Fake News Prediction

In [ ]:

```
from sklearn.preprocessing import LabelBinarizer
from nltk.corpus import stopwords
from nltk.stem.porter import PorterStemmer
from wordcloud import WordCloud,STOPWORDS
from nltk.stem import WordNetLemmatizer
from nltk.tokenize import word_tokenize,sent_tokenize
from bs4 import BeautifulSoup
import re,string,unicodedata
from nltk.tokenize.toktok import ToktokTokenizer
from nltk.stem import LancasterStemmer,WordNetLemmatizer
from sklearn.linear_model import LogisticRegression,SGDClassifier
from sklearn.naive_bayes import MultinomialNB
from sklearn.svm import SVC
from sklearn.metrics import classification_report,confusion_matrix,accuracy_score
from sklearn.model_selection import train_test_split
from string import punctuation
from nltk import pos_tag
from nltk.corpus import wordnet
```

In [ ]:

```
import pandas as pd
import pandas as pd
from sklearn import datasets, linear_model
from sklearn.model_selection import train_test_split
from matplotlib import pyplot as plt

%matplotlib inline
import warnings
warnings.filterwarnings("ignore")
import matplotlib.pyplot as plt
import numpy as np
```

In [ ]:

```
from google.colab import files
uploaded = files.upload()
```

Choose File No file selected

Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving news.csv to news (1).csv
```

In [ ]:

```
df=pd.read_csv('news.csv')
df.head(2)
```

Out[ ]:

	Unnamed: 0	title	text	label
0	8476	You Can Smell Hillary's Fear	Daniel Greenfield, a Shillman Journalism Fello...	FAKE
1	10294	Watch The Exact Moment Paul Ryan Committed Pol...	Google Pinterest Digg Linkedin Reddit Stumbleu...	FAKE

In [ ]:

```
for i in range(df.shape[0]):
  if df['label'][i]=='FAKE':
    df['label'][i]=0
```

```
  else:
    df['label'][i]=1
```

In [ ]:

```
df.head(2)
```

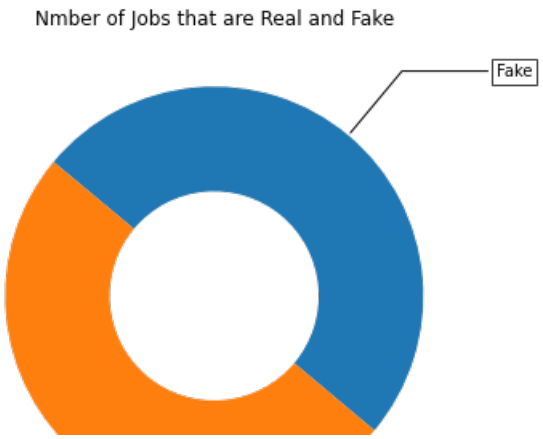
Out[ ]:

	Unnamed: 0	title	text	label
0	8476	You Can Smell Hillary's Fear	Daniel Greenfield, a Shillman Journalism Fello...	0
1	10294	Watch The Exact Moment Paul Ryan Committed Pol...	Google Pinterest Digg Linkedin Reddit Stumbleu...	0

In [ ]:

```
# PROVIDE CITATIONS TO YOUR CODE IF YOU TAKE IT FROM ANOTHER WEBSITE.
# https://matplotlib.org/gallery/pie_and_polar_charts/pie_and_donut_labels.html#sphx-glr-gallery-pie-and-polar-charts-pie-and-donut-labels-py
y_value_counts = df['label'].value_counts()

print("Number of News that are Fake News ", y_value_counts[1], ", (", float(y_value_counts[1]/float(y_value_counts[1]+y_value_counts[0]))*100,"%)")
print("Number of News that are Real", y_value_counts[0], ", (", float(y_value_counts[0]/float(y_value_counts[1]+y_value_counts[0]))*100,"%)")


fig, ax = plt.subplots(figsize=(6, 6), subplot_kw=dict(aspect="equal"))
recipe = ["Fake", "Real"]

data = [y_value_counts[1], y_value_counts[0]]

wedges, texts = ax.pie(data, wedgeprops=dict(width=0.5), startangle=-40)

bbox_props = dict(boxstyle="square,pad=0.3", fc="w", ec="k", lw=0.72)
kw = dict(xycoords='data', textcoords='data', arrowprops=dict(arrowstyle="-"),
          bbox=bbox_props, zorder=0, va="center")

for i, p in enumerate(wedges):
    ang = (p.theta2 - p.theta1)/2. + p.theta1
    y = np.sin(np.deg2rad(ang))
    x = np.cos(np.deg2rad(ang))
    horizontalalignment = {-1: "right", 1: "left"}[int(np.sign(x))]
    connectionstyle = "angle,angleA=0,angleB={}".format(ang)
    kw["arrowprops"].update({"connectionstyle": connectionstyle})
    ax.annotate(recipe[i], xy=(x, y), xytext=(1.35*np.sign(x), 1.4*y),
                horizontalalignment=horizontalalignment, **kw)

ax.set_title("Nmber of Jobs that are Real and Fake")

plt.show()
```

```
Number of News that are Fake News  3171 , ( 50.05524861878453 %)
Number of News that are Real 3164 , ( 49.94475138121547 %)
```



Observation :

There is 49.95% jobs are Real and around 50.05% are fake jobs.
Dataset is Balanced

Missing values in dataset

In [ ]:

```
#Missing values in dataset


for col in df.columns:
    nullrow=df[col].isnull().sum()
    notrow=df[col].notnull().sum()
    percentage=(nullrow*100)/(nullrow+notrow)
    if percentage > 30 :
        print("Column is ",col,percentage,"% Missing Values")
```

Observation

There is no missing value in the dataset.

Data Preprocessing

In [ ]:

```
print(df['title'].values[50])
print('*'*100)
print(df['title'].values[100])
print('*'*100)
print(df['title'].values[150])
print('*'*100)
print(df['title'].values[250])
print('*'*100)
print(df['title'].values[5000])
print('*'*100)
```

```
American politics has reached peak polarization
****************************************************************************************************

How Ted Cruz Became Ted Cruz
****************************************************************************************************

Shutdown clash to return in force by December
****************************************************************************************************

Trump mulls alternative options for making Mexico finance 'the wall'
****************************************************************************************************

Levers of Power: Flushing the Vote Down the Memory Hole
****************************************************************************************************
```

In [ ]:

```
# https://stackoverflow.com/a/47091490/4084039
import re

def decontracted(phrase):
```

```
    # specific
    phrase = re.sub(r"won't", "will not", phrase)
    phrase = re.sub(r"can\'t", "can not", phrase)

    # general
    phrase = re.sub(r"n\'t", " not", phrase)
    phrase = re.sub(r"\'re", " are", phrase)
    phrase = re.sub(r"\'s", " is", phrase)
    phrase = re.sub(r"\'d", " would", phrase)
    phrase = re.sub(r"\'ll", " will", phrase)
    phrase = re.sub(r"\'t", " not", phrase)
    phrase = re.sub(r"\'ve", " have", phrase)
    phrase = re.sub(r"\'m", " am", phrase)
    return phrase
```

In [ ]:

```
# https://gist.github.com/sebleier/554280
# we are removing the words from the stop words list: 'no', 'nor', 'not'
stopwords= ['i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', "you're", "you've",
\
            "you'll", "you'd", 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his',
'himself', \
            'she', "she's", 'her', 'hers', 'herself', 'it', "it's", 'its', 'itself', 'they', 'them',
'their',\
            'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that', "that'll",
'these', 'those', \
            'am', 'is', 'are', 'was', 'were', 'be', 'been', 'being', 'have', 'has', 'had', 'having',
'do', 'does', \
            'did', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'because', 'as', 'until', '
while', 'of', \
            'at', 'by', 'for', 'with', 'about', 'against', 'between', 'into', 'through', 'during',
'before', 'after',\
            'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under'
, 'again', 'further',\
            'then', 'once', 'here', 'there', 'when', 'where', 'why', 'how', 'all', 'any', 'both', 'e
ach', 'few', 'more',\
            'most', 'other', 'some', 'such', 'only', 'own', 'same', 'so', 'than', 'too', 'very', \
            's', 't', 'can', 'will', 'just', 'don', "don't", 'should', "should've", 'now', 'd', 'll'
, 'm', 'o', 're', \
            've', 'y', 'ain', 'aren', "aren't", 'couldn', "couldn't", 'didn', "didn't", 'doesn', "d
esn't", 'hadn',\
            "hadn't", 'hasn', "hasn't", 'haven', "haven't", 'isn', "isn't", 'ma', 'mightn',
"mightn't", 'mustn',\
            "mustn't", 'needn', "needn't", 'shan', "shan't", 'shouldn', "shouldn't", 'wasn',
"wasn't", 'weren', "weren't", \
            'won', "won't", 'wouldn', "wouldn't"]
```

In [ ]:

```
# Combining all the above statemennts
from tqdm import tqdm
preprocessed_title = []
# tqdm is for printing the status bar
for title in tqdm(df['title'].values):
    t = decontracted(title)
    t = t.replace('\\r', ' ')

    t = t.replace('\\"', ' ')
    t = t.replace('-','_')
    t = t.replace('\\n', ' ')
    t = re.sub('[^A-Za-z0-9]+', ' ',t)
    # https://gist.github.com/sebleier/554280
    t = ' '.join(e for e in t.split() if e not in stopwords)
    preprocessed_title.append(t.lower().strip())
```

```
100%|██████████| 6335/6335 [00:00<00:00, 25773.88it/s]
```

In [ ]:

```
df.drop(['title'],axis=1,inplace=True)
df['preprocessed_title']=preprocessed_title
```

In [ ]:

```
# Combining all the above statemennts
from tqdm import tqdm
preprocessed_text = []
# tqdm is for printing the status bar
for text in tqdm(df['text'].values):
    t = decontracted(text)
    t = t.replace('\\r', ' ')

    t = t.replace('\\"', ' ')
    t = t.replace('-','_')
    t = t.replace('\\n', ' ')
    t = re.sub('[^A-Za-z0-9]+', ' ',t)
    # https://gist.github.com/sebleier/554280
    t = ' '.join(e for e in t.split() if e not in stopwords)
    preprocessed_text.append(t.lower().strip())

df.drop(['text'],axis=1,inplace=True)
df['preprocessed_text']=preprocessed_text
```

```
100%|██████████| 6335/6335 [00:10<00:00, 622.12it/s]
```

In [ ]:

```
y=df['label']
X_train, X_test, y_train, y_test = train_test_split(df,y,test_size=0.3,random_state=1)


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

```
(4434, 4) (4434,)
(1901, 4) (1901,)
```

Text to Numerical Vectors TFIDF

In [ ]:

```
X_train.head(2)
```

Out[ ]:

	Unnamed: 0	label	preprocessed_title	preprocessed_text
4297	7266	0	this is what it means if you have two dimples ...	posted eddie whether back dimples not admit qu...
3757	3822	1	white house republicans work together final pu...	house republicans president obama joined force...

In [ ]:

```
# Convert text into numerical with the help of TFIDF Vectorizer
# Preprocessed Title

from sklearn.feature_extraction.text import TfidfVectorizer
vectorizer = TfidfVectorizer(min_df=10)
#print(vectorizer.get_feature_names())

train_title_tfidf = vectorizer.fit_transform(X_train['preprocessed_title'])
test_title_tfidf = vectorizer . transform(X_test['preprocessed_title'])
print("Shape of matrix after one hot encodig ",train_title_tfidf.shape)
print("Shape of matrix after one hot encodig ",test_title_tfidf.shape)
```

```
Shape of matrix after one hot encodig  (4434, 739)
Shape of matrix after one hot encodig  (1901, 739)
```

In [ ]:

In [ ]:

```
# Preprocessed text
from sklearn.feature_extraction.text import TfidfVectorizer
vectorizer = TfidfVectorizer(min_df=10)
#print(vectorizer.get_feature_names())

train_text_tfidf = vectorizer.fit_transform(X_train['preprocessed_text'])
test_text_tfidf = vectorizer . transform(X_test['preprocessed_text'])
print("Shape of matrix after one hot encodig ",train_text_tfidf.shape)
print("Shape of matrix after one hot encodig ",test_text_tfidf.shape)
```

```
Shape of matrix after one hot encodig  (4434, 13602)
Shape of matrix after one hot encodig  (1901, 13602)
```

In [ ]:

```
# Combine   text_numberical vectors.
from scipy.sparse import hstack
y_train=y_train.astype('int')
y_test=y_test.astype('int')

X_tr=hstack((train_title_tfidf,train_text_tfidf)).tocsr()
X_te=hstack((test_title_tfidf,test_text_tfidf)).tocsr()

print("Final Data Matrix")
print(X_tr.shape, y_train.shape)
print(X_te.shape, y_test.shape)
```

```
Final Data Matrix
(4434, 14341) (4434,)
(1901, 14341) (1901,)
```

In [ ]:

```
def batch_predict(clf, data):
    # roc_auc_score(y_true, y_score) the 2nd parameter should be probability estimates of the posi
tive class
    # not the predicted outputs

    y_data_pred = []
    tr_loop = data.shape[0] - data.shape[0]%1000
    # consider you X_tr shape is 49041, then your tr_loop will be 49041 - 49041%1000 = 49000
    # in this for loop we will iterate unti the last 1000 multiplier
    for i in range(0, tr_loop, 1000):
        y_data_pred.extend(clf.predict_proba(data[i:i+1000])[:,1])
    # we will be predicting for the last data points
    if data.shape[0]%1000 !=0:
        y_data_pred.extend(clf.predict_proba(data[tr_loop:])[:,1])

    return y_data_pred
```

Multinomial Naive Bayes Model

In [ ]:

```
#training the model
from sklearn.naive_bayes import MultinomialNB

mnb=MultinomialNB()
#fitting the nb for bag of words
mnb=mnb.fit(X_tr,y_train)
print(mnb)
#fitting the nb for tfidf features
#mnb_tfidf=mnb.fit(tv_train_reviews,train_category)
#print(mnb_tfidf)
```

```
MultinomialNB(alpha=1.0, class_prior=None, fit_prior=True)
```

In [ ]:

In [ ]:

```
#Predicting the model for bag of words
mnb_predict=mnb.predict(X_te)
```

In [ ]:

```
#Accuracy score for bag of words
from sklearn.metrics import classification_report,confusion_matrix,accuracy_score

mnb_score=accuracy_score(y_test,mnb_predict)
print("mnb_bow_score :",mnb_score)
```

```
mnb_bow_score : 0.902682798527091
```

Observation

- We use Accuracy as performance measure to determine the performance of model
- With the use of Machine Learning Model(MNB Model) we got Accuracy of 97.58%

Precision and Recall Matrix

In [ ]:

```
from sklearn.metrics import classification_report,confusion_matrix,accuracy_score
mnb_report=classification_report(y_test,mnb_predict,target_names=['0','1'])
print(mnb_report)
```

```
              precision    recall  f1-score   support

           0       0.92      0.89      0.90       987
           1       0.88      0.92      0.90       914

    accuracy                           0.90      1901
   macro avg       0.90      0.90      0.90      1901
weighted avg       0.90      0.90      0.90      1901
```

Confusion Matrix

In [ ]:

```
cm_cv = confusion_matrix(y_test,mnb_predict)
```

In [ ]:

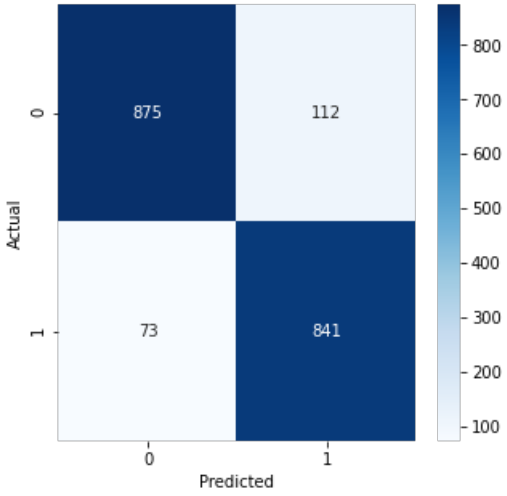
```
cm_cv = confusion_matrix(y_test,mnb_predict)

cm_cv = pd.DataFrame(cm_cv, index=[0,1], columns=[0,1])
cm_cv.index.name = 'Actual'
cm_cv.columns.name = 'Predicted'
```

In [ ]:

```
import seaborn as sns
plt.figure(figsize = (5,5))
sns.heatmap(cm_cv,cmap= "Blues",annot = True, fmt='')
```

Out[ ]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f97cdd385c0>
```



In [ ]:

```
df.head(2)
```

Out[ ]:

	Unnamed: 0	label	preprocessed_title	preprocessed_text
0	8476	0	you can smell hillary fear	daniel greenfield shillman journalism fellow f...
1	10294	0	watch the exact moment paul ryan committed pol...	google pinterest digg linkedin reddit stumbleu...

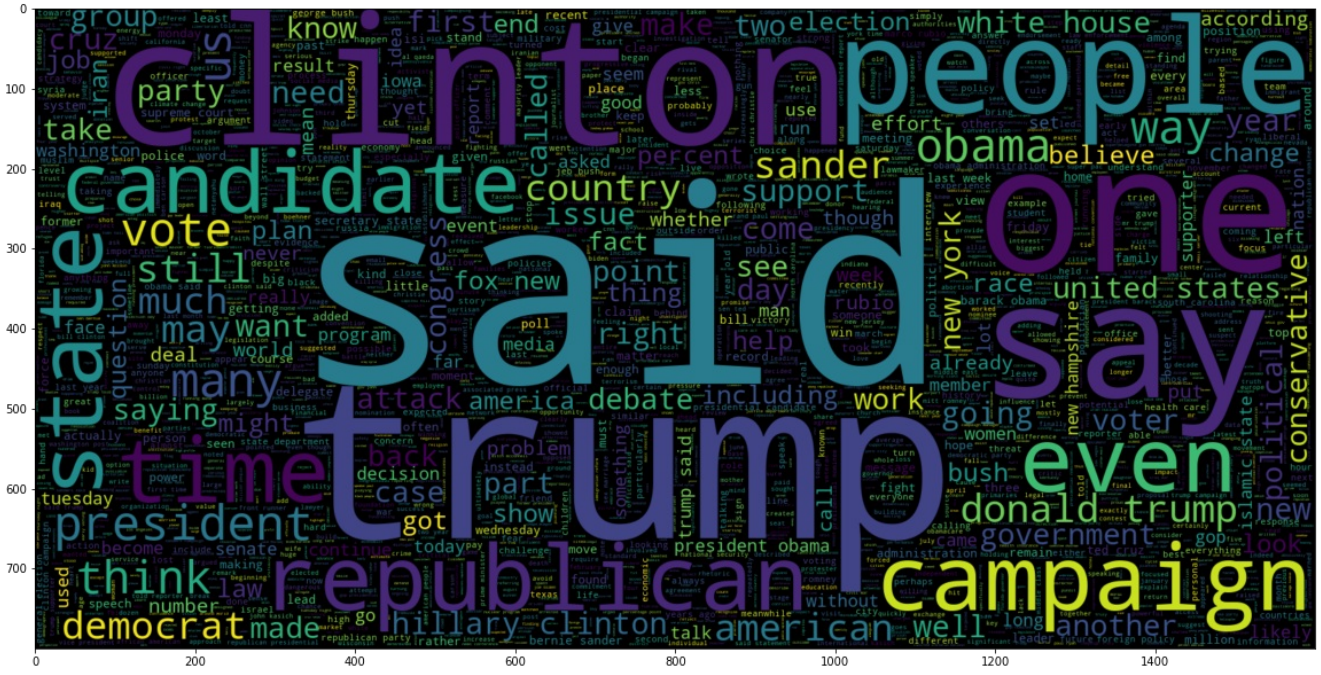
Word Cloud of Real job

In [ ]:

```
plt.figure(figsize = (20,20)) # Text that is not fraudulent(0)
wc = WordCloud(width = 1600 , height = 800 , max_words = 3000).generate(" ".join(df[df.label == 1].
preprocessed_text))
plt.imshow(wc , interpolation = 'bilinear')
```

Out[ ]:

```
<matplotlib.image.AxesImage at 0x7f97bb780a90>
```



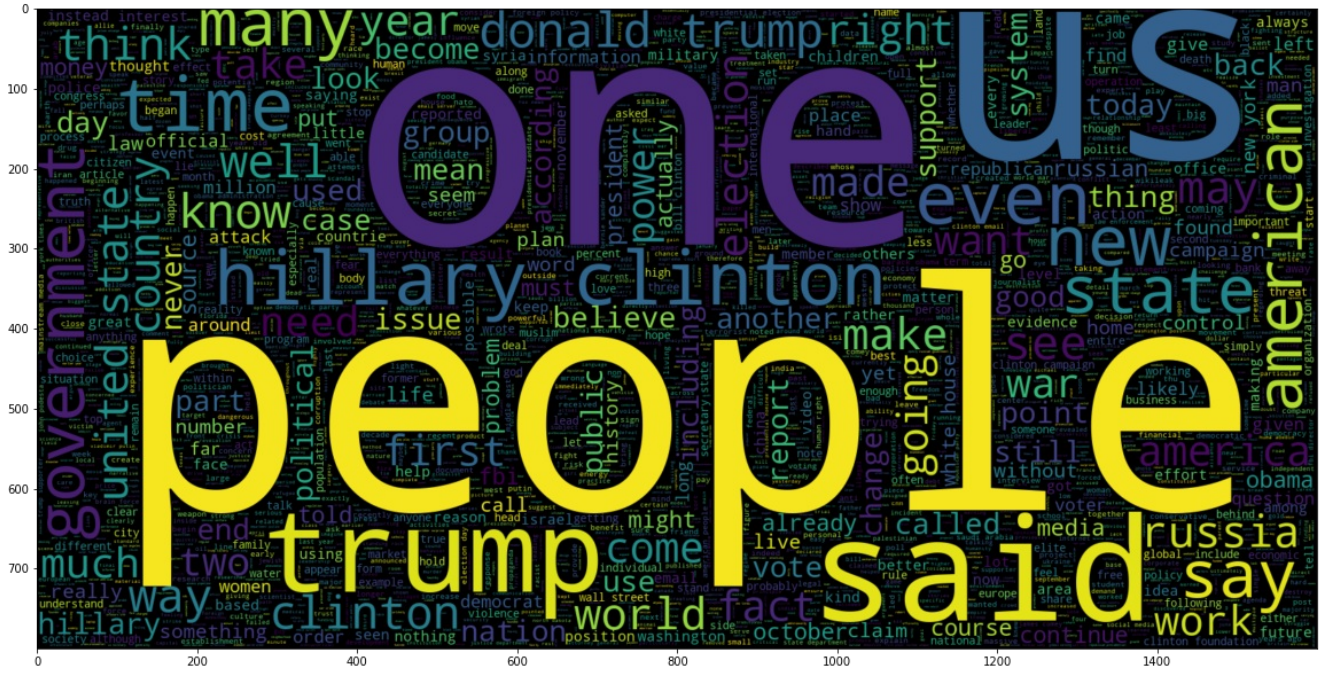
Word Cloud of Fake job

In [ ]:

```
plt.figure(figsize = (20,20)) # Text that is  fraudulent(0)
wc = WordCloud(width = 1600 , height = 800 , max_words = 3000).generate(" ".join(df[df.label == 0].
preprocessed_text))
plt.imshow(wc , interpolation = 'bilinear')
```

Out[ ]:

```
<matplotlib.image.AxesImage at 0x7f97cdcf6710>
```



Deep Learning Model

In [ ]:

```
#

#from keras.models import Sequential

from tensorflow.python.keras.layers import Dense
from tensorflow.python.keras import Sequential



model = Sequential()
model.add(Dense(units = 100 , activation = 'relu' , input_dim = X_tr.shape[1]))
model.add(Dense(units = 50 , activation = 'relu'))
model.add(Dense(units = 25 , activation = 'relu'))
model.add(Dense(units = 10 , activation = 'relu'))
model.add(Dense(units = 1 , activation = 'sigmoid'))
model.compile(optimizer = 'adam' , loss = 'binary_crossentropy' , metrics = ['accuracy'])
model.summary()
```

```
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
dense_10 (Dense)             (None, 100)               1434200
_________________________________________________________________
dense_11 (Dense)             (None, 50)                5050
_________________________________________________________________
dense_12 (Dense)             (None, 25)                1275
```

```
_________________________________________________________________
dense_13 (Dense)             (None, 10)                260       
_________________________________________________________________
dense_14 (Dense)             (None, 1)                 11        
=================================================================
Total params: 1,440,796
Trainable params: 1,440,796
Non-trainable params: 0
_________________________________________________________________
```

In [ ]:

```
# Combine all categorical, numerical and text_number vectors.
from scipy.sparse import hstack
y_train=y_train.astype('int')
y_test=y_test.astype('int')

X_tr=hstack((train_title_tfidf,train_text_tfidf)).tocsr()
X_te=hstack((test_title_tfidf,test_text_tfidf)).tocsr()

print("Final Data Matrix")
print(X_tr.shape, y_train.shape)
print(X_te.shape, y_test.shape)
```

```
Final Data Matrix
(4434, 14341) (4434,)
(1901, 14341) (1901,)
```

In [ ]:

```
type(X_tr.todense())
```

Out[ ]:

```
numpy.matrix
```

In [ ]:

```
model.fit(X_tr.todense(),y_train , epochs = 20)
```

```
Epoch 1/20
139/139 [==============================] - 1s 5ms/step - loss: 0.3445 - accuracy: 0.8793
Epoch 2/20
139/139 [==============================] - 1s 5ms/step - loss: 0.0413 - accuracy: 0.9876
Epoch 3/20
139/139 [==============================] - 1s 5ms/step - loss: 0.0061 - accuracy: 0.9986
Epoch 4/20
139/139 [==============================] - 1s 5ms/step - loss: 0.0014 - accuracy: 0.9998
Epoch 5/20
139/139 [==============================] - 1s 5ms/step - loss: 4.5152e-04 - accuracy: 1.0000
Epoch 6/20
139/139 [==============================] - 1s 5ms/step - loss: 1.7365e-04 - accuracy: 1.0000
Epoch 7/20
139/139 [==============================] - 1s 5ms/step - loss: 8.5444e-05 - accuracy: 1.0000
Epoch 8/20
139/139 [==============================] - 1s 5ms/step - loss: 4.9035e-05 - accuracy: 1.0000
Epoch 9/20
139/139 [==============================] - 1s 5ms/step - loss: 2.9771e-05 - accuracy: 1.0000
Epoch 10/20
139/139 [==============================] - 1s 5ms/step - loss: 1.9702e-05 - accuracy: 1.0000
Epoch 11/20
139/139 [==============================] - 1s 5ms/step - loss: 1.3856e-05 - accuracy: 1.0000
Epoch 12/20
139/139 [==============================] - 1s 5ms/step - loss: 1.0164e-05 - accuracy: 1.0000
Epoch 13/20
139/139 [==============================] - 1s 5ms/step - loss: 7.6164e-06 - accuracy: 1.0000
Epoch 14/20
139/139 [==============================] - 1s 5ms/step - loss: 5.8876e-06 - accuracy: 1.0000
Epoch 15/20
139/139 [==============================] - 1s 5ms/step - loss: 4.6238e-06 - accuracy: 1.0000
Epoch 16/20
139/139 [==============================] - 1s 5ms/step - loss: 3.7241e-06 - accuracy: 1.0000
Epoch 17/20
```

```
139/139 [==============================] - 1s 5ms/step - loss: 3.0394e-06 - accuracy: 1.0000
Epoch 18/20
139/139 [==============================] - 1s 5ms/step - loss: 2.5069e-06 - accuracy: 1.0000
Epoch 19/20
139/139 [==============================] - 1s 5ms/step - loss: 2.1070e-06 - accuracy: 1.0000
Epoch 20/20
139/139 [==============================] - 1s 5ms/step - loss: 1.7714e-06 - accuracy: 1.0000
```

Out[ ]:

```
<tensorflow.python.keras.callbacks.History at 0x7f97b7d73400>
```

In [ ]:

```
pred_cv = model.predict(X_te.todense())

pred_cv = np.around(pred_cv , decimals = 0)
```

In [ ]:

```
accuracy_score(pred_cv,y_test)
```

Out[ ]:

```
0.9347711730668069
```

Observation

- We use Accuracy as performance measure to determine the performance of model
- With the use of Deep Learning Model(MLP Model) we got Accuracy of 98.68%

Confusion Matrix

In [ ]:

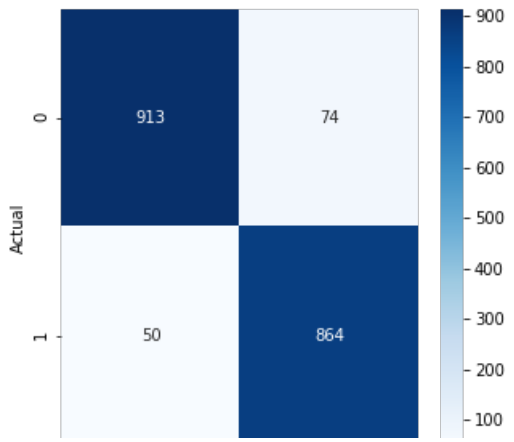
```
cm_cv = confusion_matrix(y_test,pred_cv)

cm_cv = pd.DataFrame(cm_cv, index=[0,1], columns=[0,1])
cm_cv.index.name = 'Actual'
cm_cv.columns.name = 'Predicted'
```

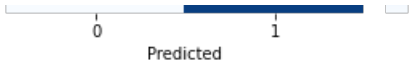
In [ ]:

```
import seaborn as sns
plt.figure(figsize = (5,5))
sns.heatmap(cm_cv,cmap= "Blues",annot = True, fmt='')
```

Out[ ]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f97bc735e80>
```





Results

In [ ]:

```
# Please compare all your models using Prettytable library
# http://zetcode.com/python/prettytable/
from prettytable import PrettyTable
x = PrettyTable()
x.field_names = ["Model","Category", "Accuracy"]
x.add_row(["Multinomial NB","Machine Learning",90.27])
x.add_row(["MLP", "Deep Learning",93.48])

print(x)
```

```
+----------------+------------------+----------+
|     Model      |     Category     | Accuracy |
+----------------+------------------+----------+
| Multinomial NB | Machine Learning |  90.27   |
|      MLP       |  Deep Learning   |  93.48   |
+----------------+------------------+----------+
```