Experiment 6

Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

```
# Import Libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from bs4 import BeautifulSoup
from wordcloud import WordCloud
import re
import string
#from textblob import TextBlob
import nltk
from nltk.corpus import stopwords
#import emoji
nltk.download('punkt')
nltk.download('wordnet')
from sklearn.preprocessing import LabelEncoder
import re
from nltk.stem import PorterStemmer
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import MultinomialNB, GaussianNB
from sklearn.svm import SVC
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.ensemble import GradientBoostingClassifier
from xgboost import XGBClassifier
from sklearn.metrics import *
from sklearn.model_selection import train_test_split
# ignore warnings
import warnings
warnings.filterwarnings('ignore')
```

```
[nltk_data] Downloading package punkt to /root/nltk_data...
[nltk_data]   Unzipping tokenizers/punkt.zip.
[nltk_data] Downloading package wordnet to /root/nltk_data...
```

```
pip install xgboost
```

```
Requirement already satisfied: xgboost in /usr/local/lib/python3.11/dist-packages (2.1.4)
Requirement already satisfied: numpy in /usr/local/lib/python3.11/dist-packages (from xgboost) (2.0.2)
Requirement already satisfied: nvidia-nccl-cu12 in /usr/local/lib/python3.11/dist-packages (from xgboost) (2.21.5)
Requirement already satisfied: scipy in /usr/local/lib/python3.11/dist-packages (from xgboost) (1.14.1)
```

Spam DataSet From Github Repo

```
url = 'https://raw.githubusercontent.com/aayushsh2003/ML/main/Experiment/Experiment%206/spam.csv'
df = pd.read_csv(url, encoding='latin-1')
```

```
df.head()
```

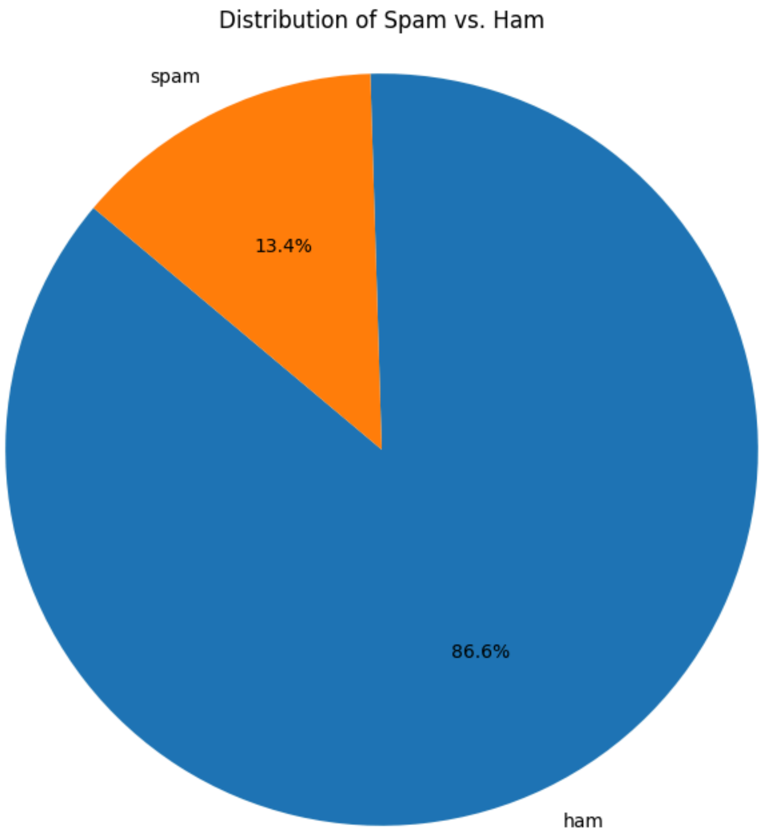
	Category	Message
0	ham	Go until jurong point, crazy.. Available only ...
1	ham	Ok lar... Joking wif u oni...
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...
3	ham	U dun say so early hor... U c already then say...
4	ham	Nah I don't think he goes to usf, he lives aro...

Next steps: Generate code with df   View recommended plots   New interactive sheet

```
pip install emoji --upgrade
```

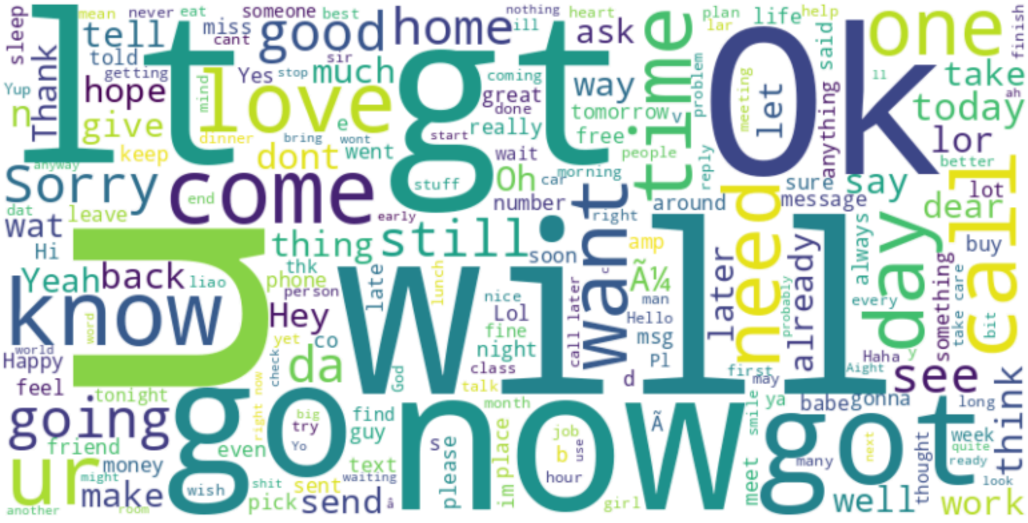
```
Collecting emoji
  Downloading emoji-2.14.1-py3-none-any.whl.metadata (5.7 kB)
Downloading emoji-2.14.1-py3-none-any.whl (590 kB)
   ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━ 590.6/590.6 kB 6.9 MB/s eta 0:00:00
Installing collected packages: emoji
Successfully installed emoji-2.14.1
```

```
# Calculate the count of each label
category_counts = df['Category'].value_counts()

# Plotting the pie chart
plt.figure(figsize=(8, 8))
plt.pie(category_counts, labels=category_counts.index, autopct='%1.1f%%', startangle=140)
plt.title('Distribution of Spam vs. Ham')
plt.axis('equal')  # Equal aspect ratio ensures that pie is drawn as a circle.
plt.show()
```

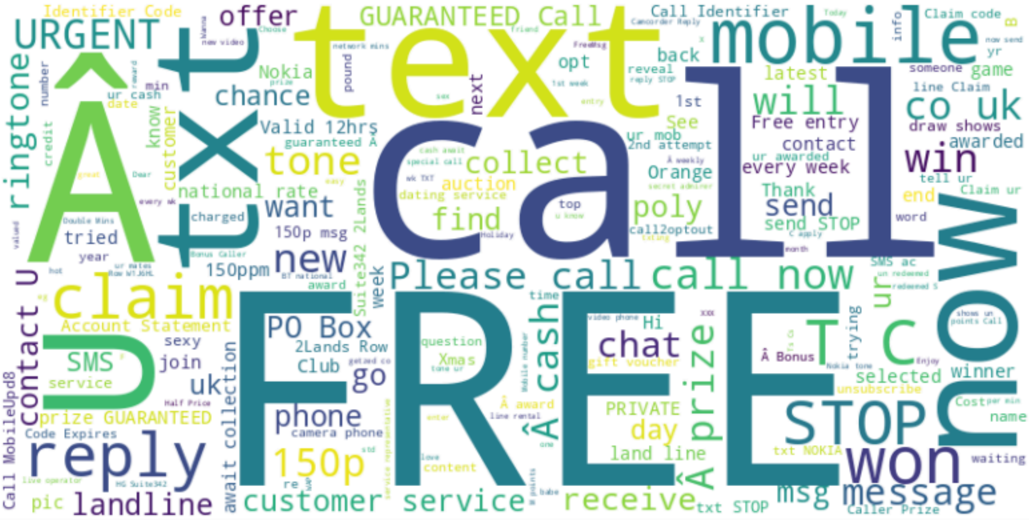


```
# Iterate through unique categories
for category in df['Category'].unique():
    # Filter the DataFrame for the current category
    filtered_df = df[df['Category'] == category]

    # Concatenate all text data for the current category
    text = ' '.join(filtered_df['Message'])

    # Generate word cloud
    wordcloud = WordCloud(width=800, height=400, background_color='white').generate(text)

    # Plot the word cloud
    plt.figure(figsize=(10, 5))
    plt.imshow(wordcloud, interpolation='bilinear')
    plt.title(f'Word Cloud for Category: {category}')
    plt.axis('off')
    plt.show()
```

Word Cloud for Category: ham



Word Cloud for Category: spam



```
# Encode Category column
le = LabelEncoder()
df['Category']=le.fit_transform(df['Category'])
df.head()
```

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

Next steps: Generate code with df View recommended plots New interactive sheet

```
# Convert 'Text' column to lowercase
df['Message'] = df['Message'].str.lower()
df.head()
```

	Category	Message
0	0	go until jurong point, crazy.. available only ...
1	0	ok lar... joking wif u oni...
2	1	free entry in 2 a wkly comp to win fa cup fina...
3	0	u dun say so early hor... u c already then say...
4	0	nah i don't think he goes to usf, he lives aro...

Next steps: Generate code with df View recommended plots New interactive sheet

```
# Remove extra white spaces from the 'Text' column
df['Message'] = df['Message'].str.strip()
df.head()
```

	Category	Message
0	0	go until jurong point, crazy.. available only ...
1	0	ok lar... joking wif u oni...
2	1	free entry in 2 a wkly comp to win fa cup fina...
3	0	u dun say so early hor... u c already then say...
4	0	nah i don't think he goes to usf, he lives aro...

Next steps: Generate code with df View recommended plots New interactive sheet

```
# Function to remove HTML tags from text
def remove_html_tags(text):
    soup = BeautifulSoup(text, 'html.parser')
    return soup.get_text()

# Remove HTML tags from 'Text' column
df['Message'] = df['Message'].apply(remove_html_tags)
```

```
# Define a function to remove URLs using regular expressions
def remove_urls(text):
    return re.sub(r'http\S+|www\S+', '', text)

# Apply the function to the 'Text' column
df['Message'] = df['Message'].apply(remove_urls)
```

```
string.punctuation

# Define the punctuation characters to remove
punctuation = string.punctuation
# Function to remove punctuation from text
def remove_punctuation(text):
    return text.translate(str.maketrans('', '', punctuation))

# Apply remove_punctuation function to 'Text' column
df['Message'] = df['Message'].apply(remove_punctuation)
```

```
def remove_special_characters(text):
    # Define the pattern to match special characters
    pattern = r'[^a-zA-Z0-9\s]'  # Matches any character that is not alphanumeric or whitespace

    # Replace special characters with an empty string
    clean_text = re.sub(pattern, '', text)

    return clean_text

# Apply the function to the 'Message' column
df['Message'] = df['Message'].apply(remove_special_characters)
```

```
# Define a function to remove non-alphanumeric characters
def remove_non_alphanumeric(text):
    return re.sub(r'[^a-zA-Z0-9\s]', '', text)

# Apply the function to the "Message" column
df['Message'] = df['Message'].apply(remove_non_alphanumeric)
```

```
# Define a dictionary of chat word mappings
chat_words = {
    "AFAIK": "As Far As I Know",
    "AFK": "Away From Keyboard",
    "ASAP": "As Soon As Possible",
    "ATK": "At The Keyboard",
    "ATM": "At The Moment",
    "A3": "Anytime, Anywhere, Anyplace",
    "BAK": "Back At Keyboard",
    "BBL": "Be Back Later",
    "BBS": "Be Back Soon",
    "BFN": "Bye For Now",
    "B4N": "Bye For Now",
    "BRB": "Be Right Back",
    "BRT": "Be Right There",
    "BTW": "By The Way",
    "B4": "Before",
    "B4N": "Bye For Now",
    "CU": "See You",
    "CUL8R": "See You Later",
    "CYA": "See You",
    "FAQ": "Frequently Asked Questions",
    "FC": "Fingers Crossed",
    "FWIW": "For What It's Worth",
    "FYI": "For Your Information",
    "GAL": "Get A Life",
    "GG": "Good Game",
    "GN": "Good Night",
    "GMTA": "Great Minds Think Alike",
    "GR8": "Great!",
    "G9": "Genius",
    "IC": "I See",
    "ICQ": "I Seek you (also a chat program)",
    "ILU": "ILU: I Love You",
    "IMHO": "In My Honest/Humble Opinion",
    "IMO": "In My Opinion",
    "IOW": "In Other Words",
    "IRL": "In Real Life",
    "KISS": "Keep It Simple, Stupid",
    "LDR": "Long Distance Relationship",
    "LMAO": "Laugh My A.. Off",
    "LOL": "Laughing Out Loud",
    "LTNS": "Long Time No See",
    "L8R": "Later",
    "MTE": "My Thoughts Exactly",
    "M8": "Mate",
    "NRN": "No Reply Necessary",
    "OIC": "Oh I See",
    "PITA": "Pain In The A..",
    "PRT": "Party",
    "PRW": "Parents Are Watching",
    "QPSA?": "Que Pasa?",
    "ROFL": "Rolling On The Floor Laughing",
    "ROFLOL": "Rolling On The Floor Laughing Out Loud",
    "ROTFLMAO": "Rolling On The Floor Laughing My A.. Off",
    "SK8": "Skate",
    "STATS": "Your sex and age",
    "ASL": "Age, Sex, Location",
    "THX": "Thank You",
    "TTFN": "Ta-Ta For Now!",
    "TTYL": "Talk To You Later",
    "U": "You",
    "U2": "You Too",
    "U4E": "Yours For Ever",
    "WB": "Welcome Back",
    "WTF": "What The F...",
    "WTG": "Way To Go!",
    "WUF": "Where Are You From?",
    "W8": "Wait...",
    "7K": "Sick:-D Laugher",
    "TFW": "That feeling when",
    "MFW": "My face when",
    "MRW": "My reaction when",
    "IFYP": "I feel your pain",
    "TNTL": "Trying not to laugh",
    "JK": "Just kidding",
    "IDC": "I don't care",
    "ILY": "I love you",
    "IMU": "I miss you",
    "ADIH": "Another day in hell",
    "ZZZ": "Sleeping, bored, tired",
    "WYWH": "Wish you were here",
    "TIME": "Tears in my eyes",
    "BAE": "Before anyone else",
    "FIMH": "Forever in my heart",
    "BSAAW": "Big smile and a wink",
    "BWL": "Bursting with laughter",
    "BFF": "Best friends forever",
    "CSL": "Can't stop laughing"
}
```

```
# Function to replace chat words with their full forms
def replace_chat_words(text):
    words = text.split()
    for i, word in enumerate(words):
        if word.lower() in chat_words:
            words[i] = chat_words[word.lower()]
    return ' '.join(words)

# Apply replace_chat_words function to 'Text' column
df['Message'] = df['Message'].apply(replace_chat_words)
```

```
# Download NLTK stopwords corpus
nltk.download('stopwords')

# Get English stopwords from NLTK
stop_words = set(stopwords.words('english'))

# Function to remove stop words from text
def remove_stopwords(text):
    words = text.split()
    filtered_words = [word for word in words if word.lower() not in stop_words]
    return ' '.join(filtered_words)

# Apply remove_stopwords function to 'Text' column
df['Message'] = df['Message'].apply(remove_stopwords)
```

```
[nltk_data] Downloading package stopwords to /root/nltk_data...
[nltk_data]   Unzipping corpora/stopwords.zip.
```

```
!pip install emoji --upgrade
import emoji

# Function to remove emojis from text
def remove_emojis(text):
    return emoji.demojize(text)

# Apply remove_emojis function to 'Text' column
df['Message'] = df['Message'].apply(remove_emojis)
```

```
Requirement already satisfied: emoji in /usr/local/lib/python3.11/dist-packages (2.14.1)
```

```
# Initialize the Porter Stemmer
porter_stemmer = PorterStemmer()

# Apply stemming
df['Message_stemmed'] = df['Message'].apply(lambda x: ' '.join([porter_stemmer.stem(word) for word in x.split()]))
```

```
# Intlize CountVectorizer
cv = CountVectorizer()

# Fitting CountVectorizer on X
X = cv.fit_transform(df['Message_stemmed']).toarray()
y = df['Category']
```

```
# Train Test Split
X_train, X_test , y_train, y_test = train_test_split(X,y,test_size = 0.2, random_state = 42)
```

```
# Gaussian Naive Bayes
gnb_model = GaussianNB()
gnb_model.fit(X_train, y_train)
gnb_pred = gnb_model.predict(X_test)
```

```
gnb_accuracy = accuracy_score(y_test, gnb_pred)
gnb_precision = precision_score(y_test, gnb_pred, average='weighted')
gnb_recall = recall_score(y_test, gnb_pred, average='weighted')
gnb_conf_matrix = confusion_matrix(y_test, gnb_pred)
```

```
# Multinomial Naive Bayes with tuned parameters
mnb_model = MultinomialNB(alpha=0.1)
mnb_model.fit(X_train, y_train)
mnb_pred = mnb_model.predict(X_test)
```

```
mnb_accuracy = accuracy_score(y_test, mnb_pred)
mnb_precision = precision_score(y_test, mnb_pred, average='weighted')
mnb_recall = recall_score(y_test, mnb_pred, average='weighted')
mnb_conf_matrix = confusion_matrix(y_test, mnb_pred)
```

```
print("Multinomial Naive Bayes:")
print(f"The accuracy score of MultinomialNB is {mnb_accuracy}, The Precision Score is {mnb_precision},The Recall Score
print(f"The Confusion matrix is \n{mnb_conf_matrix}")
print("\n")

print("Gaussian Naive Bayes:")
print(f"The accuracy score of GaussianNB is {gnb_accuracy}, The Precision Score is {gnb_precision},The Recall Score is
print(f"The Confusion matrix is \n{gnb_conf_matrix}")
print("\n")
```

```
Multinomial Naive Bayes:
The accuracy score of MultinomialNB is 0.9721973094170404, The Precision Score is 0.9728833837324558,The Recall Score is 0.97219730
The Confusion matrix is
[[947  19]
 [ 12 137]]


Gaussian Naive Bayes:
The accuracy score of GaussianNB is 0.863677130044843, The Precision Score is 0.9180444492929181,The Recall Score is 0.86367713004
The Confusion matrix is
[[828 138]
 [ 14 135]]
```