In [77]:
```python
import warnings
warnings.filterwarnings("ignore")
import numpy as np
import re
import os
import pandas as pd
from tqdm import tqdm
import string
from nltk import word_tokenize
from nltk.corpus import stopwords
import nltk
nltk.download('punkt')
nltk.download('stopwords')
import seaborn as sns
from string import punctuation
import matplotlib.pyplot as plt
import time
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import accuracy_score,confusion_matrix,precision_score
from sklearn.feature_extraction.text import TfidfVectorizer
```

```
[nltk_data] Downloading package punkt to /usr/share/nltk_data...
[nltk_data]   Package punkt is already up-to-date!
[nltk_data] Downloading package stopwords to /usr/share/nltk_data...
[nltk_data]   Package stopwords is already up-to-date!
```

Loading the preprocessed train and test data

In [78]:
```python
import pickle
df_train=pickle.load(open('../input/fake-news-case-study-preprocessed-daa/df_train.pkl','rb'))
```

Shape of train and test dataset

In [79]:
```python
df_train.shape
```

Out[79]:
```
(18285, 27)
```

In [80]:
```python
df_train.head()
```

Out[80]:

	id	title	author	text	label	num_characters_title	num_characters_text	num_word_title	num_word_text	num_sentences_title	...	Avg_sentence_length_title	Avg_sentence_length_text	Stopword_coun
0	0	House Dem Aide: We Didn't Even See Comey's Let...	Darrell Lucus	House Dem Aide: We Didn't Even See Comey's Let...	1	81	4930	19	943	1	...	19.0	25.486486	
1	1	FLYNN: Hillary Clinton, Big Woman on Campus - ...	Daniel J. Flynn	Ever get the feeling your life circles the rou...	0	55	4160	11	822	1	...	11.0	28.344828	
2	2	Why the Truth Might Get You Fired	Consortiumnews.com	Why the Truth Might Get You Fired October 29, ...	1	33	7692	7	1454	1	...	7.0	28.509804	
3	3	15 Civilians Killed In Single US Airstrike Hav...	Jessica Purkiss	Videos 15 Civilians Killed In Single US Airstr...	1	63	3237	10	612	1	...	10.0	22.666667	
4	4	Iranian woman jailed for fictional unpublished...	Howard Portnoy	Print \nAn Iranian woman has been sentenced to...	1	93	938	14	177	1	...	14.0	35.400000	

5 rows × 27 columns

Extracting independent features on X and Class label to Y variable

In [81]:
```python
Y=df_train["label"]
X=df_train.drop(["id","title","text","label","cleaned_text","cleaned_title","author"], axis=1, inplace=False)
```

In [82]:
```python
X.shape,Y.shape
```

Out[82]:
```
((18285, 20), (18285,))
```

Splitting the dataset to train and test dataset

In [83]:
```python
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, Y, test_size=0.25, stratify=Y,random_state=42)
```

In [84]:
```python
print(X_train.shape, y_train.shape)
print(X_test.shape, y_test.shape)
```

```
(13713, 20) (13713,)
(4572, 20) (4572,)
```

1. Traning Naive bayes model

Vectorizing our text features using tfidf vectorizer

In [85]:
```python
vectorizer_tfidf =TfidfVectorizer(max_features=3500)
vectorizer_tfidf.fit(X_train["Without_Stopwords_title"].values)

# we use the fitted tfidfVectorizer to convert the text to vector
X_train_title_tfidf = vectorizer_tfidf.transform(X_train['Without_Stopwords_title']).toarray()
X_test_title_tfidf = vectorizer_tfidf.transform(X_test['Without_Stopwords_title']).toarray()

print("After vectorizations shape of train and test data")
print(X_train_title_tfidf.shape, y_train.shape)
print(X_test_title_tfidf.shape, y_test.shape)
print("="*100)
```

```
After vectorizations shape of train and test data
(13713, 3500) (13713,)
(4572, 3500) (4572,)
====================================================================================================
```

In [86]:
```python
vectorizer_text_tfidf =TfidfVectorizer(max_features=4500)
vectorizer_text_tfidf.fit(X_train["Without_Stopwords_text"].values)

# we use the fitted countVectorizer to convert the text to vector
X_train_text_tfidf = vectorizer_text_tfidf.transform(X_train['Without_Stopwords_text'].values).toarray()
X_test_text_tfidf = vectorizer_text_tfidf.transform(X_test['Without_Stopwords_text'].values).toarray()

print("After vectorizations shape of train and test data")
print(X_train_text_tfidf.shape, y_train.shape)
print(X_test_text_tfidf.shape, y_test.shape)
print("="*100)
```

```
After vectorizations shape of train and test data
(13713, 4500) (13713,)
(4572, 4500) (4572,)
====================================================================================================
```

In [87]:
```python
# stacking all the features for train and test dataset
X_train_final_tfidf = np.hstack((X_train_title_tfidf, X_train_text_tfidf))
X_test_final_tfidf = np.hstack((X_test_title_tfidf , X_test_text_tfidf))

print("Final Data matrix")
print(X_train_final_tfidf.shape, y_train.shape)
print(X_test_final_tfidf.shape, y_test.shape)
print("="*100)
```

```
Final Data matrix
(13713, 8000) (13713,)
(4572, 8000) (4572,)
====================================================================================================
```

In [88]:
```python
gnb = GaussianNB()
gnb.fit(X_train_final_tfidf,y_train)
y_pred = gnb.predict(X_test_final_tfidf)
accuracy = accuracy_score(y_test,y_pred)
precision = precision_score(y_test,y_pred)
print("Gaussian NB accuracy on test dataset :",accuracy)
print("Gaussian NB precision on test dataseet :",precision)
```

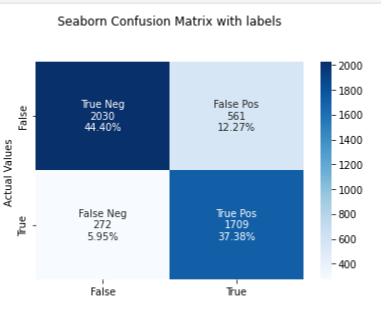
```
Gaussian NB accuracy on test dataset : 0.8178040244969379
Gaussian NB precision on test dataseet : 0.752863436123348
```

Plotting confusion mattrix

In [89]:
```python
from sklearn.metrics import confusion_matrix

#Generate the confusion matrix
cf_matrix = confusion_matrix(y_test, y_pred)

print(cf_matrix)
```

```
[[2030  561]
 [ 272 1709]]
```

In [90]:
```python
group_names = ['True Neg','False Pos','False Neg','True Pos']

group_counts = ["{0:0.0f}".format(value) for value in
                cf_matrix.flatten()]

group_percentages = ["{0:.2%}".format(value) for value in
                     cf_matrix.flatten()/np.sum(cf_matrix)]

labels = [f"{v1}\n{v2}\n{v3}" for v1, v2, v3 in
          zip(group_names,group_counts,group_percentages)]

labels = np.asarray(labels).reshape(2,2)

ax = sns.heatmap(cf_matrix, annot=labels, fmt='', cmap='Blues')

ax.set_title('Seaborn Confusion Matrix with labels\n\n');
ax.set_xlabel('\nPredicted Values')
ax.set_ylabel('Actual Values ');

ax.xaxis.set_ticklabels(['False','True'])
ax.yaxis.set_ticklabels(['False','True'])

## Display the visualization of the Confusion Matrix.
plt.show()
```



k-nearest neighbors Classifier

In [91]:
```python
from sklearn.neighbors import KNeighborsClassifier
neigh = KNeighborsClassifier()
neigh.fit(X_train_final_tfidf,y_train)
y_pred = neigh.predict(X_test_final_tfidf)
accuracy = accuracy_score(y_test,y_pred)
precision = precision_score(y_test,y_pred)
print("k-nearest neighbors accuracy on testdataset :",accuracy)
print("k-nearest neighbors precision on testdataset :",precision)
```

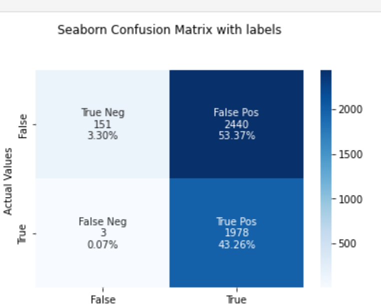
```
k-nearest neighbors accuracy on testdataset : 0.46566054243219596
k-nearest neighbors precision on testdataset : 0.447713897691263
```

Plotting confusion mattrix

In [92]:
```python
from sklearn.metrics import confusion_matrix

#Generate the confusion matrix
cf_matrix = confusion_matrix(y_test, y_pred)

print(cf_matrix)
```

```
[[ 151 2440]
 [   3 1978]]
```

In [93]:
```python
group_names = ['True Neg','False Pos','False Neg','True Pos']

group_counts = ["{0:0.0f}".format(value) for value in
                cf_matrix.flatten()]

group_percentages = ["{0:.2%}".format(value) for value in
                     cf_matrix.flatten()/np.sum(cf_matrix)]

labels = [f"{v1}\n{v2}\n{v3}" for v1, v2, v3 in
          zip(group_names,group_counts,group_percentages)]

labels = np.asarray(labels).reshape(2,2)

ax = sns.heatmap(cf_matrix, annot=labels, fmt='', cmap='Blues')

ax.set_title('Seaborn Confusion Matrix with labels\n\n');
ax.set_xlabel('\nPredicted Values')
ax.set_ylabel('Actual Values ');

ax.xaxis.set_ticklabels(['False','True'])
ax.yaxis.set_ticklabels(['False','True'])

## Display the visualization of the Confusion Matrix.
plt.show()
```



2. Traning Logistic Regression model

In [94]:
```python
from sklearn.linear_model import LogisticRegression
LR = LogisticRegression(random_state=12)
LR.fit(X_train_final_tfidf,y_train)
y_pred = LR.predict(X_test_final_tfidf)
accuracy = accuracy_score(y_test,y_pred)
precision = precision_score(y_test,y_pred)
print("LR accuracy on testdataset :",accuracy)
print("LR precision on testdataset :",precision)
```

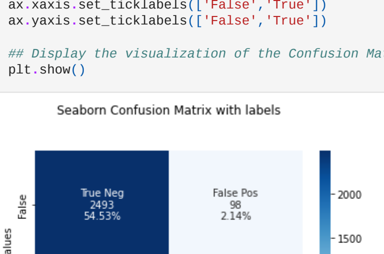
```
LR accuracy on testdataset : 0.9733158355205599
LR precision on testdataset : 0.9523114355231144
```

Plotting confusion mattrix

In [95]:
```python
from sklearn.metrics import confusion_matrix

#Generate the confusion matrix
cf_matrix = confusion_matrix(y_test, y_pred)

print(cf_matrix)
```

```
[[2493   98]
 [  24 1957]]
```

In [96]:
```python
group_names = ['True Neg','False Pos','False Neg','True Pos']

group_counts = ["{0:0.0f}".format(value) for value in
                cf_matrix.flatten()]

group_percentages = ["{0:.2%}".format(value) for value in
                     cf_matrix.flatten()/np.sum(cf_matrix)]

labels = [f"{v1}\n{v2}\n{v3}" for v1, v2, v3 in
          zip(group_names,group_counts,group_percentages)]

labels = np.asarray(labels).reshape(2,2)

ax = sns.heatmap(cf_matrix, annot=labels, fmt='', cmap='Blues')

ax.set_title('Seaborn Confusion Matrix with labels\n\n');
ax.set_xlabel('\nPredicted Values')
ax.set_ylabel('Actual Values ');

ax.xaxis.set_ticklabels(['False','True'])
ax.yaxis.set_ticklabels(['False','True'])

## Display the visualization of the Confusion Matrix.
plt.show()
```



Summary of above trained models:-

In [1]:
```python
from prettytable import PrettyTable

# Specify the Column Names while initializing the Table
myTable = PrettyTable([ "Vectorizer","Model", "Accuracy On test Data","Precision on Test Data"])

# Add rows
myTable.add_row(["tfidf Vectorizer","Gaussian NB", "81.7", "75.2"])
myTable.add_row(["-------", "-------", "-------","-------"])
myTable.add_row(["tfidf Vectorizer","KNN", "46.5", "44.7"])
myTable.add_row(["-------", "-------", "-------","-------"])
myTable.add_row(["tfidf Vectorizer","Logistic Regression", "97.3", "95.2"])

print(myTable)
```

```
+------------------+---------------------+-----------------------+------------------------+
|    Vectorizer    |        Model        | Accuracy On test Data | Precision on Test Data |
+------------------+---------------------+-----------------------+------------------------+
| tfidf Vectorizer |     Gaussian NB     |          81.7         |          75.2          |
|     -------      |       -------       |        -------        |        -------         |
| tfidf Vectorizer |         KNN         |          46.5         |          44.7          |
|     -------      |       -------       |        -------        |        -------         |
| tfidf Vectorizer | Logistic Regression |          97.3         |          95.2          |
+------------------+---------------------+-----------------------+------------------------+
```

Observations:-

1. After vectorizing our test features title and text using tfidf vectorizer i have trained below three first cut model i. Gaussian NB ii. KNN iii. Logistice regression
2. In Gaussian NB i am getting accuracy on test data is 81.7% and precesion 75.2%
3. In KNN i am getting accuracy on test data is 46.5% and precesion 44.7% clear KNN is not performing well on test so model may be having high variance
4. Logistic regression i am getting 97.3% accracy and 95.2 precesion on test data which is best out of all three models. which shows that our data is linearly seperable hence Logistic regression is performing well