Machine Learning Lab 8: Spam classification with Naive bayes

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In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns

# import libraries
```

In [45]:
```
df = pd.read_csv('data\\spam.csv')
df.head()

# import dataset
```

Out[45]:

	Category	Message
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...

EDA

In [3]:
```
df.info()

# check for null values
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 5572 entries, 0 to 5571
Data columns (total 2 columns):
 #   Column    Non-Null Count  Dtype 
---  ------    --------------  ----- 
 0   Category  5572 non-null   object
 1   Message   5572 non-null   object
dtypes: object(2)
memory usage: 87.2+ KB
```

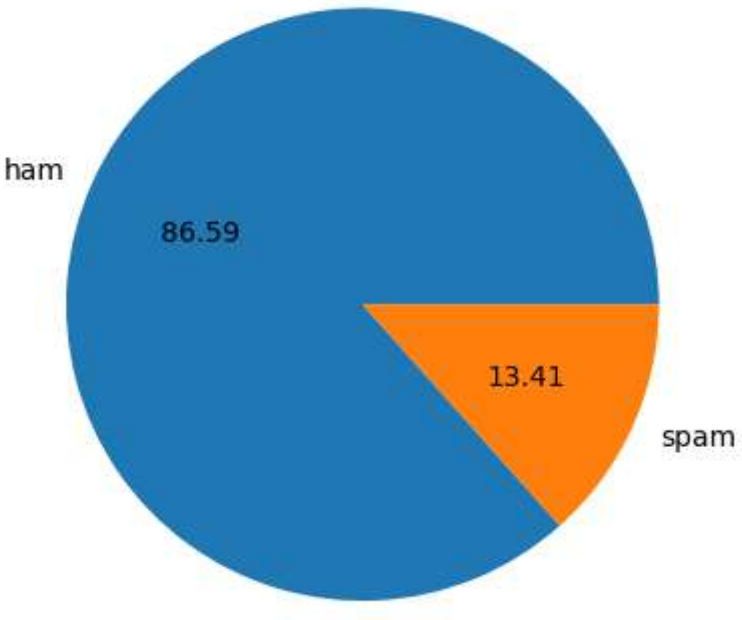
In [4]:
```
df.isna().sum()
```

```
# check for null values
```

Out[4]:
```
Category    0
Message     0
dtype: int64
```

In [46]:
```
plt.pie(df['Category'].value_counts(), labels=['ham', 'spam'], autopct="%0.2f", lab
plt.plot()

# plot pie chart for ham and spam (class distribution)
```

Out[46]:
```
[]
```



In [47]:
```
import nltk
import spacy
import re

nlp = spacy.load('en_core_web_lg')

# import libraries and load spacy model
```

In [7]:
```
stopwords = spacy.lang.en.stop_words.STOP_WORDS

df['Message'] = df['Message'].apply(lambda x: re.sub(r'[^\w\s]', '', x))
df['Message'] = df['Message'].apply(lambda x: ' '.join([word.lower() for word in x.
df['Message'] = df['Message'].apply(lambda x: ' '.join([word.lemma_ for word in nlp

df['Message'].head()

# remove stopwords, punctuations, lemmatize and convert to lower case
```

Out[7]:
```
0    go jurong point crazy available bugis n great ...
1                              ok lar joke wif u oni
2    free entry 2 wkly comp win fa cup final tkts 2...
3                                u dun early hor u c
4                  nah I do not think go usf life
Name: Message, dtype: object
```

In [48]:
```
df.Message[0]

# checking the above process
```

Out[48]:
```
'Go until jurong point, crazy.. Available only in bugis n great world la e buffe
t... Cine there got amore wat...'
```

In [21]:
```
from sklearn.feature_extraction.text import TfidfVectorizer
vectorizer = TfidfVectorizer()

embeddings = vectorizer.fit_transform(df['Message'])
target = df['Category'].map({'ham': 0, 'spam': 1})

# apply tfidf vectorizer to dataset
```

In [22]:
```
from sklearn.model_selection import train_test_split

X_train, X_test, y_train, y_test = train_test_split(embeddings, target, test_size=0

# split dataset into train and test
```

In [23]:
```
from sklearn.naive_bayes import MultinomialNB
naive_bayes = MultinomialNB(alpha=1.0, force_alpha=True)

# instantiate MultinomialNB
```

In [24]:
```
naive_bayes.fit(X_train, y_train)

# fit MultinomialNB to train set
```

Out[24]:
```
MultinomialNB()
```

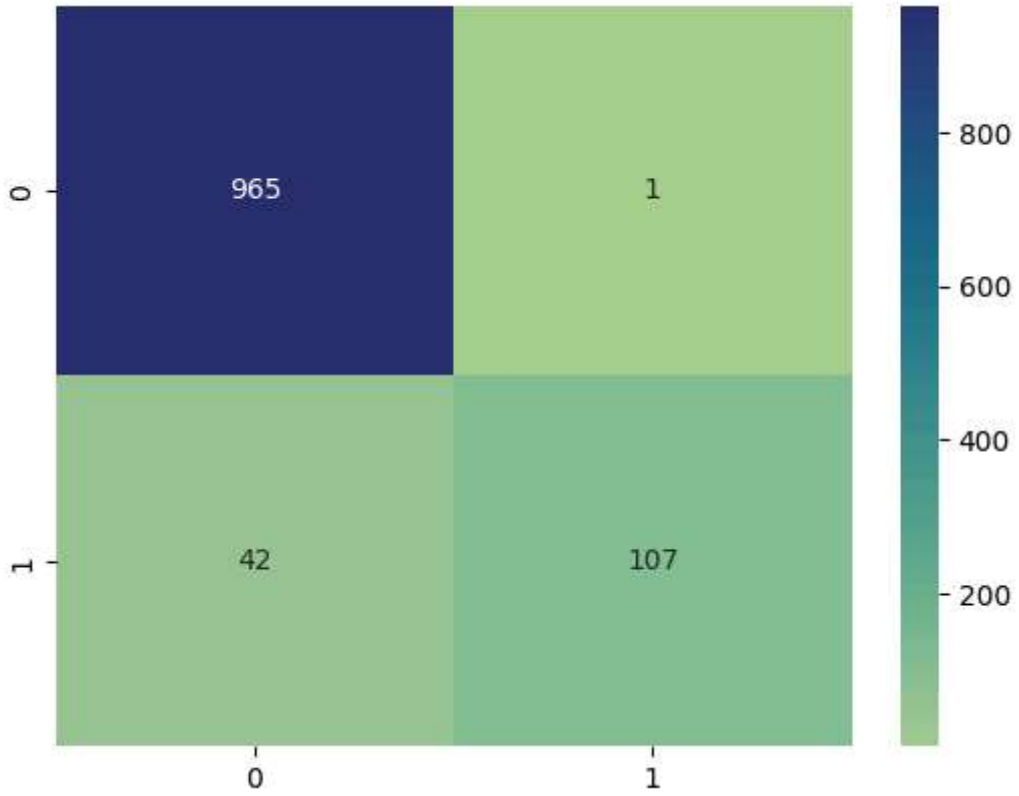
In [65]:
```
print(naive_bayes.score(X_train, y_train))
print(naive_bayes.score(X_test, y_test))

# check train and test scores
```

```
0.9748709894547902
0.9614349775784753
```

In [26]:
```
y_pred = naive_bayes.predict(X_test)

# predict on test set
```

In [73]:
```
from sklearn.metrics import confusion_matrix, classification_report

sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, cmap='crest', fmt='.0f')

# plotting confusion matrix
```

Out[73]: <Axes: >

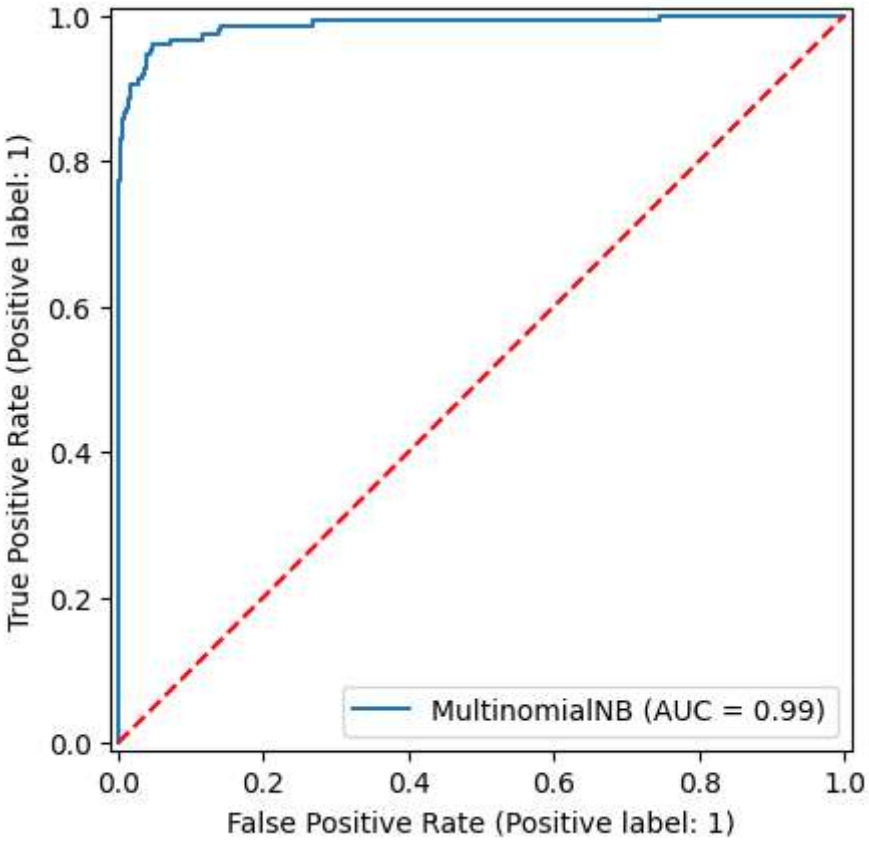


In [74]:
```
print(classification_report(y_test, y_pred))

# print classification report
```

```
              precision    recall  f1-score   support

           0       0.96      1.00      0.98       966
           1       0.99      0.72      0.83       149

    accuracy                           0.96      1115
   macro avg       0.97      0.86      0.91      1115
weighted avg       0.96      0.96      0.96      1115
```

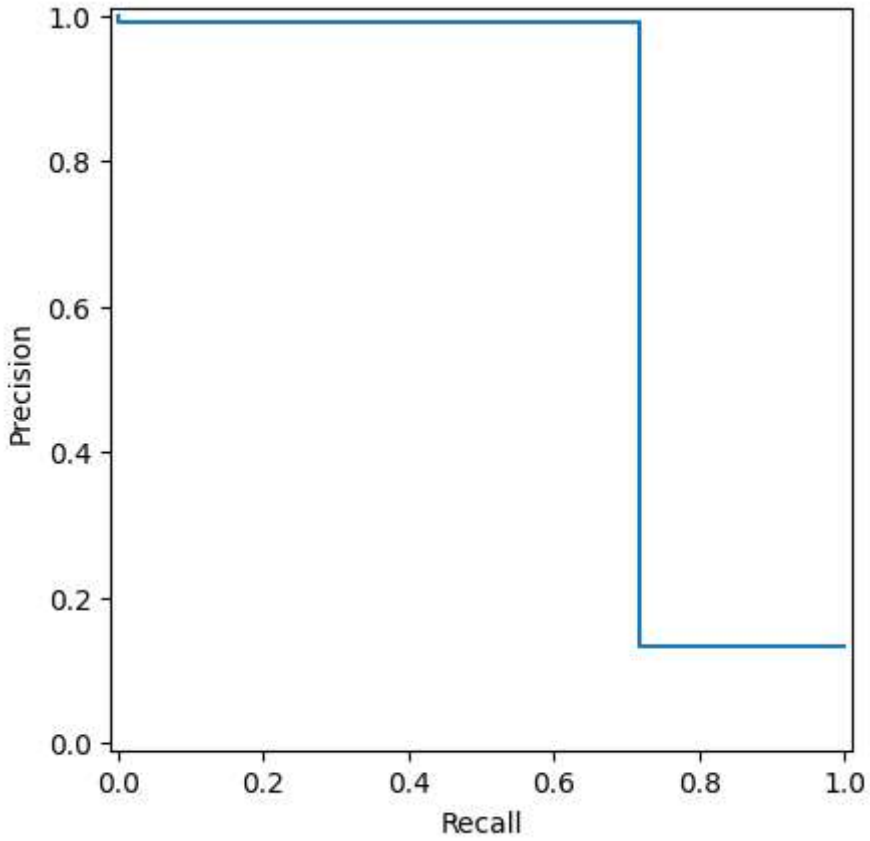
In [80]:
```
from sklearn.metrics import RocCurveDisplay, PrecisionRecallDisplay, precision_reca
RocCurveDisplay.from_estimator(naive_bayes, X_test, y_test)
plt.plot([0,1], [0,1], 'r--')

# plotting roc curve
```

Out[80]: [<matplotlib.lines.Line2D at 0x140b85090d0>]



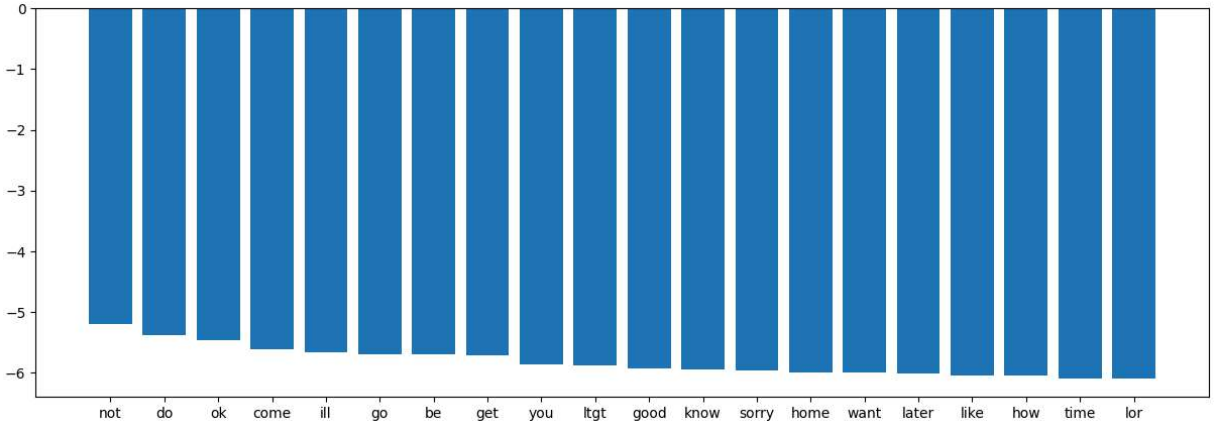
In [81]:
```
precision, recall, threshold = precision_recall_curve(y_test, y_pred)
PrecisionRecallDisplay(precision, recall).plot()

# plotting precision recall curve
```

Out[81]:
```
<sklearn.metrics._plot.precision_recall_curve.PrecisionRecallDisplay at 0x140b8281
b10>
```



In [82]:
```
feature_log_prob = naive_bayes.feature_log_prob_
features = vectorizer.get_feature_names_out()

top20 = sorted(zip(naive_bayes.feature_log_prob_[0], features), reverse=True)[:20]

plt.figure(figsize=(15, 5))
plt.bar([x[1] for x in top20], [x[0] for x in top20])

# plot top 20 features and their weights
```

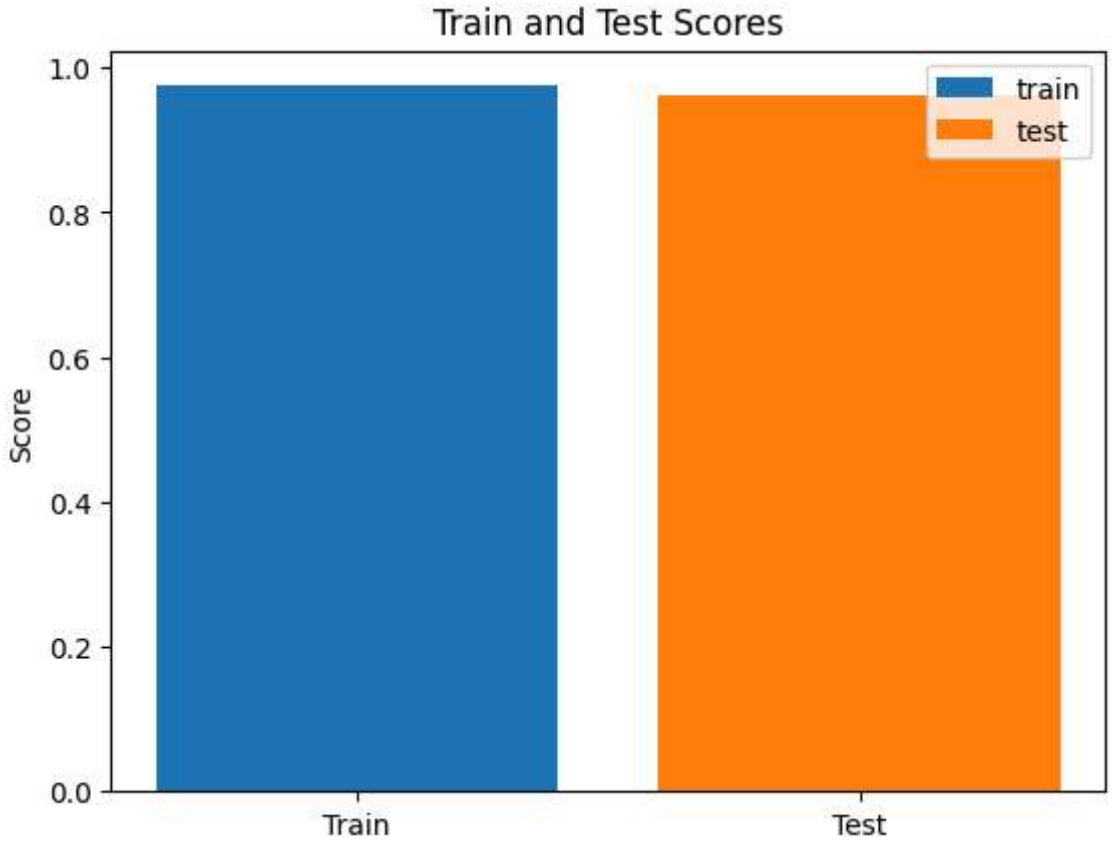
Out[82]: <BarContainer object of 20 artists>



In [83]:
```
plt.bar(1, naive_bayes.score(X_train, y_train), label='train')
plt.bar(2,naive_bayes.score(X_test, y_test), label='test')
plt.ylabel('Score')
plt.legend()
```

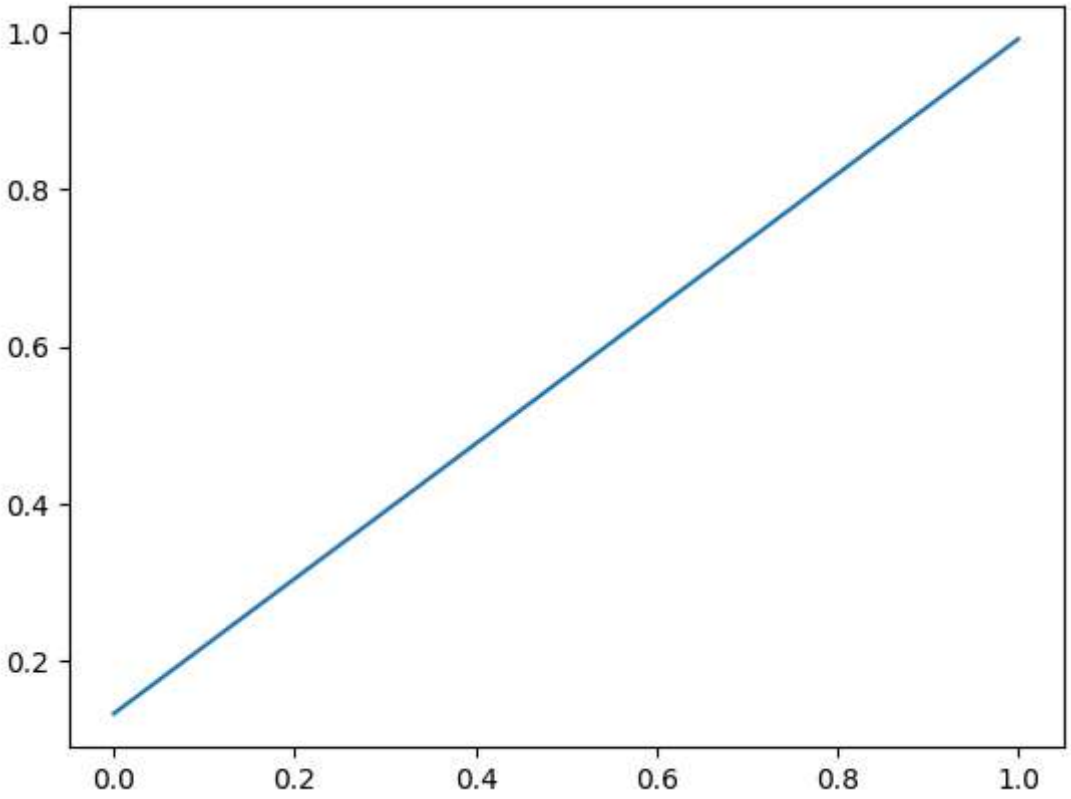
```
plt.xticks([1, 2], ['Train', 'Test'])
plt.title('Train and Test Scores')
plt.plot()

# plot train and test scores
```

Out[83]: []



In [87]:
```
plt.plot(threshold, precision[:-1], label='precision')

# plot precision and threshold
```

Out[87]: [<matplotlib.lines.Line2D at 0x140a3632650>]



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