#UkraineWar Sentiment Analysis + Topic Discovery

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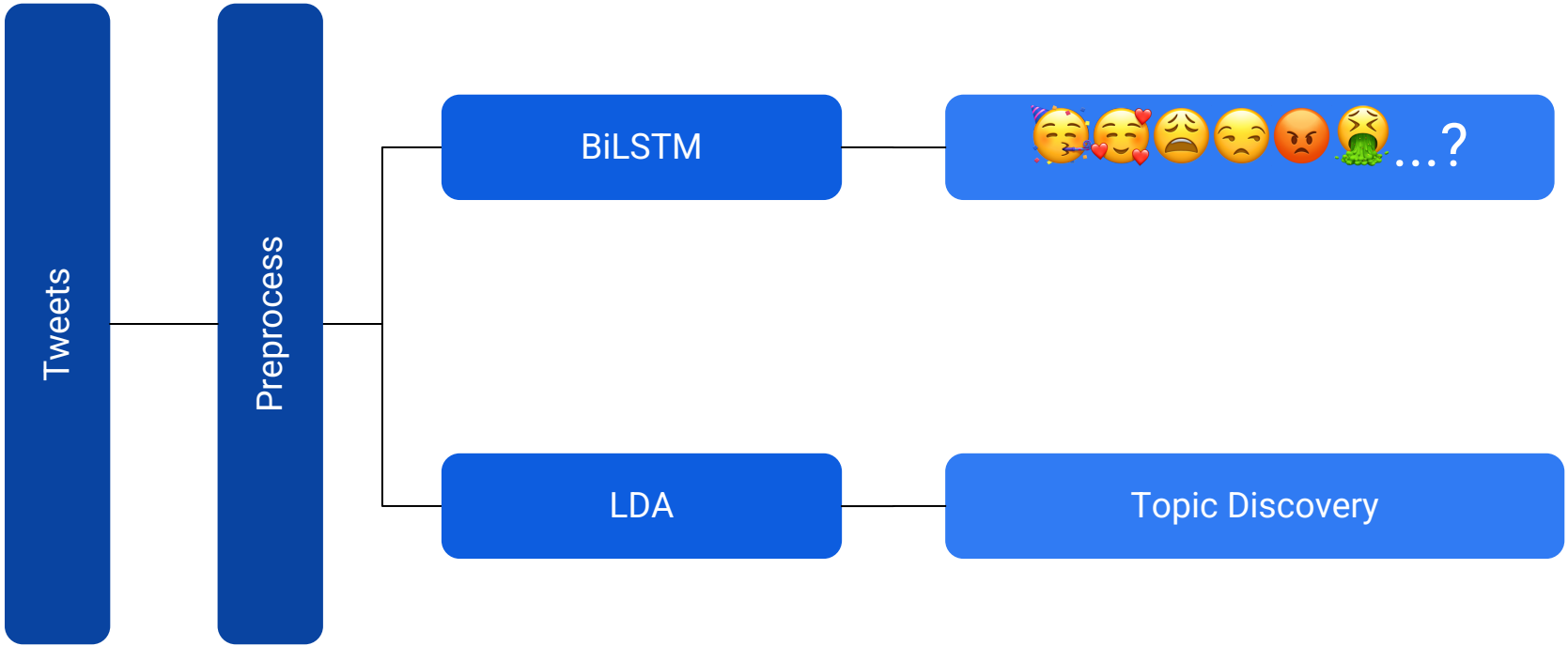
Introduction

The current conflict between Russia and Ukraine has caused people and groups to suffer at different levels and aspects globally.

To better understand English-speaking Twitter users' reactions to this conflict, we use bidirectional LSTM model to analyze the **sentiments** and use LDA to discover **topics** of the discussions. We also visualize our results to explore how the emotions change overtime and possible relations between topics and emotions.

Project Outlook



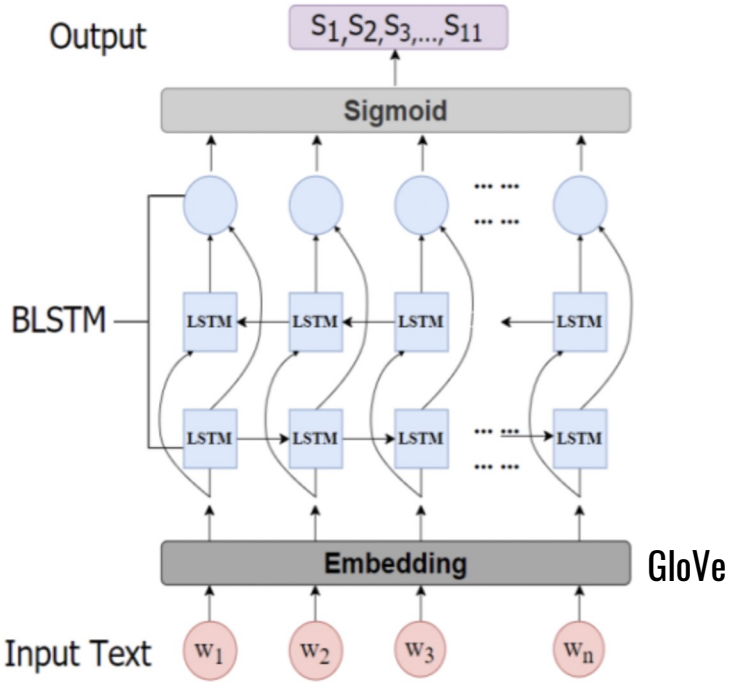
Preprocessing

Original tweet	RT@NYTimes: ⚡#BREAKING SUNDAY: RAW VIDEO Of #Russian Column Destroyed By #Ukraine Forces Near #Kyiv
Remove special characters and Retweets	BREAKING SUNDAY RAW VIDEO Of Russian Column Destroyed By Ukraine Forces Near Kyiv
Lowercase and delete words with length < 2	breaking sunday raw video russian column destroyed ukraine forces near kyiv
Remove stop words	breaking sunday raw video russian column destroyed ukraine forces near kyiv
Lemmatization	break sunday raw video russian column destroy ukraine force near kyiv

Sentiment Analysis

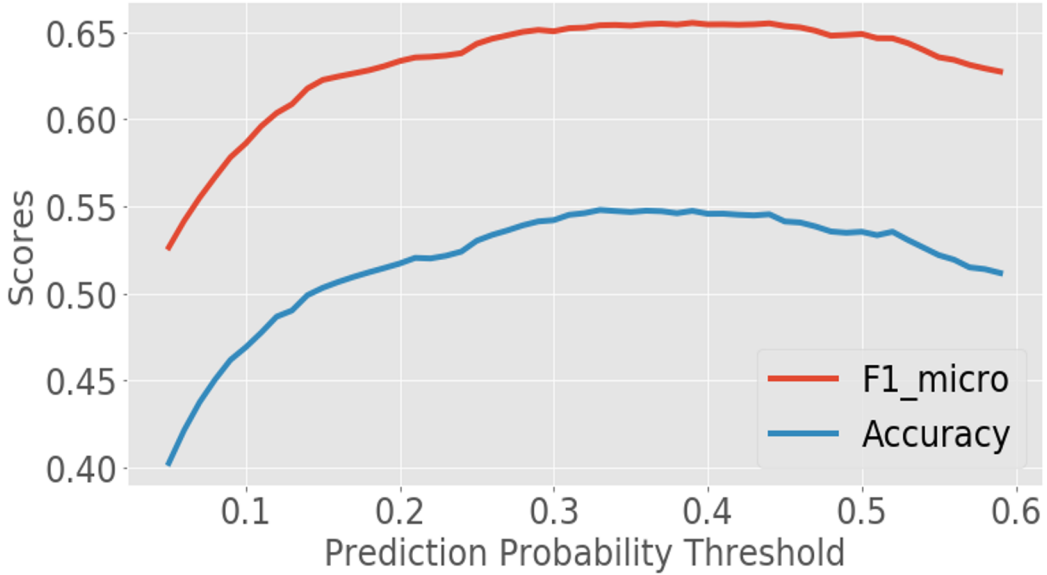
Bidirectional LSTM model for Sentiment Analysis

- Embedding layer - GloVe
- Unidirectional Long Short - Term Memory
  - Recurrent neural network learning order dependence in sequence prediction problems
- Bidirectional Long Short - Term Memory
  - Advantage: The bi-directional semantic dependencies can be better captured
  - Disadvantage: Requires more time for training
- Additional Dense Layer with Sigmoid to output probabilities for multiple labels

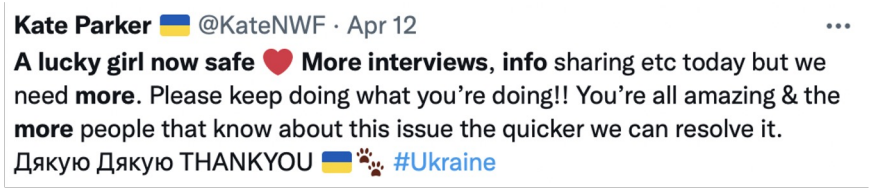


Choosing the threshold

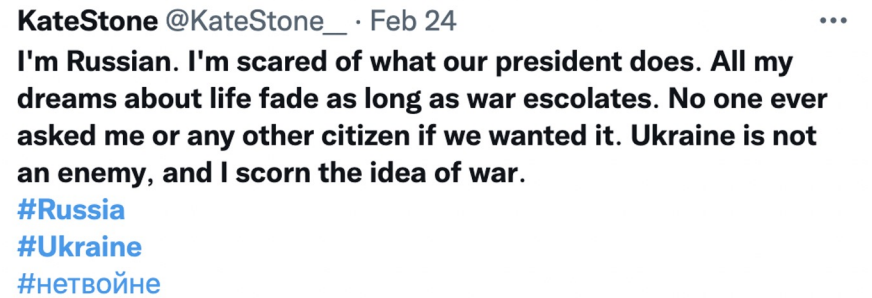
- One tweet can be labeled with multiple sentiments that have probabilities above the threshold.
- We have chosen the threshold to be 0.37 based on the accuracy and f1 micro score. The accuracy and f1 micro score decrease after 0.37.



Result Example



JOY 😄

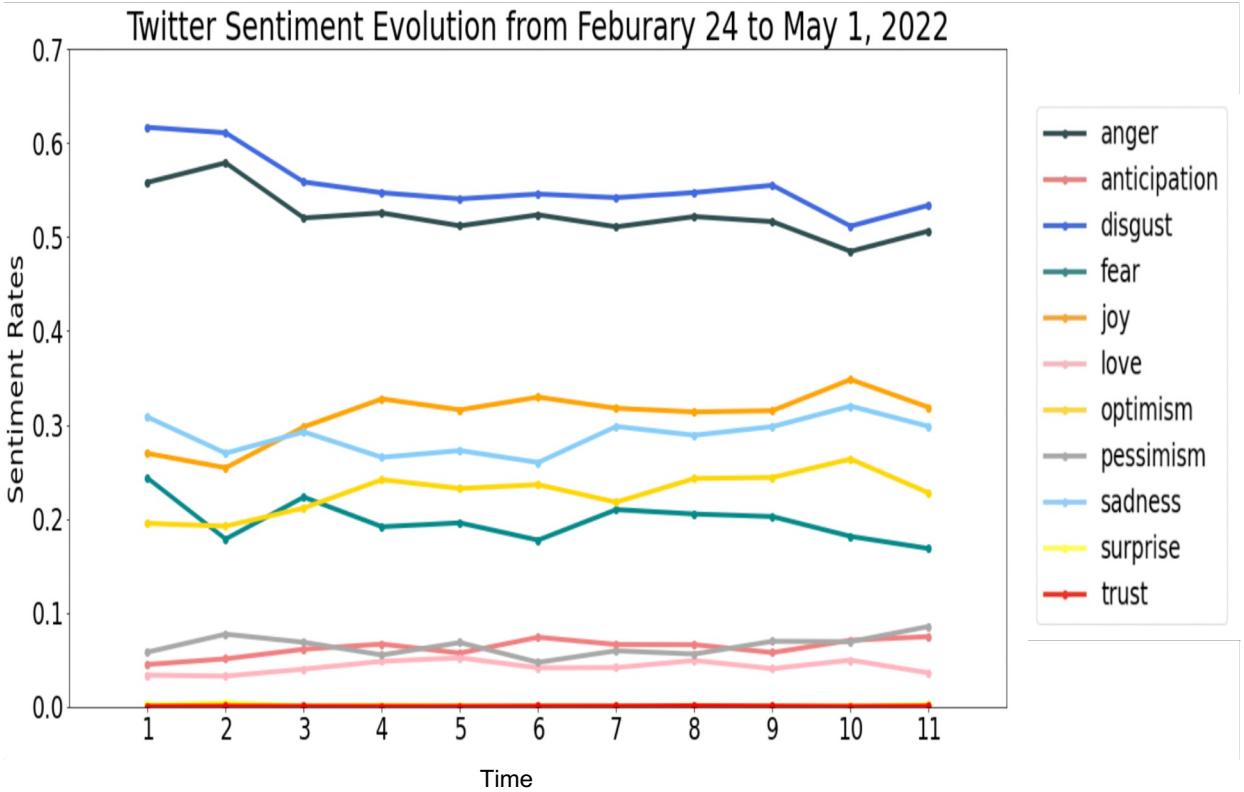


DISGUST 🤮, ANGER 😠

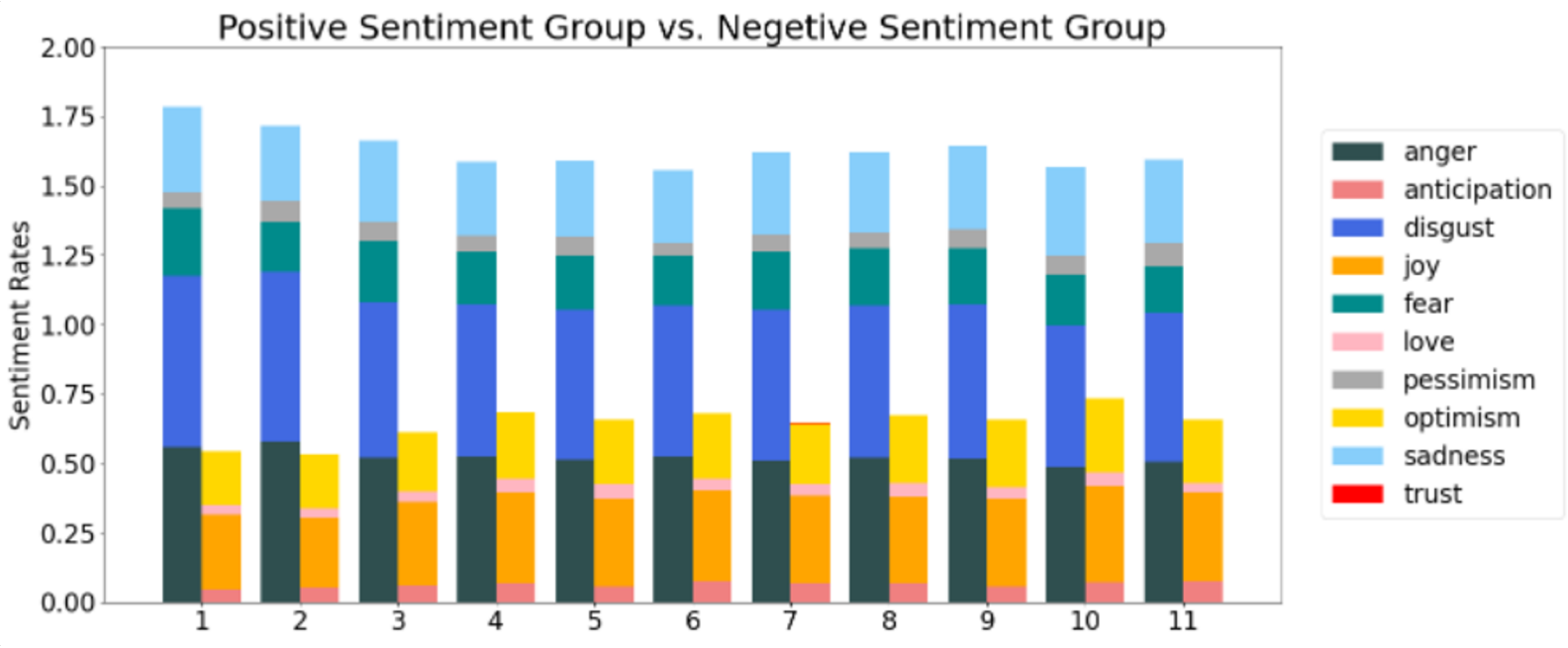
Time trend of sentiments

- 11 sentiments have been captured

- Top 3 sentiments:
  - 1. Disgust
  - 2. Fear
  - 3. Joy
- Changes over time:
  - Gradual decrease for negative sentiments
  - Gradual increasing trend for positive sentiments



Percentage of Total Positive and Negative tweets



Misclassified Result Example

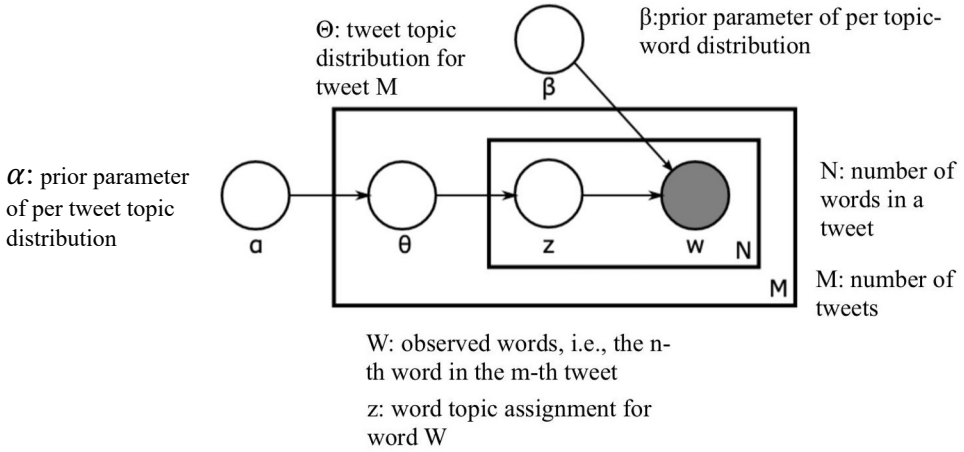
For tweets that do not strongly associate with any of the 11 labels, the model cannot classify it correctly.

We need to explore more beyond the 11 sentiments...

Topic Discovery

Latent Dirichlet Allocation (LDA) for Topic Discovery

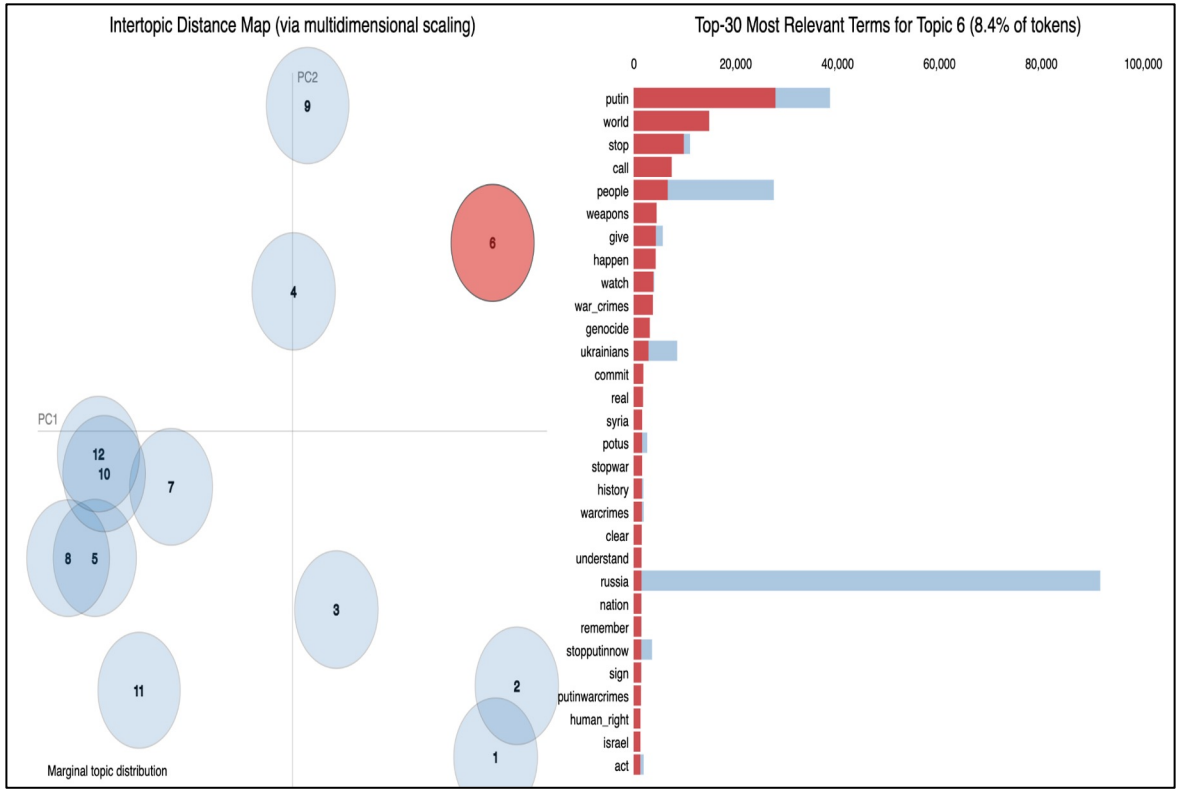
- Unsupervised learning method allows us to detect latent topics that govern the words in twitter datasets.
- Output a file that contains all the topics made of all the words with their probabilities to belong to that topic
- We can conduct human analysis to define such topics more precisely



LDA Example Results 1: (Topic “Putin”)

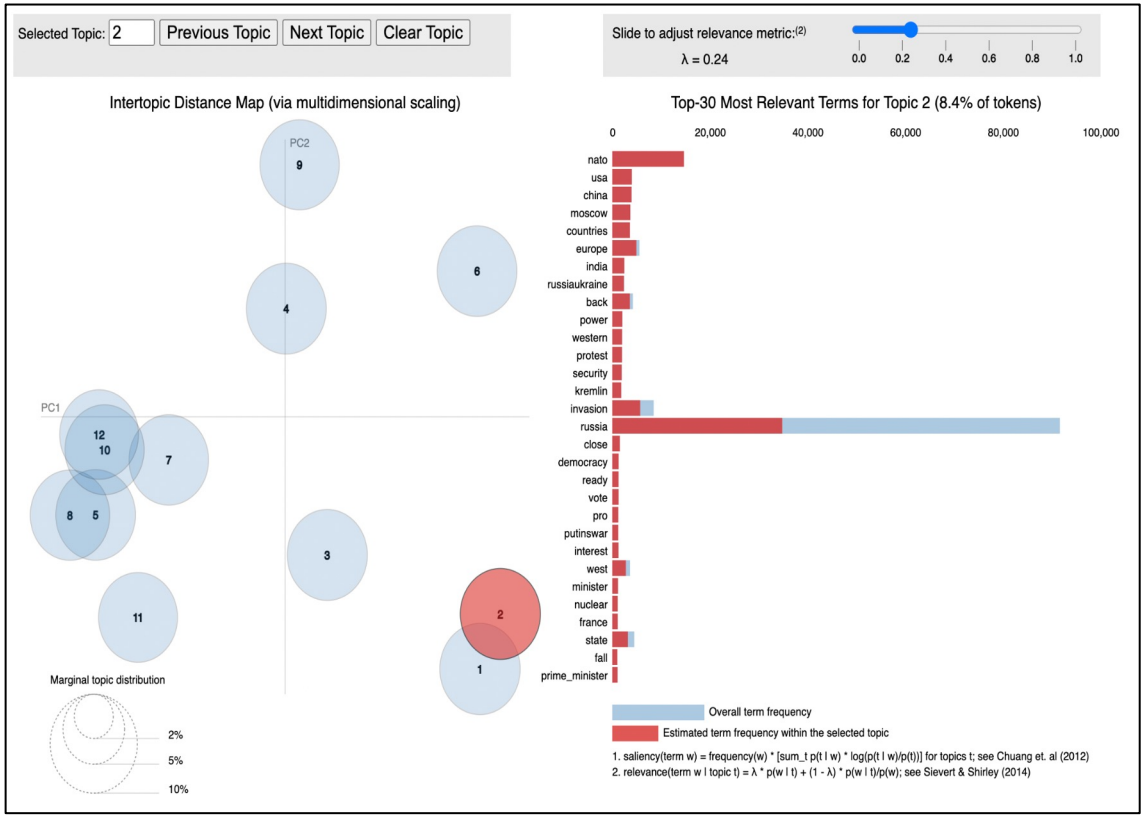
- Most meaningful words:
  - **Putin**
  - **Russia**
  - Stop putin now
  - Stopwar
  - Genocide
  - War_crimes
  - Putin War Crime
  - Warcrimes

- Potential sentiment
  - Anti - War emotion



LDA Results 2: (Topic “Zelenskyy”)

- Most Significant words:
  - **Ukraine**
  - **Zelenskyy**
  - Live
  - good
  - Protect
  - Freedom
  - Hope
  - Stand
  - Love
- Potential sentiment:
  - Supportive
- Benefit: Capture some extra sentiments that we have not included in our train dataset



Discussion

- The Sentiment Analysis model help us to understand the general reactions to the war between Ukraine and Russia. However, 11 sentiments are not enough for the model to summarize the millions of online discussions effectively. The LDA model helps us to further understand the most concerned topics.
- The topic discovery model can help us to improve our sentiment analysis model.
    - We can explore sentiments with high frequency that are not covered in our 11 labels and add more appropriate sentiment observations to train our model.
    - Some topic groups from the LDA model show strong attitudes, such as supporting Ukraine. We can introduce a layer to our model after the BiLSTM, which can detect key words from a topic group associated with positive sentiment and increase the likelihood of classifying the tweet as positive.

Thank you for watching this presentation!