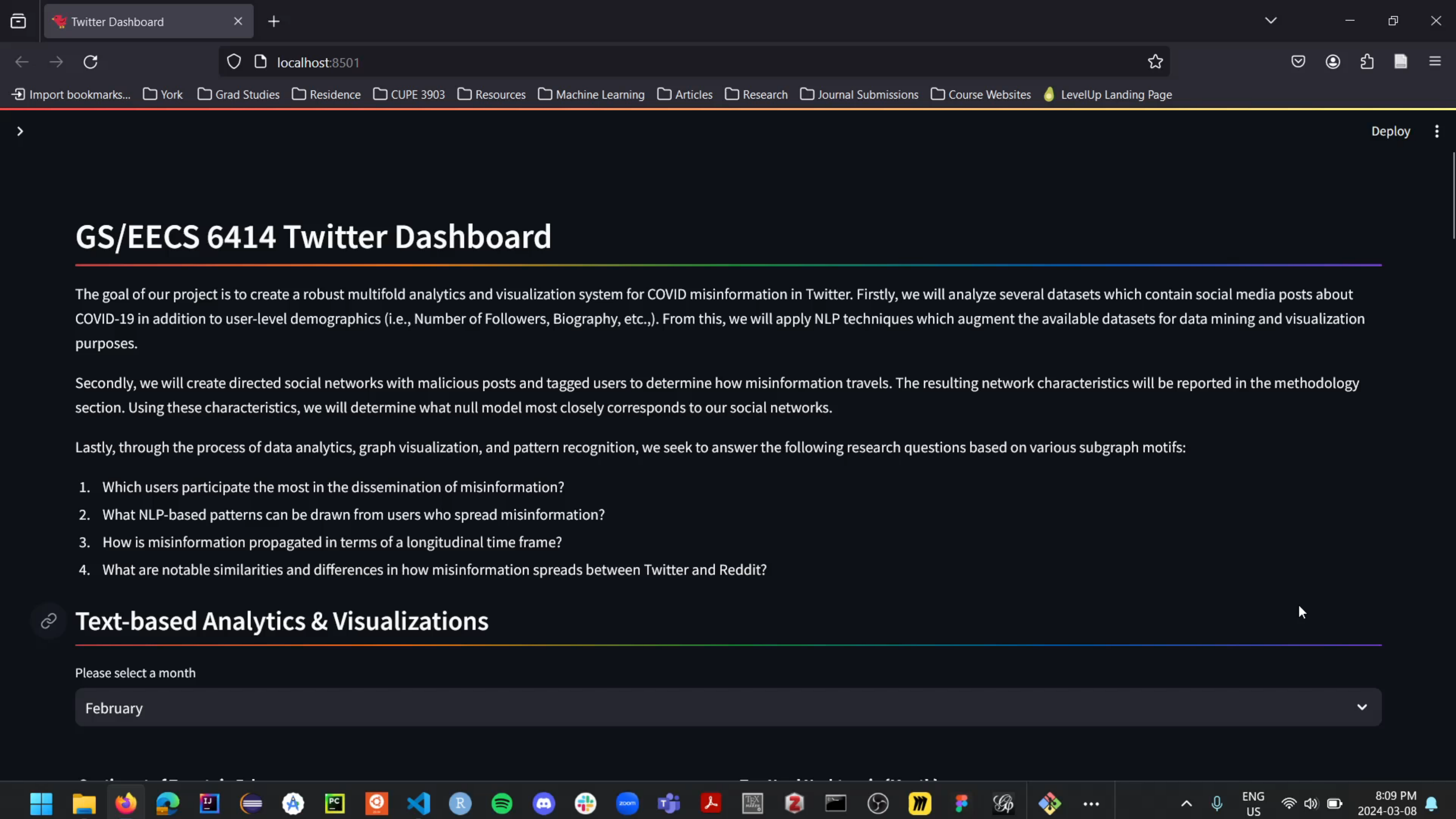
Property	Value
Nodes	35,147
Edges	35,146
Degree Distribution	2.99
Triangles	0
Clustering Coefficient	0
Modularity	0.980
Communities	112
Diameter	31

New Contribution: Interactive QA Dashboard

Goals:

1. Intuitive, Accessible, Efficient Visualizations to answer the Research Questions
2. Interactive, Scalable Solutions





GS/EECS 6414 Twitter Dashboard

The goal of our project is to create a robust multifold analytics and visualization system for COVID misinformation in Twitter. Firstly, we will analyze several datasets which contain social media posts about COVID-19 in addition to user-level demographics (i.e., Number of Followers, Biography, etc.,). From this, we will apply NLP techniques which augment the available datasets for data mining and visualization purposes.

Secondly, we will create directed social networks with malicious posts and tagged users to determine how misinformation travels. The resulting network characteristics will be reported in the methodology section. Using these characteristics, we will determine what null model most closely corresponds to our social networks.

Lastly, through the process of data analytics, graph visualization, and pattern recognition, we seek to answer the following research questions based on various subgraph motifs:

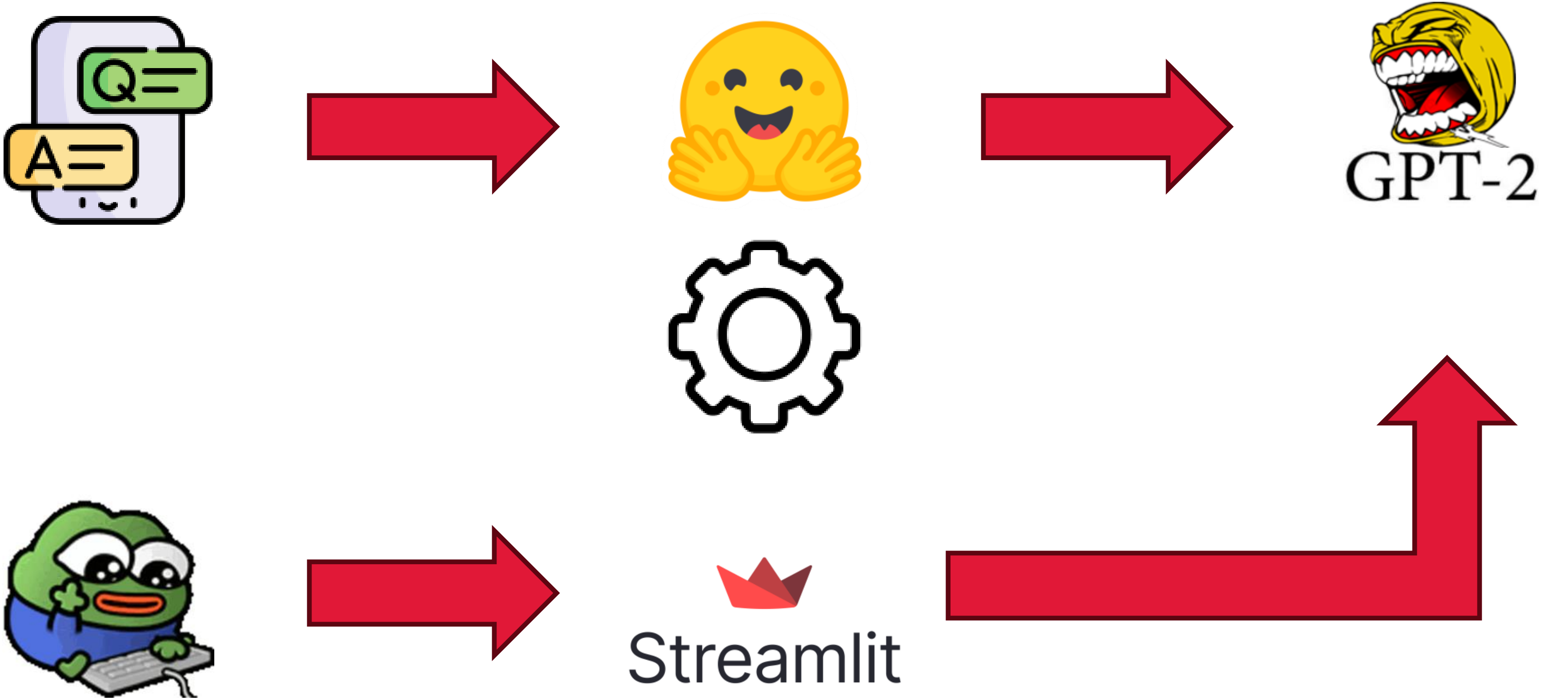
1. Which users participate the most in the dissemination of misinformation?
2. What NLP-based patterns can be drawn from users who spread misinformation?
3. How is misinformation propagated in terms of a longitudinal time frame?
4. What are notable similarities and differences in how misinformation spreads between Twitter and Reddit?

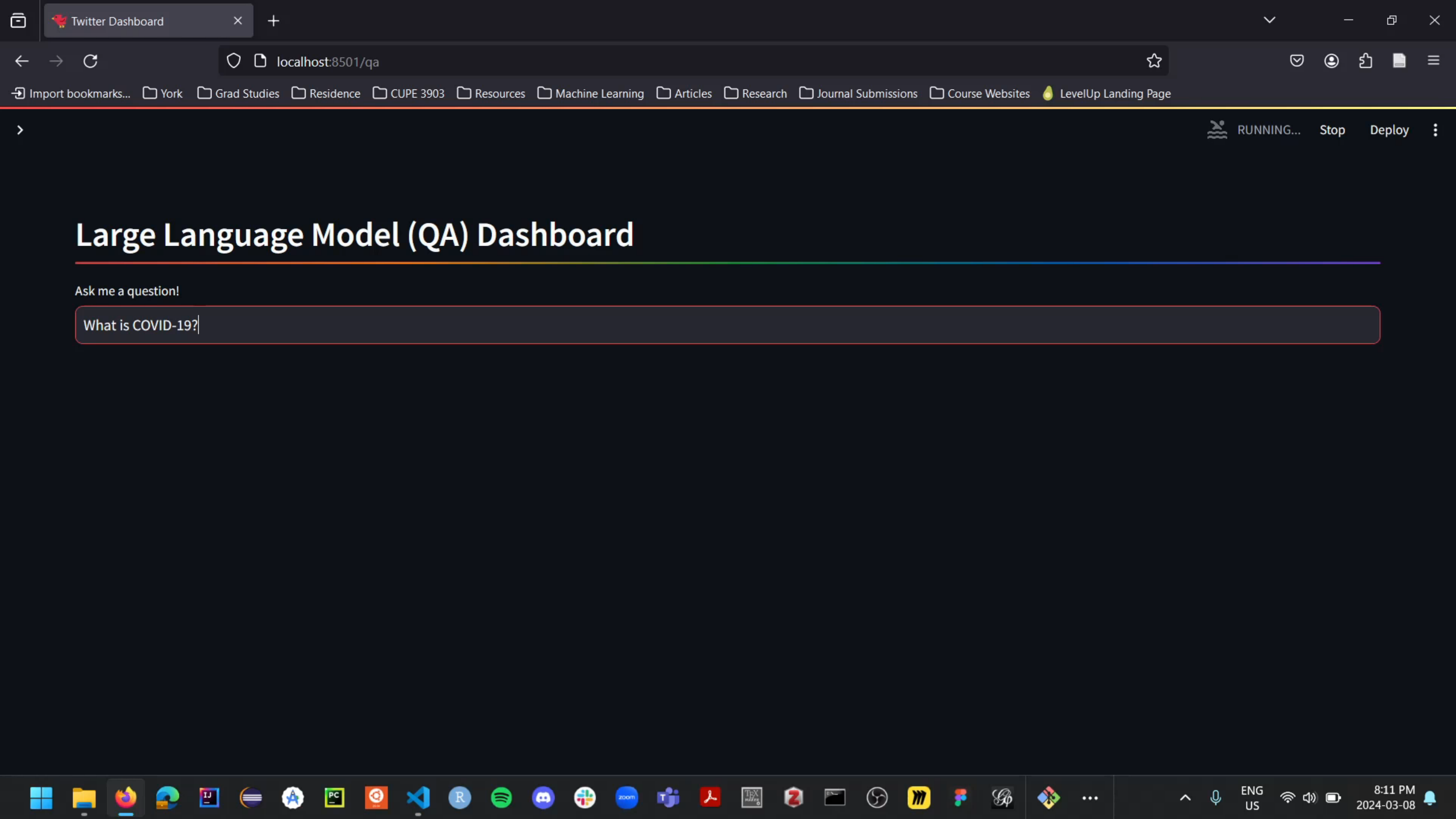
Text-based Analytics & Visualizations

Please select a month

February

New Contribution: QA Large Language Model



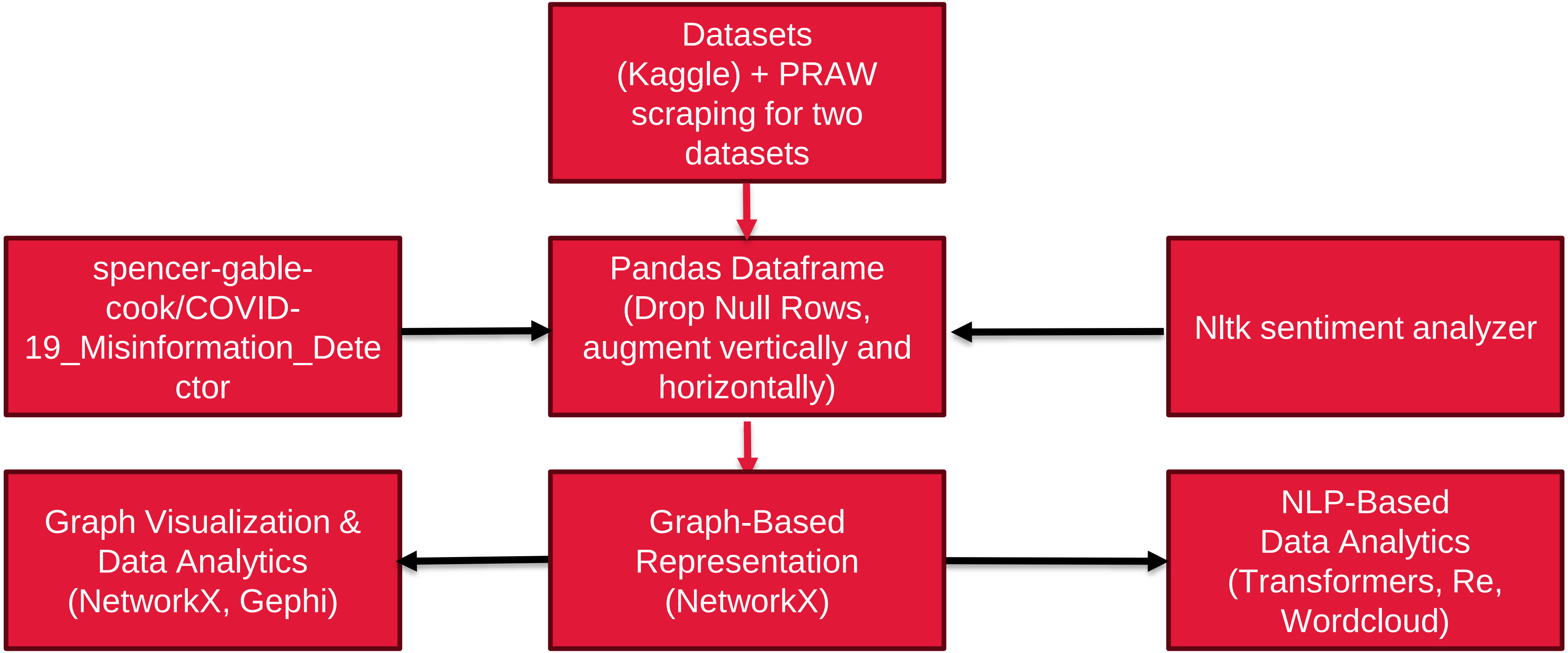


Large Language Model (QA) Dashboard

Ask me a question!

What is COVID-19?

Methodology (Reddit)



Datasets (Kaggle) + PRAW scraping for two datasets

spencer-gable-cook/COVID-19_Misinformation_Detector

Pandas Dataframe (Drop Null Rows, augment vertically and horizontally)

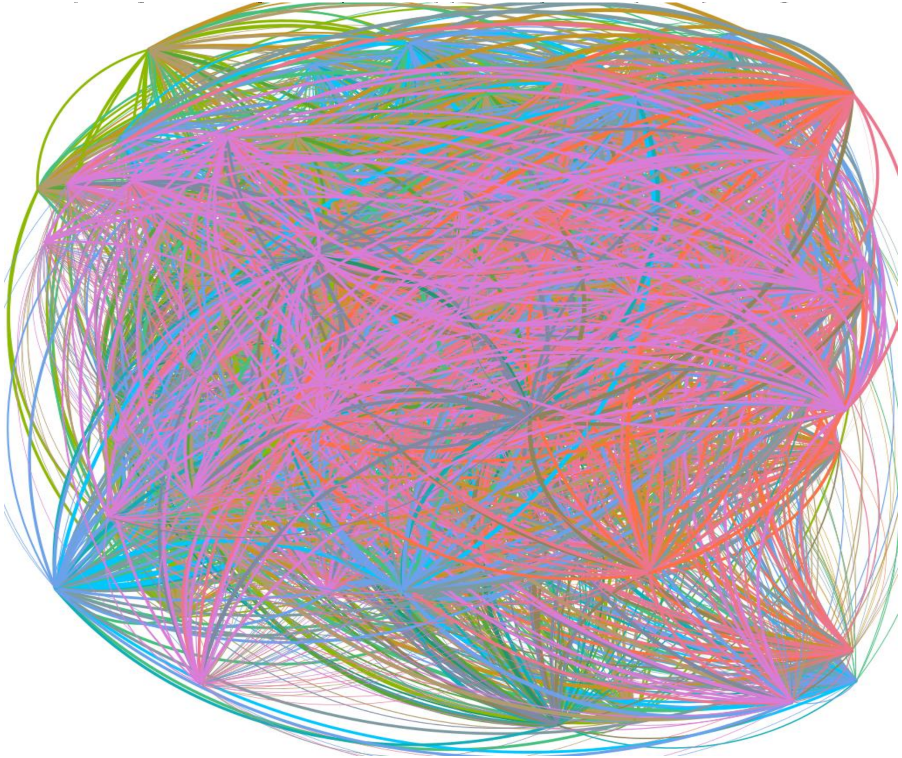
Nltk sentiment analyzer

Graph Visualization & Data Analytics (NetworkX, Gephi)

Graph-Based Representation (NetworkX)

NLP-Based Data Analytics (Transformers, Re, Wordcloud)

Results and Analysis (Reddit)



PageRank	Top 10 PageRank Users in the Reddit Graph User throwaway742858 has score contribution: 0.02105 User BipolarRN has score contribution: 0.02105 User zombiephish has score contribution: 0.02073 User jdfertig has score contribution: 0.02035 User ghafgarionbaconsmith has score contribution: 0.01824 User TheDarkKitten95 has score contribution: 0.01764 User gebba54 has score contribution: 0.01739 User littlestircrazy has score contribution: 0.01721 User captaindata1701 has score contribution: 0.01721 User volcomp has score contribution: 0.0172
Hubs	Top 10 Authority Users in the Reddit Graph User BipolarRN has score contribution: 0.021 User throwaway742858 has score contribution: 0.0207 User zombiephish has score contribution: 0.02031 User jdfertig has score contribution: 0.0203 User ghafgarionbaconsmith has score contribution: 0.01827 User Kerboq has score contribution: 0.01743 User gebba54 has score contribution: 0.01733 User volcomp has score contribution: 0.01677 User TheDarkKitten95 has score contribution: 0.01676 User virgilash has score contribution: 0.01638
Authorities	Top 10 Hub Users in the Reddit Graph User BipolarRN has score contribution: 0.021 User throwaway742858 has score contribution: 0.0207 User zombiephish has score contribution: 0.02031 User jdfertig has score contribution: 0.0203 User ghafgarionbaconsmith has score contribution: 01827 User Kerboq has score contribution: 0.01743 User gebba54 has score contribution: 0.01733 User volcomp has score contribution: 0.01677 User TheDarkKitten95 has score contribution: 0.01676 User virgilash has score contribution: 0.01638

Conclusion and Analysis (1)

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Conclusion and Analysis (2)

- Differences between **Reddit** and **Twitter**:
  - Reddit seemed to have much more neutrality and positivity in their user-content in comparison with Twitter
  - Node importance (i.e., PageRank, HITS) in Twitter shows great **disparity** between user influence while Reddit is much more **equitable**.
  - Reddit has more moderation with stricter rules, coupled with the ability to quarantine communities
- Limitations:
  - Quarantined subreddits have **small network diameter** and high user **overlap** between each other.
  - Twitter Dataset is a **premature snapshot** of the misinformation network; more longitudinal evaluations are required.

That's all folks!