email-spam-classification

September 29, 2024

[71]:
```
# This Python 3 environment comes with many helpful analytics libraries␣
 ↪installed
# It is defined by the kaggle/python Docker image: https://github.com/kaggle/
 ↪docker-python
# For example, here's several helpful packages to load

import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)

# Input data files are available in the read-only "../input/" directory
# For example, running this (by clicking run or pressing Shift+Enter) will list␣
 ↪all files under the input directory

import os
for dirname, _, filenames in os.walk('/kaggle/input'):
    for filename in filenames:
        print(os.path.join(dirname, filename))

# You can write up to 20GB to the current directory (/kaggle/working/) that␣
 ↪gets preserved as output when you create a version using "Save & Run All"
# You can also write temporary files to /kaggle/temp/, but they won't be saved␣
 ↪outside of the current session
```

```
/kaggle/input/email-classification-ham-spam/email_classification.csv
```

[72]:
```
import pandas as pd
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.metrics import classification_report, confusion_matrix
import warnings
warnings.filterwarnings("ignore", category=FutureWarning)
warnings.filterwarnings("ignore", category=UserWarning)
```

```
df = pd.read_csv("/kaggle/input/email-classification-ham-spam/
  ↪email_classification.csv")
df.info()
```

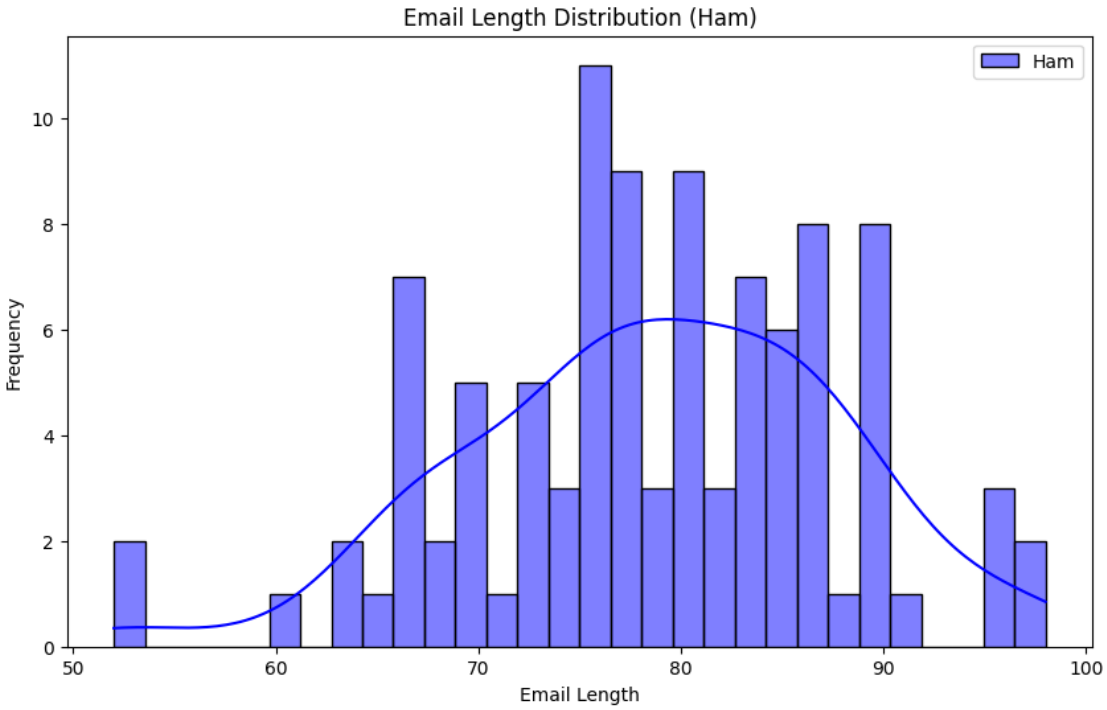
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 179 entries, 0 to 178
Data columns (total 2 columns):
 #   Column  Non-Null Count  Dtype
---  ------  --------------  -----
 0   email   179 non-null    object
 1   label   179 non-null    object
dtypes: object(2)
memory usage: 2.9+ KB
```

[73]:
```
print(df.head())
```

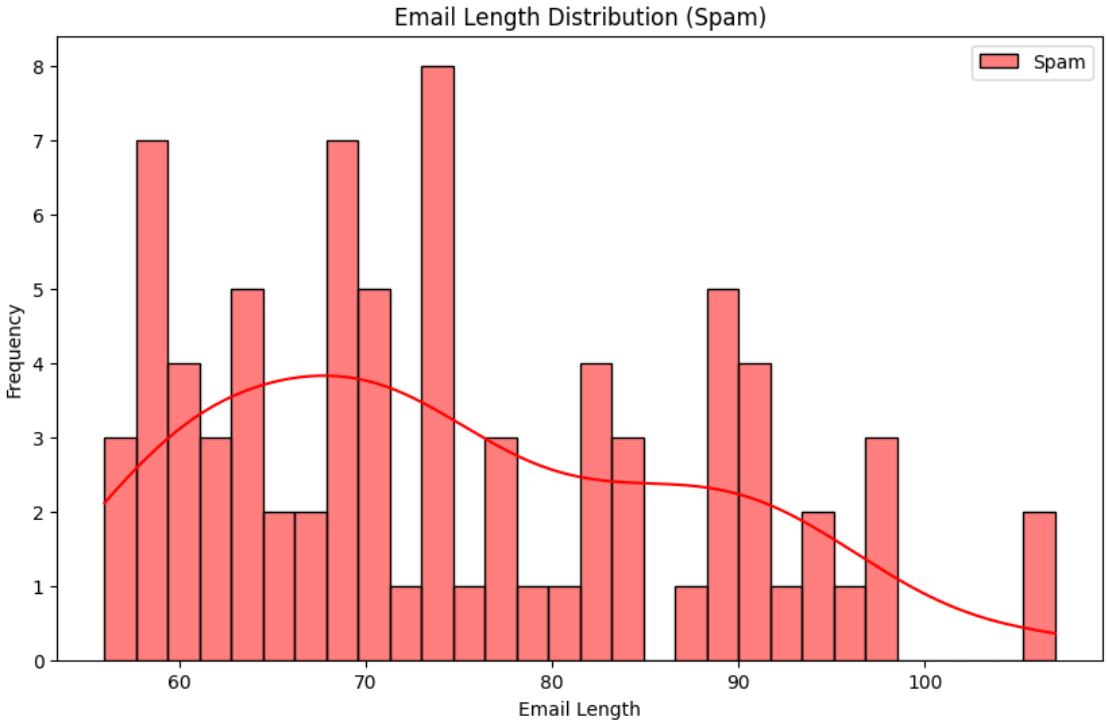
```
                                               email label
0  Upgrade to our premium plan for exclusive acce…   ham
1  Happy holidays from our team! Wishing you joy …   ham
2  We're hiring! Check out our career opportuniti…   ham
3  Your Amazon account has been locked. Click her…  spam
4  Your opinion matters! Take our survey and help…   ham
```

[74]:
```
# Text Vectorization (TF-IDF)
vectorizer = TfidfVectorizer(stop_words='english')
X = vectorizer.fit_transform(df['email'])
y = df['label'].apply(lambda x: 1 if x == 'spam' else 0)
```

[75]:
```
df['email_length'] = df['email'].apply(len)

# Email Length Distribution Plot
plt.figure(figsize=(10,6))
sns.histplot(df[df['label']=='ham']['email_length'], bins=30, color='blue',␣
  ↪label='Ham', kde=True)
plt.title('Email Length Distribution (Ham)')
plt.xlabel('Email Length')
plt.ylabel('Frequency')
plt.legend()
plt.show()
```

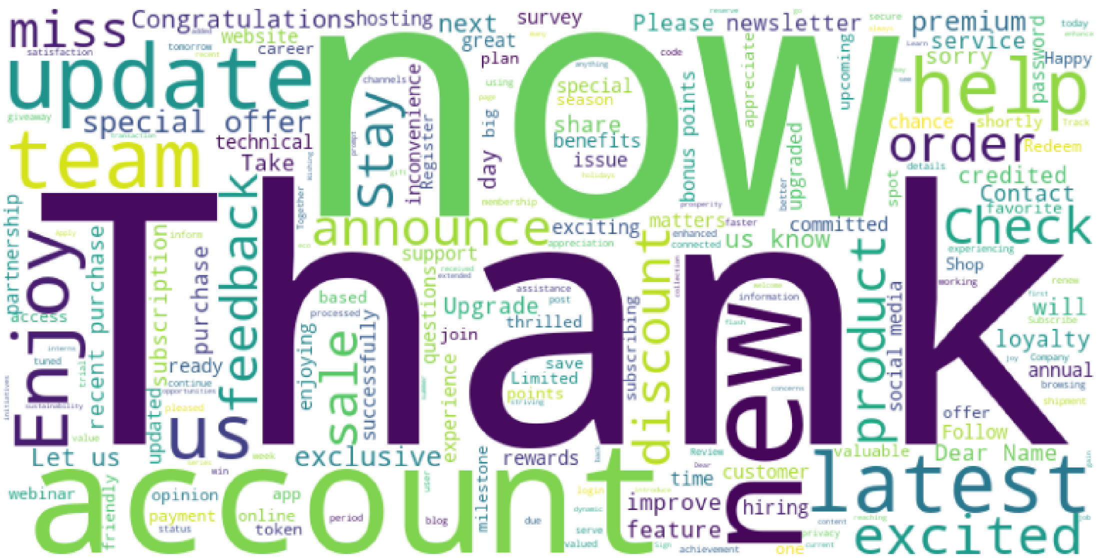


[76]:
```
df['email_length'] = df['email'].apply(len)

# Email Length Distribution Plot
plt.figure(figsize=(10,6))
sns.histplot(df[df['label']=='spam']['email_length'], bins=30, color='red',␣
 ↪label='Spam', kde=True)
plt.title('Email Length Distribution (Spam)')
plt.xlabel('Email Length')
plt.ylabel('Frequency')
plt.legend()
plt.show()
```

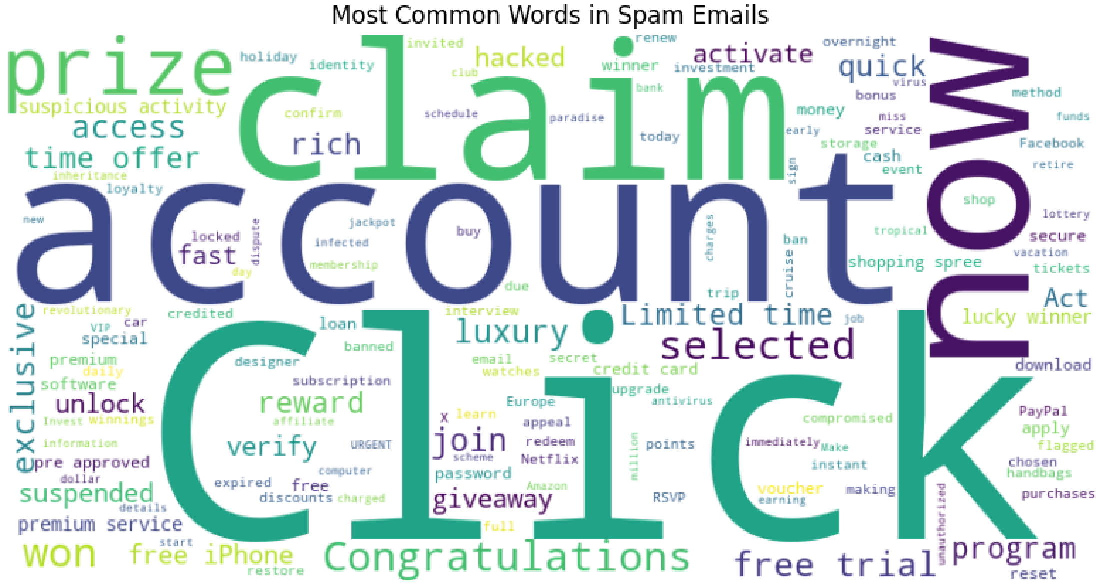


[77]:
```
from wordcloud import WordCloud

# Generate word cloud for Ham
ham_words = ' '.join([text for text in df[df['label'] == 'ham']['email']])
wordcloud_ham = WordCloud(width=800, height=400, background_color='white').
 ↪generate(ham_words)

plt.figure(figsize=(10,6))
plt.imshow(wordcloud_ham, interpolation='bilinear')
plt.title('Most Common Words in Ham Emails')
plt.axis('off')
plt.show()

# Generate word cloud for Spam
spam_words = ' '.join([text for text in df[df['label'] == 'spam']['email']])
wordcloud_spam = WordCloud(width=800, height=400, background_color='white').
 ↪generate(spam_words)

plt.figure(figsize=(10,6))
plt.imshow(wordcloud_spam, interpolation='bilinear')
plt.title('Most Common Words in Spam Emails')
plt.axis('off')
plt.show()
```

Most Common Words in Ham Emails

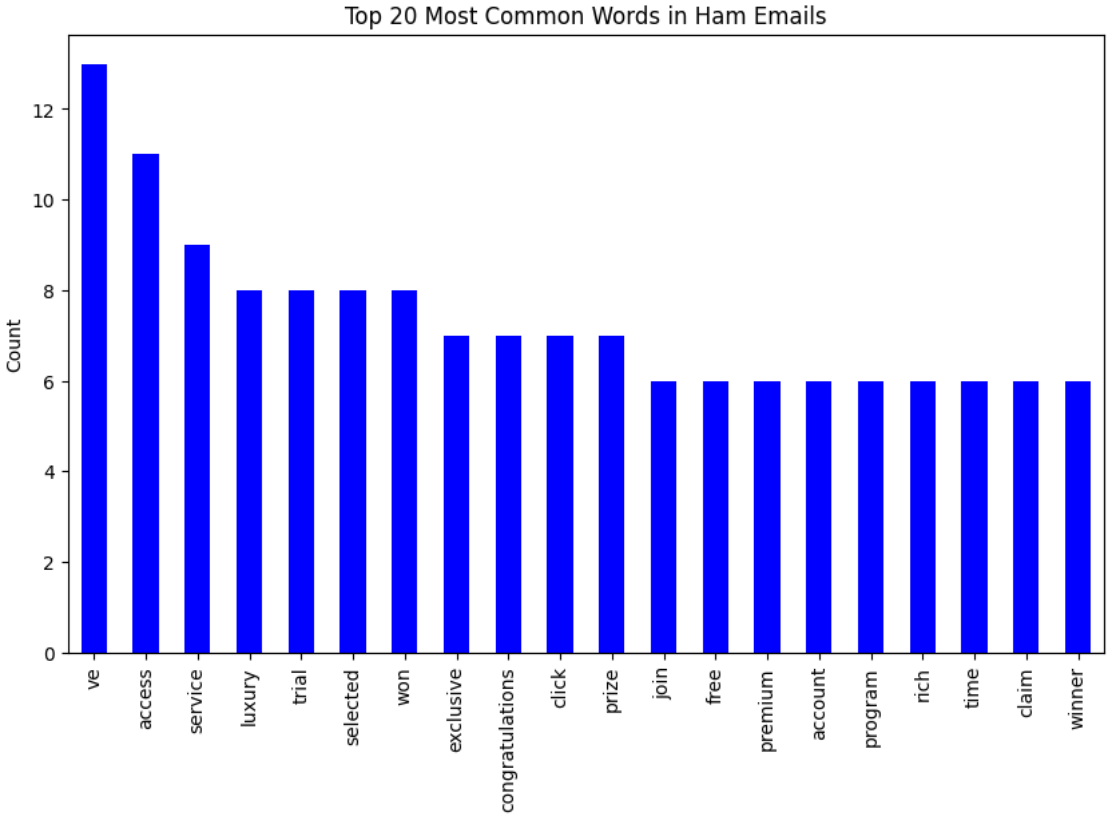


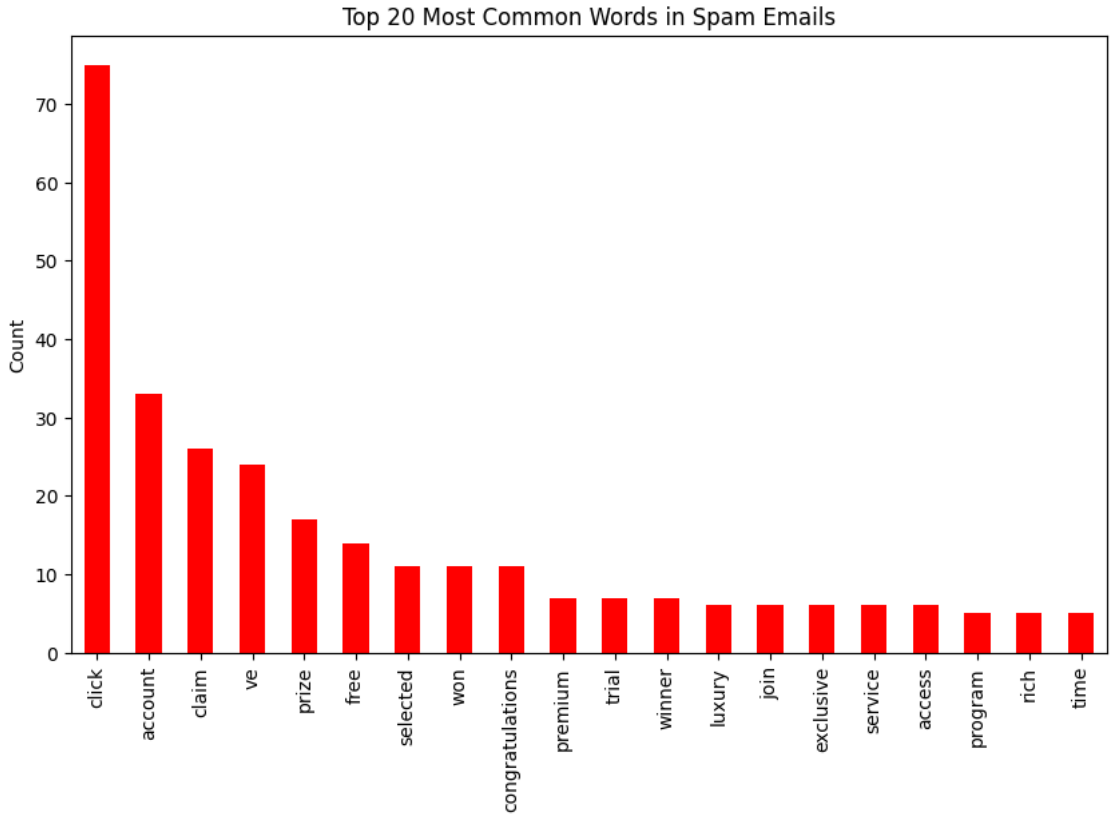
Most Common Words in Spam Emails




```python
[78]: from sklearn.feature_extraction.text import CountVectorizer
      import pandas as pd

      # Vectorize the text using CountVectorizer
      vectorizer = CountVectorizer(stop_words='english', max_features=20)
      X_ham = vectorizer.fit_transform(df[df['label'] == 'ham']['email'])
      X_spam = vectorizer.fit_transform(df[df['label'] == 'spam']['email'])
```

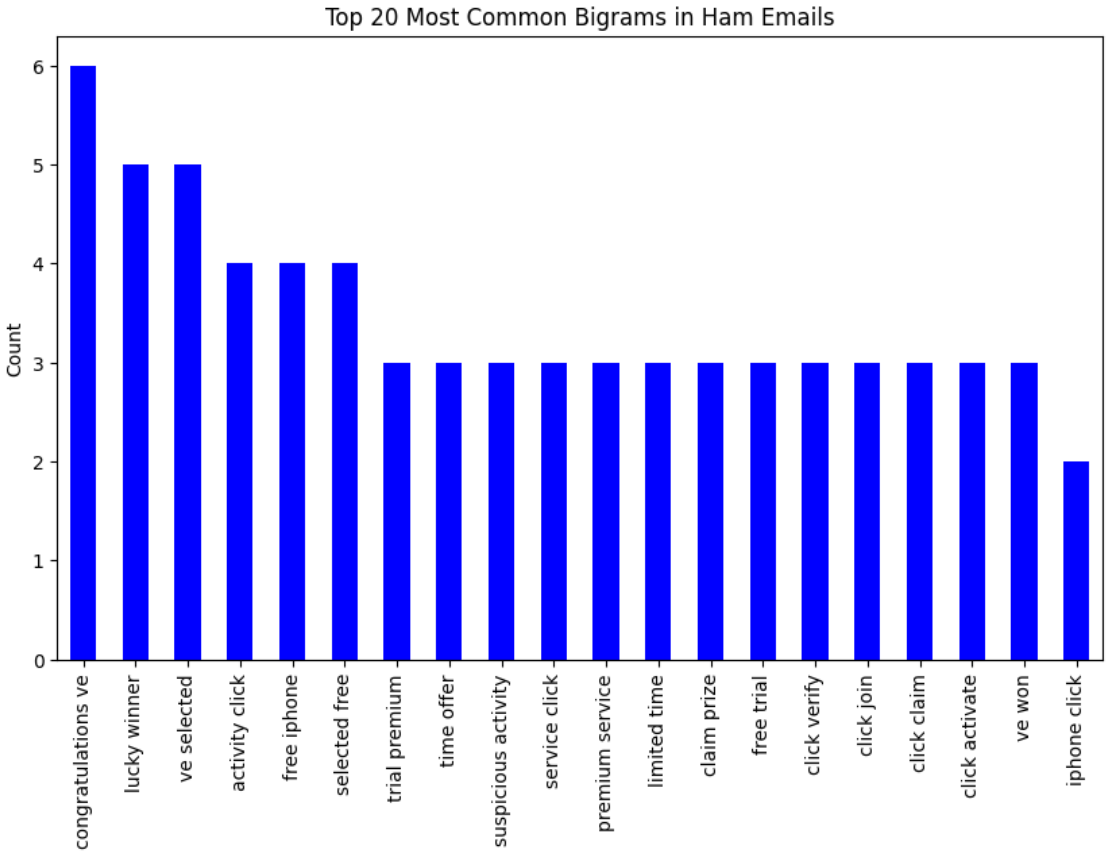
```
# Convert to dfFrame for easy plotting
df_ham = pd.DataFrame(X_ham.toarray(), columns=vectorizer.
  ↪get_feature_names_out())
df_spam = pd.DataFrame(X_spam.toarray(), columns=vectorizer.
  ↪get_feature_names_out())

# Sum of word counts
ham_word_count = df_ham.sum().sort_values(ascending=False)
spam_word_count = df_spam.sum().sort_values(ascending=False)

# Plotting
plt.figure(figsize=(10,6))
ham_word_count.plot(kind='bar', color='blue')
plt.title('Top 20 Most Common Words in Ham Emails')
plt.ylabel('Count')
plt.show()

plt.figure(figsize=(10,6))
spam_word_count.plot(kind='bar', color='red')
plt.title('Top 20 Most Common Words in Spam Emails')
plt.ylabel('Count')
plt.show()
```

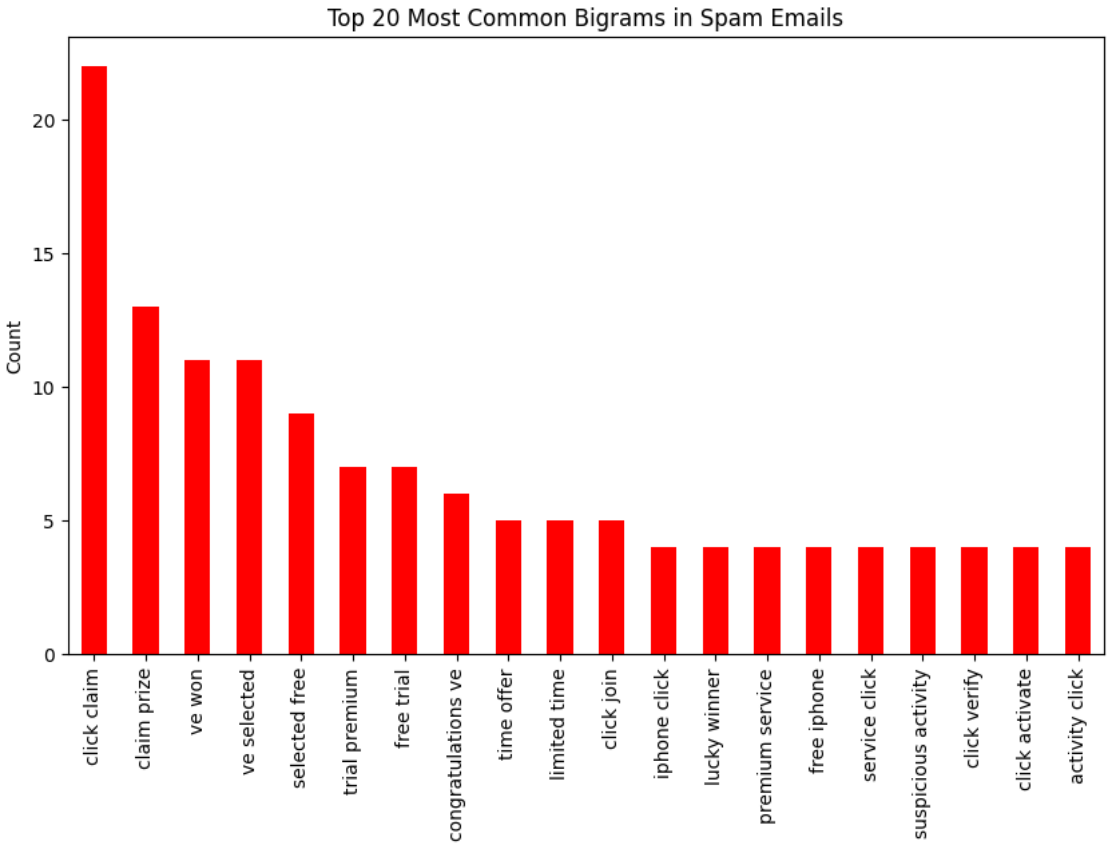




[79]:
```
from sklearn.feature_extraction.text import CountVectorizer

# Vectorizing bigrams
bigram_vectorizer = CountVectorizer(ngram_range=(2,2), stop_words='english',␣
 ↪max_features=20)
X_ham_bigrams = bigram_vectorizer.fit_transform(df[df['label'] ==␣
 ↪'ham']['email'])
X_spam_bigrams = bigram_vectorizer.fit_transform(df[df['label'] ==␣
 ↪'spam']['email'])

# Convert to DataFrame
df_ham_bigrams = pd.DataFrame(X_ham_bigrams.toarray(),␣
 ↪columns=bigram_vectorizer.get_feature_names_out())
df_spam_bigrams = pd.DataFrame(X_spam_bigrams.toarray(),␣
 ↪columns=bigram_vectorizer.get_feature_names_out())

# Sum of bigram counts
ham_bigram_count = df_ham_bigrams.sum().sort_values(ascending=False)
```

```
spam_bigram_count = df_spam_bigrams.sum().sort_values(ascending=False)

# Plotting Bigrams
plt.figure(figsize=(10,6))
ham_bigram_count.plot(kind='bar', color='blue')
plt.title('Top 20 Most Common Bigrams in Ham Emails')
plt.ylabel('Count')
plt.show()

plt.figure(figsize=(10,6))
spam_bigram_count.plot(kind='bar', color='red')
plt.title('Top 20 Most Common Bigrams in Spam Emails')
plt.ylabel('Count')
plt.show()
```





[80]:
```
# Train-Test Split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,␣
↪random_state=42)
```

[81]:
```
# KNN Model
knn = KNeighborsClassifier(n_neighbors=5)
knn.fit(X_train, y_train)
y_pred_knn = knn.predict(X_test)
```

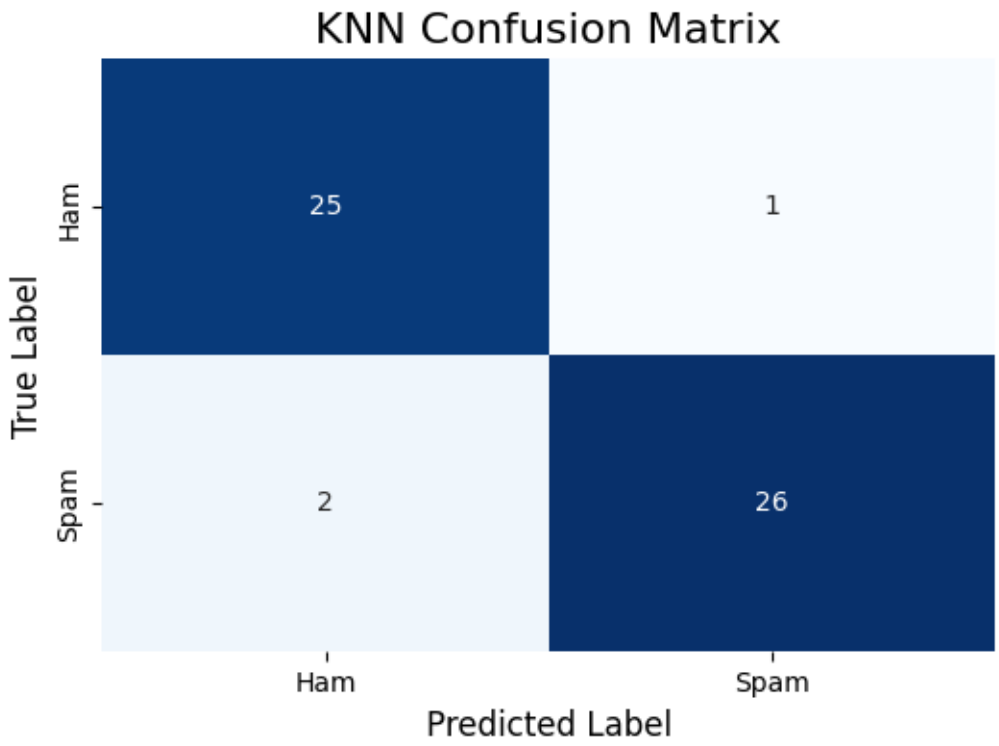
[82]:
```
# SVM Model
svm = SVC(kernel='linear')
svm.fit(X_train, y_train)
y_pred_svm = svm.predict(X_test)
```

[83]:
```
# Evaluation
print("KNN Classification Report:\n", classification_report(y_test, y_pred_knn))
print("SVM Classification Report:\n", classification_report(y_test, y_pred_svm))
```

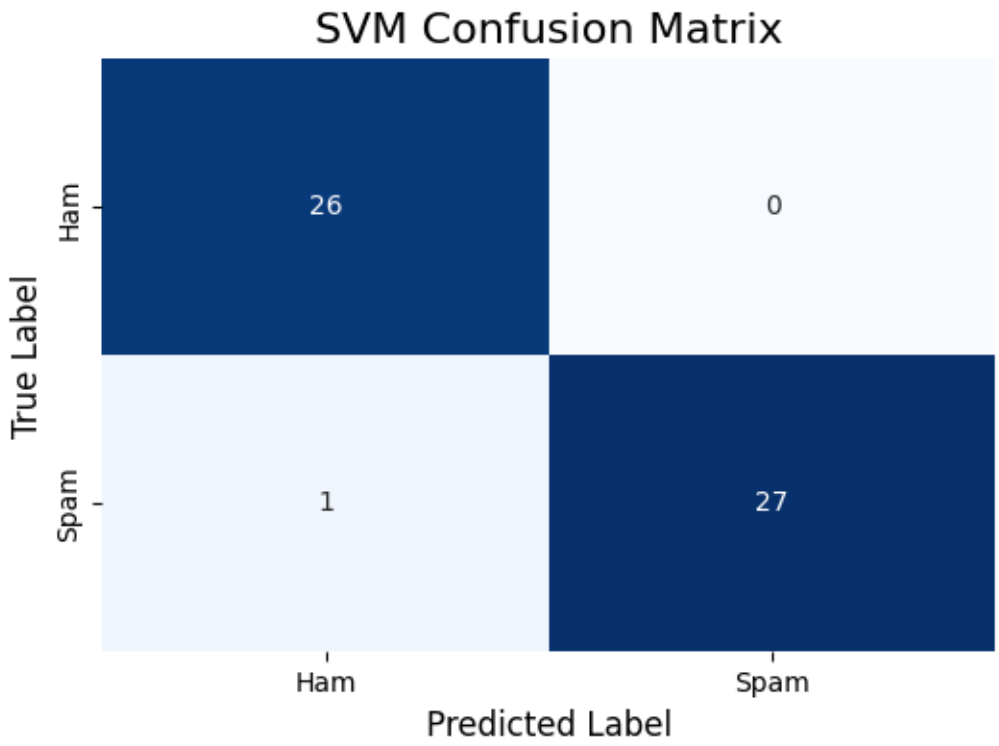
```
KNN Classification Report:
              precision    recall  f1-score   support
```

```
              0       0.93      0.96      0.94        26
              1       0.96      0.93      0.95        28

       accuracy                           0.94        54
      macro avg       0.94      0.95      0.94        54
   weighted avg       0.95      0.94      0.94        54

SVM Classification Report:
                  precision    recall  f1-score   support

              0       0.96      1.00      0.98        26
              1       1.00      0.96      0.98        28

       accuracy                           0.98        54
      macro avg       0.98      0.98      0.98        54
   weighted avg       0.98      0.98      0.98        54
```

[84]:
```python
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import confusion_matrix

# Function to plot the confusion matrix
def plot_confusion_matrix(cm, model_name):
    plt.figure(figsize=(6, 4))
    sns.heatmap(cm, annot=True, fmt='d', cmap='Blues', cbar=False,
                xticklabels=['Ham', 'Spam'], yticklabels=['Ham', 'Spam'])
    plt.title(f'{model_name} Confusion Matrix', fontsize=16)
    plt.xlabel('Predicted Label', fontsize=12)
    plt.ylabel('True Label', fontsize=12)
    plt.show()

# KNN Confusion Matrix
cm_knn = confusion_matrix(y_test, y_pred_knn)
plot_confusion_matrix(cm_knn, 'KNN')
```



[85]:
```
# SVM Confusion Matrix
cm_svm = confusion_matrix(y_test, y_pred_svm)
plot_confusion_matrix(cm_svm, 'SVM')
```


SVM Confusion Matrix
True Label
Ham
Spam
26
0
1
27
Ham
Spam
Predicted Label