Hate Speech detection

Dataset: https://www.kaggle.com/datasets/arkhoshghalb/twitter-sentiment-analysis-hatred-speech

Importing Required Libraries

```
import pandas as pd
import numpy as np
import re
import seaborn as sns
import matplotlib.pyplot as plt
from matplotlib import style
style.use('ggplot')
from nltk.tokenize import word_tokenize
from nltk.stem import WordNetLemmatizer
from nltk.corpus import stopwords
import nltk
nltk.download('stopwords')
nltk.download('punkt')
nltk.download('wordnet')
stop_words = set(stopwords.words('english'))
from wordcloud import WordCloud
from sklearn.feature_extraction.text import TfidfVectorizer
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.svm import SVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import accuracy_score, classification_report,
confusion_matrix, ConfusionMatrixDisplay
```

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

```
tweet_df = pd.read_csv('/content/train.csv')
tweet_df.head()
```

```
   id  label                                              tweet
0   1      0   @user when a father is dysfunctional and is s...
1   2      0  @user @user thanks for #lyft credit i can't us...
2   3      0                                bihday your majesty
3   4      0  #model   i love u take with u all the time in ...
4   5      0             factsguide: society now    #motivation
```

```
tweet_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 31962 entries, 0 to 31961
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype 
---  ------  --------------  ----- 
 0   id      31962 non-null  int64 
 1   label   31962 non-null  int64 
 2   tweet   31962 non-null  object
dtypes: int64(2), object(1)
memory usage: 749.2+ KB
```

```
print(tweet_df['tweet'].iloc[0],"\n")
```

```
 @user when a father is dysfunctional and is so selfish he drags his
kids into his dysfunction.   #run
```

Data Preprocessing

- Removing links,mails,more than one spaces
- Tokenization using NLTK
- Removing stop words

```
def data_processing(tweet):
    tweet = tweet.lower()
    tweet = re.sub(r"https\S+|www\S+http\S+", '', tweet, flags =
re.MULTILINE)
    tweet = re.sub(r'\@w+|\#','', tweet)
    tweet = re.sub(r'[^\w\s]','',tweet)
    tweet = re.sub(r'ð','',tweet)
    tweet_tokens = word_tokenize(tweet)
    filtered_tweets = [w for w in tweet_tokens if not w in stop_words]
    return " ".join(filtered_tweets)

tweet_df.tweet = tweet_df['tweet'].apply(data_processing)
tweet_df = tweet_df.drop_duplicates('tweet')
```

- Lemmatization Using NLTK

```
lemmatizer = WordNetLemmatizer()
def lemmatizing(data):
    tweet = [lemmatizer.lemmatize(word) for word in data]
    return data

tweet_df['tweet'] = tweet_df['tweet'].apply(lambda x: lemmatizing(x))

print(tweet_df['tweet'].iloc[0],"\n")
```

```
user father dysfunctional selfish drags kids dysfunction run
```

```
tweet_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 29345 entries, 0 to 31961
Data columns (total 3 columns):
 #   Column  Non-Null Count  Dtype 
---  ------  --------------  ----- 
 0   id      29345 non-null  int64 
 1   label   29345 non-null  int64 
 2   tweet   29345 non-null  object
dtypes: int64(2), object(1)
memory usage: 917.0+ KB
```

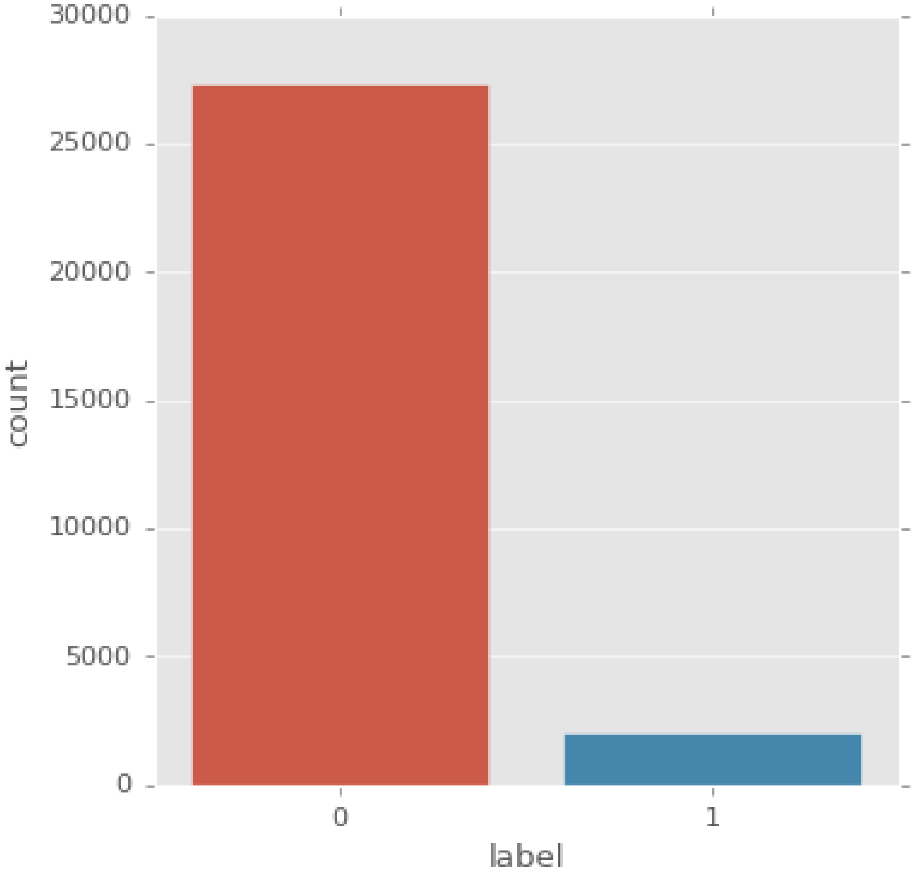
```
tweet_df['label'].value_counts()
```

```
0    27352
1     1993
Name: label, dtype: int64
```

Data Visualization

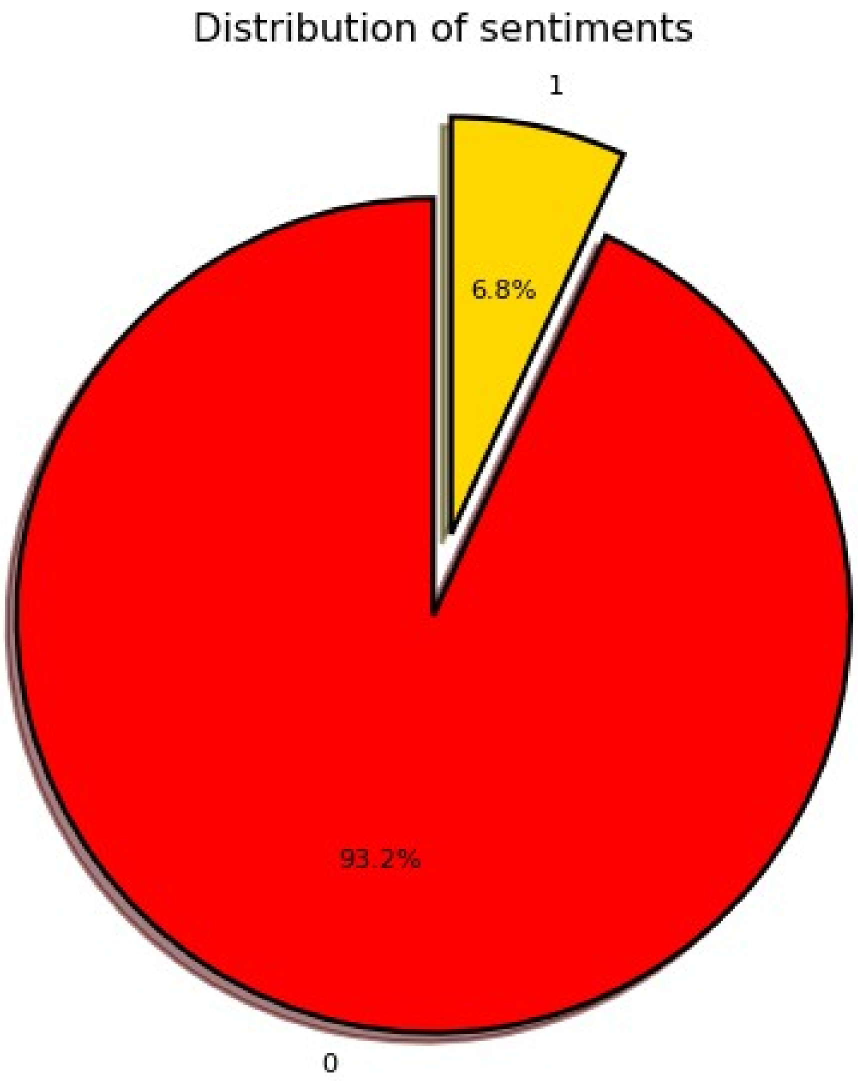
```
fig = plt.figure(figsize=(5,5))
sns.countplot(x='label', data = tweet_df)
```

```
<Axes: xlabel='label', ylabel='count'>
```



```
fig = plt.figure(figsize=(7,7))
colors = ("red", "gold")
wp = {'linewidth':2, 'edgecolor':"black"}
tags = tweet_df['label'].value_counts()
explode = (0.1, 0.1)
tags.plot(kind='pie',autopct = '%1.1f%%', shadow=True, colors =
colors, startangle =90,
         wedgeprops = wp, explode = explode, label='')
plt.title('Distribution of sentiments')
```

```
Text(0.5, 1.0, 'Distribution of sentiments')
```

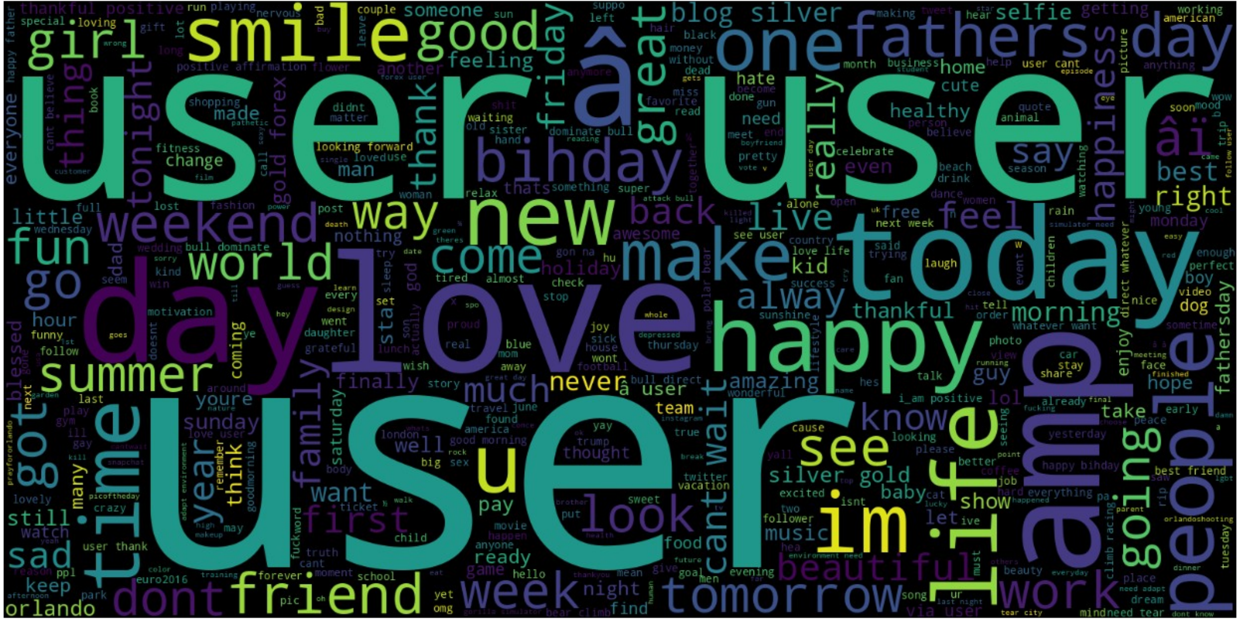


```
non_hate_tweets = tweet_df[tweet_df.label == 0]
non_hate_tweets.head()

   id  label                                              tweet
0   1      0  user father dysfunctional selfish drags kids d...
1   2      0  user user thanks lyft credit cant use cause do...
2   3      0                                     bihday majesty
3   4      0                      model love u take u time ur
4   5      0                     factsguide society motivation

text = ' '.join([word for word in non_hate_tweets['tweet']])
plt.figure(figsize=(20,15), facecolor='None')
wordcloud = WordCloud(max_words=500, width=1600,
height=800).generate(text)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Frequent words in non hate tweets', fontsize = 19)
plt.show()
```

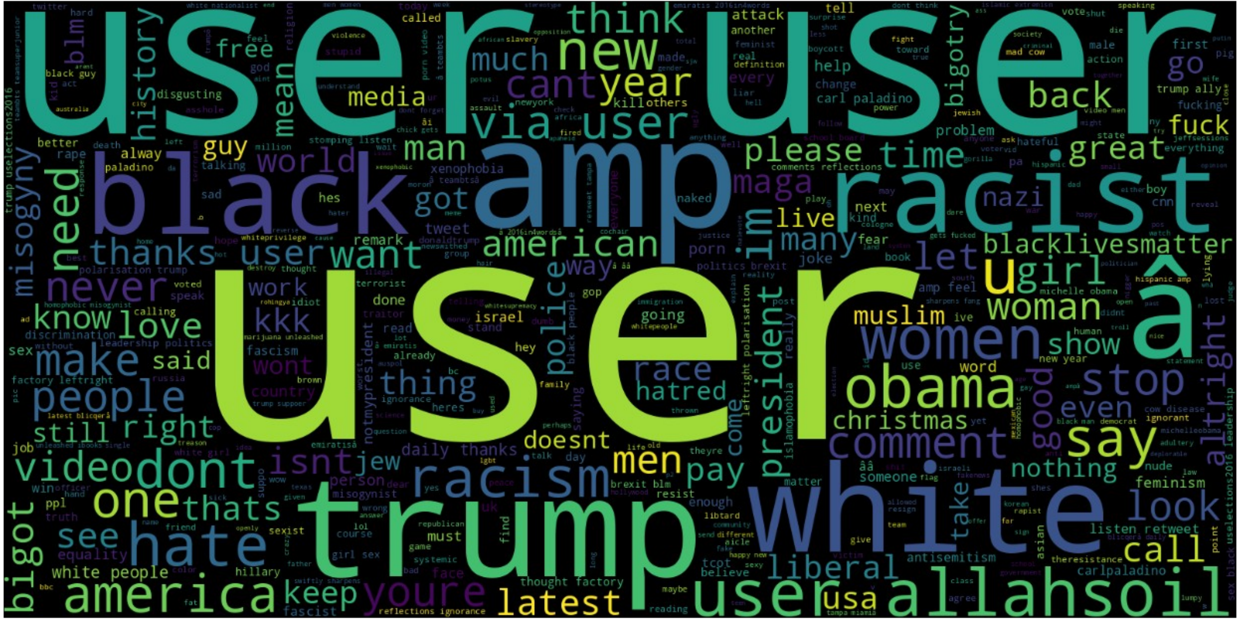
Frequent words in non hate tweets



```
hate_tweets = tweet_df[tweet_df.label == 1]
hate_tweets.head()

    id  label                                              tweet
13  14      1  user cnn calls michigan middle school build wa...
14  15      1  comment australia opkillingbay seashepherd hel...
17  18      1                                      retweet agree
23  24      1                       user user lumpy says prove lumpy
34  35      1  unbelievable 21st century wed need something l...

text = ' '.join([word for word in hate_tweets['tweet']])
plt.figure(figsize=(20,15), facecolor='None')
wordcloud = WordCloud(max_words=500, width=1600,
height=800).generate(text)
plt.imshow(wordcloud, interpolation='bilinear')
plt.axis('off')
plt.title('Frequent words in hate tweets', fontsize = 19)
plt.show()
```



Frequent words in hate tweets

Text Representation(Vectorization)

- Use of TfIdf -> Text frequency - Inverse document frequency using sklearn

```
vect = TfidfVectorizer(ngram_range=(1,2)).fit(tweet_df['tweet'])

feature_names = vect.get_feature_names_out()
print("Number of features: {}\n".format(len(feature_names)))
print("First 10 features: \n{}".format(feature_names[:10]))

Number of features: 208579

First 10 features:
['0000001' '0000001 polluting' '00027' '00027 photooftheday' '001'
'0035'
 '00h30' '01' '01 4995' '01 7900']

vect = TfidfVectorizer(ngram_range=(1,3)).fit(tweet_df['tweet'])

feature_names = vect.get_feature_names_out()
print("Number of features: {}\n".format(len(feature_names)))
print("First 10 features: \n{}".format(feature_names[:10]))

Number of features: 380305

First 10 features:
['0000001' '0000001 polluting' '0000001 polluting niger' '00027'
 '00027 photooftheday' '00027 photooftheday music' '001' '0035'
'00h30'
 '01']
```

Model building

```
X = tweet_df['tweet']
Y = tweet_df['label']
X = vect.transform(X)

x_train, x_test, y_train, y_test = train_test_split(X, Y,
test_size=0.2, random_state=42)

print("Size of x_train:", (x_train.shape))
print("Size of y_train:", (y_train.shape))
print("Size of x_test: ", (x_test.shape))
print("Size of y_test: ", (y_test.shape))
```

```
Size of x_train: (23476, 380305)
Size of y_train: (23476,)
Size of x_test:  (5869, 380305)
Size of y_test:  (5869,)
```

Hyperparameter tuning using GridSearchCV

```
from sklearn.model_selection import GridSearchCV
import warnings
warnings.filterwarnings('ignore')

param_grid = {'C':[100, 10, 1.0, 0.1, 0.01], 'solver' :['newton-cg',
'lbfgs','liblinear']}
grid_logit = GridSearchCV(LogisticRegression(), param_grid, cv = 5)
grid_logit.fit(x_train, y_train)
print("Best Cross validation score:
{:.2f}".format(grid_logit.best_score_))
print("Best parameters: ", grid_logit.best_params_)
```

```
Best Cross validation score: 0.95
Best parameters:  {'C': 100, 'solver': 'newton-cg'}
```

```
logreg = LogisticRegression(C=100,solver= 'newton-cg')
logreg.fit(x_train, y_train)
logreg_predict = logreg.predict(x_test)
logreg_acc = accuracy_score(logreg_predict, y_test)
print("Test accuarcy: {:.2f}%".format(logreg_acc*100))
```

```
Test accuarcy: 94.89%
```

```
print(confusion_matrix(y_test, logreg_predict))
print("\n")
print(classification_report(y_test, logreg_predict))

style.use('classic')
```

```
cm = confusion_matrix(y_test, logreg_predict, labels=logreg.classes_)
disp = ConfusionMatrixDisplay(confusion_matrix=cm,
display_labels=logreg.classes_)
disp.plot()
```

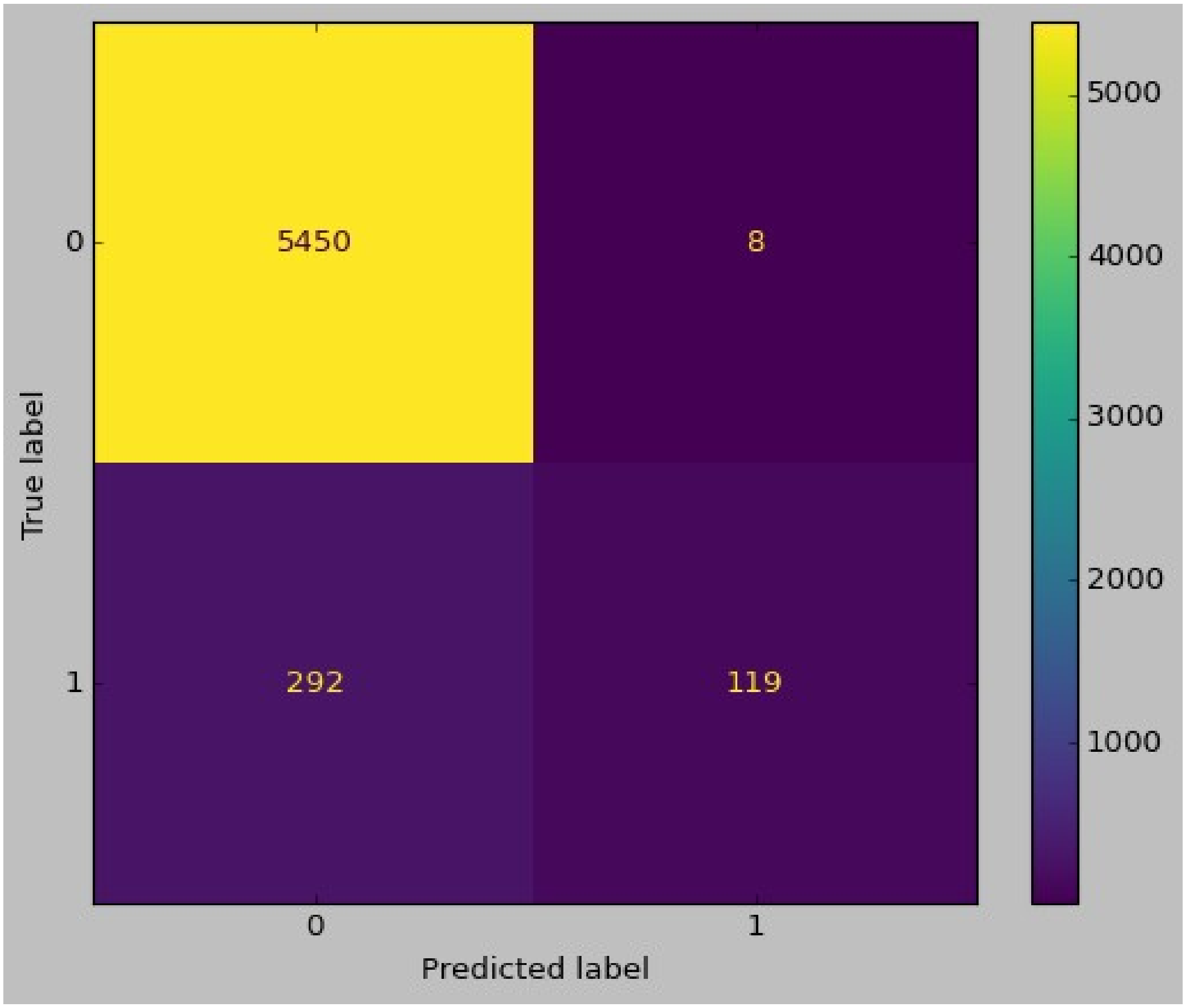
```
[[5450    8]
 [ 292  119]]


              precision    recall  f1-score   support

           0       0.95      1.00      0.97      5458
           1       0.94      0.29      0.44       411

    accuracy                           0.95      5869
   macro avg       0.94      0.64      0.71      5869
weighted avg       0.95      0.95      0.94      5869


<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay at
0x7ade1f4de290>
```



```
des = DecisionTreeClassifier()
des.fit(x_train, y_train)
des_predict = des.predict(x_test)
des_acc = accuracy_score(des_predict, y_test)
print("Test accuarcy: {:.2f}%".format(des_acc*100))
```

```
Test accuarcy: 94.45%
```

```
des2 = DecisionTreeClassifier(criterion='entropy')
des2.fit(x_train, y_train)
des2_predict = des2.predict(x_test)
des2_acc = accuracy_score(des2_predict, y_test)
print("Test accuarcy: {:.2f}%".format(des2_acc*100))
```

```
Test accuarcy: 93.83%
```

```
svc = SVC()
svc.fit(x_train, y_train)
svc_predict = svc.predict(x_test)
```

```
svc_acc = accuracy_score(svc_predict, y_test)
print("Test accuarcy: {:.2f}%".format(svc_acc*100))
```

```
Test accuarcy: 93.99%
```

```
knn=KNeighborsClassifier()
knn.fit(x_train,y_train)
knn_predict=knn.predict(x_test)
knn_acc = accuracy_score(knn_predict,y_test)
print("Test accuarcy: {:.2f}%".format(knn_acc*100))
```

```
Test accuarcy: 94.43%
```

```
print(logreg.predict(x_test[20:30]))
print(des.predict(x_test[20:30]))
print(des2.predict(x_test[20:30]))
print(svc.predict(x_test[20:30]))
print(knn.predict(x_test[20:30]))
print("Actual",y_test[20:30].values)
```

```
[0 0 0 0 1 0 0 0 0 0]
[0 0 0 0 1 0 0 0 0 0]
[0 0 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 0 0]
[0 0 0 0 0 0 0 0 0 0]
Actual [0 0 0 0 1 0 0 1 0 0]
```