In [1]:
```
import pandas as pd
import numpy as np
import nltk
import matplotlib.pyplot as plt
import string
from nltk.corpus import stopwords
from nltk.stem import PorterStemmer
import re
from sklearn.model_selection import train_test_split
from collections import Counter
from sklearn.feature_extraction.text import CountVectorizer
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn import metrics
```

In [2]:
```
#DATA LOADING
```

In [3]:
```
mail = pd.read_csv('spam.csv', encoding='latin-1')
```

In [4]:
```
mail
```

Out[4]:

	v1	v2	Unnamed: 2	Unnamed: 3	Unnamed: 4
0	ham	Go until jurong point, crazy.. Available only ...	NaN	NaN	NaN
1	ham	Ok lar... Joking wif u oni...	NaN	NaN	NaN
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	NaN	NaN	NaN
3	ham	U dun say so early hor... U c already then say...	NaN	NaN	NaN
4	ham	Nah I don't think he goes to usf, he lives aro...	NaN	NaN	NaN
...	...	...	...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...	NaN	NaN	NaN
5568	ham	Will Ì_ b going to esplanade fr home?	NaN	NaN	NaN
5569	ham	Pity, * was in mood for that. So...any other s...	NaN	NaN	NaN
5570	ham	The guy did some bitching but I acted like i'd...	NaN	NaN	NaN
5571	ham	Rofl. Its true to its name	NaN	NaN	NaN

5572 rows × 5 columns

In [5]:
```
#sms.drop(['Unnamed: 2','Unnamed: 3', 'Unnamed: 4'], axis = 1, inplace = True)
mail.dropna(how="any", inplace=True, axis=1)
mail.columns = ['label', 'message']
mail
```

Out[5]:

	label	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...
...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...
5568	ham	Will Ì_ b going to esplanade fr home?
5569	ham	Pity, * was in mood for that. So...any other s...
5570	ham	The guy did some bitching but I acted like i'd...
5571	ham	Rofl. Its true to its name

5572 rows × 2 columns

In [6]:
```
#Exploratory Data Analysis (EDA)
```

In [7]:
```
mail.describe()
```

Out[7]:

	label	message
count	5572	5572
unique	2	5169
top	ham	Sorry, I'll call later
freq	4825	30

In [8]:
```
mail.groupby('label').describe()
```

Out[8]:

	message			
	count	unique	top	freq
label				
ham	4825	4516	Sorry, I'll call later	30
spam	747	653	Please call our customer service representativ...	4

In [9]:
```
mail['label_num'] = mail.label.map({'ham':0, 'spam':1})
mail
```

Out[9]:

	label	message	label_num
0	ham	Go until jurong point, crazy.. Available only ...	0
1	ham	Ok lar... Joking wif u oni...	0
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	1
3	ham	U dun say so early hor... U c already then say...	0
4	ham	Nah I don't think he goes to usf, he lives aro...	0
...	...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...	1
5568	ham	Will Ì_ b going to esplanade fr home?	0
5569	ham	Pity, * was in mood for that. So...any other s...	0
5570	ham	The guy did some bitching but I acted like i'd...	0
5571	ham	Rofl. Its true to its name	0

5572 rows × 3 columns

In [10]:
```
mail['message_len'] = mail.message.apply(len)
mail
```

Out[10]:

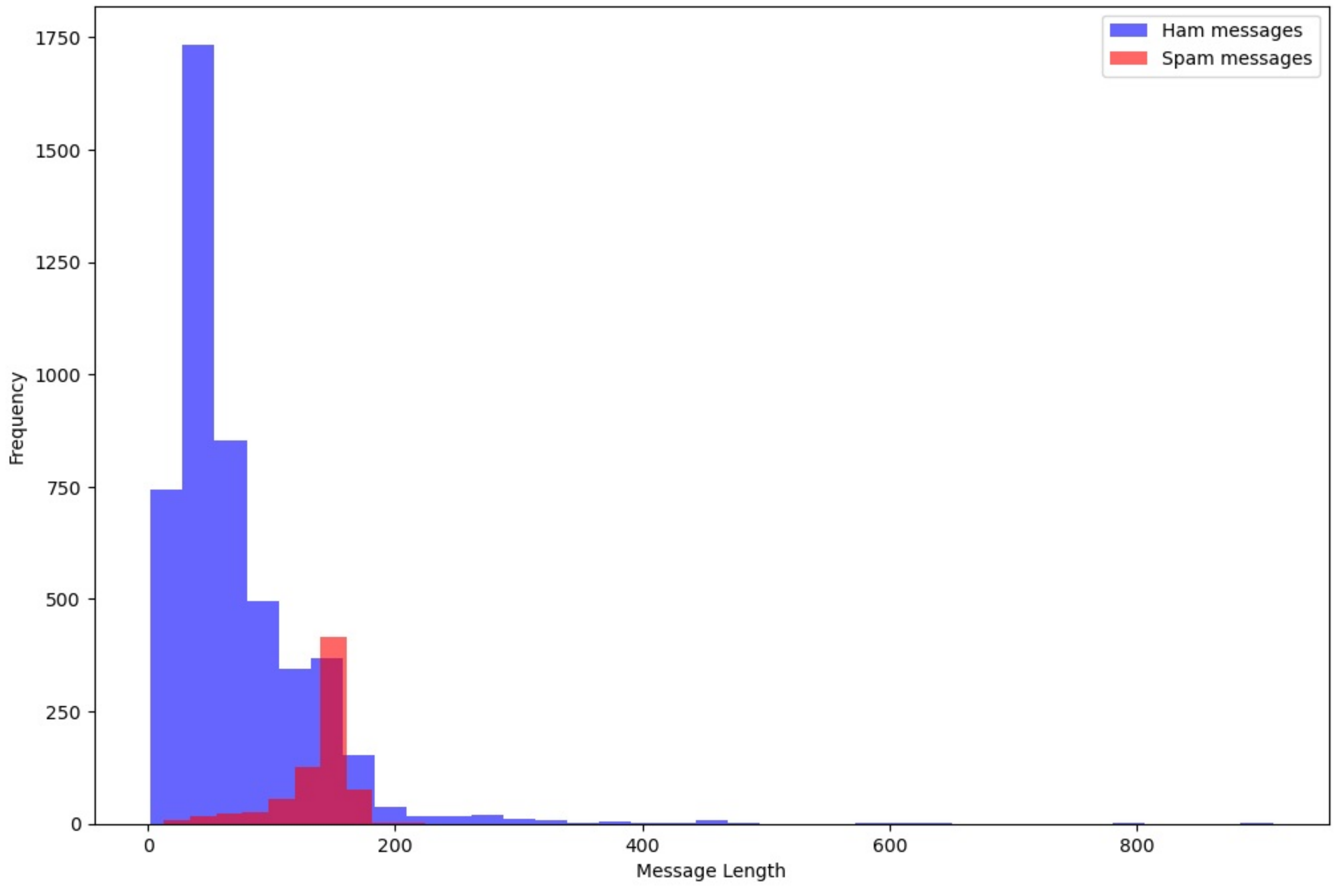
	label	message	label_num	message_len
0	ham	Go until jurong point, crazy.. Available only ...	0	111
1	ham	Ok lar... Joking wif u oni...	0	29
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	1	155
3	ham	U dun say so early hor... U c already then say...	0	49
4	ham	Nah I don't think he goes to usf, he lives aro...	0	61
...	...	...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...	1	161
5568	ham	Will Ì_ b going to esplanade fr home?	0	37
5569	ham	Pity, * was in mood for that. So...any other s...	0	57
5570	ham	The guy did some bitching but I acted like i'd...	0	125
5571	ham	Rofl. Its true to its name	0	26

5572 rows × 4 columns

In [11]:
```
plt.figure(figsize=(12, 8))

mail[mail.label=='ham'].message_len.plot(bins=35, kind='hist', color='blue',
                                       label='Ham messages', alpha=0.6)
mail[mail.label=='spam'].message_len.plot(kind='hist', color='red',
                                       label='Spam messages', alpha=0.6)
plt.legend()
plt.xlabel("Message Length")
```

Out[11]:
```
Text(0.5, 0, 'Message Length')
```



In [12]:
```
mail[mail.label=='ham'].describe()
```

Out[12]:

	label_num	message_len
count	4825.0	4825.000000
mean	0.0	71.023627
std	0.0	58.016023
min	0.0	2.000000
25%	0.0	33.000000
50%	0.0	52.000000
75%	0.0	92.000000
max	0.0	910.000000

In [13]:
```
mail[mail.label=='spam'].describe()
```

Out[13]:

	label_num	message_len
count	747.0	747.000000
mean	1.0	138.866131
std	0.0	29.183082
min	1.0	13.000000
25%	1.0	132.500000
50%	1.0	149.000000
75%	1.0	157.000000
max	1.0	224.000000

In [14]:
```
mail[mail.message_len == 910].message.iloc[0]
```

Out[14]:
```
"For me the love should start with attraction.i should feel that I need her every time around me.she should be
the first thing which comes in my thoughts.I would start the day and end it with her.she should be there every
time I dream.love will be then when my every breath has her name.my life should happen around her.my life will
be named to her.I would cry for her.will give all my happiness and take all her sorrows.I will be ready to figh
t with anyone for her.I will be in love when I will be doing the craziest things for her.love will be when I do
n't have to proove anyone that my girl is the most beautiful lady on the whole planet.I will always be singing
praises for her.love will be when I start up making chicken curry and end up makiing sambar.life will be the mo
st beautiful then.will get every morning and thank god for the day because she is with me.I would like to say a
lot..will tell later.."
```

In [15]:
```
#TEXT PreProcessing
```

In [16]:
```
# Initialize the stemmer and stopwords
stemmer = PorterStemmer()
stopwords = set(stopwords.words('english') + ['u', 'ü', 'ur', '4', '2', 'im', 'dont', 'doin', 'ure'])

def clean_text(text):
    # Remove HTML tags
    text = re.sub('<.*?>', '', text)
    # Remove non-alphabetic characters and convert to lowercase
    text = re.sub('[^a-zA-Z]', ' ', text).lower()
    # Remove Mentions
    text = re.sub(r'@\S+', '', text)
    # Remove Hashtags
    text = re.sub(r'#\S+', '', text)
    # Remove stopwords and stem the words
    words = [stemmer.stem(w) for w in text.split() if w not in stopwords]
    # Join the words back into a string
    cleaned_text = ' '.join(words)
    return text
```

In [17]:
```
mail['clean_msg'] = mail.message.apply(clean_text)

mail
```

Out[17]:

	label	message	label_num	message_len	clean_msg
0	ham	Go until jurong point, crazy.. Available only ...	0	111	go until jurong point crazy available only ...
1	ham	Ok lar... Joking wif u oni...	0	29	ok lar joking wif u oni
2	spam	Free entry in 2 a wkly comp to win FA Cup fina...	1	155	free entry in a wkly comp to win fa cup fina...
3	ham	U dun say so early hor... U c already then say...	0	49	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...	0	61	nah i don t think he goes to usf he lives aro...
...	...	...	...	...	...
5567	spam	This is the 2nd time we have tried 2 contact u...	1	161	this is the nd time we have tried contact u...
5568	ham	Will Ì_ b going to esplanade fr home?	0	37	will b going to esplanade fr home
5569	ham	Pity, * was in mood for that. So...any other s...	0	57	pity was in mood for that so any other s...
5570	ham	The guy did some bitching but I acted like i'd...	0	125	the guy did some bitching but i acted like i d...
5571	ham	Rofl. Its true to its name	0	26	rofl its true to its name

5572 rows × 5 columns

In [18]:
```
words = mail[mail.label=='ham'].clean_msg.apply(lambda x: [word.lower() for word in x.split()])
ham_words = Counter()

for msg in words:
    ham_words.update(msg)

print(ham_words.most_common(50))
```

```
[('i', 2948), ('you', 1944), ('to', 1554), ('the', 1126), ('a', 1060), ('u', 1026), ('and', 857), ('in', 820),
('me', 772), ('my', 750), ('is', 732), ('it', 713), ('that', 558), ('of', 525), ('for', 501), ('s', 490), ('hav
e', 440), ('can', 440), ('so', 435), ('but', 434), ('your', 417), ('not', 415), ('are', 414), ('m', 412), ('t',
393), ('on', 393), ('do', 384), ('at', 378), ('we', 355), ('if', 354), ('will', 341), ('be', 335), ('gt', 318),
('lt', 316), ('get', 311), ('how', 304), ('now', 300), ('no', 298), ('just', 293), ('ok', 287), ('when', 287),
('up', 287), ('what', 273), ('with', 272), ('ll', 265), ('go', 253), ('this', 252), ('all', 245), ('ur', 241),
('know', 236)]
```

In [19]:
```
words = mail[mail.label=='spam'].clean_msg.apply(lambda x: [word.lower() for word in x.split()])
spam_words = Counter()

for msg in words:
    spam_words.update(msg)

print(spam_words.most_common(50))
```

```
[('to', 688), ('a', 391), ('call', 370), ('you', 299), ('your', 264), ('free', 228), ('the', 206), ('for', 204)
, ('now', 203), ('or', 192), ('u', 186), ('p', 180), ('txt', 170), ('is', 158), ('on', 144), ('ur', 144), ('hav
e', 135), ('mobile', 129), ('from', 128), ('text', 126), ('stop', 126), ('and', 122), ('claim', 113), ('with',
109), ('reply', 104), ('t', 99), ('s', 99), ('www', 98), ('of', 97), ('prize', 93), ('this', 89), ('get', 86),
('our', 85), ('only', 84), ('in', 82), ('are', 80), ('just', 78), ('no', 76), ('cash', 76), ('won', 76), ('uk',
74), ('win', 72), ('nokia', 71), ('i', 70), ('send', 70), ('new', 69), ('c', 63), ('urgent', 63), ('week', 60),
('out', 60)]
```

In [20]:
```
#SplitDATA and Vectorize
```

In [21]:
```
# split X and y into training and testing sets

X = mail.clean_msg
y = mail.label_num
print(X.shape)
print(y.shape)

X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=1)

print(X_train.shape)
print(X_test.shape)
print(y_train.shape)
print(y_test.shape)
```

```
(5572,)
(5572,)
(4179,)
(1393,)
(4179,)
(1393,)
```

In [22]:
```
# instantiate the vectorizer
vect = CountVectorizer()

# learn training data vocabulary, then use it to create a document-term matrix
X_train_dtm = vect.fit_transform(X_train)

# examine the document-term matrix
print(type(X_train_dtm), X_train_dtm.shape)

# transform testing data (using fitted vocabulary) into a document-term matrix
X_test_dtm = vect.transform(X_test)
print(type(X_test_dtm), X_test_dtm.shape)
```

```
<class 'scipy.sparse._csr.csr_matrix'> (4179, 6664)
<class 'scipy.sparse._csr.csr_matrix'> (1393, 6664)
```

In [23]:
```
#Building and evaluating the model
```

In [24]:
```
SVM = SVC()
```

In [25]:
```
SVM.fit(X_train_dtm, y_train)
```

Out[25]:
```
▾ SVC
SVC()
```

In [26]:
```
# make class predictions for X_test_dtm
y_pred_class = SVM.predict(X_test_dtm)

# calculate accuracy of class predictions
print("=======Accuracy Score===========")
print(metrics.accuracy_score(y_test, y_pred_class))

# print the confusion matrix
print("=======Confision Matrix===========")
metrics.confusion_matrix(y_test, y_pred_class)
```

```
=======Accuracy Score===========
0.9849246231155779
=======Confision Matrix===========
```

Out[26]:
```
array([[1212,    1],
       [  20,  160]], dtype=int64)
```

In [27]:
```
KN = KNeighborsClassifier()
```

In [28]:
```
KN.fit(X_train_dtm, y_train)
```

Out[28]:
```
▾ KNeighborsClassifier
KNeighborsClassifier()
```

In [29]:
```
y_pred_class = KN.predict(X_test_dtm)

# calculate accuracy of class predictions
print("=======Accuracy Score===========")
print(metrics.accuracy_score(y_test, y_pred_class))

# print the confusion matrix
print("=======Confision Matrix===========")
print(metrics.confusion_matrix(y_test, y_pred_class))
```

```
=======Accuracy Score===========
0.9296482412060302
=======Confision Matrix===========
[[1212    1]
 [  97   83]]
```

In [30]:
```
DT = DecisionTreeClassifier()
```

In [31]:
```
DT.fit(X_train_dtm, y_train)
```

Out[31]:
```
▾ DecisionTreeClassifier
DecisionTreeClassifier()
```

In [32]:
```
y_pred_class = DT.predict(X_test_dtm)

# calculate accuracy of class predictions
print("=======Accuracy Score===========")
print(metrics.accuracy_score(y_test, y_pred_class))

# print the confusion matrix
print("=======Confision Matrix===========")
print(metrics.confusion_matrix(y_test, y_pred_class))
```

```
=======Accuracy Score===========
0.968413496051687
=======Confision Matrix===========
[[1189   24]
 [  20  160]]
```

In [33]:
```
#Comparing the models
```

In [34]:
```
# Classifiers
names = [
    "KNN Classifier",
    "Decision Tree",
    "SVM",
]

models = [
    KNeighborsClassifier(),
    DecisionTreeClassifier(),
    SVC(),

]
```

In [35]:
```
def score(X_train, y_train, X_test, y_test, names, models):
    score_df = pd.DataFrame()
    score_train = []
    confusion_matrices = []

    for name, model in zip(names, models):
        model.fit(X_train, y_train)
        y_pred_class = model.predict(X_test)
        score_train.append(metrics.accuracy_score(y_test, y_pred_class))
        confusion_matrices.append(metrics.confusion_matrix(y_test, y_pred_class))

    score_df["Classifier"] = names
    score_df["Training accuracy"] = score_train
    score_df["Confusion matrix"] = confusion_matrices
    score_df.sort_values(by='Training accuracy', ascending=False, inplace=True)

    return score_df
```

In [36]:
```
score(X_train_dtm, y_train, X_test_dtm, y_test, names=names, models=models)
```

Out[36]:

	Classifier	Training accuracy	Confusion matrix
2	SVM	0.984925	[[1212, 1], [20, 160]]
1	Decision Tree	0.965542	[[1185, 28], [20, 160]]
0	KNN Classifier	0.929648	[[1212, 1], [97, 83]]

In [37]:
```
#Test the models
```

In [40]:
```
def classify_email(email):
    cleaned_email = clean_text(email)
    email_dtm = vect.transform([cleaned_email])
    prediction = SVM.predict(email_dtm)
    if prediction[0] == 0:
        return 'DT : ham'
    else:
        return 'DT : spam'
```

In [41]:

```
email = "Hello, this is a legitimate email."
classification = classify_email(email)
print(classification)  # Output: ham

email = "Congratulations! You have won a prize. Click here to win it for free."
classification = classify_email(email)
print(classification)
```

```
DT : ham
DT : spam
```

In [ ]: