```
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.naive_bayes import MultinomialNB
from sklearn.metrics import accuracy_score, classification_report

# Load your dataset
df = pd.read_csv('email.csv')

print(df.head())
df.info()
miss=df.isna().sum()
print("\nMissing Values:\n",miss)
df.dropna(inplace=True)
print("\nMissing Values:\n",df.isna().sum())


# Assuming the dataset has two columns: 'Message' and 'Category'
('spam' or 'ham')
# Map 'spam' to 1 and 'ham' to 0
df['Category'] = df['Category'].map({'spam': 1, 'ham': 0})

# Check for missing values in the target variable
missing_values = df['Category'].isnull().sum()
print(f'Missing values in Category: {missing_values}')

# Drop rows with missing values in 'Category'
df.dropna(subset=['Category'], inplace=True)

# Extract features (X) and labels (y)
X = df['Message'] # Assuming 'Message' is the column name for the
email text
y = df['Category']

# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.2, random_state=42)

# Convert text data to numerical data using CountVectorizer
vectorizer = CountVectorizer()
X_train_transformed = vectorizer.fit_transform(X_train)
X_test_transformed = vectorizer.transform(X_test)

# Train a Naive Bayes classifier
model = MultinomialNB()
model.fit(X_train_transformed, y_train)

# Predict on the test data
y_pred = model.predict(X_test_transformed)

# Calculate accuracy and print classification report
```

```
accuracy = accuracy_score(y_test, y_pred)
print(f'Accuracy: {accuracy}')
print(classification_report(y_test, y_pred))

# Function to predict if a message is spam or ham
def predict_message(message):
transformed_message = vectorizer.transform([message])
prediction = model.predict(transformed_message)
return 'spam' if prediction[0] == 1 else 'ham'

# Example usage
message = input("Enter a message to classify as spam or ham: ")
print(f'The message is classified as: {predict_message(message)}')

import matplotlib.pyplot as plt
import seaborn as sns
import numpy as np

# Assume `results` is a dictionary that stores model performance from
previous steps.
# Example:
# results = {
#     'Naive Bayes': {'accuracy': 0.95, 'y_pred': y_pred_nb},
#     'SVM': {'accuracy': 0.93, 'y_pred': y_pred_svm},
#     'KNN': {'accuracy': 0.91, 'y_pred': y_pred_knn},
#     # Add other models...
# }

# Model names and accuracy values
model_names = list(results.keys())
accuracy_scores = [results[model]['accuracy'] for model in results]

# Bar Plot - Accuracy Comparison
plt.figure(figsize=(10, 6))
sns.barplot(x=model_names, y=accuracy_scores, palette='magma')
plt.title('Accuracy Comparison of Different Models', fontsize=14)
plt.ylabel('Accuracy', fontsize=12)
plt.xlabel('Models', fontsize=12)
plt.xticks(rotation=45)
plt.show()

# Scatter Plot - True vs Predicted Values for a specific model (e.g.,
Naive Bayes)
# You can change the model to visualize for another one

y_test = np.array(y_test)  # Convert y_test to numpy array if it's a
Pandas Series
y_pred_nb = results['Naive Bayes']['y_pred']  # Assuming Naive Bayes
is one of the models
```

```
plt.figure(figsize=(8, 6))
plt.scatter(range(len(y_test)), y_test, color='blue', label='True
Labels', alpha=0.6)
plt.scatter(range(len(y_pred_nb)), y_pred_nb, color='red',


label='Predicted Labels (Naive Bayes)', alpha=0.6)
plt.title('True vs Predicted Labels (Naive Bayes)', fontsize=14)
plt.xlabel('Samples', fontsize=12)
plt.ylabel('Spam/Ham (1 = Spam, 0 = Ham)', fontsize=12)
plt.legend()
plt.show()


# Logistic Regression Model
log_reg = LogisticRegression(max_iter=1000)

# Train the model
log_reg.fit(X_train_transformed, y_train)

# Predict
y_pred_logreg = log_reg.predict(X_test_transformed)

# Evaluate the model
accuracy_logreg = accuracy_score(y_test, y_pred_logreg)
print(f"\n--- Logistic Regression ---")
print(f"Accuracy: {accuracy_logreg}")
print(classification_report(y_test, y_pred_logreg))

# Plot Confusion Matrix for Logistic Regression
plot_confusion_matrix(y_test, y_pred_logreg, "Logistic Regression")

# Decision Tree Model
decision_tree = DecisionTreeClassifier()

# Train the model
decision_tree.fit(X_train_transformed, y_train)

# Predict
y_pred_dt = decision_tree.predict(X_test_transformed)

# Evaluate the model
accuracy_dt = accuracy_score(y_test, y_pred_dt)
print(f"\n--- Decision Tree ---")
print(f"Accuracy: {accuracy_dt}")
print(classification_report(y_test, y_pred_dt))

# Plot Confusion Matrix for Decision Tree
plot_confusion_matrix(y_test, y_pred_dt, "Decision Tree")
```

```
model_names = list(results.keys())
accuracy_scores = [results[model]['accuracy'] for model in results]

# Bar Plot - Accuracy Comparison
plt.figure(figsize=(10, 6))
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def predict_message(message):
  transformed_message = vectorizer.transform([message])
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   # Example usage
message = input("Enter a message to classify as spam or ham: ")
print(f'The message is classified as: {predict_message(message)}')
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