

Deployment of a Anti-Vaccine Tweet Detection Model

Sean Ng (DSIF 3)

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Introduction and Problem Statement



Misinformation



Vaccine Hesitancy





Outbreaks of severe infection



Unsafe reopening of borders



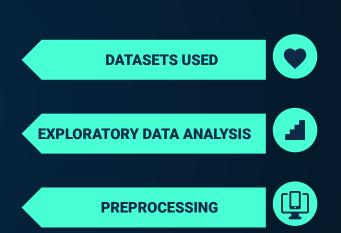
Goals of Project

 Evaluating the performance of different natural language processing models to identify anti-vaccination tweets that were published during the COVID-19 pandemic

 Deriving a minimum viable product by use of the most effective machine learning model to deploy a preliminary vaccine misinformation detection framework

Dataset Description





Datasets used

Hayawi, Kadhim, Sakib Shahriar, Mohamed Adel Serhani, Ikbal Taleb, and Sujith Samuel Mathew. "ANTi-Vax: a novel Twitter dataset for COVID-19 vaccine misinformation detection." Public Health 203 (2022): 23-30.

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 12989 entries, 0 to 12988
Data columns (total 23 columns):
    Column
                                Non-Null Count
                                                Dtype
    -----
                                -----
___
    created at
                                12989 non-null
                                                object
    hashtags
                                3565 non-null
                                                object
    favorite count
                                12989 non-null
                                                int64
3
                                12989 non-null int64
4
    lang
                                12989 non-null
                                                object
    possibly sensitive
                                5577 non-null
                                                float64
    retweet count
                                12989 non-null int64
    source
                                12989 non-null
                                                object
    text
                                12989 non-null
                                                object
    tweet url
                                12989 non-null
                                                object
    user created at
                                12989 non-null
                                                object
11
    user id
                                12989 non-null
                                                int64
    user default profile image 12989 non-null
                                                bool
13
    user description
                                11849 non-null
                                                object
    user favourites count
                                12989 non-null int64
15
    user followers count
                                12989 non-null int64
    user friends count
                                12989 non-null int64
    user listed count
                                12989 non-null int64
17
    user location
                                9526 non-null
                                                object
19
    user name
                                12987 non-null object
                                12989 non-null
                                                object
    user screen name
    user statuses count
                                12989 non-null
                                                int64
    user verified
                                12989 non-null
dtypes: bool(2), float64(1), int64(9), object(11)
memory usage: 2.1+ MB
```

A novel dataset containing over 12000 COVID-19 vaccine-related tweets and labeled tweet for vaccine misinformation detection

Time period: December 2020 to July 2021

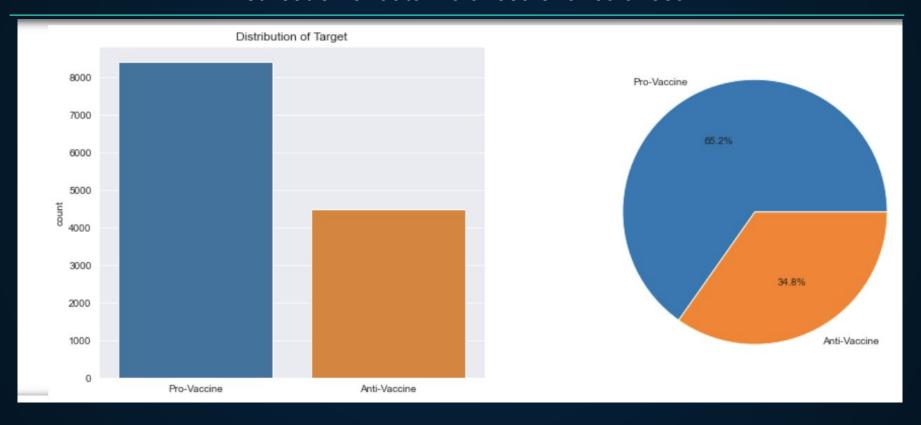
Datasets used

Hayawi, Kadhim, Sakib Shahriar, Mohamed Adel Serhani, Ikbal Taleb, and Sujith Samuel Mathew. "ANTi-Vax: a novel Twitter dataset for COVID-19 vaccine misinformation detection." Public Health 203 (2022): 23-30.

	text	is_misinfo
0	My 87 year old grandmother has been quarantining in her Florida house for close to a year. She was so excited to go to @CityDaytona to get her COVID vaccine next week, only to find out @CountyOfVolusia only has 2000 doses spread out over 2 days. For a county of 500,000+. 1/3	0
1	I'm so excited that with this vaccine I can see the day where we get back to the work of thanking and celebrating (in person and face to face) all the amazing work our healthcare heroes do every day. I'm very ready to throw our "Pandemic is over" party! #417fightscovid https://t.co/T7O6ypn8Ax	0
2	So excited that I was able to close out 2020 on a positive note with getting the first dose of the COVID-19 vaccine! https://t.co/Y1mSXVPBMD	0
3	Well, it happened. My daughter used my grandchildren to try to guilt me in to taking the vaccine for the CCP bioweapon. Satan is disguised in so many forms. Be on your guardeven when it feels like your heart is being ripped out. #StandStrong 🙏	1
4	I'm getting my COVID-19 vaccine, baby! I'm so fucking excited!	0

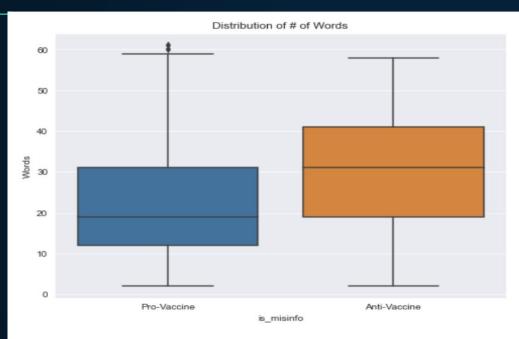
EXPLORATORY DATA ANALYSIS

Distribution of data: Balanced or unbalanced?



EXPLORATORY DATA ANALYSIS

Distribution of words



```
stats.f_oneway(df[df['is_misinfo']==0]['text'].str.split().apply(lambda x: len(x)),
df[df['is_misinfo']==1]['text'].str.split().apply(lambda x: len(x)))
```

F_onewayResult(statistic=1081.5857926254666, pvalue=7.652907009238765e-228)

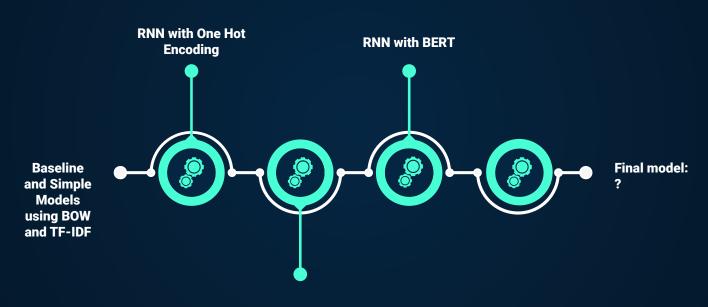
PREPROCESSING

```
def clean text(text):
        '''Make text lowercase, remove text in square brackets, remove links, remove punctuation
        and remove words containing numbers. '''
       text = text.lower()
       text = re.sub('\[\cdot,*?\]', '', text)
       text = re.sub('https?://\S+|www\.\S+', '', text)
       text = re.sub('<.*?>+', '', text)
       text = re.sub('[%s]' % re.escape(string.punctuation), '', text)
       text = re.sub('\n', '', text)
       text = re.sub('\w*\d\w*', '', text)
10
11
       text = ''.join([c for c in text if c not in string.punctuation])
       tokens = re.split('\W+', text)
12
13
       text = ' '.join([word for word in tokens if word not in stop words])
14
       text = nlp(text)
15
       text = ' '.join([word.lemma for word in text])
16
       return text
```

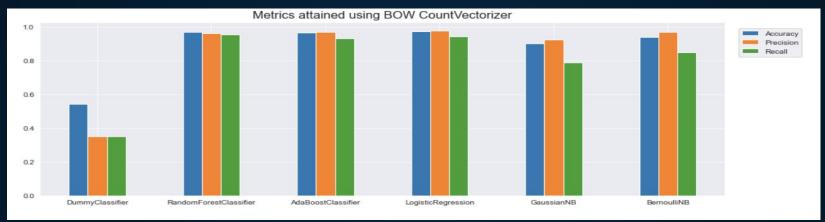
PREPROCESSING

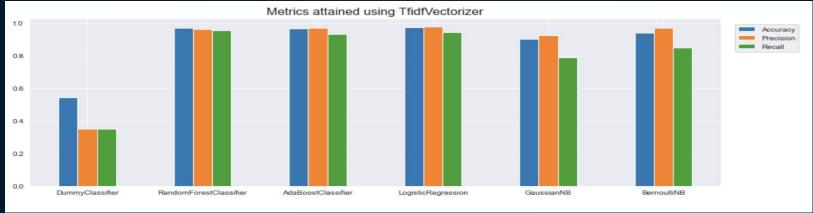
	text	is_misinfo	clean_text
0	My 87 year old grandmother has been quarantining in her Florida house for close to a year. She was so excited to go to @CityDaytona to get her COVID vaccine next week, only to find out @CountyOfVolusia only has 2000 doses spread out over 2 days. For a county of 500,000+. 1/3	0	year old grandmother quarantine florida house close year excite go citydaytona get next week find countyofvolusia dose spread day county
1	I'm so excited that with this vaccine I can see the day where we get back to the work of thanking and celebrating (in person and face to face) all the amazing work our healthcare heroes do every day. I'm very ready to throw our "Pandemic is over" party! #417fightscovid https://t.co/T7O6ypn8Ax	0	excite see day get back work thank celebrate person face face amazing work healthcare hero every day ready throw pandemic party
2	So excited that I was able to close out 2020 on a positive note with getting the first dose of the COVID-19 vaccine! https://t.co/Y1mSXVPBMD	0	excite able close positive note get first dose
3	Well, it happened. My daughter used my grandchildren to try to guilt me in to taking the vaccine for the CCP bioweapon. Satan is disguised in so many forms. Be on your guardeven when it feels like your heart is being ripped out. #StandStrong	1	well happen daughter use grandchild try guilt take ccp bioweapon satan disguise many form guardeven feel like heart rip standstrong
4	I'm getting my COVID-19 vaccine, baby! I'm so fucking excited!	0	get baby fuck excited

Modelling Process



Baseline & Simple Models (BOW vs TF-IDF)





Baseline & Simple Models (BOW vs TF-IDF)

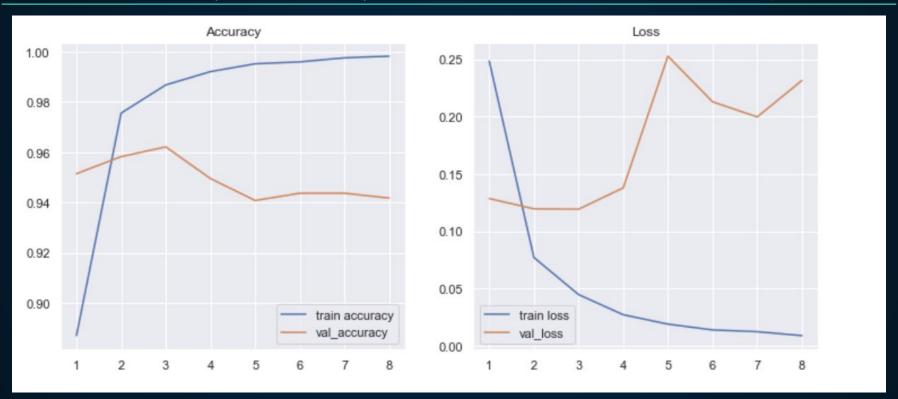
	clf	Accuracy	Precision	Recall
0	DummyClassifier	0.545092	0.350489	0.349688
1	RandomForestClassifier	0.970779	0.961765	0.954558
2 3 4	AdaBoostClassifier	0.966703	0.970891	0.932949
	LogisticRegression	0.972430	0.978150	0.942367
	GaussianNB	0.904184	0.925145	0.790524
5	BernoulliNB	0.938259	0.972049	0.848163

(V)	clf	Accuracy	Precision	Recall	9
0	DummyClassifier	0.544121	0.348412	0.346909	
1	RandomForestClassifier	0.970682	0.962288	0.953728	
2	AdaBoostClassifier	0.964955	0.970987	0.927686	
3	LogisticRegression	0.968352	0.972934	0.935718	
4	GaussianNB	0.897195	0.888072	0.808535	
5	BernoulliNB	0.938259	0.972049	0.848163	

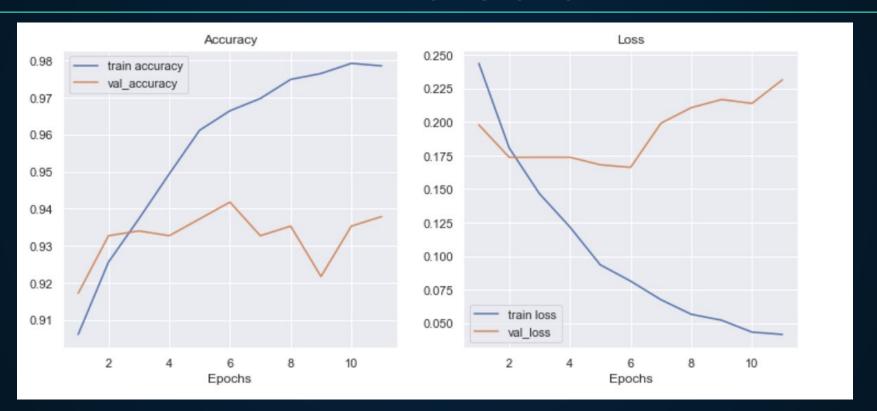
RNN (& LSTM) with one hot Encoding

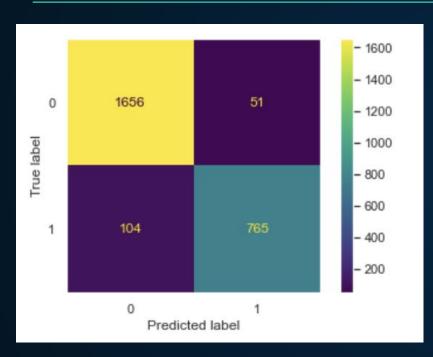
```
onehot repr = [one hot(words, voc size) for words in corpus]
  onehot repr
[[1650,
 1600.
 3882.
                                        0 ... 1252 1127 1024]
 3088,
 205,
 1575.
                                        0 ... 1771 922 3147]
 316,
 1650,
 4567,
                                        0 ... 3047 4129 2842]
 1063,
 1328,
 3047,
 3552.
 3349.
                                        0 ... 2130 2999 1452]
 722,
 3376,
 2842,
                                        0 ... 1274 2987 2533]
 1252,
 1127,
                                        0 ... 1023 2843 4662]]
```

RNN (& LSTM) with one hot Encoding



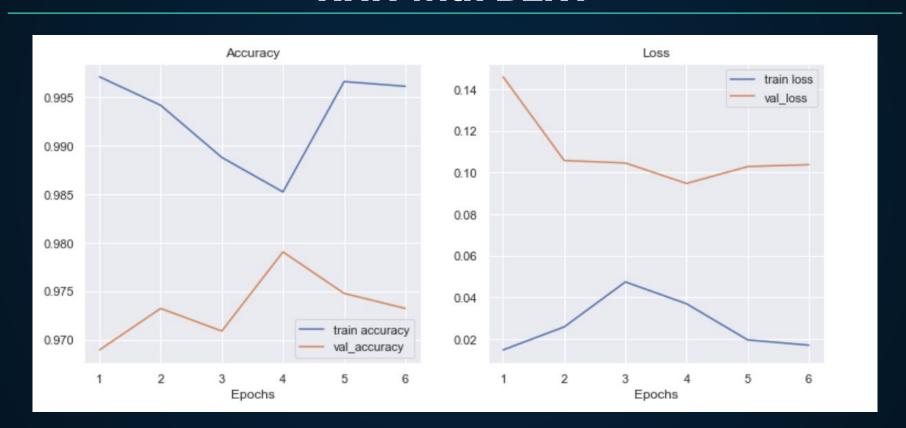
```
1 glove matrix
                 , 0.
                             , 0.
                                        , ..., 0.
                                                         , 0.
array([[ 0.
        0.
                 ],
                 , 0.
                             , 0.
        0.
                                         , ..., 0.
                                                            0.
        0.
                 , 0.35396
      [-0.11164]
                            , -0.21636
                                        , \ldots, -0.10389 , 0.39103 ,
       0.0045548],
      . . . ,
      [-0.086452, -0.15659, 0.038341, ..., 0.11365, -0.14378]
        1.1634
                 ],
                 , 0.
                             , 0.
      [ 0.
                                        , ..., 0.
                                                         , 0.
        0.
                 1,
      [ 0.
                 , 0.
                                0.
                                         , ..., 0.
                                                            0.
        0.
                 ]])
```



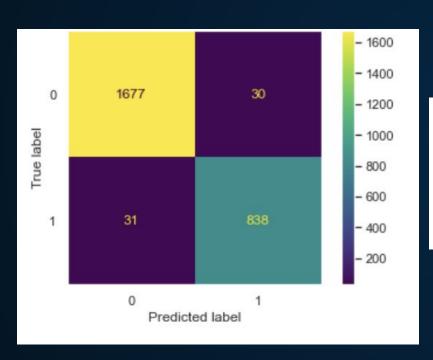


	precision	recall	fl-score	support	
0	0.94	0.97	0.96	1707	
1	0.94	0.88	0.91	869	
accuracy			0.94	2576	
macro avg	0.94	0.93	0.93	2576	
weighted avg	0.94	0.94	0.94	2576	

RNN with BERT



RNN with BERT



	precision	recall	f1-score	support	
0	0.98	0.98	0.98	1707	
1	0.97	0.96	0.96	869	
accuracy			0.98	2576	
macro avg	0.97	0.97	0.97	2576	
weighted avg	0.98	0.98	0.98	2576	

Choice of Final Model

Random Forest Model with TF-IDF Vectorizer!



Twitter Anti-Vaccine Classifier

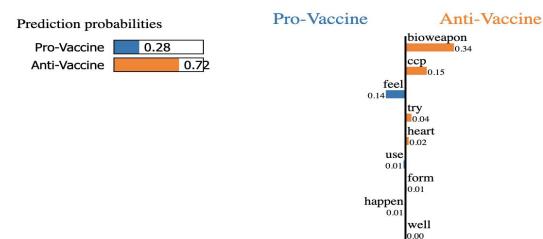
Well, it happened. My daughter used my grandchildren to try to guilt me in to taking the vaccine for the CCP bioweapon. Satan is disguised in so many forms. Be on your guard...even when it feels like your heart is being ripped out

satan

Submit

Vaccine-Misinformation; confidence (72.0%)

LIME-explained results:



Text with highlighted words

well happen daughter use grandchild try guilt taking vaccine ccp bioweapon satan disguise many form guardeven feel like heart rip

Flask API

```
<!DOCTYPE html>
    <head>
        <title>{{ title }} Twitter Anti Vaccine Classification </title>
   </<u>head</u>>
        <h1>Twitter Anti-Vaccine Classifier</h1>
        <form method="POST">
           <textarea name="input_text" placeholder="Content of tweet:" rows="3" cols="100"></textarea><br/>br><br/>
           <input class="example_a" type="submit">
        {% if prediction %}
           <<u>h2</u>> {{ prediction }}</<u>h2</u>>
           {% else %}
           {% endif %}
        {% if exp %}
        <h3 align="left">LIME-explained results:</h3>
        <div class="container">
           {{ exp|safe }}
        {% endif %}
   </body>
```

Twitter Anti-Vaccine Classifier

```
Content of tweet:
Submit
{% if prediction %}
{{ prediction }}
{% else %}
{% endif %}
{% if exp %}
LIME-explained results:
{{ explsafe }}
{% endif %}
```

Flask API

```
from flask import Flask, request, render_template
import pickle
from sklearn.pipeline import make_pipeline
from lime.lime text import LimeTextExplainer
import os
import spacy
nlp = spacy.load('en_core_web_sm')
from nltk.corpus import stopwords
import nltk
nltk.download('stopwords')
import re
import string
app = Flask(__name__, template_folder='template')
infile = open('rf model.pkl', 'rb')
model = pickle.load(infile)
infile.close()
infile = open('tf.pkl', 'rb')
vectorizer = pickle.load(infile)
infile.close()
c = make_pipeline(vectorizer, model)
class_names = {'Pro-Vaccine': 'Pro-Vaccine', 'Anti-Vaccine': 'Vaccine Misinformation'},
LIME_explainer = LimeTextExplainer(class names=class_names)
@app.route('/')
    # open('static/interpret.html', 'w').close()
    return render_template('index.html')
@app.route('/', methods=['POST'])
def predict tweet():
    def clean_text(text):
        '''Make text lowercase, remove text in square brackets, remove links, remove punctuation
        and remove words containing numbers.'''
        stop_words = stopwords.words('english') + ['u', 'ur', '4', '2', 'im', 'dont', 'doin', 'ure']
        text = text.lower()
```

From Docker, ready for deployment!

Former FEMA operative Celeste Solum on what she says is in the Gates vaccine – I say that the 'bioweapon' is not in fact the 'virus' which does not exist, but the vaccine justified by the 'virus' and people will have to decide what they they think

I'm so excited that with this vaccine I can see the day where we get back to the work of thanking and celebrating (in person and face to face) all the amazing work our healthcare heroes do every day. I'm very ready to throw our "Pandemic is over" party

Delaying second doses of vaccine is the right call, say UK's chief medical officers\nhttps://t.co/uq21Xa49a4\n\nl'm totally against the experimental rushed vaccine, but... \n\nPfizer issue a warning 1 and SAGE just do what the hell they want ... what's happening here

CONCLUSION

- Process of cleaning up data could be improved
- Attempt to deploy using deep learning
- Use a bigger computer



SPECIAL THANKS TO THE GA LECTURERS, TAs & CLASSMATES FOR THE PAST 6 MONTHS JOURNEY!

OUR GOALS



USABILITY

Despite being red, Mars is a cold place, not hot. It's full of iron oxide dust



POSITIONING

Venus has a beautiful name and is the second planet from the Sun



EXPANSION

Neptune is the fourth-largest planet in our Solar System

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- Circuit of user experience
- Timeline infographic
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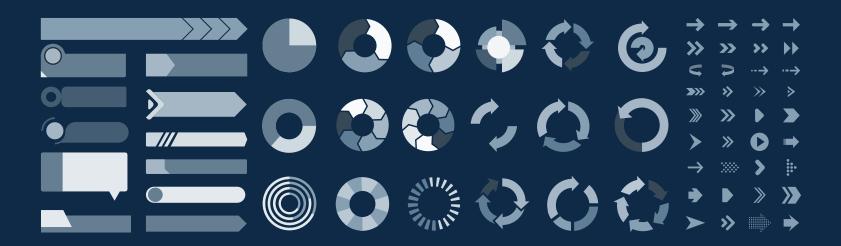


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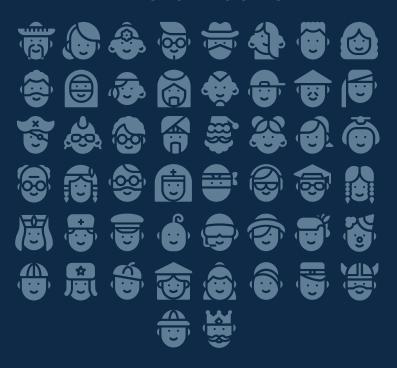


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