NLP Classification of Articles

Import Necessary Packages

In [1]:

```
import pandas as pd
import numpy as np

#for text pre-processing
import re, string
import nltk
from nltk.tokenize import word_tokenize
from nltk.corpus import stopwords
from nltk.tokenize import word_tokenize
from nltk.stem import SnowballStemmer
from nltk.corpus import wordnet
from nltk.stem import WordNetLemmatizer

nltk.download('punkt')
nltk.download('averaged_perceptron_tagger')
nltk.download('wordnet')

#for model-building
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.naive_bayes import MultinomialNB
from sklearn.metrics import classification_report, f1_score, accuracy_sc
from sklearn.metrics import roc_curve, auc, roc_auc_score

# bag of words
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.feature_extraction.text import CountVectorizer

#for word embedding
import gensim
from gensim.models import Word2Vec
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\tp511\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]     C:\Users\tp511\AppData\Roaming\nltk_data...
[nltk_data]   Package averaged_perceptron_tagger is already up-to-
[nltk_data]       date!
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\tp511\AppData\Roaming\nltk_data...
[nltk_data]   Package wordnet is already up-to-date!
```

Load dataset

In [2]:

```
data_train = pd.read_csv('data_train.txt', header=None)
data_train.columns = ['text']
data_test = pd.read_csv('data_valid.txt', header=None)
data_test.columns = ['text']
labels_train = pd.read_csv('labels_train_original.txt', header=None)
labels_train.columns = ["label"]
labels_test = pd.read_csv('labels_valid_original.txt', header=None)
labels_test.columns = ["label"]
```

In [3]:

```
data_train
```

Out[3]:

	text
0	the sign in front of the steepled church read ...
1	lindsey larsen a soprano and samuel ramey the ...
2	to the editor sylvia ann hewlett 's book creat...
3	illinois tool works inc glenview ill a maker o...
4	to the editor robert schaeffer op ed feb 19 ex...
...	...
1995	to the editor re invective 's comeback by will...
1996	a critic 's notebook article on aug 2 about th...
1997	mike shanahan the winning coach in super bowls...
1998	dear diary at a recent performance of the full...
1999	for a half the jets had survived hanging close...

2000 rows × 1 columns

In [4]:

```
df_train = pd.DataFrame()
df_train['text'] = data_train
df_train['orig_label'] = labels_train
df_train
```

Out[4]:

	text	orig_label
0	the sign in front of the steepled church read ...	News
1	lindsey larsen a soprano and samuel ramey the ...	Classifieds
2	to the editor sylvia ann hewlett 's book creat...	Opinion
3	illinois tool works inc glenview ill a maker o...	News
4	to the editor robert schaeffer op ed feb 19 ex...	Opinion
...	...	...
1995	to the editor re invective 's comeback by will...	Opinion
1996	a critic 's notebook article on aug 2 about th...	Features
1997	mike shanahan the winning coach in super bowls...	News
1998	dear diary at a recent performance of the full...	Classifieds
1999	for a half the jets had survived hanging close...	News

2000 rows × 2 columns

In [5]:

```
df_test = pd.DataFrame()
df_test['text'] = data_test
df_test['orig_label'] = labels_test
df_test
```

Out[5]:

	text	orig_label
0	to the editor re restructuring for security by...	Opinion
1	to the editor in small town gay america op ed ...	Opinion
2	don king the boxing promoter has stated that m...	Opinion
3	to the editor bill keller god and george w bus...	Opinion
4	andres rios stood in front of il monello and r...	News
...	...	...
1995	there are plenty of lines in shakespeare 's wo...	Features
1996	to the editor sadly we appear as hypocrites to...	Opinion
1997	the baseball fates played a cruel joke on the ...	News
1998	under pressure from congress to explain lapses...	Classifieds
1999	the cops are not backing off not one bit never...	News

2000 rows × 2 columns

In [6]:

```python
# Converting labels to numeric
def label_conv(dataset):
    dataset['target'] = None
    for i in range(len(dataset)):
        if dataset['orig_label'][i] == "News":
            dataset['target'][i] = 0
        elif dataset['orig_label'][i] == "Opinion":
            dataset['target'][i]  = 1
        elif dataset['orig_label'][i] == "Classifieds":
            dataset['target'][i] = 2
        elif dataset['orig_label'][i] == "Features":
            dataset['target'][i] = 3

label_conv(df_train)
label_conv(df_test)
```

In [7]:

```python
# Number of observations for each class in training dataset
print(df_train['target'].value_counts())
```

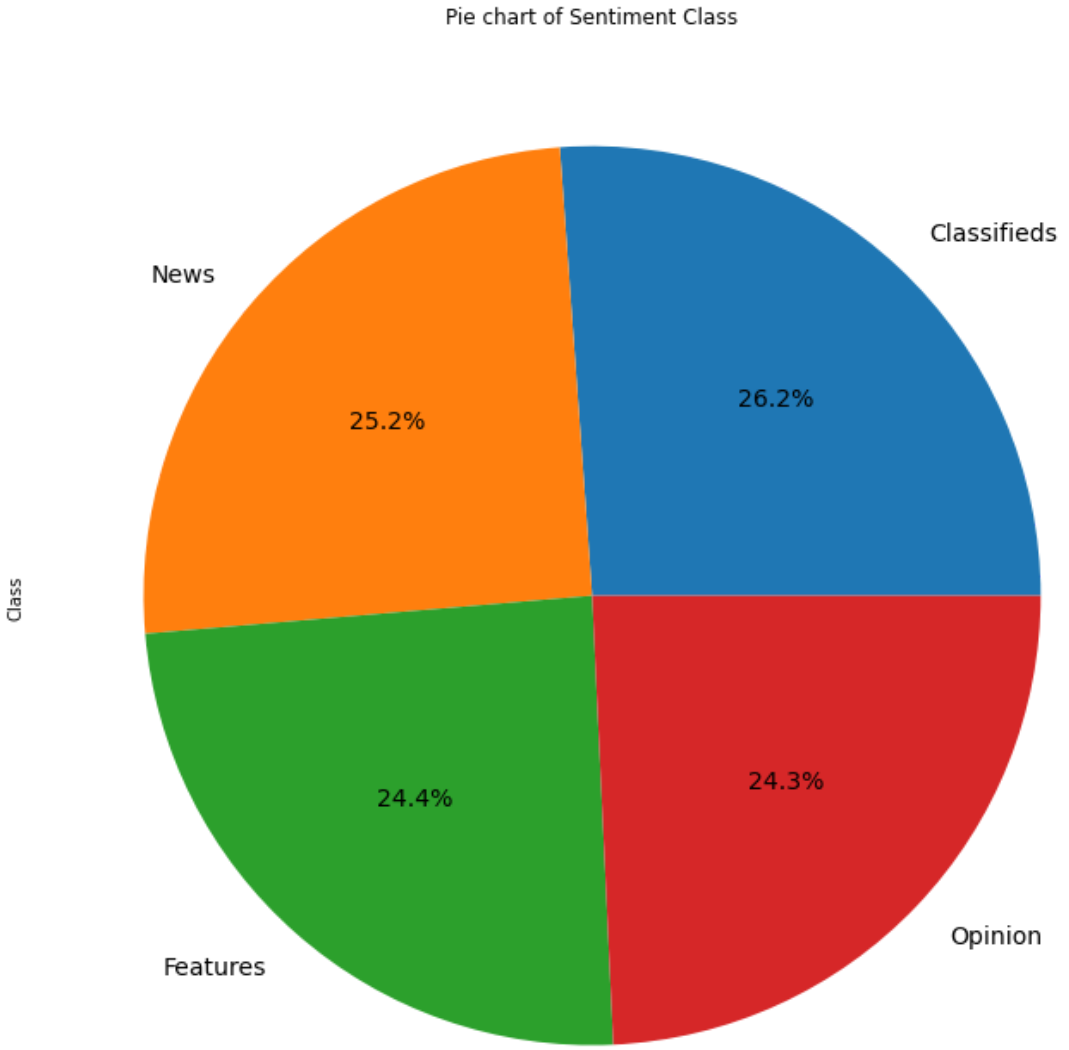
```
2    523
0    504
3    488
1    485
Name: target, dtype: int64
```

In [23]:

```
df2=df_train.copy(deep=True)
df2["Class"] = df2['orig_label']
pie1=pd.DataFrame(df2['Class'].replace(0,'News').replace(1,'Opinion').re
pie1.reset_index(inplace=True)
pie1.plot(kind='pie', title='Pie chart of Sentiment Class',y = 'Class',
          autopct='%1.1f%%', shadow=False, labels=pie1['index'], legend
```

Out[23]:

```
<AxesSubplot:title={'center':'Pie chart of Sentiment Class'}, ylabel='Clas
s'>
```



Pre-process Text

In [8]:

```
#convert to lowercase, strip and remove punctuations
def preprocess(text):
    text = text.lower()
    text=text.strip()
    text=re.compile('<.*?>').sub('', text)
    text = re.compile('[%s]' % re.escape(string.punctuation)).sub(' ', te
    text = re.sub('\s+', ' ', text)
    text = re.sub(r'\[[0-9]*\]',' ',text)
    text=re.sub(r'[^\w\s]', '', str(text).lower().strip())
    text = re.sub(r'\d',' ',text)
    text = re.sub(r'\s+',' ',text)
    return text


# STOPWORD REMOVAL
def stopword(string):
    a= [i for i in string.split() if i not in stopwords.words('english')]
    return ' '.join(a)

#LEMMATIZATION
# Initialize the lemmatizer
wl = WordNetLemmatizer()

# This is a helper function to map NTLK position tags
def get_wordnet_pos(tag):
    if tag.startswith('J'):
        return wordnet.ADJ
    elif tag.startswith('V'):
        return wordnet.VERB
    elif tag.startswith('N'):
        return wordnet.NOUN
    elif tag.startswith('R'):
        return wordnet.ADV
    else:
        return wordnet.NOUN

# Tokenize the sentence
def lemmatizer(string):
    word_pos_tags = nltk.pos_tag(word_tokenize(string)) # Get position te
    a=[wl.lemmatize(tag[0], get_wordnet_pos(tag[1])) for idx, tag in enum
    return " ".join(a)
```

In [9]:

```
# Final pre-processing
def finalpreprocess(string):
    return lemmatizer(stopword(preprocess(string)))

df_train['clean_text'] = df_train['text'].apply(lambda x: finalpreproces
df_train.head()
```

Out[9]:

	text	orig_label	target	clean_text
0	the sign in front of the steepled church read ...	News	0	sign front steepled church read sunday sermon ...
1	lindsey larsen a soprano and samuel ramey the ...	Classifieds	2	lindsey larsen soprano samuel ramey bass marry...
2	to the editor sylvia ann hewlett 's book creat...	Opinion	1	editor sylvia ann hewlett book create life ing...
3	illinois tool works inc glenview ill a maker o...	News	0	illinois tool work inc glenview ill maker ever...
4	to the editor robert schaeffer op ed feb 19 ex...	Opinion	1	editor robert schaeffer op ed feb explain dear...

Vectorize the text

In [11]:

```
#SPLITTING THE TRAINING DATASET INTO TRAIN AND TEST
X_train, X_test, y_train, y_test = train_test_split(df_train["clean_text"
y_test = y_test.astype('int')
y_train = y_train.astype('int')

#Word2Vec
# Word2Vec runs on tokenized sentences
X_train_tok= [nltk.word_tokenize(i) for i in X_train]
X_test_tok= [nltk.word_tokenize(i) for i in X_test]
```

In [12]:

```
#Tf-Idf
tfidf_vectorizer = TfidfVectorizer(use_idf=True)
X_train_vectors_tfidf = tfidf_vectorizer.fit_transform(X_train)
X_test_vectors_tfidf = tfidf_vectorizer.transform(X_test)

#building Word2Vec model
class MeanEmbeddingVectorizer(object):
    def __init__(self, word2vec):
        self.word2vec = word2vec
        # if a text is empty we should return a vector of zeros
        # with the same dimensionality as all the other vectors
        self.dim = len(next(iter(word2vec.values())))
    def fit(self, X, y):
        return self
    def transform(self, X):
        return np.array([
            np.mean([self.word2vec[w] for w in words if w in self.word2ve
                    or [np.zeros(self.dim)], axis=0)
            for words in X])

df_train['clean_text_tok']=[nltk.word_tokenize(i) for i in df_train['clea
model = Word2Vec(df_train['clean_text_tok'],min_count=1)
w2v = dict(zip(model.wv.index_to_key, model.wv.vectors))
modelw = MeanEmbeddingVectorizer(w2v)

# converting text to numerical data using Word2Vec
X_train_vectors_w2v = modelw.transform(X_train_tok)
X_test_vectors_w2v = modelw.transform(X_test_tok)
```

Machine Learning Step

In [14]:

```
#FITTING THE CLASSIFICATION MODEL using Logistic Regression(tf-idf)
lr_tfidf = LogisticRegression(solver = 'liblinear', C=10, penalty = 'l2')
lr_tfidf.fit(X_train_vectors_tfidf, y_train)

#Predict y value for test dataset
y_predict = lr_tfidf.predict(X_test_vectors_tfidf)
y_prob = lr_tfidf.predict_proba(X_test_vectors_tfidf)[:,1]

print(classification_report(y_test,y_predict))
print('Confusion Matrix:',confusion_matrix(y_test, y_predict))

# fpr, tpr, thresholds = roc_curve(y_test, y_prob)
# roc_auc = auc(fpr, tpr)
# print('AUC:', roc_auc)
```

```
              precision    recall  f1-score   support

           0       0.69      0.66      0.67        96
           1       0.79      0.91      0.85       101
           2       0.70      0.67      0.68       114
           3       0.55      0.53      0.54        89

    accuracy                           0.69       400
   macro avg       0.69      0.69      0.69       400
weighted avg       0.69      0.69      0.69       400

Confusion Matrix: [[63  9 13 11]
 [ 4 92  0  5]
 [14  2 76 22]
 [10 13 19 47]]
```

In [15]:

```
#FITTING THE CLASSIFICATION MODEL using Logistic Regression (W2v)
lr_w2v=LogisticRegression(solver = 'liblinear', C=10, penalty = 'l2')
lr_w2v.fit(X_train_vectors_w2v, y_train)  #model

#Predict y value for test dataset
y_predict = lr_w2v.predict(X_test_vectors_w2v)
y_prob = lr_w2v.predict_proba(X_test_vectors_w2v)[:,1]

print(classification_report(y_test,y_predict))
print('Confusion Matrix:',confusion_matrix(y_test, y_predict))

# fpr, tpr, thresholds = roc_curve(y_test, y_prob)
# roc_auc = auc(fpr, tpr)
# print('AUC:', roc_auc)
```

```
              precision    recall  f1-score   support

           0       0.58      0.54      0.56        96
           1       0.64      0.80      0.71       101
           2       0.55      0.49      0.52       114
           3       0.48      0.44      0.46        89

    accuracy                           0.57       400
   macro avg       0.56      0.57      0.56       400
weighted avg       0.56      0.57      0.56       400

Confusion Matrix: [[52 11 19 14]
 [ 9 81  4  7]
 [19 18 56 21]
 [10 17 23 39]]
```

In [16]:

```
#FITTING THE CLASSIFICATION MODEL using Naive Bayes(tf-idf)
nb_tfidf = MultinomialNB()
nb_tfidf.fit(X_train_vectors_tfidf, y_train)

#Predict y value for test dataset
y_predict = nb_tfidf.predict(X_test_vectors_tfidf)
y_prob = nb_tfidf.predict_proba(X_test_vectors_tfidf)[:,1]

print(classification_report(y_test,y_predict))
print('Confusion Matrix:',confusion_matrix(y_test, y_predict))

# fpr, tpr, thresholds = roc_curve(y_test, y_prob)
# roc_auc = auc(fpr, tpr)
# print('AUC:', roc_auc)
```

```
              precision    recall  f1-score   support

           0       0.62      0.64      0.63        96
           1       0.77      0.83      0.80       101
           2       0.70      0.61      0.65       114
           3       0.56      0.60      0.58        89

    accuracy                           0.67       400
   macro avg       0.66      0.67      0.66       400
weighted avg       0.67      0.67      0.67       400

Confusion Matrix: [[61 10 16  9]
 [ 8 84  1  8]
 [17  4 69 24]
 [12 11 13 53]]
```

In [17]:

```
#Pre-processing the new dataset
df_test['clean_text'] = df_test['text'].apply(lambda x: finalpreprocess(x
X_test=df_test['clean_text']

#converting words to numerical data using tf-idf
X_vector=tfidf_vectorizer.transform(X_test)

#use the best model to predict 'target' value for the new dataset
y_predict = lr_tfidf.predict(X_vector)
y_prob = lr_tfidf.predict_proba(X_vector)[:,1]
df_test['predict_prob']= y_prob
df_test['target']= y_predict
final=df_test[['clean_text','target']].reset_index(drop=True)
print(final.head())
```

```
                                          clean_text  target
0  editor restructure security warren rudman gary...       1
1  editor small town gay america op ed nov adam g...       1
2  king box promoter state recent presidential ex...       1
3  editor bill keller god george w bush column ma...       1
4  andres rios stand front il monello recite dish...       2
```