Twitter Sentiment Analysis

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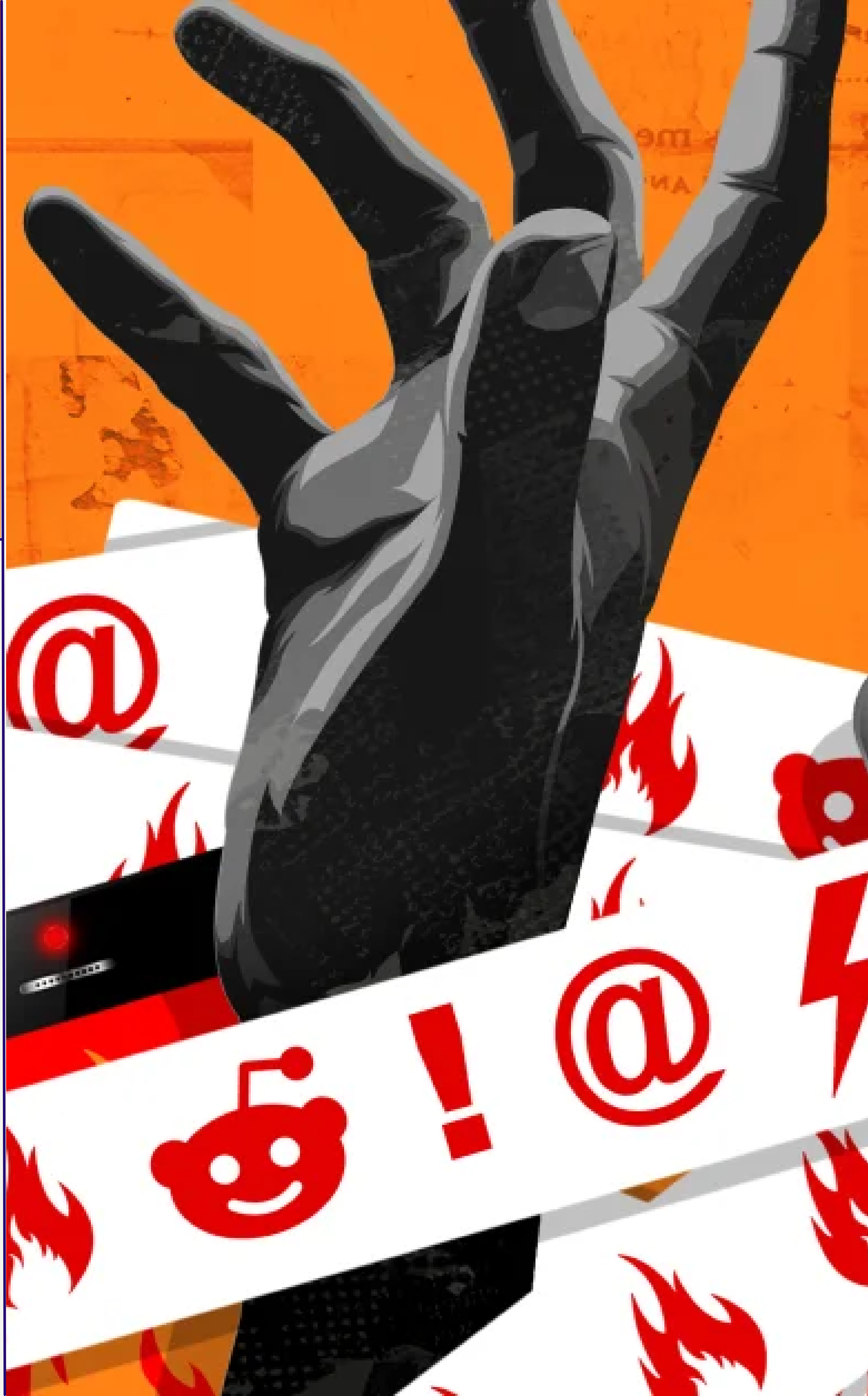
Practical Motivation

- A common occurrence on the internet
- Censorship issues
- Strong connection between hate speech and actual hate crime (HateLab project - Cardiff University)
- Early identification --> Enabling outreach programmes
- NLP Research on hate speech has been limited

Christchurch mosque shootings

A contemporary example of hate speech materialising into hate crime.

- A mass shooting that occurred in Christchurch on 15 March 2019, leaving 50 people dead and dozens others wounded.
- Shooter posted about his plans on 8chan: "time to stop shitposting and time to make a real life effort".

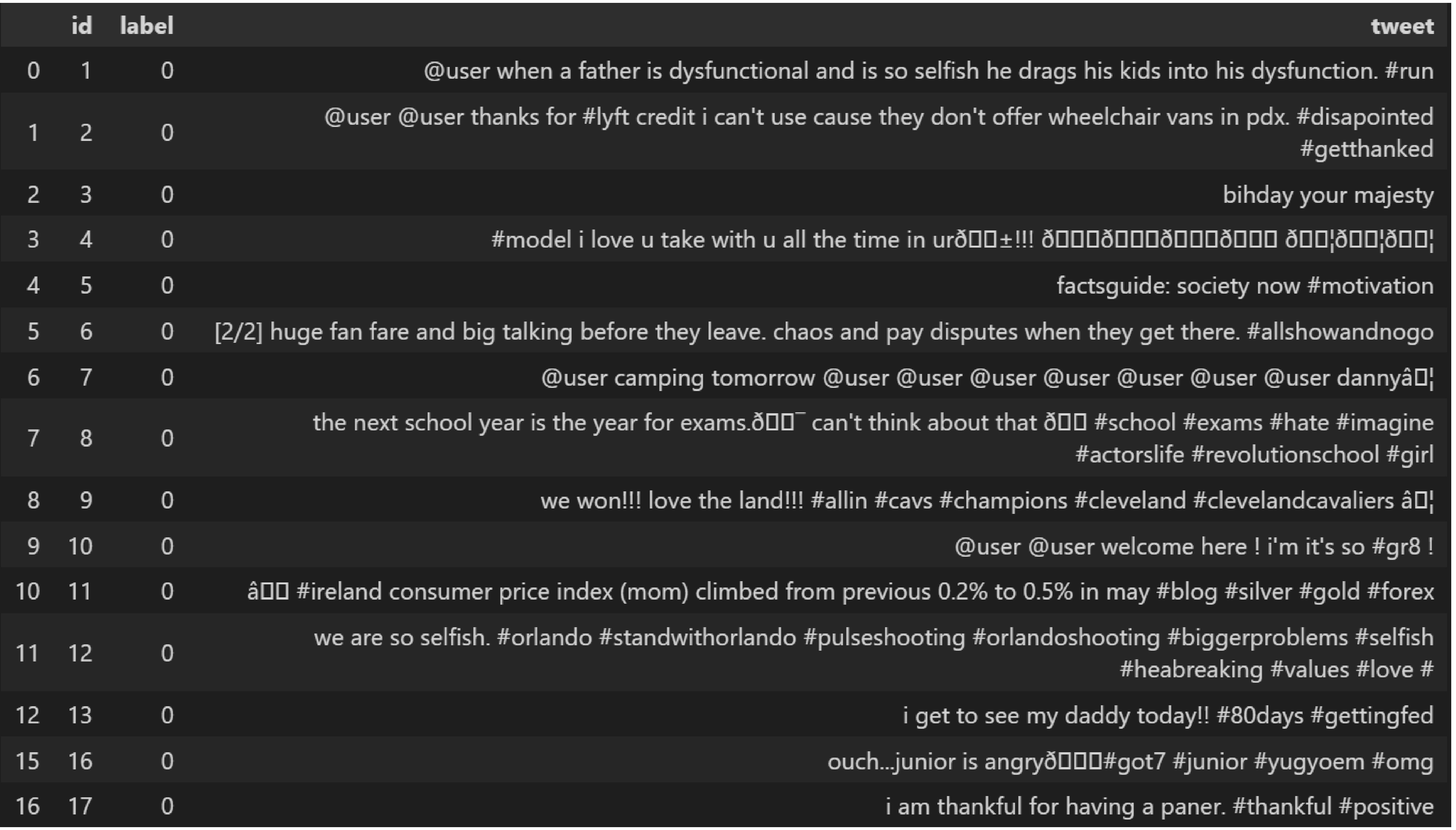


Problem Formulation

Problem to be addressed:
Effective implementation of Data Science and Natural Language Processing (NLP) concepts to find the best model to detect hate speech in tweets.

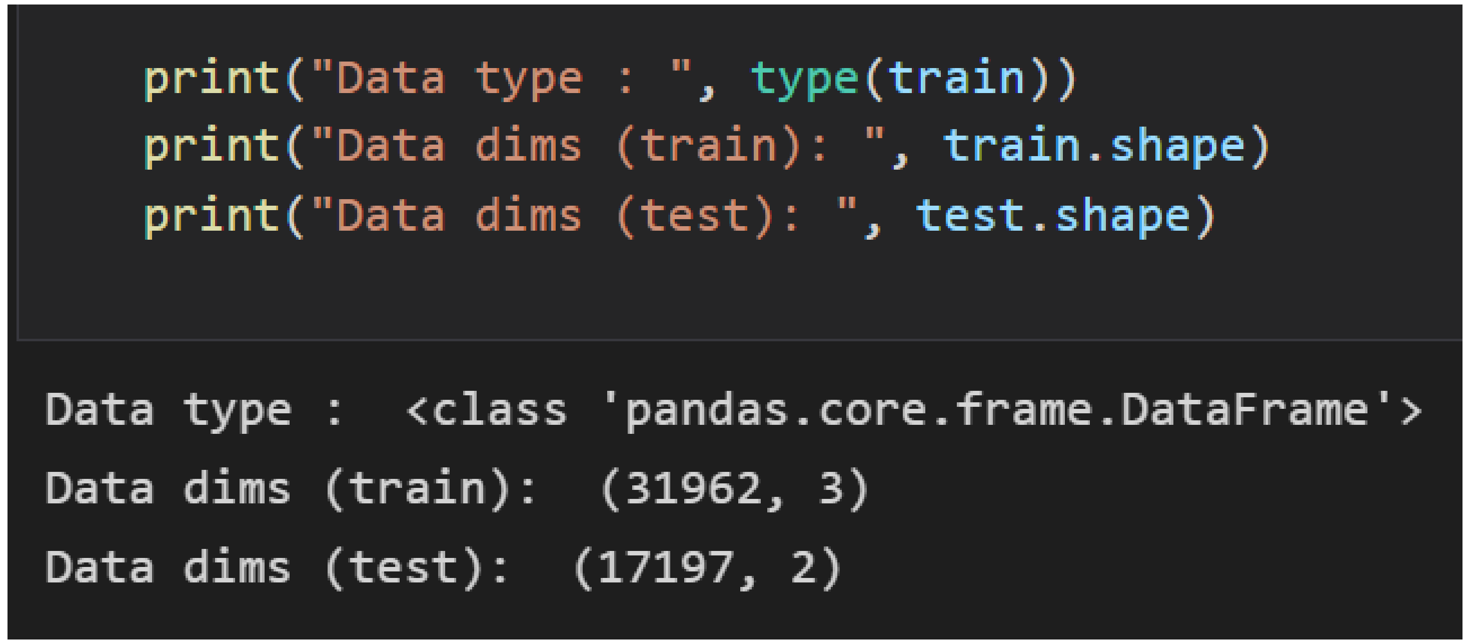
Guiding Question: How can we effectively detect hate speech in tweets?

The Dataset



	id	label	tweet
0	1	0	@user when a father is dysfunctional and is so selfish he drags his kids into his dysfunction. #run
1	2	0	@user @user thanks for #lyft credit i can't use cause they don't offer wheelchair vans in pdx. #disapointed #getthanked
2	3	0	bihday your majesty
3	4	0	#model i love u take with u all the time in urð□□±!!! ð□□□ð□□□ð□□□ð□□□ ð□□¦ð□□¦ð□□¦
4	5	0	factsguide: society now #motivation
5	6	0	[2/2] huge fan fare and big talking before they leave. chaos and pay disputes when they get there. #allshowandnogo
6	7	0	@user camping tomorrow @user @user @user @user @user @user @user dannyâ□¦
7	8	0	the next school year is the year for exams.ð□□¯ can't think about that ð□□ #school #exams #hate #imagine #actorslife #revolutionschool #girl
8	9	0	we won!!! love the land!!! #allin #cavs #champions #cleveland #clevelandcavaliers â□¦
9	10	0	@user @user welcome here ! i'm it's so #gr8 !
10	11	0	â□□ #ireland consumer price index (mom) climbed from previous 0.2% to 0.5% in may #blog #silver #gold #forex
11	12	0	we are so selfish. #orlando #standwithorlando #pulseshooting #orlandoshooting #biggerproblems #selfish #heabreaking #values #love #
12	13	0	i get to see my daddy today!! #80days #gettingfed
15	16	0	ouch...junior is angryð□□□#got7 #junior #yugyoem #omg
16	17	0	i am thankful for having a paner. #thankful #positive

Snippet from Train set



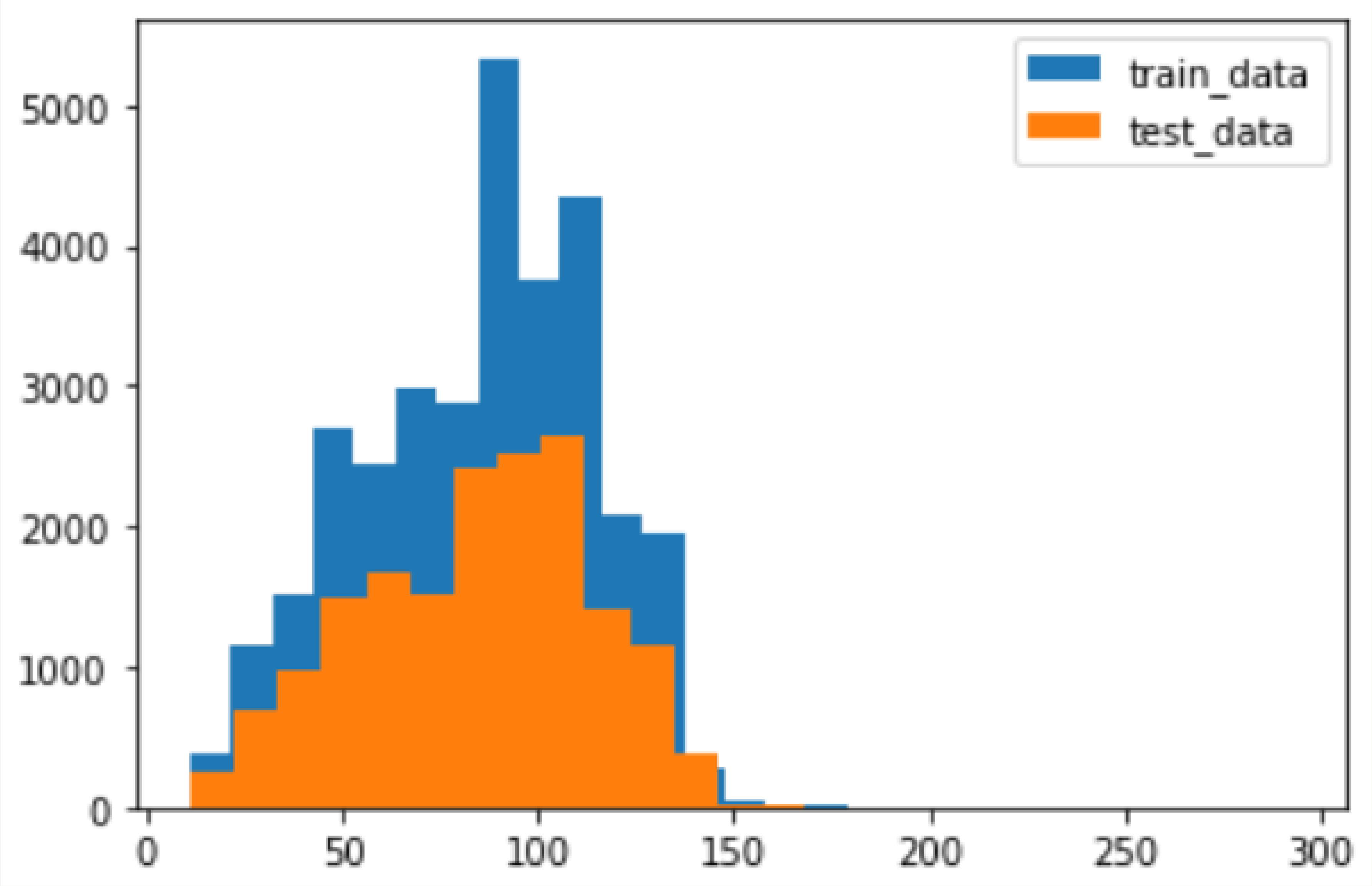
```
print("Data type : ", type(train))
print("Data dims (train): ", train.shape)
print("Data dims (test): ", test.shape)
```

```
Data type :  <class 'pandas.core.frame.DataFrame'>
Data dims (train):  (31962, 3)
Data dims (test):  (17197, 2)
```

Train set: 31,962 tweets in 3 columns

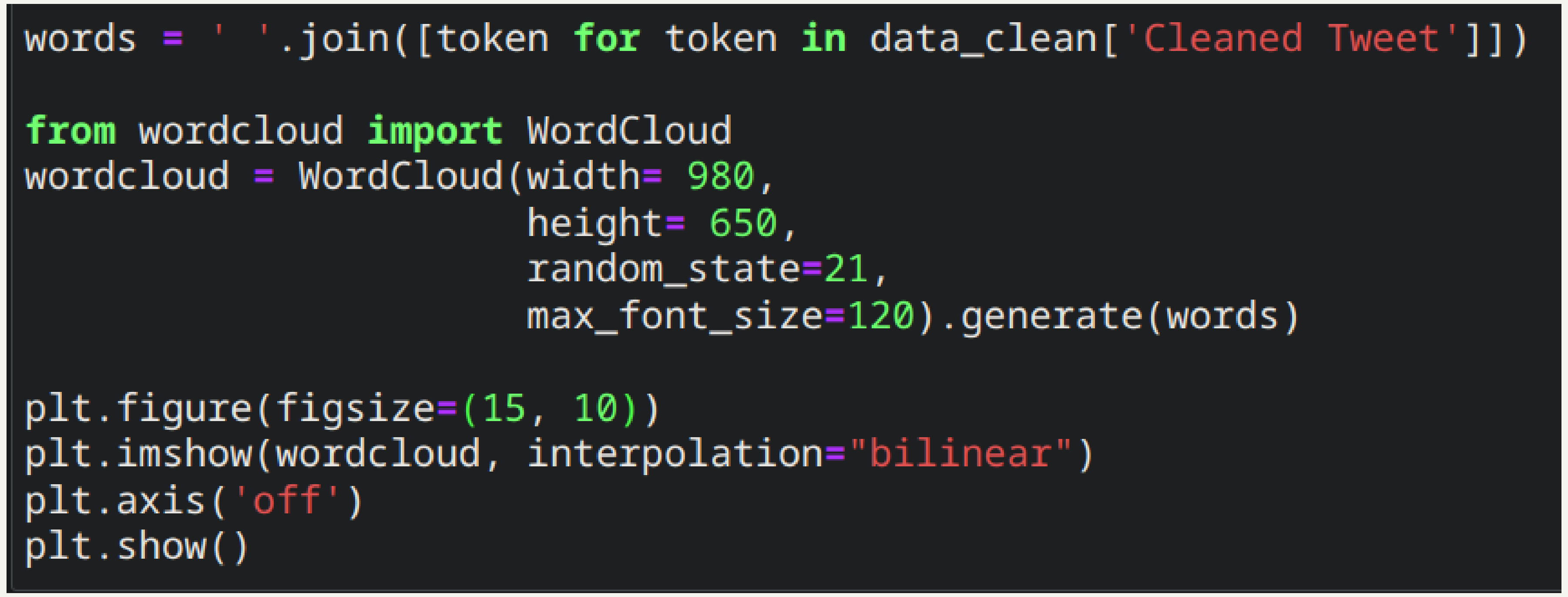
Test set: 17,197 tweets in 2 columns

Exploratory Data Analysis

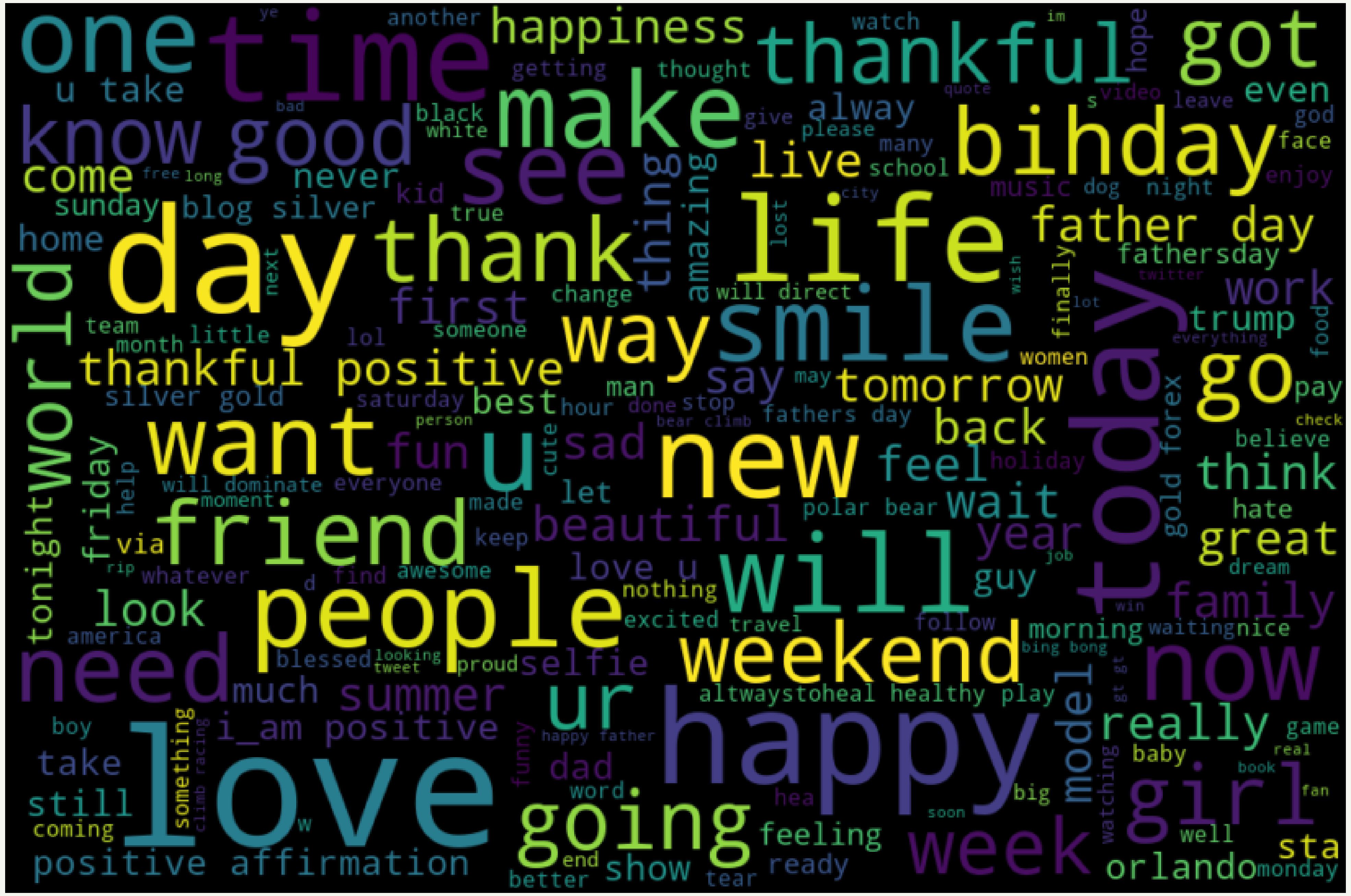


- Similarity between distribution of the length of tweets of test and train data
- Overall shape is similar => well-distributed train-test split.

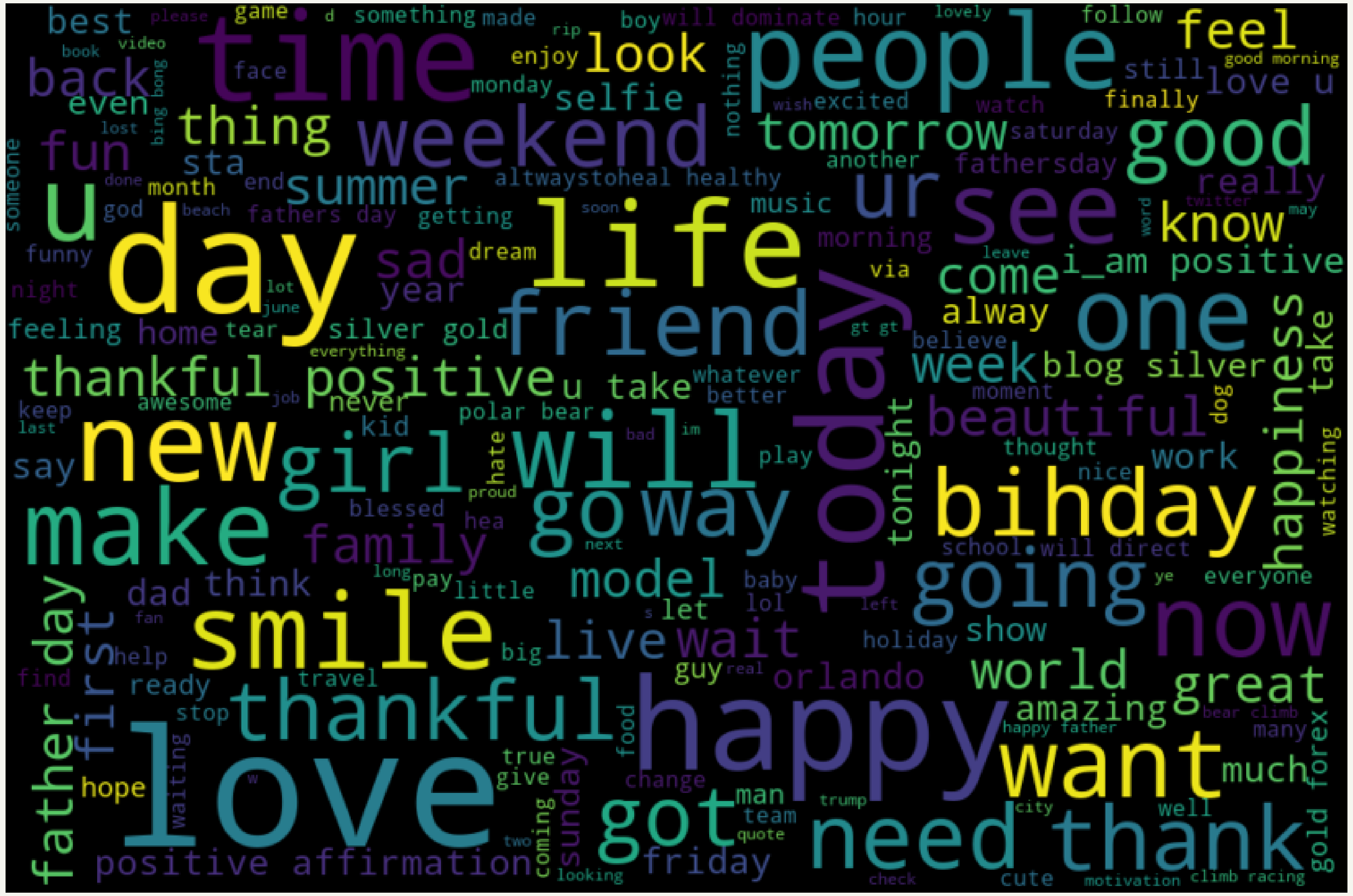
Wordcloud Representation



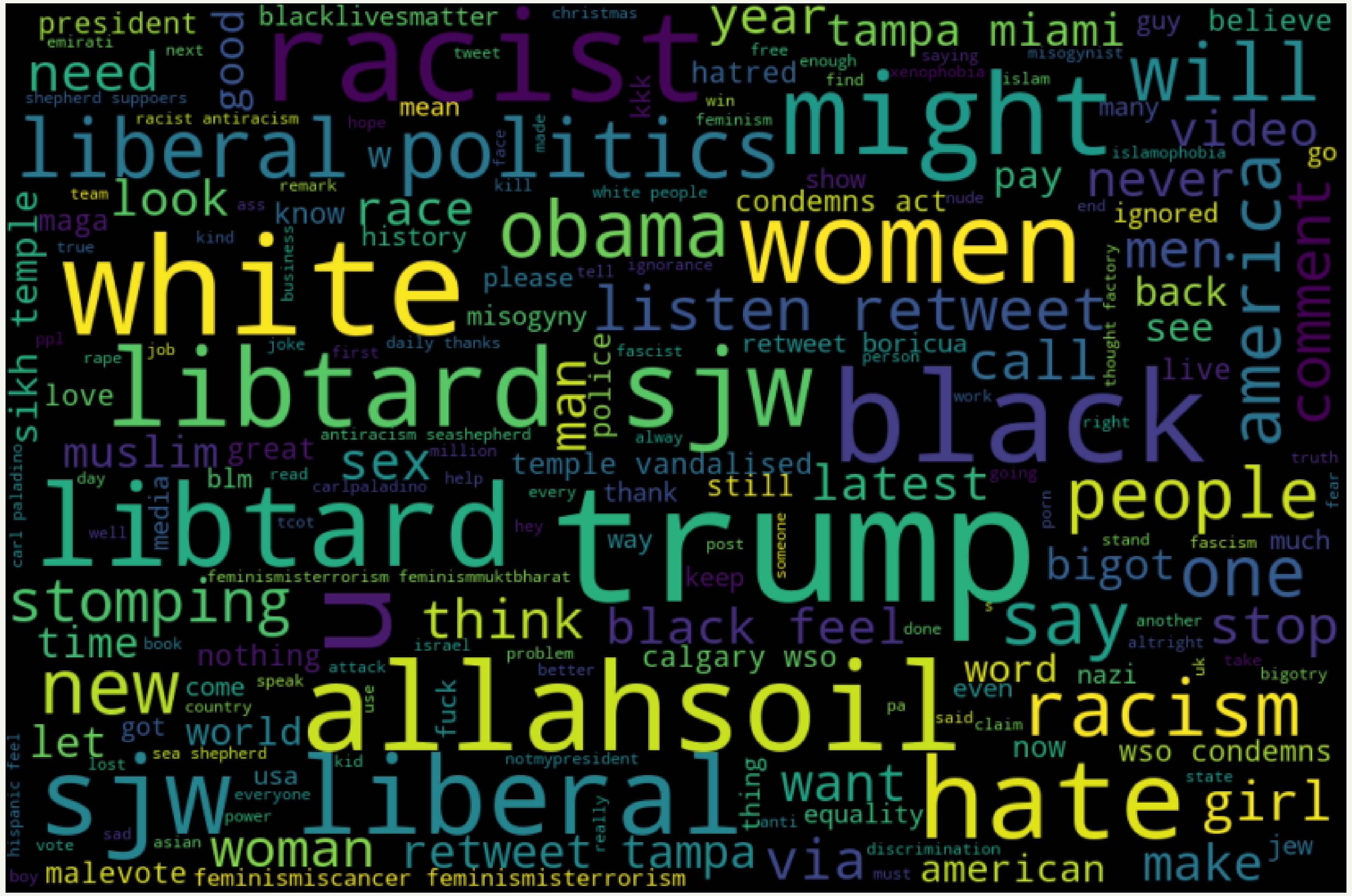
```
words = ' '.join([token for token in data_clean['Cleaned Tweet']])

from wordcloud import WordCloud
wordcloud = WordCloud(width= 980,
                      height= 650,
                      random_state=21,
                      max_font_size=120).generate(words)

plt.figure(figsize=(15, 10))
plt.imshow(wordcloud, interpolation="bilinear")
plt.axis('off')
plt.show()
```



Positive



Negative



Data Cleaning

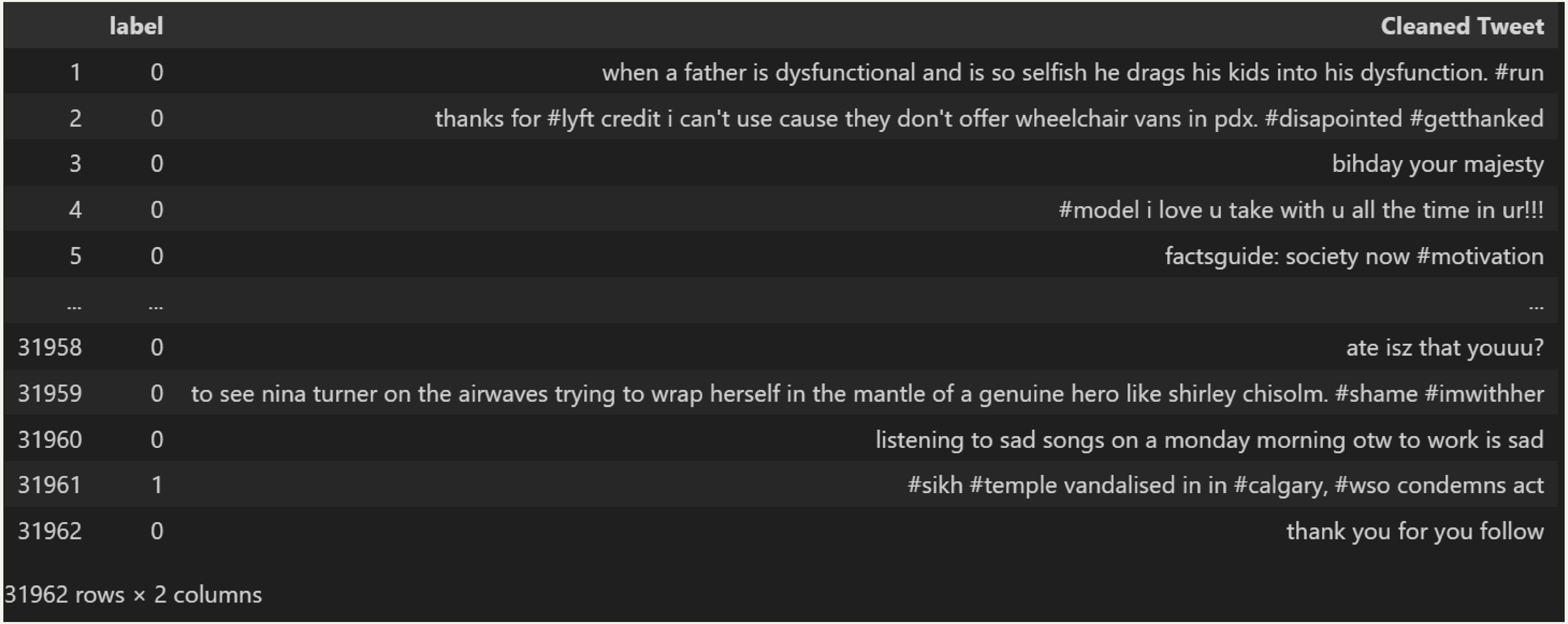
1 Renaming & dropping redundant colums

2 Reindexing

3 Removing non-ascii values

4 @user and other anomalies

data_clean

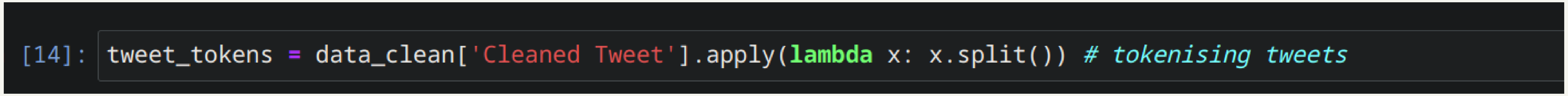


	label	Cleaned Tweet
1	0	when a father is dysfunctional and is so selfish he drags his kids into his dysfunction. #run
2	0	thanks for #lyft credit i can't use cause they don't offer wheelchair vans in pdx. #disapointed #getthanked
3	0	bihday your majesty
4	0	#model i love u take with u all the time in ur!!!
5	0	factsguide: society now #motivation
...	...	...
31958	0	ate isz that youuu?
31959	0	to see nina turner on the airwaves trying to wrap herself in the mantle of a genuine hero like shirley chisolm. #shame #imwithher
31960	0	listening to sad songs on a monday morning otw to work is sad
31961	1	#sikh #temple vandalised in in #calgary, #wso condemns act
31962	0	thank you for you follow

31962 rows × 2 columns

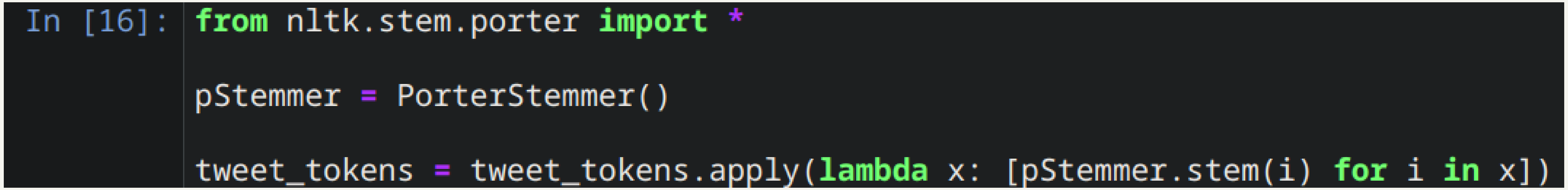
Text Normalisation

1 Tokenise tweets

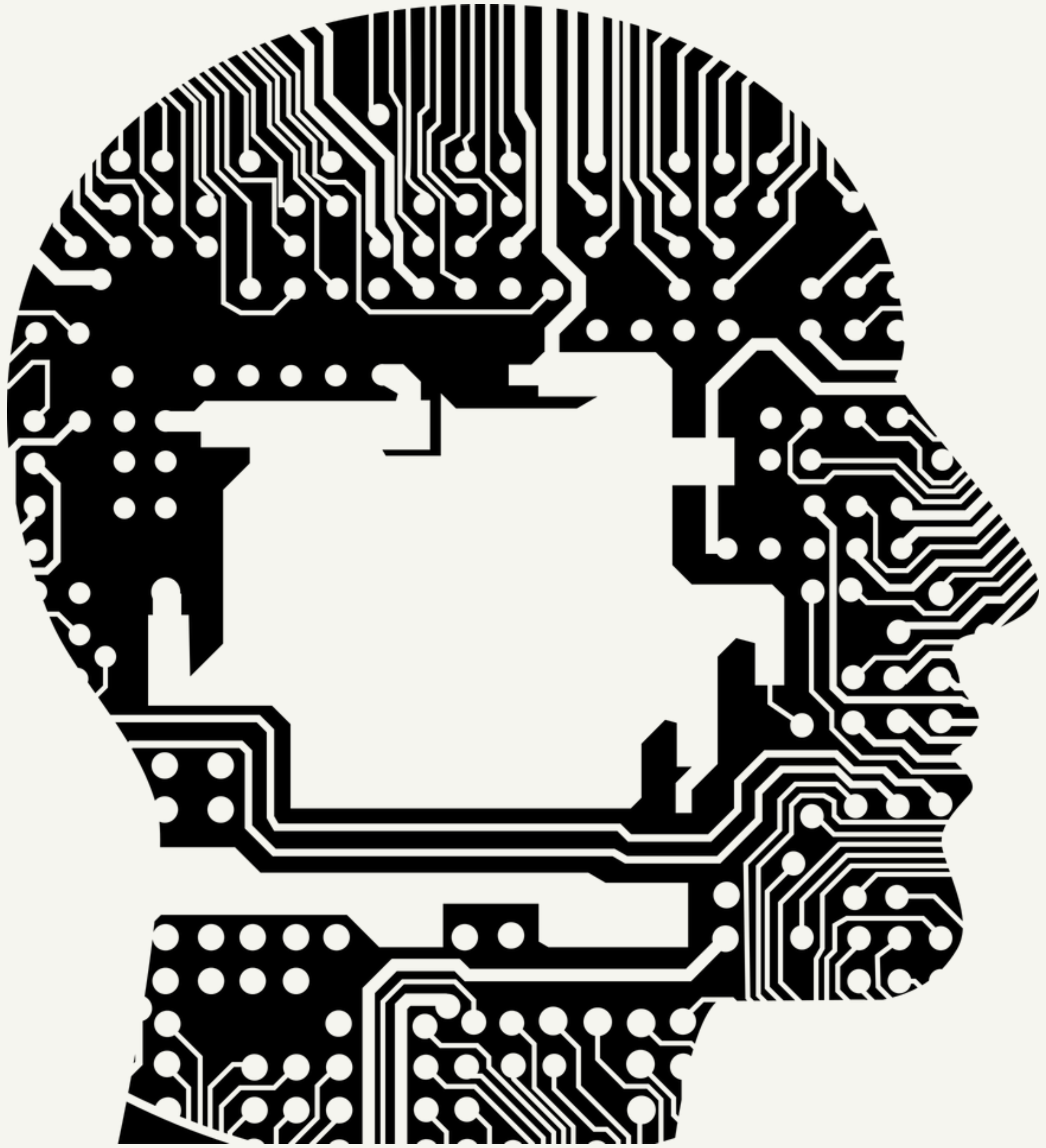


```
[14]: tweet_tokens = data_clean['Cleaned Tweet'].apply(lambda x: x.split()) # tokenising tweets
```

2 Normalise tweets



```
In [16]: from nltk.stem.porter import *

         pStemmer = PorterStemmer()

         tweet_tokens = tweet_tokens.apply(lambda x: [pStemmer.stem(i) for i in x])
```



Feature Extraction

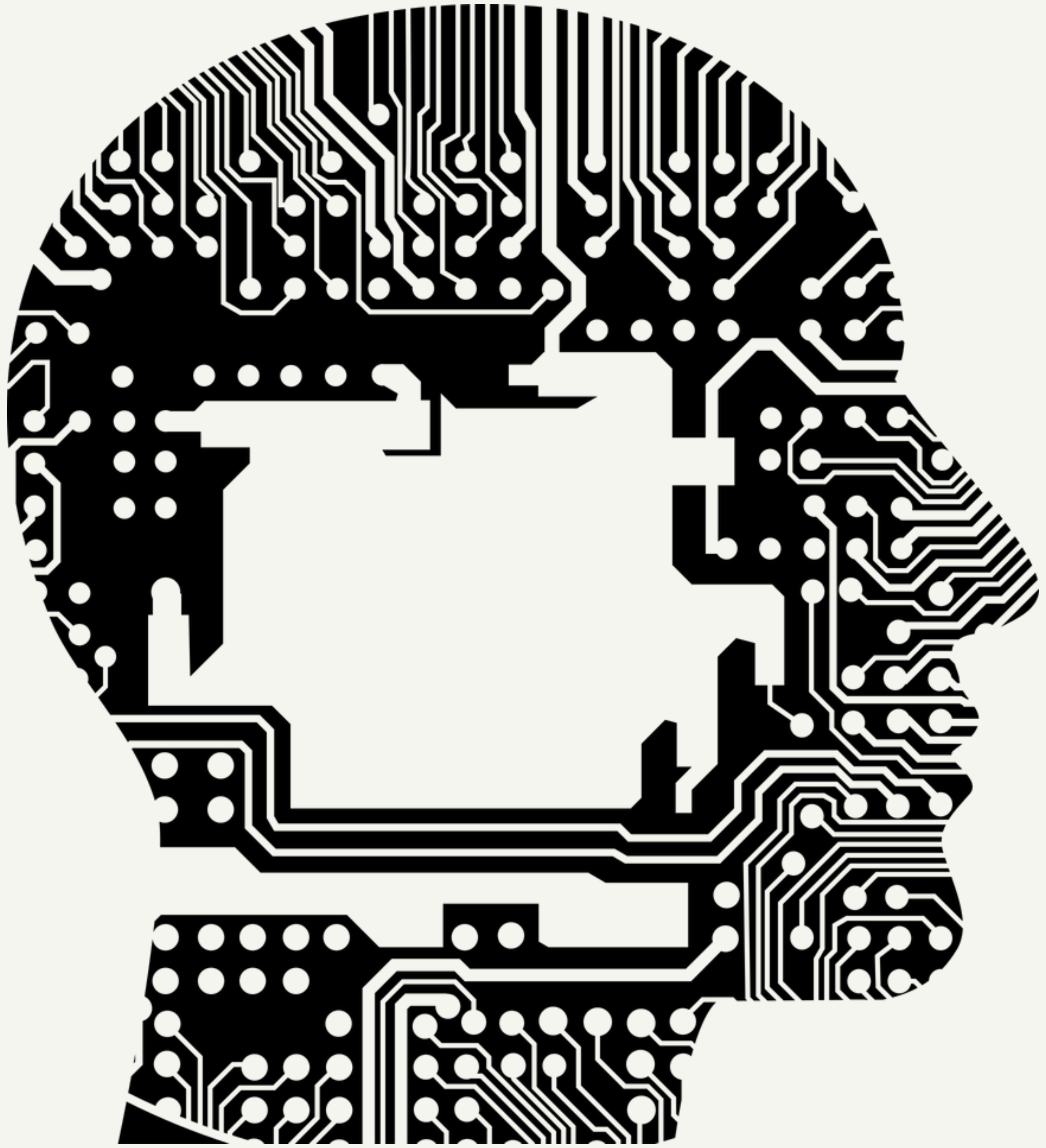
Key Features

1 Bag-Of-Words

2 TF-IDF

3 Word2Vec

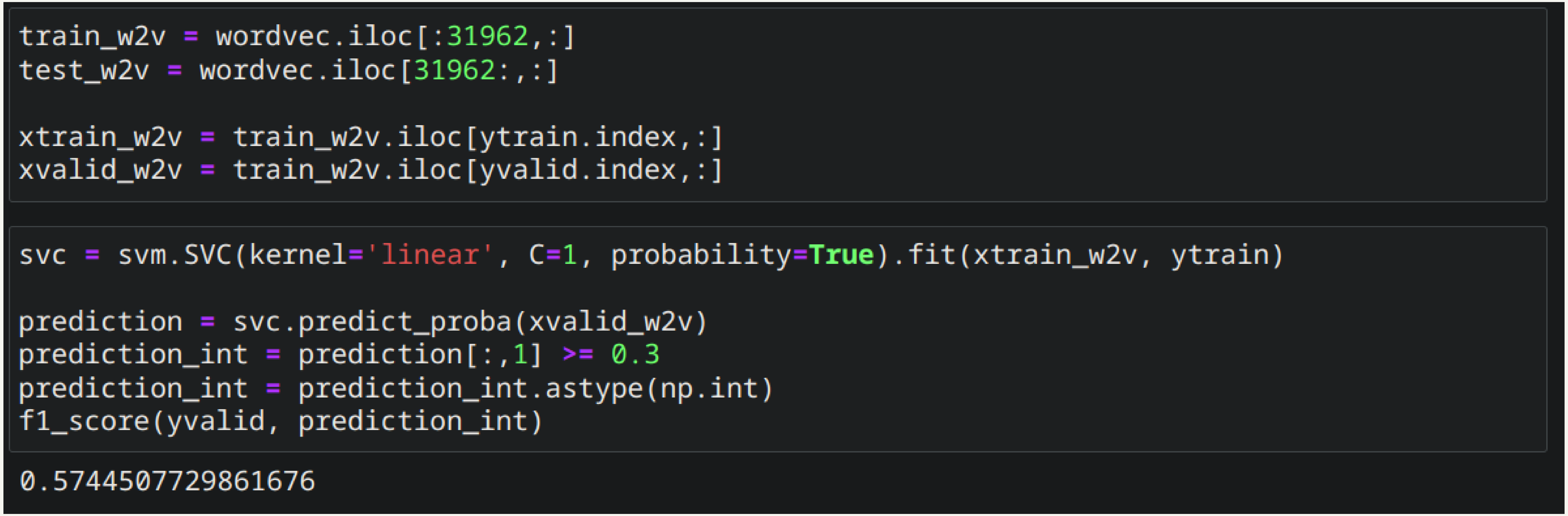
4 Doc2Vec



Machine Learning

Models used:

1. Support Vector Machine
2. Logistic Regression
3. Random Forest
4. XGBBoost

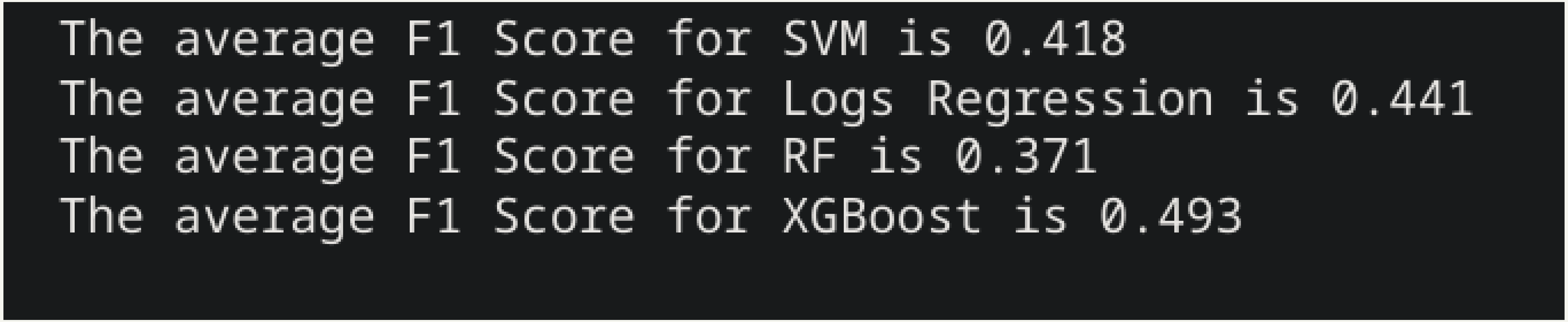


```
train_w2v = wordvec.iloc[:31962,:]
test_w2v = wordvec.iloc[31962:,:]

xtrain_w2v = train_w2v.iloc[ytrain.index,:]
xvalid_w2v = train_w2v.iloc[yvalid.index,:]
```

```
svc = svm.SVC(kernel='linear', C=1, probability=True).fit(xtrain_w2v, ytrain)

prediction = svc.predict_proba(xvalid_w2v)
prediction_int = prediction[:,1] >= 0.3
prediction_int = prediction_int.astype(np.int)
f1_score(yvalid, prediction_int)
```

```
0.5744507729861676
```

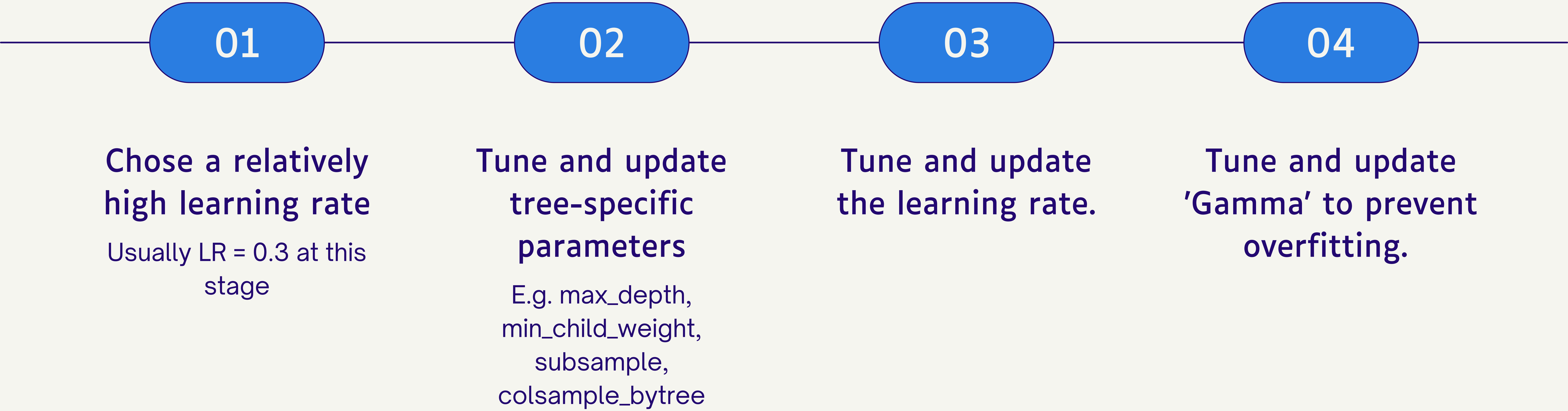
Performance Analysis



```
The average F1 Score for SVM is 0.418
The average F1 Score for Logs Regression is 0.441
The average F1 Score for RF is 0.371
The average F1 Score for XGBoost is 0.493
```

0.493	Average F1 Score for XGBoost
0.621	Highest F1 Score achieved by XGBoost via Word2Vec
~0.750	Expected F1 Score after Tuning

General Structure for Hyperparameter Tuning



01

Chose a relatively high learning rate

Usually LR = 0.3 at this stage

02

Tune and update tree-specific parameters

E.g. max_depth, min_child_weight, subsample, colsample_bytree

03

Tune and update the learning rate.

04

Tune and update 'Gamma' to prevent overfitting.

Conclusion

XGBoost as the best model

Word2Vec as the best feature

Hyperparameter Tuning for optimisation

Useful to analyse hate crime motives

Recommendations / Possible Extensions

Hyperparameter Tuning

Optimising model performance

Trying out other binary classifiers

E.g. simple decision tree, naive bayes etc.

Examining specific sentiments

Such as depression, joy, anger.

Optimising Precision and Recall

To improve time and space complexity

Visualisation

Use of GraphViz to illustrate results

Social media posts

Implementing the same techniques on platforms such as Instagram to gain a deeper insight

Thank you!