v03

April 11, 2024

[ ]:
```
# Import packages
import pandas as pd
import numpy as np
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.naive_bayes import MultinomialNB, GaussianNB
from sklearn.metrics import ConfusionMatrixDisplay

%matplotlib inline
import matplotlib.pyplot as plt
import seaborn as sns
```

[ ]:
```
# Load Dataset
data0_path = "../data/dataset_rais.xlsx"
data1_path = "../data/dataset.xlsx"
data0 = pd.read_excel(data0_path)
data1 = pd.read_excel(data1_path)
```

[ ]:
```
# Preview dataset
data0.head()
```

[ ]:
```
                                              Tweets  \
0  Sama banget Komentar ini dgn para pendukung se…
1  Ha ha ha sigundul penguasa ancol karena selama…
2  Kasihan Ibu ini jadi korban akibat dicuci otak…
3  Ha ha hakadrun pada stressssssss mengenai beber…
4  Kok sewot dgn Pidato Sambutan Bpk Joko Widodo …

                                       clean_tweets  Social  Historical  \
0  komentar dukung setia joko widodo presiden ri …     1.0         0.0
1  sigundul kuasa ancol jilat gabenar buka jeroan…     1.0         0.0
2  kasihan korban akibat cuci otak kadrun tanggun…     0.0         0.0
3  hakadrun stres pimpin negara inggeris turun an…     1.0         0.0
4  sewot pidato sambut joko widodo presiden ri hu…     0.0         0.0

   Dehumanization  Accusation  Attack  Loyalty  Threat   HS  Non HS  \
0             0.0         0.0     0.0      0.0     0.0  0.0     1.0
1             0.0         1.0     0.0      0.0     0.0  1.0     0.0
```

```
2             1.0         1.0     0.0      0.0     0.0  1.0     0.0
3             1.0         0.0     0.0      0.0     0.0  0.0     1.0
4             1.0         0.0     0.0      0.0     0.0  0.0     1.0

   Anticipation  Trust  Joy  Anger  Disgust  Fear  Sadness  Surprise
0           0.0    1.0  0.0    0.0      0.0   0.0      0.0       0.0
1           0.0    0.0  0.0    0.0      1.0   0.0      0.0       0.0
2           0.0    0.0  0.0    0.0      0.0   0.0      1.0       0.0
3           0.0    1.0  0.0    0.0      0.0   0.0      0.0       0.0
4           1.0    0.0  0.0    0.0      0.0   0.0      0.0       0.0
```

[ ]:
```
data1.head()
```

[ ]:
```
                                              Tweets  \
0  Sama banget Komentar ini dgn para pendukung se…
1  Ha ha ha sigundul penguasa ancol karena selama…
2  Kasihan Ibu ini jadi korban akibat dicuci otak…
3  Ha ha hakadrun pada stressssssss mengenai beber…
4  Kok sewot dgn Pidato Sambutan Bpk Joko Widodo …

                                      clean_tweets  Social  Historical  \
0  komentar dukung setia joko widodo presiden ri …       1           0
1  sigundul kuasa ancol jilat gabenar buka jeroan…       1           0
2  kasihan korban akibat cuci otak kadrun tanggun…       0           0
3  hakadrun stres pimpin negara inggeris turun an…       1           0
4  sewot pidato sambut joko widodo presiden ri hu…       0           0

   Dehumanization  Accusation  Attack  Loyalty  Threat  HS  Non HS  \
0               0           0     0.0        0       0   0       1
1               0           1     0.0        0       0   1       0
2               1           1     0.0        0       0   1       0
3               1           0     0.0        0       0   0       1
4               1           0     0.0        0       0   0       1

   Anticipation  Trust  Joy  Anger  Disgust  Fear  Sadness  Surprise
0             0      1    0    0.0        0     0        0         0
1             0      0    0    0.0        1     0        0         0
2             0      0    0    0.0        0     0        1         0
3             0      1    0    0.0        0     0        0         0
4             1      0    0    0.0        0     0        0         0
```

[ ]:
```
data = pd.concat([data0, data1])
data.describe()
```

[ ]:
```
            Social   Historical  Dehumanization   Accusation       Attack  \
count  3001.000000  3001.000000     3001.000000  3001.000000  3001.000000
mean      0.392536     0.018660        0.563146     0.274575     0.013995
```

```
std       0.488396     0.135345        0.496079     0.446374     0.117491
min       0.000000     0.000000        0.000000     0.000000     0.000000
25%       0.000000     0.000000        0.000000     0.000000     0.000000
50%       0.000000     0.000000        1.000000     0.000000     0.000000
75%       1.000000     0.000000        1.000000     1.000000     0.000000
max       1.000000     1.000000        1.000000     1.000000     1.000000

           Loyalty       Threat           HS       Non HS  Anticipation  \
count  3001.000000  3001.000000  3367.000000  3606.000000   3077.000000
mean      0.017328     0.039987     0.632611     0.510815      0.213845
std       0.130510     0.195961     0.482165     0.499952      0.410085
min       0.000000     0.000000     0.000000     0.000000      0.000000
25%       0.000000     0.000000     0.000000     0.000000      0.000000
50%       0.000000     0.000000     1.000000     1.000000      0.000000
75%       0.000000     0.000000     1.000000     1.000000      0.000000
max       1.000000     1.000000     1.000000     1.000000      1.000000

             Trust          Joy        Anger      Disgust         Fear  \
count  3198.000000  3152.000000  3117.000000  3107.000000  3079.000000
mean      0.165729     0.133566     0.277831     0.291600     0.038974
std       0.371895     0.340239     0.448002     0.454572     0.193564
min       0.000000     0.000000     0.000000     0.000000     0.000000
25%       0.000000     0.000000     0.000000     0.000000     0.000000
50%       0.000000     0.000000     0.000000     0.000000     0.000000
75%       0.000000     0.000000     1.000000     1.000000     0.000000
max       1.000000     1.000000     1.000000     1.000000     1.000000

            Sadness     Surprise
count  3103.000000  3146.000000
mean      0.063809     0.084234
std       0.244452     0.277782
min       0.000000     0.000000
25%       0.000000     0.000000
50%       0.000000     0.000000
75%       0.000000     0.000000
max       1.000000     1.000000
```

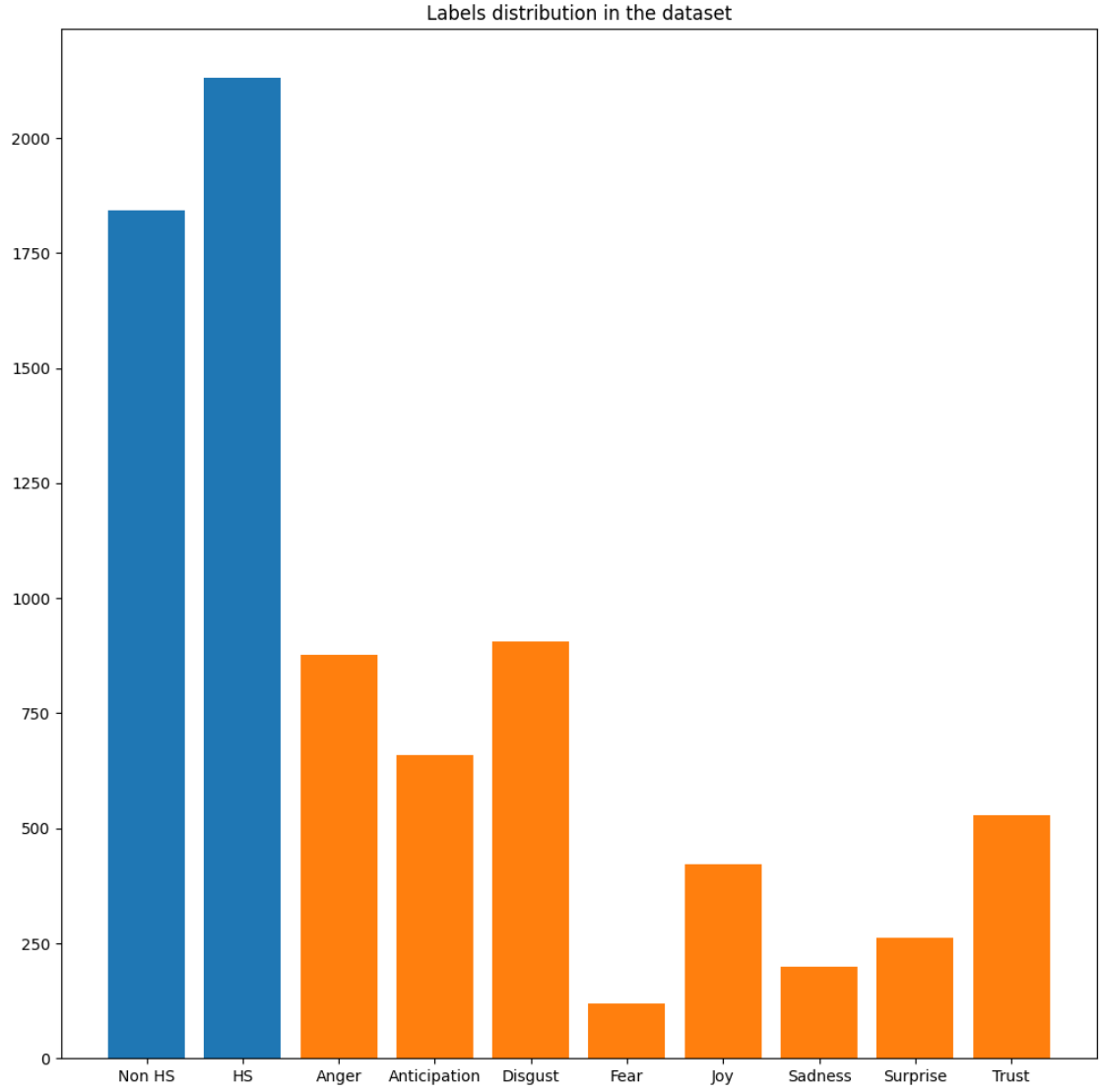
[ ]:
```
data.fillna(0, inplace=True)
data.dropna(inplace=True)
data.describe()
```

[ ]:
```
            Social   Historical  Dehumanization   Accusation       Attack  \
count  3972.000000  3972.000000     3972.000000  3972.000000  3972.000000
mean      0.296576     0.014099        0.425478     0.207452     0.010574
std       0.456805     0.117913        0.494478     0.405533     0.102298
min       0.000000     0.000000        0.000000     0.000000     0.000000
25%       0.000000     0.000000        0.000000     0.000000     0.000000
```

```
50%       0.000000     0.000000        0.000000     0.000000     0.000000
75%       1.000000     0.000000        1.000000     0.000000     0.000000
max       1.000000     1.000000        1.000000     1.000000     1.000000

           Loyalty       Threat           HS       Non HS  Anticipation  \
count  3972.000000  3972.000000  3972.000000  3972.000000   3972.000000
mean      0.013092     0.030211     0.536254     0.463746      0.165660
std       0.113682     0.171190     0.498747     0.498747      0.371822
min       0.000000     0.000000     0.000000     0.000000      0.000000
25%       0.000000     0.000000     0.000000     0.000000      0.000000
50%       0.000000     0.000000     1.000000     0.000000      0.000000
75%       0.000000     0.000000     1.000000     1.000000      0.000000
max       1.000000     1.000000     1.000000     1.000000      1.000000

             Trust          Joy        Anger      Disgust         Fear  \
count  3972.000000  3972.000000  3972.000000  3972.000000  3972.000000
mean      0.133434     0.105992     0.218026     0.228097     0.030211
std       0.340086     0.307866     0.412957     0.419658     0.171190
min       0.000000     0.000000     0.000000     0.000000     0.000000
25%       0.000000     0.000000     0.000000     0.000000     0.000000
50%       0.000000     0.000000     0.000000     0.000000     0.000000
75%       0.000000     0.000000     0.000000     0.000000     0.000000
max       1.000000     1.000000     1.000000     1.000000     1.000000

            Sadness     Surprise
count  3972.000000  3972.000000
mean      0.049849     0.066717
std       0.217660     0.249563
min       0.000000     0.000000
25%       0.000000     0.000000
50%       0.000000     0.000000
75%       0.000000     0.000000
max       1.000000     1.000000
```

[ ]:
```python
#Helper function to plot the dataset distribution
def plot_data(data: pd.DataFrame):
    plt.figure(figsize=(12, 12))
    y0_names = ["Non HS", "HS"]
    y1_names = [
        "Anger",
        "Anticipation",
        "Disgust",
        "Fear",
        "Joy",
        "Sadness",
        "Surprise",
        "Trust",
```

```
    ]

    y0 = data.loc[:, y0_names].values.argmax(1)  # HS
    y1 = data.loc[:, y1_names].values.argmax(1)  # Emotion

    unq0 = np.unique(y0, return_counts=True)
    unq1 = np.unique(y1, return_counts=True)

    total0 = {y0_names[x]: y for (x, y) in zip(unq0[0], unq0[1])}
    total1 = {y1_names[x]: y for (x, y) in zip(unq1[0], unq1[1])}

    plt.bar(total0.keys(), total0.values())
    plt.bar(total1.keys(), total1.values())
    plt.title('Labels distribution in the dataset')
plot_data(data)
```



[ ]:
```python
# Helper function to pre-process dataset
def preprocess_data(data: pd.DataFrame):
    # Get only the needed datas
    y0_names = ["Non HS", "HS"]
    y1_names = [
        "Anger",
        "Anticipation",
        "Disgust",
        "Fear",
        "Joy",
        "Sadness",
        "Surprise",
        "Trust",
    ]

    X = data["clean_tweets"].values  # Input
    y0 = data.loc[:, y0_names].values.argmax(1)  # HS
    y1 = data.loc[:, y1_names].values.argmax(1)  # Emotion

    # Split for train and test
    ratio = int(0.8 * len(X))
    split_data = lambda x: [x[:ratio], x[ratio:]]

    x_train, x_test = split_data(X)
    y0_train, y0_test = split_data(y0)
    y1_train, y1_test = split_data(y1)

    # TF-IDF for Feature Extraction
    tfidf = TfidfVectorizer()
    x_train = tfidf.fit_transform(x_train)
    x_test = tfidf.transform(x_test)

    feature_names = tfidf.get_feature_names_out()

    ret = {
        "x_train": x_train,
        "x_test": x_test,
        "y0_train": y0_train,
        "y0_test": y0_test,
        "y1_train": y1_train,
        "y1_test": y1_test,
        "y0_names": y0_names,
        "y1_names": y1_names,
        "feature_names": feature_names,
    }
```

```
    return tfidf, ret
```

[ ]:
```
# PreProcess the data
tf_idf, data_dict = preprocess_data(data)
```

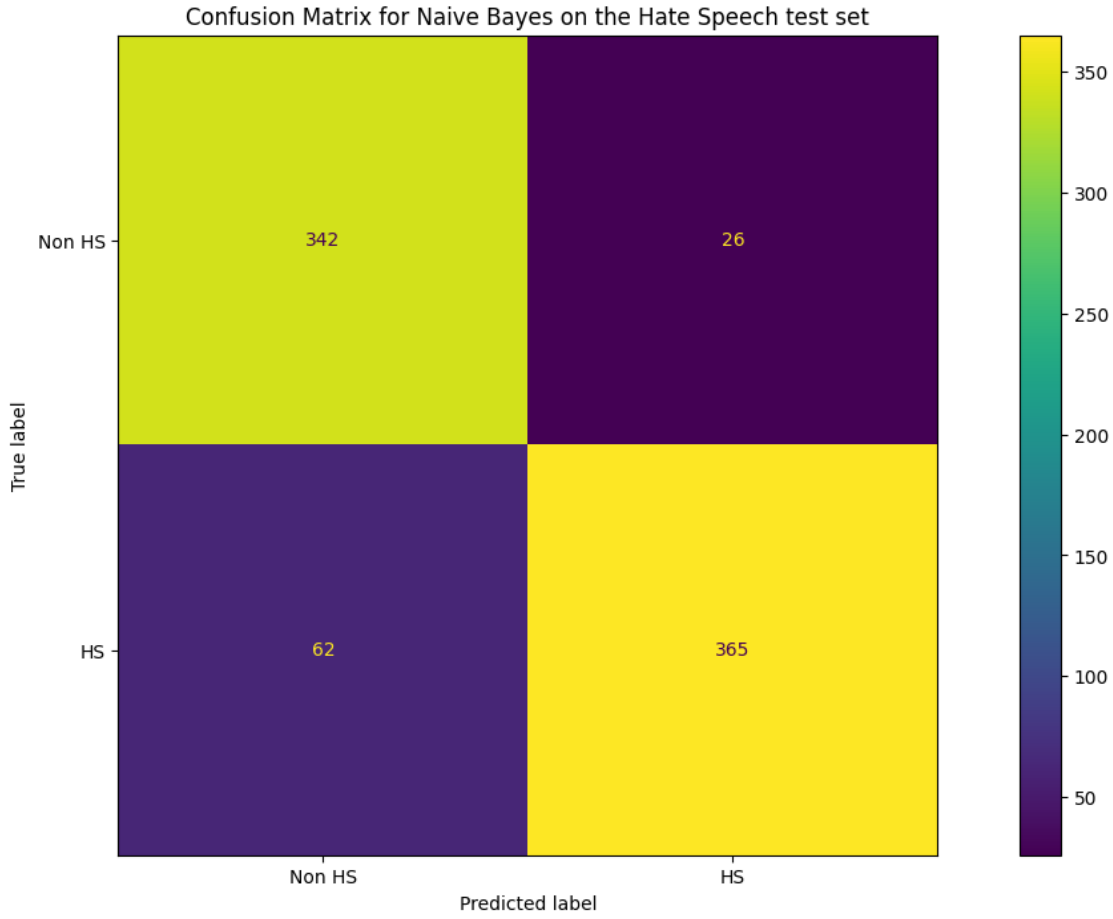
[ ]:
```
denselist = data_dict['x_train'].todense().tolist()
df_ = pd.DataFrame(denselist, columns=tf_idf.get_feature_names_out())
word_count = dict(df_.sum(axis=0))
word_count = {x: int(y*3000) for (x, y) in word_count.items()}
```

[ ]:
```
from wordcloud import WordCloud

wc = WordCloud().generate_from_frequencies(word_count)
plt.figure(figsize=(16, 16))
plt.title('Word Cloud of the features in the dataset')
plt.imshow(wc, interpolation='bilinear')
plt.show()
```

[ ]:
```
# Hate Speech Classification
hs_clf = MultinomialNB()
hs_clf.fit(data_dict["x_train"], data_dict["y0_train"])
pred = hs_clf.predict(data_dict["x_test"])
print(
    f'Mean Accuracy for Hate Speech Classification: {hs_clf.
 ↪score(data_dict["x_test"], data_dict["y0_test"])}'
)
```

```
Mean Accuracy for Hate Speech Classification: 0.889308176100629
```

[ ]:
```
# Plot the Confusion Matrix in test data
fig, ax = plt.subplots(figsize=(16, 8))
ConfusionMatrixDisplay.from_predictions(data_dict["y0_test"], pred, ax=ax)
ax.xaxis.set_ticklabels(data_dict["y0_names"])
ax.yaxis.set_ticklabels(data_dict["y0_names"])
_ = ax.set_title(f"Confusion Matrix for Naive Bayes on the Hate Speech test␣
↪set")
```



[ ]:
```
# Helper function to plot feature effects
def plot_feature_effects(clf, X_train, target_names, feature_names):
    # learned coefficients weights
    average_feature_effects = (
        clf.feature_log_prob_**2 * np.asarray(X_train.mean(axis=0)).ravel()
    )

    for i, label in enumerate(target_names[::-1]):
```

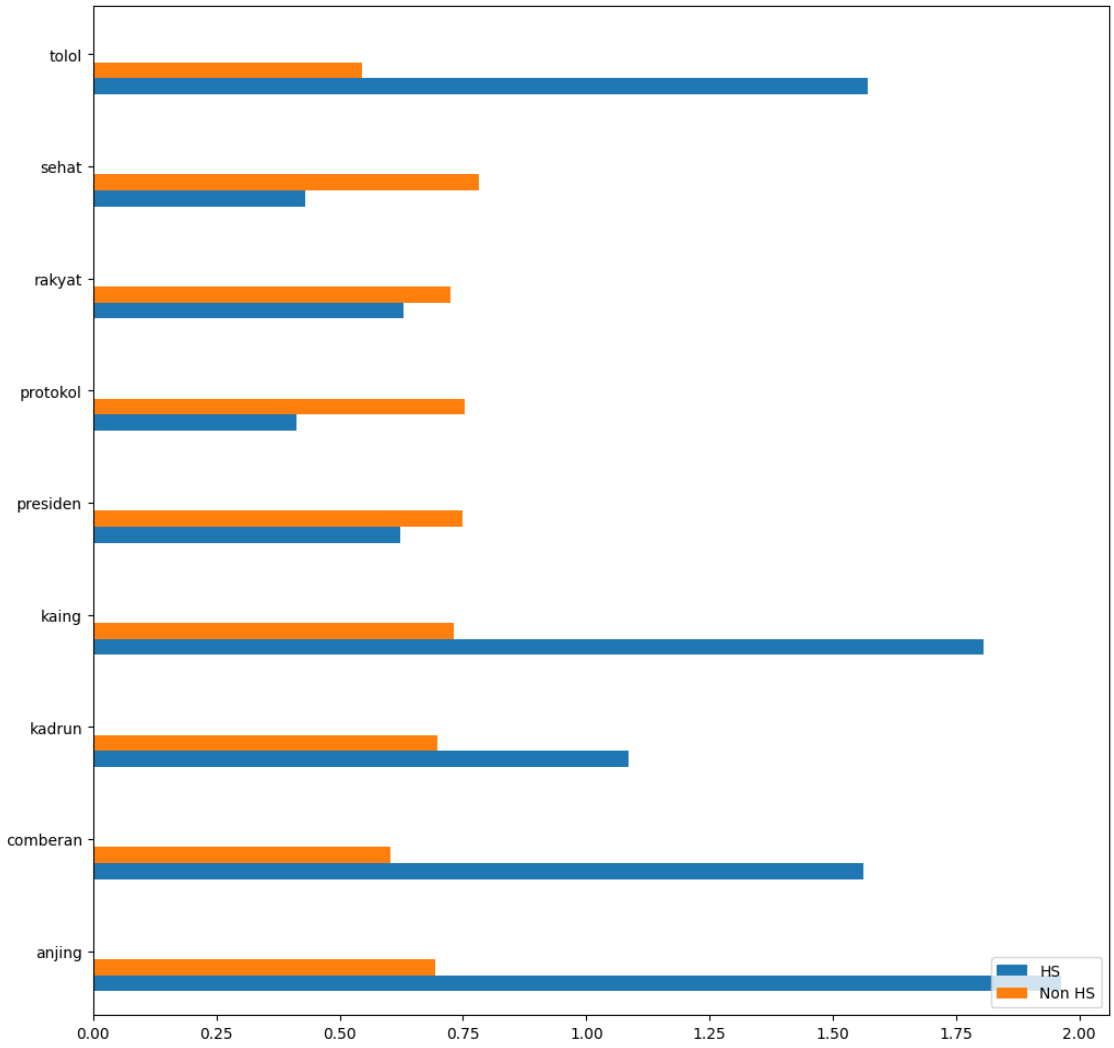
```
        top5 = np.argsort(average_feature_effects[i])[-5:][::-1]
        if i == 0:
            top = pd.DataFrame(feature_names[top5], columns=[label])
            top_indices = top5
        else:
            top[label] = feature_names[top5]
            top_indices = np.concatenate((top_indices, top5), axis=None)
    top_indices = np.unique(top_indices)
    predictive_words = feature_names[top_indices]

    # plot feature effects
    bar_size = 0.25
    padding = 0.75
    y_locs = np.arange(len(top_indices)) * (4 * bar_size + padding)

    fig, ax = plt.subplots(figsize=(12, 12))
    for i, label in enumerate(target_names[::-1]):
        ax.barh(
            y_locs + (i - 2) * bar_size,
            average_feature_effects[i, top_indices],
            height=bar_size,
            label=label,
        )
    ax.set(
        yticks=y_locs,
        yticklabels=predictive_words,
        ylim=[
            0 - 4 * bar_size,
            len(top_indices) * (4 * bar_size + padding) - 4 * bar_size,
        ],
    )
    ax.legend(loc="lower right")

    print("top 5 keywords per class:")
    print(top)

    return ax
```

[ ]:
```
plot_feature_effects(
    hs_clf, data_dict["x_train"], data_dict["y0_names"],␣
  ↪data_dict["feature_names"]
)
```

```
top 5 keywords per class:
         HS    Non HS
0    anjing     sehat
1     kaing  protokol
```

```
2     tolol  presiden
3  comberan     kaing
4    kadrun    rakyat
```

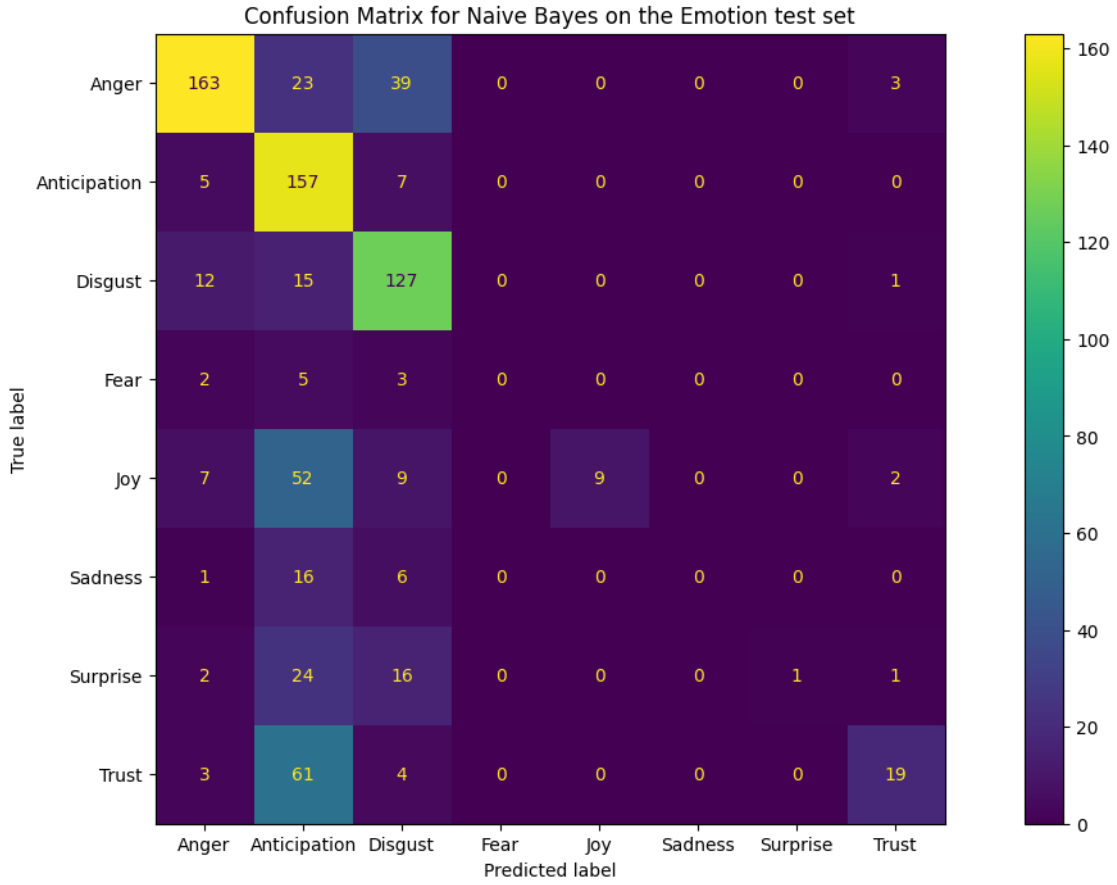
[ ]: <Axes: >



[ ]:
```python
# Emotion Classification
em_clf = MultinomialNB()
em_clf.fit(data_dict["x_train"], data_dict["y1_train"])
pred = em_clf.predict(data_dict["x_test"])
print(
    f'Mean Accuracy for Emotion Classification: {em_clf.
  ↪score(data_dict["x_test"], data_dict["y1_test"])}'
)
```

```
Mean Accuracy for Emotion Classification: 0.5987421383647799
```

[ ]:
```
# Plot the Confusion Matrix in test data
fig, ax = plt.subplots(figsize=(16, 8))
ConfusionMatrixDisplay.from_predictions(data_dict["y1_test"], pred, ax=ax)
ax.xaxis.set_ticklabels(data_dict["y1_names"])
ax.yaxis.set_ticklabels(data_dict["y1_names"])
_ = ax.set_title(f"Confusion Matrix for Naive Bayes on the Emotion test set")
```

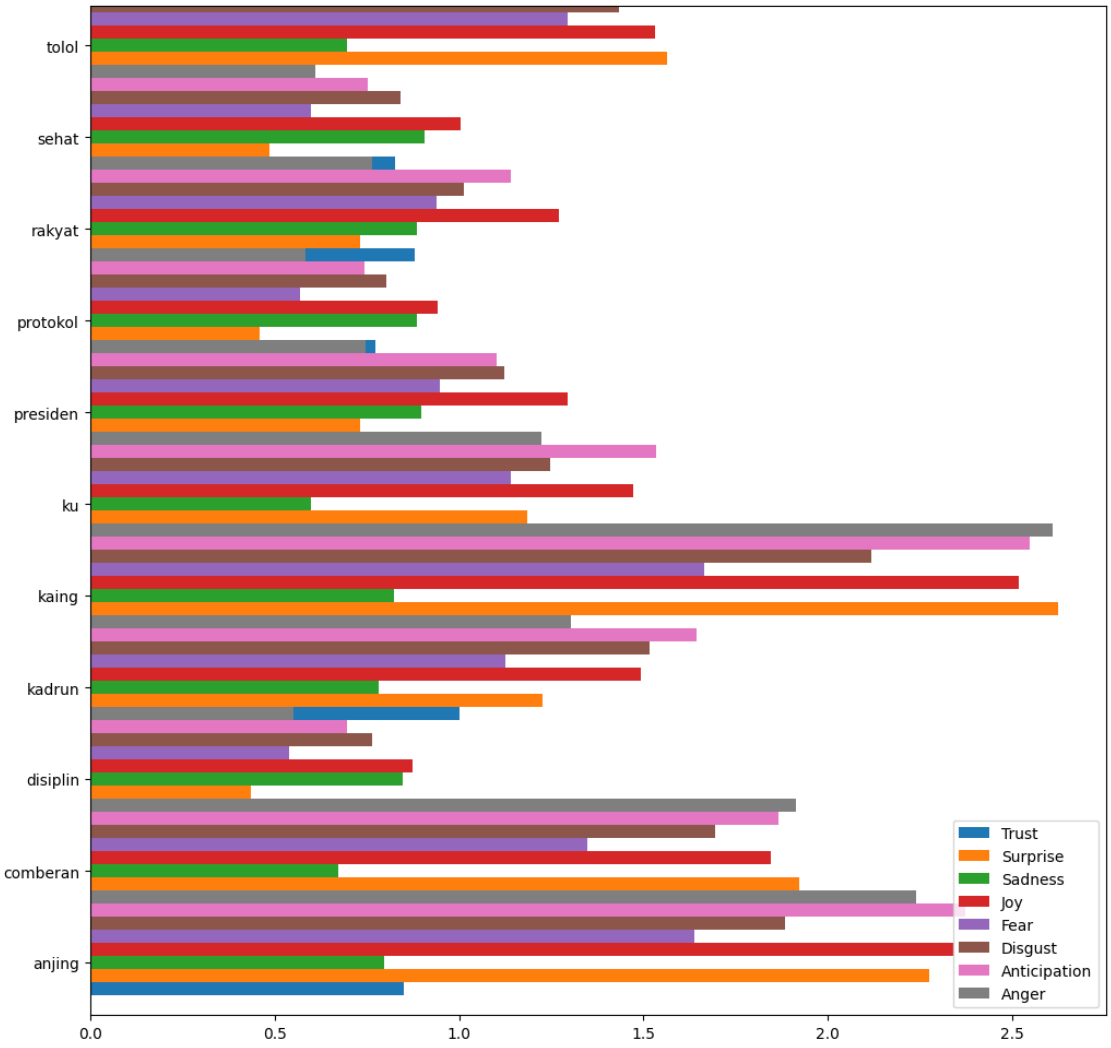


[ ]:
```
plot_feature_effects(
    em_clf, data_dict["x_train"], data_dict["y1_names"],␣
 ↪data_dict["feature_names"]
)
```

```
top 5 keywords per class:
      Trust  Surprise   Sadness       Joy      Fear   Disgust Anticipation  \
0    kadrun     kaing     sehat     kaing     kaing     kaing         kaing
1  presiden    anjing  presiden    anjing    anjing    anjing        anjing
2     kaing  comberan  protokol  comberan  comberan  comberan      comberan
3    rakyat     tolol    rakyat     tolol     tolol    kadrun       kadrun
```

```
4    anjing    kadrun  disiplin    kadrun        ku     tolol           ku

      Anger
0     kaing
1    anjing
2  comberan
3     tolol
4    kadrun
```

[ ]: <Axes: >



1 Prediction

[ ]:
```
#Helper function to run prediction
def predict(txt_input: str,
            clf_type: str= None):

    res2ht = {
        'HS': True,
        'Non HS': False
    }

    #Input Text
    pre_processed_text = tf_idf.transform([txt_input])

    # if clf_type not in ['hs', 'emotion']:
    #     raise f'clf_type should be either hs or emotion, got {clf_type}'

    # if clf_type == 'hs':
    ret = data_dict['y0_names'][hs_clf.predict(pre_processed_text)[0]]

    return {'Hate Speech': res2ht[ret],
            'Emotion': data_dict['y1_names'][em_clf.
 ↪predict(pre_processed_text)[0]]}
    # else:
    #     return data_dict['y1_names'][em_clf.predict(pre_processed_text)[0]]
```

[ ]:
```
text = 'negara gagal mengentaskan kemiskinan lembaga pendidikan semena mena␣
 ↪mencabut hak peserta didik memperoleh pendidikan bukan cuma sekali dua␣
 ↪terjadi cuma tidak tersorot berita'

#Start Predict
predict(text)
```

[ ]:
```
{'Hate Speech': True, 'Emotion': 'Sadness'}
```