

In [153... `# COMP9727 Assignment`

```
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```

In [153... `#Part 1`

In [153... `# Part 1 Question 1`

```
# In the tutorial the regex applied was for news stories, whereas for this assign
# with double meanings or when a punctuation mark can significantly change the L
# too many punctuations as such I have added full stops, commas, exclamation ma
# the lyrics to stay intact.
```

```
# As for the training-test split vs the k-fold cross validation, since the datas
# topics being under represented, the training-test split might result in an unl
# songs and the test set has all of them resulting in terrible classification re
# possiblity and also allow for better results by simulating more data for the m
# validation is used, allowing each fold to have roughly the same percentage of
```

In [153... `# Loading the Data`

```
import pandas as pd

topics = ['dark', 'emotion', 'lifestyle', 'personal', 'sadness' ]
dataset = pd.read_csv('dataset.tsv', sep='\t')
data = dataset.iloc[:, :5].astype(str).apply(' '.join, axis=1)
df = pd.DataFrame({
    'Content': data,
    'Topic': dataset.iloc[:, 5]
})

print(df)
```

	Content	Topic
0	loving the not real lake 2016 rock awake know ...	dark
1	incubus into the summer 2019 rock shouldn summ...	lifestyle
2	reignwolf hardcore 2016 blues lose deep catch ...	sadness
3	tedeschi trucks band anyhow 2016 blues run bit...	sadness
4	lukas nelson and promise of the real if i star...	dark
...
1495	ra ra riot absolutely 2016 rock year absolutel...	emotion
1496	mat kearney face to face 2018 rock breakthrough...	dark
1497	owane born in space 2018 jazz look look right ...	dark
1498	nappy roots blowin' trees 2019 hip hop nappy r...	personal
1499	skillet stars 2016 rock speak word life begin ...	sadness

[1500 rows x 2 columns]

In [153... `# Drop duplicates and missing values`

```
df = df.drop_duplicates()
df = df.dropna()
```

In [153... `print(df.info())`

```
<class 'pandas.core.frame.DataFrame'>
Index: 1480 entries, 0 to 1499
Data columns (total 2 columns):
#   Column   Non-Null Count  Dtype
---  -
0    Content  1480 non-null   object
1    Topic    1480 non-null   object
dtypes: object(2)
memory usage: 34.7+ KB
None
```

In [158...

```
import nltk
import re
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from nltk.stem import PorterStemmer

from sklearn.feature_extraction.text import CountVectorizer
from sklearn.model_selection import cross_val_score

from sklearn.naive_bayes import BernoulliNB
from sklearn.naive_bayes import MultinomialNB

nltk.download('stopwords')
nltk.download('punkt')
nltk.download('punkt_tab')

ps = PorterStemmer()
stop_words = set(stopwords.words('english'))

df_token = df.copy()
df_lower = df.copy()
df_special = df.copy()
df_stop = df.copy()
df_stem = df.copy()

def preprocess_text(text):
    text = text.lower()
    text = re.sub(r"^\w\s,!'\.", '', text)    # I have added commas, fullstops
    tokens = word_tokenize(text)
    tokens = [word for word in tokens if word not in stop_words]
    tokens = [ps.stem(word) for word in tokens]
    return ' '.join(tokens)

# Apply preprocessing to each document
df['Content'] = df['Content'].apply(preprocess_text)

# Define preprocessing function
def preprocess_token(text):
    tokens = word_tokenize(text)
    return ' '.join(tokens)

# Apply preprocessing to each document
df_token['Content'] = df_token['Content'].apply(preprocess_token)

# Define preprocessing function
def preprocess_lower(text):
    text = text.lower()
    return text
```

```

# Apply preprocessing to each document

df_lower['Content'] = df_lower['Content'].apply(preprocess_lower)

# Define preprocessing function
def preprocess_special(text):
    text = re.sub(r"^\w\s,!'\.", '', text)    # I have added commas, fullstops

    return text

# Apply preprocessing to each document

df_special['Content'] = df_special['Content'].apply(preprocess_special)

# Define preprocessing function
def preprocess_stop(text):

    tokens = word_tokenize(text)
    tokens = [word for word in tokens if word not in stop_words]
    return ' '.join(tokens)

# Apply preprocessing to each document

df_stop['Content'] = df_stop['Content'].apply(preprocess_stop)

# Define preprocessing function
def preprocess_stem(text):
    tokens = word_tokenize(text)
    tokens = [ps.stem(word) for word in tokens]
    return ' '.join(tokens)

# Apply preprocessing to each document

df_stem['Content'] = df_stem['Content'].apply(preprocess_stem)

vectorizer = CountVectorizer()
X = vectorizer.fit_transform(df['Content'])
X_token = vectorizer.fit_transform(df_token['Content'])
X_lower = vectorizer.fit_transform(df_lower['Content'])
X_special = vectorizer.fit_transform(df_special['Content'])
X_stop = vectorizer.fit_transform(df_stop['Content'])
X_stem = vectorizer.fit_transform(df_stem['Content'])

BNB = BernoulliNB()

MNB = MultinomialNB()

# Cross Validation
BNB_accuracy = cross_val_score(BNB, X, df['Topic'], cv=5, scoring='accuracy')
MNB_accuracy = cross_val_score(MNB, X, df['Topic'], cv=5, scoring='accuracy')

BNB_accuracy_token = cross_val_score(BNB, X_token, df['Topic'], cv=5, scoring='a
MNB_accuracy_token = cross_val_score(MNB, X_token, df['Topic'], cv=5, scoring='a

BNB_accuracy_lower = cross_val_score(BNB, X_lower, df['Topic'], cv=5, scoring='a
MNB_accuracy_lower = cross_val_score(MNB, X_lower, df['Topic'], cv=5, scoring='a

BNB_accuracy_special = cross_val_score(BNB, X_special, df['Topic'], cv=5, scorin
MNB_accuracy_special = cross_val_score(MNB, X_special, df['Topic'], cv=5, scorin

```

```

BNB_accuracy_stop = cross_val_score(BNB, X_stop, df['Topic'], cv=5, scoring='acc
MNB_accuracy_stop = cross_val_score(MNB, X_stop, df['Topic'], cv=5, scoring='acc

BNB_accuracy_stem = cross_val_score(BNB, X_stem, df['Topic'], cv=5, scoring='acc
MNB_accuracy_stem = cross_val_score(MNB, X_stem, df['Topic'], cv=5, scoring='acc

df_score = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy,
    'MNB Accuracy': MNB_accuracy
})

df_score.loc['Mean'] = ['Mean', np.mean(BNB_accuracy), np.mean(MNB_accuracy)]
print("\n All steps \n")
print(df_score.to_markdown(index=False), "\n")

df_token_score = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy_token,
    'MNB Accuracy': MNB_accuracy_token
})

df_token_score.loc['Mean'] = ['Mean', np.mean(BNB_accuracy_token), np.mean(MNB_a
print("\n Only Tokenising\n")
print(df_token_score.to_markdown(index=False), "\n")

df_lower_score = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy_lower,
    'MNB Accuracy': MNB_accuracy_lower
})

df_lower_score.loc['Mean'] = ['Mean', np.mean(BNB_accuracy_lower), np.mean(MNB_a
print("\nOnly Lowercase\n")
print(df_lower_score.to_markdown(index=False), "\n")

df_special_score = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy_special,
    'MNB Accuracy': MNB_accuracy_special
})

df_special_score.loc['Mean'] = ['Mean', np.mean(BNB_accuracy_special), np.mean(M
print("\n Only removing specials \n")
print(df_special_score.to_markdown(index=False), "\n")

df_stop_score = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy_stop,
    'MNB Accuracy': MNB_accuracy_stop
})

```

```
df_stop_score.loc['Mean'] = ['Mean', np.mean(BNB_accuracy_stop), np.mean(MNB_acc
print("\n Only removing stopwords \n")
print(df_stop_score.to_markdown(index=False), "\n")
```

```
df_stem_score = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy_stem,
    'MNB Accuracy': MNB_accuracy_stem
})
```

```
df_stem_score.loc['Mean'] = ['Mean', np.mean(BNB_accuracy_stem), np.mean(MNB_acc
print("\n Only stemming \n")
print(df_stem_score.to_markdown(index=False), "\n")
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]   C:\Users\micha\AppData\Roaming\nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
[nltk_data] Downloading package punkt to
[nltk_data]   C:\Users\micha\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package punkt_tab to
[nltk_data]   C:\Users\micha\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt_tab is already up-to-date!
```

All steps

Fold	BNB Accuracy	MNB Accuracy
:-----:	:-----:	:-----:
1	0.496622	0.780405
2	0.530405	0.797297
3	0.567568	0.817568
4	0.510135	0.746622
5	0.523649	0.783784
Mean	0.525676	0.785135

Only Tokenising

Fold	BNB Accuracy	MNB Accuracy
:-----:	:-----:	:-----:
1	0.496622	0.780405
2	0.530405	0.797297
3	0.567568	0.817568
4	0.510135	0.746622
5	0.52027	0.783784
Mean	0.525	0.785135

Only Lowercase

Fold	BNB Accuracy	MNB Accuracy
:-----:	:-----:	:-----:
1	0.496622	0.780405
2	0.530405	0.797297
3	0.567568	0.817568
4	0.510135	0.746622
5	0.52027	0.783784
Mean	0.525	0.785135

Only removing specials

Fold	BNB Accuracy	MNB Accuracy
:-----:	:-----:	:-----:
1	0.496622	0.780405
2	0.530405	0.797297
3	0.567568	0.817568
4	0.510135	0.746622
5	0.52027	0.783784
Mean	0.525	0.785135

Only removing stopwords

Fold	BNB Accuracy	MNB Accuracy
:-----:	:-----:	:-----:
1	0.496622	0.780405
2	0.530405	0.797297
3	0.567568	0.817568
4	0.510135	0.746622
5	0.52027	0.783784
Mean	0.525	0.785135

Only stemming

Fold	BNB Accuracy	MNB Accuracy
:-----:	-----:	-----:
1	0.496622	0.780405
2	0.530405	0.797297
3	0.567568	0.817568
4	0.510135	0.746622
5	0.523649	0.783784
Mean	0.525676	0.785135

```
In [154... # Part 1 Question 2

# After developing both BNB and MNB, normally special characters should be removed
# spaces, and tokenising removes any one letter words and converts everything else
# the text better by removing filler words that in theory have no effect on the
# text by removing capitals, essentially making capitalised and lowercase versions
# reducing variations of words into the base words.

# I tested each step independently and saw that each step has almost no bearing

# After testing with both MNB and BNB, it seems that having no preprocessing steps
# overall accuracy

# Currently my preprocessing steps only includes all steps of preprocessing. Then
# then removing stop words and finally stemming.
```

```
In [158... from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer

vectorizer50 = CountVectorizer(max_features=50)
X50 = vectorizer50.fit_transform(df['Content'])

vectorizer100 = CountVectorizer(max_features=100)
X100 = vectorizer100.fit_transform(df['Content'])

vectorizer250 = CountVectorizer(max_features=250)
X250 = vectorizer250.fit_transform(df['Content'])

vectorizer500 = CountVectorizer(max_features=500)
X500 = vectorizer500.fit_transform(df['Content'])

vectorizer1000 = CountVectorizer(max_features=1000)
X1000 = vectorizer1000.fit_transform(df['Content'])
```

```
In [154... from sklearn.model_selection import train_test_split
from sklearn.model_selection import cross_val_score

from sklearn.naive_bayes import BernoulliNB
from sklearn.naive_bayes import MultinomialNB

# Split the data into training and testing sets
# X_train, X_test, y_train, y_test = train_test_split(X, df['Topic'], test_size=

BNB = BernoulliNB()

MNB = MultinomialNB()
```

```
# Cross Validation
BNB_accuracy50 = cross_val_score(BNB, X50, df['Topic'], cv=5, scoring='accuracy')
BNB_precision50 = cross_val_score(BNB, X50, df['Topic'], cv=5, scoring='precision')
BNB_recall50 = cross_val_score(BNB, X50, df['Topic'], cv=5, scoring='recall_macro')
MNB_accuracy50 = cross_val_score(MNB, X50, df['Topic'], cv=5, scoring='accuracy')
MNB_precision50 = cross_val_score(MNB, X50, df['Topic'], cv=5, scoring='precision')
MNB_recall50 = cross_val_score(MNB, X50, df['Topic'], cv=5, scoring='recall_macro')
```

In [154...

```
df50 = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy50,
    'MNB Accuracy': MNB_accuracy50,
    'BNB Precision': BNB_precision50,
    'MNB Precision': MNB_precision50,
    'BNB Recall': BNB_recall50,
    'MNB Recall': MNB_recall50
})

df50.loc['Mean'] = ['Mean', np.mean(BNB_accuracy50), np.mean(MNB_accuracy50), np.mean(BNB_precision50), np.mean(MNB_precision50), np.mean(BNB_recall50), np.mean(MNB_recall50)]

print(df50.to_markdown(index=False))
```

Fold	BNB Accuracy	MNB Accuracy	BNB Precision	MNB Precision
BNB Recall	MNB Recall			
1	0.537162	0.668919	0.422429	0.631375
2	0.570946	0.682432	0.534497	0.678217
3	0.506757	0.662162	0.411974	0.607542
4	0.530405	0.668919	0.452656	0.623674
5	0.530405	0.648649	0.45152	0.608463
Mean	0.535135	0.666216	0.454615	0.629854

In [154...

```
# Part 1 Question 3

# Since the dataset is heavily imbalanced with the 'dark' topic having the most
# meaning that choosing to focus on the macro averages for precision and recall

# Macro averages determine the precision and recall relative to the actual topic
# to the topic not allowing larger topics high accuracy to skew results. Weighted
# is the aggregated scores rather than the score per topic. Therefore since the
# relative to the topics.

# As shown MNB severely outperforms BNB with almost a 20% accuracy difference in
```

In [154...

```
# Cross Validation
BNB_accuracy100 = cross_val_score(BNB, X100, df['Topic'], cv=5, scoring='accuracy')
BNB_precision100 = cross_val_score(BNB, X100, df['Topic'], cv=5, scoring='precision')
BNB_recall100 = cross_val_score(BNB, X100, df['Topic'], cv=5, scoring='recall_macro')
MNB_accuracy100 = cross_val_score(MNB, X100, df['Topic'], cv=5, scoring='accuracy')
MNB_precision100 = cross_val_score(MNB, X100, df['Topic'], cv=5, scoring='precision')
MNB_recall100 = cross_val_score(MNB, X100, df['Topic'], cv=5, scoring='recall_macro')
```



```
In [154... # Cross Validation
BNB_accuracy250 = cross_val_score(BNB, X250, df['Topic'], cv=5, scoring='accuracy')
BNB_precision250 = cross_val_score(BNB, X250, df['Topic'], cv=5, scoring='precision')
BNB_recall250 = cross_val_score(BNB, X250, df['Topic'], cv=5, scoring='recall')
MNB_accuracy250 = cross_val_score(MNB, X250, df['Topic'], cv=5, scoring='accuracy')
MNB_precision250 = cross_val_score(MNB, X250, df['Topic'], cv=5, scoring='precision')
MNB_recall250 = cross_val_score(MNB, X250, df['Topic'], cv=5, scoring='recall')
```

```
In [154... # Cross Validation
BNB_accuracy500 = cross_val_score(BNB, X500, df['Topic'], cv=5, scoring='accuracy')
BNB_precision500 = cross_val_score(BNB, X500, df['Topic'], cv=5, scoring='precision')
BNB_recall500 = cross_val_score(BNB, X500, df['Topic'], cv=5, scoring='recall')
MNB_accuracy500 = cross_val_score(MNB, X500, df['Topic'], cv=5, scoring='accuracy')
MNB_precision500 = cross_val_score(MNB, X500, df['Topic'], cv=5, scoring='precision')
MNB_recall500 = cross_val_score(MNB, X500, df['Topic'], cv=5, scoring='recall')
```

```
In [154... # Cross Validation
BNB_accuracy1000 = cross_val_score(BNB, X1000, df['Topic'], cv=5, scoring='accuracy')
BNB_precision1000 = cross_val_score(BNB, X1000, df['Topic'], cv=5, scoring='precision')
BNB_recall1000 = cross_val_score(BNB, X1000, df['Topic'], cv=5, scoring='recall')
MNB_accuracy1000 = cross_val_score(MNB, X1000, df['Topic'], cv=5, scoring='accuracy')
MNB_precision1000 = cross_val_score(MNB, X1000, df['Topic'], cv=5, scoring='precision')
MNB_recall1000 = cross_val_score(MNB, X1000, df['Topic'], cv=5, scoring='recall')
```

```
In [155... print("50 features")
print(df50.to_markdown(index=False), "\n")

df100 = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy100,
    'MNB Accuracy': MNB_accuracy100,
    'BNB Precision': BNB_precision100,
    'MNB Precision': MNB_precision100,
    'BNB Recall': BNB_recall100,
    'MNB Recall': MNB_recall100
})

df100.loc['Mean'] = ['Mean', np.mean(BNB_accuracy100), np.mean(MNB_accuracy100),
                    np.mean(BNB_precision100), np.mean(MNB_precision100),
                    np.mean(BNB_recall100), np.mean(MNB_recall100)]

print("100 features")
print(df100.to_markdown(index=False), "\n")

df250 = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy250,
    'MNB Accuracy': MNB_accuracy250,
    'BNB Precision': BNB_precision250,
    'MNB Precision': MNB_precision250,
    'BNB Recall': BNB_recall250,
    'MNB Recall': MNB_recall250
})

df250.loc['Mean'] = ['Mean', np.mean(BNB_accuracy250), np.mean(MNB_accuracy250),
                    np.mean(BNB_precision250), np.mean(MNB_precision250),
                    np.mean(BNB_recall250), np.mean(MNB_recall250)]

print("250 features")
print(df250.to_markdown(index=False), "\n")
```

```

df500 = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy500,
    'MNB Accuracy': MNB_accuracy500,
    'BNB Precision': BNB_precision500,
    'MNB Precision': MNB_precision500,
    'BNB Recall': BNB_recall500,
    'MNB Recall': MNB_recall500
})

df500.loc['Mean'] = ['Mean', np.mean(BNB_accuracy500), np.mean(MNB_accuracy500),

print("500 features")
print(df500.to_markdown(index=False), "\n")

df1000 = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Accuracy': BNB_accuracy1000,
    'MNB Accuracy': MNB_accuracy1000,
    'BNB Precision': BNB_precision1000,
    'MNB Precision': MNB_precision1000,
    'BNB Recall': BNB_recall1000,
    'MNB Recall': MNB_recall1000
})

df1000.loc['Mean'] = ['Mean', np.mean(BNB_accuracy1000), np.mean(MNB_accuracy1000)
print("1000 features")
print(df1000.to_markdown(index=False), "\n")

```

50 features

Fold	BNB Accuracy	MNB Accuracy	BNB Precision	MNB Precision
BNB Recall	MNB Recall			
:-----	:-----	:-----	:-----	:-----
:-----	:-----	:-----	:-----	:-----
1	0.537162	0.668919	0.422429	0.631375
0.430394	0.656375			
2	0.570946	0.682432	0.534497	0.678217
0.465691	0.689794			
3	0.506757	0.662162	0.411974	0.607542
0.412492	0.626674			
4	0.530405	0.668919	0.452656	0.623674
0.426098	0.637622			
5	0.530405	0.648649	0.45152	0.608463
0.420338	0.632113			
Mean	0.535135	0.666216	0.454615	0.629854
0.431002	0.648516			

100 features

Fold	BNB Accuracy	MNB Accuracy	BNB Precision	MNB Precision
BNB Recall	MNB Recall			
:-----	:-----	:-----	:-----	:-----
:-----	:-----	:-----	:-----	:-----
1	0.570946	0.763514	0.513052	0.738339
0.499054	0.771197			
2	0.621622	0.790541	0.535351	0.786627
0.515308	0.774913			
3	0.537162	0.766892	0.473324	0.724022
0.451522	0.739126			
4	0.601351	0.726351	0.530376	0.712162
0.505644	0.714472			
5	0.574324	0.739865	0.518144	0.697833
0.491958	0.726721			
Mean	0.581081	0.757432	0.51405	0.731796
0.492697	0.745286			

250 features

Fold	BNB Accuracy	MNB Accuracy	BNB Precision	MNB Precision
BNB Recall	MNB Recall			
:-----	:-----	:-----	:-----	:-----
:-----	:-----	:-----	:-----	:-----
1	0.601351	0.878378	0.542875	0.876161
0.54492	0.897674			
2	0.665541	0.847973	0.534952	0.864945
0.544871	0.839072			
3	0.652027	0.875	0.608044	0.850597
0.555423	0.860344			
4	0.635135	0.793919	0.581463	0.777146
0.546014	0.776102			
5	0.567568	0.810811	0.475036	0.792701
0.470795	0.798757			
Mean	0.624324	0.841216	0.548474	0.83231
0.532404	0.83439			

500 features

Fold	BNB Accuracy	MNB Accuracy	BNB Precision	MNB Precision
BNB Recall	MNB Recall			
:-----	:-----	:-----	:-----	:-----
:-----	:-----	:-----	:-----	:-----
1	0.652027	0.881757	0.619817	0.868952

0.601303		0.88582							
2		0.685811		0.881757		0.578387		0.889004	
0.573917		0.839369							
3		0.679054		0.864865		0.571968		0.827451	
0.561227		0.835457							
4		0.648649		0.844595		0.577529		0.816541	
0.553792		0.818742							
5		0.614865		0.827703		0.533378		0.805025	
0.524994		0.789638							
Mean		0.656081		0.860135		0.576216		0.841395	
0.563046		0.833805							

1000 features

Fold	BNB Accuracy	MNB Accuracy	BNB Precision	MNB Precision
BNB Recall	MNB Recall			
1	0.608108	0.837838	0.553926	0.81932
0.534278	0.85122			
2	0.672297	0.85473	0.541449	0.830673
0.558015	0.80264			
3	0.662162	0.858108	0.52166	0.823403
0.531137	0.840266			
4	0.618243	0.810811	0.557116	0.801621
0.516363	0.782901			
5	0.635135	0.814189	0.535521	0.787784
0.516332	0.771685			
Mean	0.639189	0.835135	0.541934	0.81256
0.531225	0.809742			

In [155...

```
# Part 1 Question 4

# Based on evidence, 500 features seems to yeild the greatest results before res
# but by manually tweaking the number of features, 500 - 600 seems to be the pla
```

In [155...

```
# Part 1 Question 5

# I have chosen SVM, because it was also used by Lett Yi Kyaw in USING SUPPORT V
# text classification.

# Support Vector Machines in short work by creating a plane to separate the data
# extracted and once the features have been extracted, they are plotted onto a f
# feature space into 5 topics, the model then tries to optimise these planes to
# is multiclass, the SVC model will use the one vs one scheme, which essentially
# meaning since there are 5 topics, there will be a total of 10 classifiers

# I have chosen to use the default settings, and my hypothesis is that the SVM s
# classify the songs against all other possible topics meaning it should always
# predict the class and BNB uses binary features to determine whether the featur
# should have a higher success rate.
```

In [155...

```
from sklearn.svm import SVC

SVM = SVC()

# Cross Validation
SVM_accuracy500 = cross_val_score(SVM, X500, df['Topic'], cv=5, scoring='accurac
SVM_precision500 = cross_val_score(SVM, X500, df['Topic'], cv=5, scoring='precis
```

```
SVM_recall500 = cross_val_score(SVM, X500, df['Topic'], cv=5, scoring='recall_ma

dfSVM = pd.DataFrame({
    'Fold': [1, 2, 3, 4, 5],
    'BNB Acc': BNB_accuracy500,
    'MNB Acc': MNB_accuracy500,
    'SVM Acc': SVM_accuracy500,
    'BNB Precision': BNB_precision500,
    'MNB Precision': MNB_precision500,
    'SVM Precision': SVM_precision500,
    'BNB Recall': BNB_recall500,
    'MNB Recall': MNB_recall500,
    'SVM Recall': SVM_recall500
})

dfSVM.loc['Mean'] = ['Mean', np.mean(BNB_accuracy500), np.mean(MNB_accuracy500),

print("500 features")
print(dfSVM.to_markdown(index=False), "\n")
```

500 features

Fold	BNB Acc	MNB Acc	SVM Acc	BNB Precision	MNB Precision
SVM Precision	BNB Recall	MNB Recall	SVM Recall		
1	0.652027	0.881757	0.800676	0.619817	0.868952
2	0.685811	0.881757	0.797297	0.578387	0.889004
3	0.679054	0.864865	0.787162	0.571968	0.827451
4	0.648649	0.844595	0.753378	0.577529	0.816541
5	0.614865	0.827703	0.756757	0.533378	0.805025
Mean	0.656081	0.860135	0.779054	0.576216	0.841395

In [155... *# After seeing the results it seems as though my hypothesis is wrong, it seems t
draw is that BNB is the worst because it relies on binary features which would
didn't perform well most likely because the feature space could not be split w
to the topic is it about.*

It seems MNB is the best based on the metrics and with the default settings, b

In [166... *# Part 2*
import pandas **as** pd

```
topics = ['dark', 'emotion', 'lifestyle', 'personal', 'sadness' ]
dataset = pd.read_csv('dataset.tsv', sep='\t')
data = dataset.iloc[:, :5].astype(str).apply(' '.join, axis=1)
df = pd.DataFrame({
    'Content': data,
    'Topic': dataset.iloc[:, 5]
})

user1_data = pd.read_csv('user1.tsv', sep='\t')
print(user1)
```

```

user2_data = pd.read_csv('user2.tsv', sep='\t')

df = df.drop_duplicates()
df = df.dropna()

```

	topic	keywords
0	dark	fire, enemy, pain, storm, fight
1	sadness	cry, alone, heartbroken, tears, regret
2	personal	dream, truth, life, growth, identity
3	lifestyle	party, city, night, light, rhythm
4	emotion	love, memory, hug, kiss, feel

```

In [169... import nltk
import re
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from nltk.stem import PorterStemmer

from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, classification_report
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_selection import SelectKBest, chi2
from sklearn.naive_bayes import MultinomialNB

nltk.download('stopwords')
nltk.download('punkt')
nltk.download('punkt_tab')

ps = PorterStemmer()
stop_words = set(stopwords.words('english'))

def preprocess_text(text):
    text = text.lower()
    text = re.sub(r"^\w\s,!'\.", '', text)    # I have added commas, fullstops
    tokens = word_tokenize(text)
    tokens = [word for word in tokens if word not in stop_words]
    tokens = [ps.stem(word) for word in tokens]
    return ' '.join(tokens)

# Apply preprocessing to each document
df['Content'] = df['Content'].apply(preprocess_text)

train = df.iloc[:750].copy()
test = df.iloc[750:1000].copy()

vectorizer500 = TfidfVectorizer(max_features=500)
Xtrain500 = vectorizer500.fit_transform(train['Content'])
Xtest500 = vectorizer500.fit_transform(test['Content'])

MNB = MultinomialNB()
MNB.fit(Xtrain500, train['Topic'])

# Predict the categories of the test set
train['Predicted'] = MNB.predict(Xtrain500)

dark_keywords = user1.iloc[0]['keywords'].split()
dark_pattern = '|'.join(dark_keywords)
sadness_keywords = user1.iloc[1]['keywords'].split()

```

```

sadness_pattern = '|'.join(sadness_keywords)
personal_keywords = user1.iloc[2]['keywords'].split()
personal_pattern = '|'.join(personal_keywords)
lifestyle_keywords = user1.iloc[3]['keywords'].split()
lifestyle_pattern = '|'.join(lifestyle_keywords)
emotion_keywords = user1.iloc[4]['keywords'].split()
emotion_pattern = '|'.join(emotion_keywords)

user1_keywords = {'dark': dark_pattern,
                  'sadness': sadness_pattern,
                  'personal': personal_pattern,
                  'lifestyle': lifestyle_pattern,
                  'emotion': emotion_pattern}

user1_likes = {topic: [] for topic in topics}
user1_profile = {topic: [] for topic in topics}

for topic in topics:
    keywords = user1_keywords[topic]
    likes = train[(train['Predicted'] == topic) & (train['Content'].str.contains
    user1_likes[topic] = likes
    combine = ' '.join(user1_likes[topic]['Content'])
    combine = combine.split()
    print(combine)
    document = vectorizer500.fit_transform(combine)
    user1_profile[topic] = document
    all_features = vectorizer500.get_feature_names_out()
    print("Top 20 words for ", topic, " : ")
    vector = user1_profile[topic].toarray()
    indices = (-vector).argsort()[:20]
    words = [all_features[i] for i in indices]
    print(words)

# Print accuracy and classification report
print("MNB")
print(accuracy_score(test['Topic'], y_pred))
print(classification_report(test['Topic'], y_pred))

```

```

[nltk_data] Downloading package stopwords to
[nltk_data] C:\Users\micha\AppData\Roaming\nltk_data...
[nltk_data] Package stopwords is already up-to-date!
[nltk_data] Downloading package punkt to
[nltk_data] C:\Users\micha\AppData\Roaming\nltk_data...
[nltk_data] Package punkt is already up-to-date!
[nltk_data] Downloading package punkt_tab to
[nltk_data] C:\Users\micha\AppData\Roaming\nltk_data...
[nltk_data] Package punkt_tab is already up-to-date!

```

['love', 'real', 'lake', '2016', 'rock', 'awak', 'know', 'go', 'see', 'time', 'clear', 'world', 'mirror', 'world', 'mirror', 'magic', 'hour', 'confu', 'power', 'steal', 'word', 'unheard', 'unheard', 'certain', 'forget', 'bless', 'angri', 'weat her', 'head', 'angri', 'weather', 'head', 'angri', 'weather', 'head', 'know', 'gentl', 'night', 'mindless', 'fight', 'walk', 'wood', 'zayd', 'wolf', 'gladiat', '2018', 'rock', 'start', 'climb', 'face', 'armi', 'viper', 'lion', 'reach', 'cau', 'time', 'tear', 'kingdom', 'liar', 'jail', 'heart', 'pessimist', 'nail', 'mouth', 'impressionist', 'spend', 'money', 'therapist', 'accept', 'gladiat', 'gladiat', 'gladiat', 'pick', 'fight', 'god', 'giant', 'slayer', 'boneshak', 'domin', 'freight', 'train', 'wreck', 'ball', 'gladiat', 'tell', 'think', 'believe', 'catch', 'crossfir', 'troubl', 'singl', 'feel', 'gold', 'underneath', 'lock', 'door', 'second', 'catch', 'breath', 'cau', 'heart', 'jumpin', 'chest', 'know', 'give', 'cau', 'see', 'best', 'time', 'accept', 'gladiat', 'gladiat', 'gladiat', 'pick', 'fight', 'god', 'giant', 'slayer', 'boneshak', 'domin', 'freight', 'train', 'wreck', 'ball', 'gladiat', 'reason', 'fight', 'reason', 'fight', 'shake', 'hand', 'devil', 'night', 'tell', 'reason', 'fight', 'gladiat', 'gladiat', 'gladiat', 'pick', 'fight', 'god', 'giant', 'slayer', 'bone', 'shaker', 'domin', 'freight', 'train', 'wreck', 'ball', 'gladiat', 'gladiat', 'gladiat', 'pick', 'fight', 'god', 'giant', 'slayer', 'bone', 'shaker', 'domin', 'freight', 'train', 'wreck', 'ball', 'gladiat', 'korn', 'differ', 'world', 'feat', '.', 'corey', 'taylor', '2016', 'rock', 'dream', 'past', 'break', 'wall', 'build', 'insid', 'thought', 'grasp', 'transparent', 'constantli', 'fight', 'collid', 'differ', 'world', 'place', 'feel', 'kill', 'wall', 'magic', 'spell', 'work', 'anymor', 'kill', 'kill', 'face', 'friend', 'relax', 'true', 'world', 'tri', 'hide', 'kind', 'mess', 'reckless', 'place', 'make', 'feel', 'aliv', 'differ', 'world', 'place', 'feel', 'kill', 'wall', 'magic', 'spell', 'work', 'anymor', 'kill', 'kill', 'face', 'friend', 'purpo', 'chang', 'behavior', 'end', 'constraint', 'stranger', 'get', 'forc', 'perspect', 'know', 'feel', 'dark', 'want', 'harder', 'harder', 'harder', 'harder', 'harder', 'harder', 'want', 'harder', 'harder', 'harder', 'harder', 'harder', 'think', 'feel', 'kill', 'wall', 'magic', 'spell', 'work', 'anymor', 'kill', 'kill', 'face', 'friend', 'electr', 'swing', 'circu', 'empir', '2017', 'jazz', 'hear', 'recal', 'papa', 'knee', 'tell', 'stori', 'see', 'parad', 'peopl', 'brave', 'battlefield', 'take', 'empir', 'fight', 'free', 'papa', 'tell', 'tantantara', 'hear', 'papa', 'tantantara', 'babapdada', 'fli', 'funnel', 'crackl', 'radio', 'emerg', 'connect', 'telephon', 'exchang', 'reach', 'oper', 'reason', 'tell', 'point', 'build', 'empir', 'papa', 'tell', 'tantantara', 'hear', 'papa', 'tantantara', 'babapdada', 'know', 'year', 'build', 'empir', 'strong', 'time', 'imaginari', 'line', 'fade', 'away', 'battl', 'go', 'common', 'grind', 'point', 'build', 'empir', 'papa', 'tell', 'tantantara', 'hear', 'papa', 'tantantara', 'babapdada', 'papa', 'tell', 'tantantara', 'hear', 'papa', 'tantantara', 'babapdada', 'know', 'year', 'build', 'empir', 'strong', 'time', 'imaginari', 'line', 'fade', 'away', 'point', 'build', 'point', 'build', 'point', 'build', 'empir', 'abstract', 'orchestra', 'new', 'day', '2018', 'jazz', 'slide', 'wasteland', 'world', 'hunger', 'take', 'life', 'prey', 'aliv', 'yeah', 'need', 'feel', 'poison', 'rise', 'morn', 'clear', 'night', 'feel', 'strength', 'destroy', 'straight', 'heart', 'venom', 'bite', 'right', 'shed', 'skin', 'tonight', 'fang', 'hard', 'hide', 'know', 'go', 'yeah', 'need', 'feel', 'poison', 'rise', 'morn', 'clear', 'night', 'feel', 'strength', 'destroy', 'straight', 'heart', 'venom', 'bite', 'regret', 'escap', 'deci', 'control', 'burn', 'die', 'yeah', 'wrap', 'buri', 'fang', 'insid', 'make', 'night', 'sight', 'run', 'away', 'know', 'hide', 'instinct', 'cold', 'blood', 'hate', 'bearer', 'fate', 'wrong', 'place', 'wrong', 'time', 'terror', 'feel', 'poison', 'rise', 'straight', 'heart', 'venom', 'bite', 'feel', 'poison', 'rise', 'morn', 'clear', 'night', 'feel', 'strength', 'destroy', 'straight', 'heart', 'venom', 'bite', 'regret', 'escap', 'deci', 'control', 'burn', 'die', 'yeah', 'wrap', 'buri', 'fang', 'insid', 'stay', 'insid', 'tonight', 'vanish', 'sit', 'venom', 'control', 'right', 'appetit', 'grow', 'lose', 'final', 'fight', 'show', 'guitar', 'outro', 'wax', 'tailor', 'ecstasi', '2017', 'jazz', 'lock', 'away', 'thing', 'innoc', 'ball', 'chain', 'feel', 'face', 'rose', 'hand', 'smile', 'understand', 'free', 'wall', 'head', 'clear', 'free', 'fall', 'right', 'fear', 'wrong', 'head', 'high', 'fear', 'daughter', 'take', 'life', 'young', 'swear', 'go', 'insan', 'hear', 'voic', 'head', 'know', 'mother', 'dea

[illegible]

egga', 'gon', 'na', 'hell', 'think', 'food', 'scrap', 'tabl', 'desper', 'disabl',
'land', 'live', 'gwaan', 'like', 'simpl', 'ting', 'jump', 'bark', 'gravalici', 'l
ike', 'harbour', 'shark', 'blood', 'blood', 'blood', 'blood', 'blood', 'blood',
'blood', 'peopl', 'yeah', 'blood', 'blood', 'blood', 'blood', 'blood', 'blood',
'blood', 'thing', 'overstand', 'kill', 'black', 'feel', 'shame', 'hide', 'selfinf
lict', 'genocid', 'step', 'asid', 'weep', 'moan', 'feel', 'pressur', 'right', 'in
sid', 'bone', 'wall', 'hold', 'head', 'bawl', 'blood', 'blood', 'blood', 'blood',
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eopl', 'yeah', 'nyahbinghi', 'bobo', 'shanti', 'disput', 'say', 'know', 'care',
'flag', 'plan', 'divid', 'rule', 'peopl', 'lose', 'martyr', 'thing', 'right', 'fi
ght', 'blood', 'blood', 'blood', 'blood', 'blood', 'blood', 'blood', 'peopl', 'ye
ah', 'blood', 'blood', 'blood', 'blood', 'blood', 'blood', 'blood', 'peopl', 'yea
h', 'peopl', 'peopl', 'yeah', 'peopl', 'peopl', 'yeah', 'gon', 'na', 'need', 'sha
ke', 'kiss', 'bare', 'wit', 'break', 'world', 'take', 'advantag', 'stand', 'asi
d', 'look', 'prophesi', 'rise', 'second', 'look', 'blood', 'yeah', 'blood', 'bloo
d', 'blood', 'peopl', 'yeah', 'yeah', 'peopl', 'peopl', 'peopl', 'michael', 'w.',
'smith', 'surround', 'fight', 'battl', '2018', 'rock', 'fight', 'battl', 'fight',
'battl', 'fight', 'battl', 'fight', 'battl', 'prai', 'worship', 'fight', 'battl',
'tonight', 'look', 'like', 'surround', 'surround', 'look', 'like', 'surround', 's
urround', 'look', 'like', 'surround', 'surround', 'look', 'like', 'surround', 'su
rround', 'fight', 'battl', 'fight', 'battl', 'fight', 'battl', 'fight', 'battl',
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19', 'rock', 'driftin', 'beneath', 'horizon', 'bodi', 'weak', 'tryin', 'shore',
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'strong', 'belong', 'holdin', 'anchor', 'stead', 'stead', 'anchor', 'keepin',
'feet', 'grind', 'angri', 'ocean', 'break', 'wave', 'anchor', 'stead', 'stead',
'come', 'stead', 'stead', 'tire', 'fightin', 'fear', 'hidin', 'give', 'breath',
'tell', 'rest', 'leav', 'hear', 'callin', 'pullin', 'shame', 'face', 'rain', 'anc
hor', 'stead', 'stead', 'anchor', 'keepin', 'feet', 'grind', 'angri', 'ocean',
'break', 'wave', 'anchor', 'stead', 'stead', 'come', 'stead', 'stead', 'wan',
'na', 'know', 'drown', 'anchor', 'stead', 'stead', 'wan', 'na', 'anchor', 'keep
in', 'feet', 'grind', 'know', 'drown', 'angri', 'ocean', 'break', 'wave', 'ancho
r', 'stead', 'stead', 'come', 'stead', 'stead', 'codi', 'johnson', 'billi',
"'s", 'brother', '2016', 'countri', 'bull', 'fight', 'lead', 'gon', 'na', 'figh
t', 'gon', 'na', 'fight', 'brother', 'feelin', 'like', 'superman', 'cold', 'bee
r', 'hand', 'waitin', 'week', 'long', 'jukebox', 'shadowbox', 'nothin', 'lipstic
k', 'shoot', 'littl', 'fireb', 'shoot', 'littl', 'ball', 'wall', 'crowd', 'need',
'smoke', 'toke', 'cau', 'tonight', 'burnin', 'step', 'right', 'pay', 'littl', 'co
ver', 'drink', 'bunch', 'redneck', 'mother', 'light', 'lead', 'gon', 'na', 'figh
t', 'gon', 'na', 'fight', 'brother', 'gon', 'na', 'fight', 'gon', 'na', 'fight',
'brother', 'yonder', 'come', 'plow', 'trash', 'talkin', 'cowboy', 'actin', 'lik
e', 'feet', 'tall', 'kissin', 'ontrea', 'hell', 'date', 'bathroom', 'stall', 'roo
f', 'higher', 'proof', 'howlin', 'like', 'bluetick', 'hound', 'stead', 'beer',
'flow', 'go', 'circu', 'come', 'yeah', 'step', 'right', 'pay', 'littl', 'cover',
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ther', 'goin', 'fine', 'till', 'moonshin', 'spill', 'drink', 'know', 'better', 'h
ell', 'know', 'better', 'rare', 'take', 'swing', 'say', 'step', 'right', 'pay',
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n', 'na', 'fight', 'gon', 'na', 'fight', 'brother', 'gon', 'na', 'fight', 'gon',
'na', 'fight', 'brother', 'bull', 'fight', 'lead', 'gon', 'na', 'fight', 'gon',
'na', 'fight', 'brother', 'shovel', 'rope', 'death', 'glori', '2017', 'blue', 'ch
eap', 'hood', 'strike', 'bargain', 'world', 'end', 'make', 'payment', 'sofa', 'gi
rl', 'hate', 'tattoo', 'knuckl', 'hand', 'hand', 'slap', 'kid', 'cau', 'understan
d', 'death', 'stori', 'death', 'stori', 'gimmickhungri', 'dig', 'gold', 'roll',
'grab', 'tell', 'sell', 'believ', 'test', 'research', 'nun', 'later', 'join', 'ch
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a', 'play', 'think', 'death', 'play', 'blue', 'king', 'sure', 'look', 'better',
'death', 'stori', 'death', 'stori', 'dingi', 'basement', 'dingi', 'street', 'dra

g', 'hand', 'clap', 'drag', 'beat', 'beat', 'time', 'beat', 'tri', 'year', 'hea
r', 'song', 'death', 'stori', 'death', 'stori', 'gon', 'na', 'march', 'long', 'go
n', 'na', 'travel', 'long', 'time', 'travel', 'mountain', 'gon', 'na', 'travel',
'sea', 'gon', 'na', 'fight', 'brother', 'gon', 'na', 'fight', 'loo', 'gon', 'na',
'rai', 'troubl', 'gon', 'na', 'rai', 'hell', 'gon', 'na', 'fight', 'brother', 'go
n', 'na', 'rai', 'hell', 'death', 'stori', 'death', 'stori', 'death', 'stori', 'd
eath', 'stori', 'eli', 'young', 'band', 'skin', 'bone', '2017', 'countri', 'ski
n', 'bone', 'backroad', 'home', 'long', 'stori', 'yeah', 'goodbi', 'imagin', 'thi
nk', 'plan', 'know', 'happen', 'skin', 'bone', 'skin', 'bone', 'life', 'wheel',
'engin', 'need', 'spark', 'yeah', 'keep', 'goin', 'skin', 'bone', 'backroad', 'ho
me', 'long', 'stori', 'yeah', 'goodbi', 'imagin', 'think', 'plan', 'know', 'happe
n', 'skin', 'bone', 'skin', 'bone', 'yeah', 'fight', 'like', 'shoot', 'whiskey',
'forgiv', 'pill', 'takin', 'mornin', 'smile', 'kiss', 'yeah', 'sayin', 'babi', 'k
now', 'skin', 'bone', 'backroad', 'home', 'long', 'stori', 'goodbi', 'imagin', 't
hink', 'plan', 'know', 'happen', 'skin', 'bone', 'skin', 'bone', 'heart', 'head',
'hand', 'drug', 'runnin', 'blood', 'skin', 'bone', 'skin', 'bone', 'sleep', 'wol
f', 'new', 'king', '2017', 'rock', 'stand', 'fight', 'need', 'mean', 'second', 'g
uessin', 'yeah', 'gon', 'na', 'wear', 'crown', 'cau', 'stand', 'fight', 'stop',
'king', 'ignor', 'like', 'pass', 'rai', 'voic', 'scar', 'scar', 'power', 'come',
'ignor', 'stand', 'fight', 'need', 'lyric', 'commerci', 'moon', 'taxi', 'two', 'h
igh', '2018', 'rock', 'feel', 'world', 'spinnin', 'control', 'bring', 'cold', 'hi
de', 'feel', 'insid', 'high', 'walk', 'hand', 'tonight', 'come', 'fight', 'woahoo
h', 'high', 'hard', 'tell', 'live', 'hear', 'voic', 'call', 'street', 'singin',
'readi', 'readi', 'singin', 'readi', 'readi', 'high', 'walk', 'hand', 'tonight',
'come', 'fight', 'woahoooh', 'high', 'high', 'go', 'hold', 'hold', 'high', 'walk',
'hand', 'tonight', 'come', 'fight', 'high', 'walk', 'hand', 'tonight', 'come', 'f
ight', 'high', 'high', 'kill', 'black', 'tar', '2016', 'blue', 'invent', 'handso
m', 'fairy', 'fair', 'game', 'world', 'look', 'sharpen', 'blade', 'london', 'blo
od', 'thirsti', 'pari', 'vein', 'open', 'vein', 'pul', 'mean', 'brui', 'wing', 's
parrow', 'gon', 'na', 'catch', 'hair', 'night', 'arrow', 'prick', 'quick', 'pic
k', 'fight', 'world', 'trip', 'bid', 'blood', 'catatonia', 'york', 'black', 'ru
n', 'run', 'brui', 'wing', 'sparrow', 'cook', 'light', 'tuck', 'prim', 'prim', 'd
ivin', 'cool', 'thing', 'crazi', 'look', 'white', 'screen', 'field', 'daisi', 'pu
ll', 'stay', 'stand', 'stay', 'stand', 'talib', 'kweli', 'ny', 'weather', 'repor
t', '2018', 'hip', 'hop', 'come', 'yeah', 'like', 'opportun', 'thank', 'everybod
i', 'rid', 'long', 'journey', 'life', 'path', 'destin', 'journey', 'appreci', 'bl
ood', 'sweat', 'tear', 'year', 'struggl', 'hate', 'fear', 'york', 'citi', 'come',
'prepar', 'rain', 'hail', 'sleet', 'snow', 'weather', 'ride', 'peopl', 'place',
'knowledg', 'bear', 'welcom', 'check', 'futurist', 'lyricist', 'straight', 'renai
ss', 'suffer', 'chain', 'rap', 'edg', 'peopl', 'suffer', 'slave', 'chain', 'voya
g', 'maiden', 'like', 'mother', 'hell', 'aveng', 'capitalist', 'product', 'sell',
'start', 'spell', 'word', 'fell', 'rhyme', 'turn', 'song', 'fell', 'line', 'pain
t', 'pictur', 'peopl', 'bleed', 'bar', 'teen', 'mean', 'reach', 'star', 'fail',
'fell', 'write', 'cloud', 'tighten', 'vowel', 'word', 'bite', 'allow', 'gangste
r', 'grind', 'allow', 'probabl', 'fight', 'stage', 'fore', 'fight', 'crowd', 'sen
d', 'peopl', 'face', 'homi', 'rid', 'inspir', 'write', 'lyric', 'commerci', 'kin
g', 'leon', 'wall', '2016', 'rock', 'leav', 'tryin', 'right', 'fight', 'fight',
'point', 'wast', 'space', 'faceless', 'crowd', 'tell', 'know', 'right', 'walk',
'away', 'wall', 'come', 'wall', 'come', 'wall', 'come', 'wall', 'come', 'seein',
'fall', 'lyric', 'commerci', 'black', 'pistol', 'fire', 'wake', 'riot', '2016',
'blue', 'bite', 'tongu', 'shout', 'lung', 'bore', 'tear', 'like', 'track', 'sel
l', 'score', 'forc', 'hand', 'wick', 'command', 'better', 'white', 'knuckl', 'cri
mson', 'crown', 'catch', 'trippin', 'babi', 'riot', 'riot', 'riot', 'riot', 'kno
w', 'babi', 'bind', 'break', 'fight', 'weak', 'hand', 'size', 'littl', 'lie', 'bl
ame', 'forc', 'hand', 'wick', 'command', 'better', 'white', 'knuckl', 'crimson',
'crown', 'catch', 'trippin', 'babi', 'riot', 'riot', 'riot', 'know', 'riot', 'tak
e', 'share', 'bore', 'walk', 'hand', 'hand', 'devil', 'time', 'throw', 'roll', 't
ear', 'waitin', 'long', 'waitin', 'long', 'babi', 'riot', 'bishop', 'brigg', 'whi
te', 'flag', '2018', 'rock', 'shoot', 'shoot', 'grind', 'grind', 'play', 'dead',
'got', 'ta', 'wear', 'paper', 'promi', 'break', 'feed', 'energi', 'expect', 'symp

athi', 'smoke', 'go', 'know', 'afraid', 'shed', 'littl', 'blood', 'smoke', 'flare', 'go', 'flare', 'go', 'wave', 'white', 'flag', 'time', 'fight', 'fight', 'fight', 'fight', 'wave', 'white', 'flag', 'slow', 'fight', 'fight', 'fight', 'fight', 'whoa', 'whoa', 'whoa', 'whoa', 'lyric', 'commerci', 'metallica', "'re", 'dead', '2016', 'rock', 'dark', 'fall', 'light', 'reaper', 'call', 'walk', 'straight', 'right', 'doubt', 'return', 'shall', 'permeat', 'scar', 'seduc', 'deviat', 'cau', 'sinner', 'futura', 'saint', 'past', 'begin', 'end', 'return', 'dead', 'dear', 'dead', 'dear', 'live', 'forev', 'pain', 'know', 'flame', 'consum', 'warm', 'die', 'bone', 'loss', 'madli', 'fight', 'kingdom', 'come', 'walk', 'right', 'open', 'door', 'sinner', 'futura', 'saint', 'past', 'begin', 'end', 'return', 'dead', 'dear', 'dead', 'dear', 'live', 'forev', 'sinner', 'futura', 'saint', 'past', 'begin', 'end', 'return', 'dead', 'dear', 'dead', 'dear', 'live', 'live', 'forev', 'return', 'ash', 'shed', 'skin', 'black', 'rise', 'shall', 'live', 'forev', 'joe', 'corfield', 'shimmer', '2016', 'jazz', 'heaven', 'heaven', 'mater', 'night', 'rai', 'sword', 'holi', 'blood', 'burn', 'pyre', 'defend', 'command', 'holi', 'mater', 'stand', 'fight', 'deu', 'regnum', 'heaven', 'heaven', 'brother', 'beliv', 'sword', 'night', 'blood', 'thunder', 'strike', 'reward', 'come', 'kill', 'plunder', 'fate', 'crusad', 'holi', 'mater', 'stand', 'fight', 'deu', 'regnum', 'heaven', 'follow', 'follow', 'mater', 'mater', 'deu', 'regnum', 'sanctu', 'christu', 'deu', 'vult', 'sanctu', 'iesu', 'deu', 'vult', 'sanctu', 'christu', 'deu', 'vult', 'cantu', 'lupu', 'agnu', 'christu', 'sanctu', 'lupu', 'movement', 'heart', '2016', 'regga', 'pull', 'jaw', 'death', 'knife', 'move', 'slow', 'skin', 'bone', 'time', 'head', 'sever', 'light', 'life', 'know', 'second', 'chanc', 'grant', 'feet', 'plant', 'heart', 'moment', 'stand', 'know', 'stronger', 'hurt', 'stand', 'claw', 'draw', 'light', 'hole', 'soul', 'understand', 'ascend', 'aliv', 'look', 'insid', 'ounc', 'fight', 'surviv', 'say', 'matter', 'drown', 'thought', 'past', 'matter', 'last', 'count', 'bless', 'free', 'grip', 'heresi', 'know', 'stronger', 'hurt', 'stand', 'hurt', 'know', 'break', 'break', 'skin', 'stand', 'claw', 'draw', 'hell', 'know', 'claw', 'draw', 'edg', 'death', 'know', 'ascend', 'ascend', 'with', 'fishbelli', '86', 'onion', '2018', 'blue', 'fishbelli', 'white', 'night', 'hang', 'dark', 'think', 'fist', 'fight', 'think', 'knock', 'girl', 'steal', 'money', 'health', 'onion', 'happi', 'bontemp', 'wealth', 'mandisa', 'bleed', '2017', 'rock', 'bleed', 'beauti', 'come', 'bleed', 'tell', 'tell', 'divid', 'wake', 'today', 'headlin', 'innoc', 'life', 'take', 'hatr', 'hard', 'think', 'good', 'mistake', 'cau', 'heart', 'break', 'tell', 'leav', 'right', 'point', 'finger', 'take', 'side', 'gon', 'na', 'realiz', 'bleed', 'beauti', 'come', 'bleed', 'tell', 'tell', 'divid', 'gon', 'na', 'fight', 'fight', 'gon', 'na', 'shout', 'bleed', 'tell', 'tell', 'divid', 'tell', 'judg', 'kind', 'cloth', 'wear', 'color', 'skin', 'black', 'black', 'white', 'white', 'insid', 'insid', 'father', 'open', 'eye', 'bleed', 'bleed', 'beauti', 'come', 'bleed', 'bleed', 'tell', 'tell', 'divid', 'gon', 'na', 'fight', 'fight', 'fight', 'gon', 'na', 'shout', 'bleed', 'bleed', 'tell', 'tell', 'divid', 'drive', 'dark', 'fight', 'say', 'drive', 'dark', 'fight', 'bleed', 'bleed', 'beauti', 'come', 'stand', 'unit', 'bleed', 'bleed', 'tell', 'tell', 'divid', 'gon', 'na', 'fight', 'fight', 'fight', 'gon', 'na', 'shout', 'bleed', 'bleed', 'bleed', 'stand', 'unit', 'stand', 'unit', 'stand', 'unit', 'father', 'pray', 'famili', 'come', 'right', 'seek', 'face', 'forgiv', 'sin', 'heal', 'incr', 'land', 'savior', 'amen', 'thieveri', 'corpor', 'music', 'make', 'stagger', '2018', 'jazz', 'catch', 'tide', 'divid', 'moment', 'stand', 'fight', 'futura', 'bright', 'burn', 'insid', 'hand', 'fell', 'line', 'time', 'fail', 'forget', 'realiti', 'insan', 'human', 'tear', 'seam', 'aaaah', 'go', 'go', 'aaaah', 'gon', 'na', 'gon', 'na', 'blind', 'devot', 'shade', 'insid', 'heart', 'tie', 'break', 'lie', 'pull', 'apart', 'time', 'steal', 'dream', 'realiti', 'insan', 'human', 'call', 'free', 'aaaah', 'go', 'go', 'aaaah', 'gon', 'na', 'gon', 'na', 'aaaah', 'go', 'go', 'aaaah', 'gon', 'na', 'gon', 'na', 'turn', 'away', 'promi', 'aaaah', 'go', 'go', 'aaaah', 'gon', 'na', 'gon', 'na', 'aaaah', 'go', 'go', 'aaaah', 'gon', 'na', 'gon', 'na', 'local', 'nativ', 'dark', 'day', '2016', 'pop', 'final', 'come', 'final', 'hop', 'race', 'home', 'hou', 'look', 'black', 'white', 'dark', 'day', 'summer', 'million', 'way', 'line', 'holi', 'seventh', 'sign', 'go', 'hand', 'hand', 'fear', 'afterlif', 'fight', 'fight', 'know', 'dollar', 'strong', 'reli', 'turn', 'corner', 'know', 'sight', 'dark', 'day', 'summer', 'rain', 'water', 'fine', 'wil

d', 'combin', 'right', 'line', 'go', 'hand', 'hand', 'fear', 'afterlif', 'fight', 'fight', 'know', 'long', 'long', 'cafe', 'jazz', 'delux', 'coff', 'hou', '2016', 'jazz', 'hear', 'scream', 'black', 'brui', 'beat', 'blow', 'need', 'blood', 'sweat', 'skin', 'bone', 'rage', 'rattl', 'cage', 'say', 'easi', 'strong', 'surviv', 'readi', 'stand', 'readi', 'hangman', 'hear', 'scream', 'like', 'want', 'hear', 'yell', 'like', 'mean', 'go', 'loud', 'strong', 'proud', 'hard', 'home', 'hear', 'hear', 'hear', 'hear', 'hear', 'scream', 'pull', 'push', 'right', 'place', 'wipe', 'smile', 'right', 'face', 'watch', 'break', 'blink', 'miss', 'leav', 'readi', 'fight', 'readi', 'hear', 'scream', 'like', 'want', 'hear', 'yell', 'like', 'mean', 'go', 'loud', 'strong', 'proud', 'hard', 'home', 'hear', 'hear', 'hear', 'hear', 'hear', 'scream', 'hear', 'scream', 'like', 'want', 'hear', 'yell', 'like', 'mean', 'go', 'loud', 'strong', 'proud', 'hard', 'home', 'hear', 'hear', 'hear', 'hear', 'hear', 'scream', 'hear', 'scream', 'like', 'want', 'hear', 'yell', 'like', 'mean', 'go', 'loud', 'strong', 'proud', 'hard', 'home', 'hear', 'hear', 'hear', 'hear', 'hear', 'scream', 'tribal', 'seed', 'empress', '2017', 'regga', 'citi', 'sinner', 'need', 'open', 'heart', 'feel', 'piti', 'open', 'weak', 'unfaz', 'unscath', 'dreadlock', 'daughter', 'mission', 'live', 'cau', 'travel', 'desert', 'travel', 'scorcher', 'hear', 'wisdom', 'mesmer', 'voyag', 'lay', 'eye', 'mythic', 'kingdom', 'hear', 'understand', 'jerusalem', 'stand', 'wisest', 'fulfil', 'role', 'coven', 'empress', 'invit', 'empir', 'deepest', 'desir', 'univ', 'conspir', 'empress', 'invit', 'empir', 'deepest', 'desir', 'univ', 'conspir', 'night', 'starlight', 'reveal', 'sign', 'come', 'ari', 'uplift', 'world', 'dawn', 'burn', 'burn', 'wick', 'discern', 'burn', 'burn', 'sight', 'queen', 'return', 'build', 'wisdom', 'youth', 'bring', 'right', 'foolish', 'polit', 'leadership', 'fight', 'wick', 'repel', 'evil', 'forc', 'abroad', 'stand', 'wisest', 'fulfil', 'role', 'coven', 'pisk', 'ai', 'n't', 'right', '2018', 'jazz', 'sleep', 'pray', 'lord', 'soul', 'angel', 'watch', 'night', 'till', 'morn', 'light', 'amen', 'wife', 'stick', 'kid', 'right', 'situat', 'leav', 'hand', 'right', 'argu', 'pick', 'fight', 'noon', 'midnight', 'hope', 'verbal', 'exchang', 'lead', 'fist', 'fight', 'say', 'want', 'right', 'voic', 'head', 'softer', 'mcknight', 'wan', 'na', 'fail', 'spite', 'gallant', 'effort', 'plethora', 'insight', 'reason', 'sleep', 'night', 'bottle', 'liquor', 'vice', 'thing', 'contin', 'wrong', 'miss', 'right', 'plan', 'life', 'star', 'deep', 'mirror', 'dislik', 'star', 'wish', 'life', 'come', 'think', 'twice', 'turn', 'breath', 'leav', 'windpip', 'devil', 'entic', 'feel', 'real', 'tight', 'desir', 'light', 'pray', 'ignit', 'spark', 'soul', 'despit', 'recent', 'challeng', 'face', 'trife', 'send', 'better', 'day', 'invit', 'close', 'edg', 'soon', 'inflight', 'hold', 'close', 'edg', 'feel', 'like', 'easier', 'exit', 'understand', 'brother', 'jet', 'life', 'hell', 'hard', 'tell', 'bless', 'testimoni', 'test', 'sibl', 'sextet', 'receiv', 'death', 'threat', 'molest', 'run', 'live', 'rest', 'like', 'beat', 'odd', 'best', 'teen', 'youngin', 'pregnant', 'livin', 'fast', 'chasin', 'unprotect', 'lame', 'tri', 'game', 'helmet', 'fool', 'tri', 'cool', 'smoother', 'suggest', 'test', 'thank', 'neg', 'test', 'say', 'attitud', 'posit', 'opposit', 'wretch', 'kill', 'like', 'grand', 'daddi', 'leav', 'blood', 'clot', 'famili', 'tie', 'thread', 'bloodlin', 'hold', 'face', 'dread', 'wick', 'world', 'infest', 'roach', 'rat', 'sucker', 'gat', 'dead', 'leav', 'bullet', 'emb', 'head', 'main', 'world', 'know', 'head', 'brother', 'credit', 'maintain', 'fall', 'edg', 'thank', 'christi', 'huff', 'black', 'white', '2019', 'countri', 'time', 'game', 'fight', 'hurt', 'tear', 'stay', 'straight', 'core', 'room', 'second', 'place', 'home', 'rise', 'rise', 'versu', 'beast', 'rise', 'strong', 'surviv', 'rise', 'time', 'weak', 'time', 'rise', 'break', 'dust', 'come', 'reach', 'deep', 'break', 'grind', 'beat', 'brush', 'come', 'come', 'time', 'settl', 'score', 'blood', 'fight', 'break', 'talk', 'trash', 'step', 'plate', 'rise', 'refu', 'rise', 'ash', 'dust', 'rise', 'rememb', 'rise', 'trust', 'eagl', 'death', 'metal', 'high', 'voltag', '"s"', 'long', 'way', 'top', 'wan', 'na', 'rock', '"n"', '"', 'roll', '2019', 'blue', 'winter', 'lose', 'grip', 'ocean', 'free', 'ship', 'glide', 'break', 'open', 'north', 'wind', 'sail', 'froth', 'sea', 'grow', 'stronger', 'heart', 'easier', 'breath', 'day', 'turn', 'night', 'night', 'turn', 'day', 'determin', 'grow', 'breath', 'take', 'stand', 'sword', 'hand', 'soon', 'fall', 'stand', 'sword', 'hand', 'heed', 'reach', 'hanö', 'wait', 'ship', 'like', 'attack', 'prey', 'come', 'forc', 'oar', 'like', 'wretch', 'earth', 'weak', 'prepar', 'fight', 'fri

end', 'slay', 'remain', 'know', 'near', 'jaw', 'appear', 'tell', 'withdraw', 'stand', 'skirmish', 'quell', 'offer', 'join', 'crew', 'join', 'friend', 'hell', 'stand', 'sword', 'hand', 'soon', 'fall', 'stand', 'sword', 'hand', 'heed', 'nonpoint', 'chao', 'earthquak', '2018', 'rock', 'black', 'oper', 'chang', 'moneycolor', 'black', 'wham', 'get', 'spin', 'polit', 'correct', 'watch', 'everybodi', 'fight', 'sister', 'versu', 'brother', 'peac', 'versu', 'poor', 'differ', 'versu', 'differ', 'versu', 'floor', 'wall', 'versu', 'door', 'shore', 'black', 'water', 'black', 'money', 'black', 'moneybag', 'greed', 'season', 'swing', 'turn', 'oasi', 'wan', 'na', 'decid', 'gon', 'na', 'know', 'evil', 'sign', 'time', 'mind', 'busi', 'stay', 'line', 'call', 'enterpri', 'away', 'tape', 'leav', 'thing', 'state', 'chao', 'earthquak', 'chao', 'earthquak', 'away', 'tape', 'leav', 'thing', 'state', 'chao', 'earthquak', 'lyric', 'commerci', 'black', 'pistol', 'fire', 'fever', 'break', '2017', 'blue', 'tell', 'tell', 'dream', 'tell', 'leav', 'tell', 'real', 'leav', 'cri', 'loud', 'racket', 'voic', 'head', 'scream', 'shout', 'weak', 'knee', 'thank', 'hard', 'sleepwalk', 'deadend', 'street', 'know', 'write', 'bone', 'push', 'right', 'mind', 'know', 'write', 'face', 'fight', 'hide', 'fever', 'start', 'start', 'start', 'mess', 'paper', 'stall', 'stori', 'tell', 'tell', 'know', 'write', 'bone', 'push', 'right', 'mind', 'know', 'write', 'face', 'fight', 'hide', 'fever', 'start', 'tell', 'tell', 'dream', 'tell', 'leav', 'tell', 'real', 'leav', 'know', 'write', 'bone', 'push', 'right', 'mind', 'know', 'write', 'face', 'fight', 'hide', 'start', 'start', 'start', 'start', 'start', 'start', 'start', 'start', 'start', 'start', 'start', 'j.', 'rawl', 'hha', 'outro', 'joshi', 'get', '2016', 'hip', 'hop', 'stand', 'land', 'bring', 'mad', 'bear', 'destroy', 'trail', 'tartarean', 'rider', 'armata', 'strigoi', 'morn', 'break', 'retir', 'sear', 'heat', 'avoid', 'await', 'dark', 'proud', 'walachian', 'fighter', 'armata', 'strigoi', 'stormbound', 'avatar', 'son', 'sorrow', 'one', 'tomorrow', 'suck', 'armata', 'strigoi', 'haill', 'cross', 'kill', 'bibl', 'seven', 'sin', 'defin', 'deploy', 'moldavian', 'striker', 'armata', 'strigoi', 'pray', 'mater', 'sacr', 'give', 'birth', 'drink', 'blood', 'fall', 'believ', 'armata', 'strigoi', 'stormbound', 'avatar', 'son', 'sorrow', 'one', 'tomorrow', 'suck', 'armata', 'strigoi', 'avril', 'lavign', 'head', 'water', '2019', 'pop', 'got', 'ta', 'calm', 'want', 'want', 'window', 'door', 'safe', 'warm', 'yeah', 'life', 'fight', 'reach', 'shore', 'voic', 'drive', 'forc', 'pull', 'overboard', 'head', 'water', 'drown', 'get', 'harder', 'meet', 'altar', 'fall', 'knee', 'drown', 'drown', 'drown', 'drown', 'pull', 'cau', 'underneath', 'undertow', 'come', 'hold', 'close', 'need', 'need', 'head', 'water', 'drown', 'get', 'harder', 'meet', 'altar', 'fall', 'knee', 'drown', 'drown', 'drown', 'drown', 'drown', 'drown', 'drown', 'drown', 'head', 'water', 'water', 'drown', 'weather', 'swim', 'ocean', 'like', 'forev', 'breath', 'head', 'water', 'lose', 'breath', 'come', 'rescu', 'wait', 'young', 'fall', 'asleep', 'head', 'water', 'drown', 'get', 'harder', 'meet', 'altar', 'fall', 'knee', 'drown', 'drown', 'drown', 'drown', 'head', 'water', 'water', 'drown', 'sam', 'smith', 'fire', 'fire', '2018', 'pop', 'mother', 'say', 'romant', 'say', 'danc', 'movi', 'start', 'believ', 'know', 'mayb', 'cau', 'littl', 'older', 'mayb', 'like', 'think', 'lean', 'shoulder', 'word', 'breath', 'steal', 'thing', 'know', 'save', 'cold', 'normal', 'kill', 'desir', 'winner', 'control', 'sinner', 'ruin', 'beauti', 'rhythm', 'cau', 'unfold', 'tell', 'look', 'perfect', 'direct', 'normal', 'kill', 'desir', 'winner', 'control', 'sinner', 'ruin', 'beauti', 'rhythm', 'normal', 'kill', 'desir', 'winner', 'control', 'sinner', 'ruin', 'beauti', 'rhythm', 'cau', 'unfold', 'tell', 'look', 'perfect', 'direct', 'perfect', 'direct', 'steel', 'pul', 'human', 'traffick', '2019', 'regga', 'good', 'fight', 'good', 'terribl', 'human', 'traffic', 'know', 'captur', 'bind', 'gainst', 'free', 'skin', 'human', 'traffic', 'nightmar', 'real', 'life', 'steal', 'know', 'feel', 'forc', 'prostitut', 'women', 'slaveri', 'take', 'advantag', 'children', 'rob', 'digniti', 'stop', 'illeg', 'activ', 'peopl', 'chain', 'captiv', 'urgenc', 'crime', 'human', 'human', 'traffic', 'know', 'captur', 'bind', 'gainst', 'free', 'skin', 'human', 'traffic', 'nightmar', 'real', 'life', 'steal', 'know', 'feel', 'steal', 'steal', 'border', 'order', 'intern', 'crisi', 'million', 'get', 'exploit

t', 'forc', 'work', 'believ', 'modern', 'time', 'mankind', 'unkind', 'human', 'human', 'human', 'human', 'traffic', 'human', 'traffic', 'fight', 'heart', 'go', 'victim', 'human', 'traffic', 'abomin', 'cruelti', 'vilest', 'kind', 'walk', 'creation', 'human', 'traffic', 'begin', 'stop', 'traffic', 'fight', 'terribl', 'terribl', 'kidnap', 'good', 'traffic', 'racket', 'smash', 'come', 'bash', 'good', 'shenseea', 'tie', '2018', 'regga', 'shenseea', 'oouuuu', 'oouuuu', 'oouuu', 'oouuu', 'strangl', 'viagra', 'chiney', 'brush', 'tight', 'underneath', 'clean', 'tidi', 'cover', 'mouth', 'whine', 'hand', 'throat', 'tight', 'pumpum', 'clean', 'tidi', 'yeah', 'readi', 'girl', 'babi', 'beat', 'like', 'hate', 'bawl', 'lord', 'come', 'save', 'like', 'slaveri', 'turn', 'steer', 'leav', 'right', 'shift', 'stick', 'gear', 'grind', 'hand', 'breast', 'like', 'cement', 'pave', 'hotter', 'hell', 'like', 'sinner', 'hold', 'squeeze', 'like', 'trigger', 'lack', 'cau', 'blurri', 'vision', 'come', 'glow', 'shimmer', 'like', 'bimma', 'oouuu', 'oouuu', 'oouuu', 'oouuu', 'oouuu', 'oouuu', 'upti', 'oouuu', 'ttie', 'strangl', 'viagra', 'chiney', 'brush', 'tight', 'underneath', 'clean', 'tidi', 'cover', 'mouth', 'whine', 'hand', 'throat', 'tight', 'pumpum', 'clean', 'tidi', 'lock', 'like', 'charge', 'feloni', 'ball', 'swing', 'like', 'legaci', 'special', 'long', 'like', 'line', 'embassi', 'spank', 'cau', 'like', 'stop', 'touch', 'right', 'spot', 'submiss', 'babe', 'fight', 'pass', 'cloud', 'like', 'pilot', 'oouuu', 'oouuu', 'oouuu', 'oouuu', 'oouuu', 'oouuu', 'upti', 'oouuu', 'ttie', 'strangl', 'viagra', 'chiney', 'brush', 'tight', 'underneath', 'clean', 'tidi', 'cover', 'mouth', 'whine', 'hand', 'throat', 'tight', 'pumpum', 'clean', 'tidi', 'score', 'fear', '2019', 'rock', 'whoaohoh', 'whoaohoh', 'whoaohoh', 'whoaohoh', 'whoaohoh', 'whoaohoh', 'whoaohoh', 'whoaohoh', 'knock', 'demon', 'creep', 'round', 'chang', 'shot', 'running', 'tell', 'chain', 'drive', 'battl', 'hard', 'face', 'mirror', 'scar', 'make', 'deeper', 'push', 'cau', 'stronger', 'time', 'stand', 'stand', 'hand', 'hand', 'fight', 'fear', 'fight', 'fear', 'rise', 'grind', 'gon', 'na', 'believ', 'fight', 'fear', 'fight', 'fear', 'blood', 'sweat', 'tear', 'pain', 'tast', 'sweeter', 'whoaohoh', 'whoaohoh', 'fight', 'fear', 'lyric', 'commerci', 'grupo', 'maximo', 'grado', 'el', 'hombr', 'del', 'equipo', '2016', 'pop', 'sell', 'feel', 'fool', 'go', 'lead', 'kind', 'reali', 'nice', 'nice', 'burn', 'prari', 'know', 'come', 'time', 'unwind', 'somebodi', 'suffer', 'know', 'damag', 'health', 'fight', 'worri', 'know', 'time', 'guard', 'shield', 'care', 'know', 'damag', 'health', 'song', 'incom', 'bring', 'close', 'leav', 'haunt', 'dream', 'believ', 'believ', 'breath', 'breath', 'stop', 'breath', 'breath', 'stop', 'breath', 'breath', 'stop', 'breath', 'jess', 'royal', 'modern', 'day', 'juda', '2017', 'regga', 'come', 'music', 'thing', 'offspr', 'peopl', 'rate', 'choo', 'hate', 'play', 'card', 'backbit', 'hypocrit', 'twosid', 'lass', 'modern', 'spreader', 'rumor', 'afraid', 'bleed', 'like', 'fight', 'light', 'shin', 'time', 'cau', 'view', 'wan', 'na', 'step', 'shoe', 'wish', 'live', 'feel', 'confu', 'ach', 'know', 'fake', 'step', 'bring', 'closer', 'grave', 'like', 'column', 'easili', 'shake', 'certain', 'unnu', 'guid', 'master', 'defend', 'fate', 'ordain', 'great', 'teeth', 'tongu', 'gon', 'na', 'reward', 'word', 'shall', 'profound', 'screw', 'want', 'drown', 'slew', 'like', 'goliath', 'stone', 'crown', 'pisseth', 'wall', 'babylon', 'shall', 'escap', 'time', 'word', 'wise', 'choo', 'right', 'hinder', 'foolish', 'pride', 'weapon', 'form', 'shall', 'prospa', 'prospa', 'tell', 'forc', 'ripe', 'maga', 'disrespect', 'face', 'disast', 'deni', 'concoct', 'brew', 'spliff', 'neva', 'sluu', 'cashew', 'paro', 'narrow', 'view', 'forget', 'jew', 'friend', 'tuff', 'gong', 'suppress', 'truth', 'absolut', 'pollut', 'jason', 'isbel', '400', 'unit', 'chao', 'cloth', '2017', 'countri', 'grind', 'dark', 'take', 'take', 'heart', 'wrap', 'round', 'tree', 'like', 'lover', 'leav', 'chao', 'cloth', 'quiet', 'corner', 'rare', 'proof', 'real', 'despit', 'struggl', 'forget', 'fight', 'death', 'friend', 'black', 'metal', 'tshirt', 'shield', 'past', 'breath', 'friend', 'monster', 'kill', 'monster', 'kill', 'choo', 'place', 'turn', 'collar', 'better', 'frame', 'face', 'hate', 'hate', 'somebodi', 'know', 'leav', 'trail', 'crumb', 'know', 'realiz', 'garden', 'grow', 'fight', 'death', 'friend', 'airwav', 'grand', 'battlefield', 'past', 'breath', 'friend', 'monster', 'kill', 'monster', 'kill', 'sleep', 'build', 'machin', 'want', 'hear', 'dream', 'night', 'burn', 'ferri', 'wheel', 'mean', 'anybodi', 'guess', 'lover', 'leav', 'chao', 'cloth', 'debri', 'sort', 'hell', 'ghost', 'mess', 'fight', 'death', 'friend', 'fight', 'like', 'chain', 'wheel', 'past', 'breath

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Top 20 words for dark :

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[array(['2016', 'roll', 'role', 'rock', 'roar', 'rise', 'riot', 'right',
        'ride', 'rid', 'rhythm', 'reward', 'return', 'rest', 'resist',
        'reign', 'regret', 'regnum', 'regga', 'redneck', 'rebellion',
        'rebel', 'reason', 'realiz', 'realiti', 'real', 'readi', 'reach',
        'rope', 'rare', 'rose', 'ruin', 'shimmer', 'shield', 'shenseea',
        'shed', 'shame', 'shall', 'shaker', 'shake', 'shackl', 'send',
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'sell', 'seein', 'see', 'second', 'sea', 'scream', 'score', 'scar',
'say', 'save', 'satan', 'sanctu', 'sam', 'saint', 'runnin', 'run',
'rule', 'round', 'rain', 'rai', 'racket', 'papa', 'pair', 'pain',
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'oooh', 'onion', 'one', 'offer', 'ocean', 'nothin', 'normal',
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'push', 'pumpum', 'pull', 'pul', 'proud', 'prospa', 'promi',
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'spark', 'space', 'south', 'soul', 'sorrow', 'soon', 'song', 'son',
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'state', 'tell', 'tear', 'tantantara', 'take', 'ta', 'sword',
'swing', 'sweat', 'surviv', 'surround', 'suffer', 'stronger',
'strong', 'shore', 'strigoi', 'street', 'strangl', 'straight',
'stori', 'stop', 'stick', 'step', 'steep', 'steel', 'steal',
'stead', 'stay', 'statu', 'strength', 'money', 'moment', 'modern',
'die', 'devil', 'deu', 'destroy', 'desir', 'deserv', 'deep',
'death', 'dear', 'dead', 'day', 'dark', 'danda', 'danba', 'damag',
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'dilli', 'divid', 'fever', 'fell', 'feet', 'feel', 'fear', 'fate',
'fang', 'fall', 'fair', 'fail', 'face', 'escap', 'enemi', 'end',
'empress', 'empir', 'edg', 'earthquak', 'drown', 'drive', 'drink',
'dream', 'draw', 'dragon', 'drag', 'door', 'domin', 'direct',
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'honour', 'home', 'holi', 'hold', 'hip', 'insid', 'high', 'hero',
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'scar', 'say', 'save', 'satan', 'sanctu', 'sam', 'saint', 'runnin',
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'weak', 'wave', 'water', 'watch', 'warm', 'want', 'wall', 'thank',
'test', 'terribl', 'spell', 'spark', 'space', 'south', 'soul',
'sorrow', 'soon', 'song', 'son', 'somebodi', 'smoke', 'smith',
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Top 20 words for lifestyle :

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dtype=object)]
[]

```

ValueError

Traceback (most recent call last)

Cell In[1696], line 73

```
71 combine = combine.split()
72 print(combine)
--> 73 document = vectorizer500.fit_transform(combine)
74 user1_profile[topic] = document
75 all_features = vectorizer500.get_feature_names_out()
```

File ~\anaconda3\Lib\site-packages\sklearn\feature_extraction\text.py:2091, in TfidfVectorizer.fit_transform(self, raw_documents, y)

```
2084 self._check_params()
2085 self._tfidf = TfidfTransformer(
2086     norm=self.norm,
2087     use_idf=self.use_idf,
2088     smooth_idf=self.smooth_idf,
2089     sublinear_tf=self.sublinear_tf,
2090 )
-> 2091 X = super().fit_transform(raw_documents)
2092 self._tfidf.fit(X)
2093 # X is already a transformed view of raw_documents so
2094 # we set copy to False
```

File ~\anaconda3\Lib\site-packages\sklearn\base.py:1473, in _fit_context.<locals>.<decorator.<locals>.wrapper(estimator, *args, **kwargs)

```
1466 estimator._validate_params()
1468 with config_context(
1469     skip_parameter_validation=(
1470         prefer_skip_nested_validation or global_skip_validation
1471     )
1472 ):
-> 1473     return fit_method(estimator, *args, **kwargs)
```

File ~\anaconda3\Lib\site-packages\sklearn\feature_extraction\text.py:1372, in CountVectorizer.fit_transform(self, raw_documents, y)

```
1364         warnings.warn(
1365             "Upper case characters found in"
1366             " vocabulary while 'lowercase'"
1367             " is True. These entries will not"
1368             " be matched with any documents"
1369         )
1370         break
-> 1372 vocabulary, X = self._count_vocab(raw_documents, self.fixed_vocabulary_)
1374 if self.binary:
1375     X.data.fill(1)
```

File ~\anaconda3\Lib\site-packages\sklearn\feature_extraction\text.py:1278, in CountVectorizer._count_vocab(self, raw_documents, fixed_vocab)

```
1276     vocabulary = dict(vocabulary)
1277     if not vocabulary:
-> 1278         raise ValueError(
1279             "empty vocabulary; perhaps the documents only contain stop wo"
1280             "rds"
1281         )
1282     if indptr[-1] > np.iinfo(np.int32).max: # = 2**31 - 1
1283         if _IS_32BIT:
```

ValueError: empty vocabulary; perhaps the documents only contain stop words

In [162...

```
import numpy as np
import matplotlib.pyplot as plt

# Plot the distribution of the actual topics in the test set
unique_true, counts_true = np.unique(y_test, return_counts=True)

# Plot the distribution of the predicted topics
unique_pred, counts_pred = np.unique(y_pred, return_counts=True)

plt.figure(figsize=(8,4))

# Create bar width
barWidth = 0.2

# Set position of bar on X axis
r1 = np.arange(len(counts_true))
r2 = [x + barWidth for x in r1]

# Create subplot for 'true' distribution
plt.bar(r1, counts_true, color='b', width=barWidth, edgecolor='white', label='True')

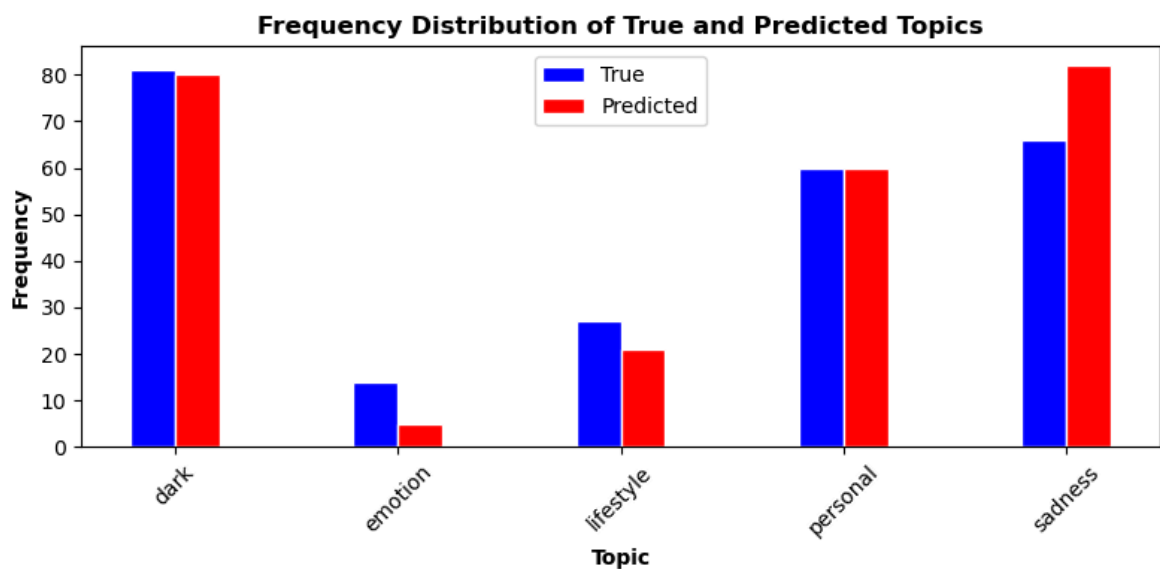
# Create subplot for 'predicted' distribution
plt.bar(r2, counts_pred, color='r', width=barWidth, edgecolor='white', label='Predicted')

plt.xlabel('Topic', fontweight='bold')
plt.ylabel('Frequency', fontweight='bold')
plt.title('Frequency Distribution of True and Predicted Topics', fontweight='bold')

plt.xticks([r + barWidth/2 for r in range(len(counts_true))], topics, rotation=45)

plt.legend()

plt.tight_layout()
plt.savefig('topic_distribution.png')
plt.show()
```



In []: