# NLP Project

## COVID-19 Tweets Sentiment Analysis

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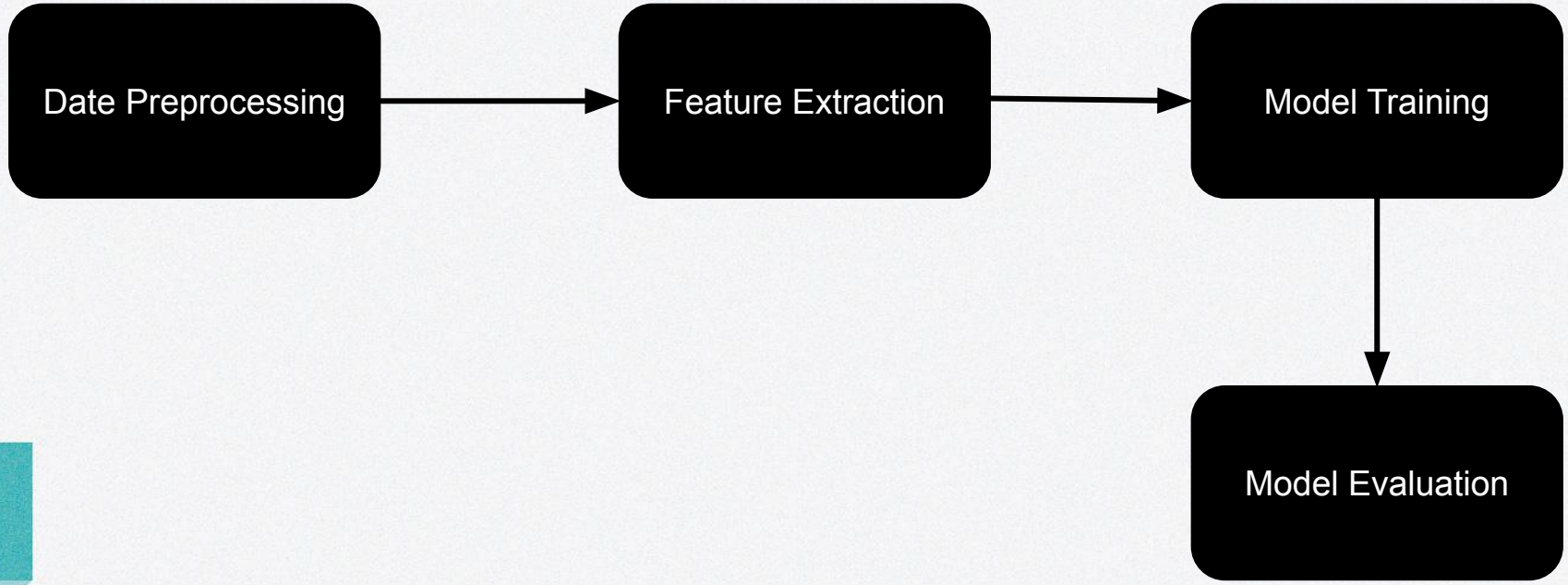
# Project Pipeline



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# Data Preprocessing

## Preprocessing Phase consists of several steps :

1. Read Data from file into list of ( text / categories / stance ) we only preprocess the text

2. Normalization and stemming using **ArabicLightStemmer** library from **tashaphyne.stemming** package
   I. Convert all characters to the same shape using the normalizer
   II. Convert word to original from through stemming to by removing prefixes and suffexes

3. The **Bert** preprocessing was done **ArabertPreprocessor** tokenized using **AutoTokenizer**

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# Feature Extraction

## The feature extraction phase is composed of many steps:

1. build the vocabulary by adding all the words in all text to a single vocabulary set
2. Removal of stop words, using the nltk stopwords set we removed all stop words from the text
3. We tried extracting several features as
   i. **Bag of words** : Using CountVectorizer from **sklearn.feature_extraction.text**, we trained the countVector on the corpus and used the BOG vector as a feature for training the model
   ii. **TF-IDF :** Using **TfidfVectorizer** from **sklearn.feature_extraction.text**, we trained the **TfidfVectorizer** on the corpus and used the TF-IDF vector as a feature for training the model
   iii. **Frequency Vector :** Counting the number of positive, negative, and neutral words in each sentence, we build a vector of length 3 which is used in training the model
   iv. **Word Embeddings :** We used a pre-trained Word2Vec word embeddings for the LSTM model

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# Model Training

- Naive Bayes

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| -1 | 0.56 | 0.43 | 0.48 | 70 |
| 0 | 0.43 | 0.43 | 0.43 | 126 |
| 1 | 0.89 | 0.91 | 0.90 | 804 |
| accuracy | | | 0.81 | 1000 |
| macro avg | 0.62 | 0.59 | 0.60 | 1000 |
| weighted avg | 0.81 | 0.81 | 0.81 | 1000 |

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| advice | 1.00 | 0.10 | 0.18 | 10 |
| celebrity | 0.80 | 0.86 | 0.83 | 145 |
| info_news | 0.73 | 0.78 | 0.76 | 545 |
| others | 0.00 | 0.00 | 0.00 | 17 |
| personal | 0.50 | 0.62 | 0.56 | 128 |
| plan | 0.22 | 0.17 | 0.19 | 82 |
| requests | 0.20 | 0.10 | 0.13 | 20 |
| restrictions | 0.00 | 0.00 | 0.00 | 2 |
| rumors | 0.00 | 0.00 | 0.00 | 15 |
| unrelated | 0.57 | 0.33 | 0.42 | 36 |
| accuracy | | | 0.66 | 1000 |
| macro avg | 0.40 | 0.30 | 0.31 | 1000 |
| weighted avg | 0.63 | 0.66 | 0.64 | 1000 |

- LSTM

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| -1 | 0.27 | 0.40 | 0.32 | 70 |
| 0 | 0.25 | 0.35 | 0.29 | 126 |
| 1 | 0.91 | 0.82 | 0.86 | 804 |
| accuracy | | | 0.73 | 1000 |
| macro avg | 0.48 | 0.52 | 0.49 | 1000 |
| weighted avg | 0.78 | 0.73 | 0.75 | 1000 |

| | | | | |
|---|---|---|---|---|
| accuracy | | | 0.21 | 1000 |
| macro avg | 0.16 | 0.33 | 0.17 | 1000 |
| weighted avg | 0.16 | 0.21 | 0.16 | 1000 |

# AraBert

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| advice | 0.40 | 0.20 | 0.27 | 10 |
| celebrity | 0.86 | 0.88 | 0.87 | 145 |
| info_news | 0.74 | 0.80 | 0.77 | 545 |
| others | 0.07 | 0.06 | 0.06 | 17 |
| personal | 0.54 | 0.56 | 0.55 | 128 |
| plan | 0.35 | 0.27 | 0.31 | 82 |
| requests | 0.23 | 0.15 | 0.18 | 20 |
| restrictions | 1.00 | 0.50 | 0.67 | 2 |
| rumors | 0.38 | 0.20 | 0.26 | 15 |
| unrelated | 0.54 | 0.42 | 0.47 | 36 |
| accuracy | | | 0.68 | 1000 |
| macro avg | 0.51 | 0.40 | 0.44 | 1000 |
| weighted avg | 0.66 | 0.68 | 0.67 | 1000 |

# AraBert

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| NEGATIVE | 0.60 | 0.54 | 0.57 | 70 |
| NEUTRAL | 0.55 | 0.48 | 0.52 | 126 |
| POSITIVE | 0.91 | 0.93 | 0.92 | 804 |
| accuracy | | | 0.85 | 1000 |
| macro avg | 0.69 | 0.65 | 0.67 | 1000 |
| weighted avg | 0.84 | 0.85 | 0.84 | 1000 |

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# Our Trials

- **Naive bayes (alpha = .31) + SMOTE using TF/IDF**

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| -1 | 0.41 | 0.56 | 0.47 | 70 |
| 0 | 0.40 | 0.51 | 0.45 | 126 |
| 1 | 0.92 | 0.86 | 0.89 | 804 |
| accuracy | | | 0.79 | 1000 |
| macro avg | 0.58 | 0.64 | 0.60 | 1000 |
| weighted avg | 0.82 | 0.79 | 0.80 | 1000 |

- **Naive bayes + SMOTE using BOG**

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| -1 | 0.41 | 0.36 | 0.39 | 80 |
| 0 | 0.47 | 0.42 | 0.44 | 140 |
| 1 | 0.88 | 0.91 | 0.89 | 780 |
| accuracy | | | 0.80 | 1000 |
| macro avg | 0.59 | 0.56 | 0.57 | 1000 |
| weighted avg | 0.79 | 0.80 | 0.79 | 1000 |

- **SVM + SMOTE  using TF/IDF**

| | precision | recall | f1-score | support |
|---|---|---|---|---|
| -1 | 0.41 | 0.36 | 0.39 | 80 |
| 0 | 0.47 | 0.42 | 0.44 | 140 |
| 1 | 0.88 | 0.91 | 0.89 | 780 |
| accuracy | | | 0.80 | 1000 |
| macro avg | 0.59 | 0.56 | 0.57 | 1000 |
| weighted avg | 0.79 | 0.80 | 0.79 | 1000 |

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- **SVM + SMOTE using TF/IDF**

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| | precision | recall | f1-score | support |
|---|---|---|---|---|
| advice | 0.50 | 0.20 | 0.29 | 10 |
| celebrity | 0.84 | 0.86 | 0.85 | 145 |
| info_news | 0.74 | 0.72 | 0.73 | 545 |
| others | 0.00 | 0.00 | 0.00 | 17 |
| personal | 0.56 | 0.66 | 0.60 | 128 |
| plan | 0.19 | 0.24 | 0.21 | 82 |
| requests | 0.19 | 0.15 | 0.17 | 20 |
| restrictions | 1.00 | 0.50 | 0.67 | 2 |
| rumors | 0.17 | 0.07 | 0.10 | 15 |
| unrelated | 0.44 | 0.44 | 0.44 | 36 |
| accuracy | | | 0.64 | 1000 |
| macro avg | 0.46 | 0.38 | 0.41 | 1000 |
| weighted avg | 0.64 | 0.64 | 0.64 | 1000 |

- **Naive Bayes using BOG**

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```
max f1= 0.5927599454092305 @ alpha= 0.16600000000000012
              precision    recall  f1-score   support

          -1       0.47      0.47      0.47        70
           0       0.43      0.40      0.41       135
           1       0.89      0.90      0.89       795

    accuracy                           0.80      1000
   macro avg       0.60      0.59      0.59      1000
weighted avg       0.80      0.80      0.80      1000

max f1= 0.36997395662325017 @ alpha= 0.01400000000000000
              precision    recall  f1-score   support

      advice       0.30      0.38      0.33         8
   celebrity       0.82      0.84      0.83       142
   info_news       0.72      0.74      0.73       531
      others       0.06      0.07      0.06        14
    personal       0.57      0.52      0.54       140
        plan       0.29      0.24      0.26       102
    requests       0.15      0.14      0.14        22
restrictions       0.50      0.25      0.33         4
      rumors       0.07      0.09      0.08        11
   unrelated       0.33      0.46      0.39        26
...
    accuracy                           0.63      1000
   macro avg       0.38      0.37      0.37      1000
weighted avg       0.63      0.63      0.63      1000
```

# Thank You