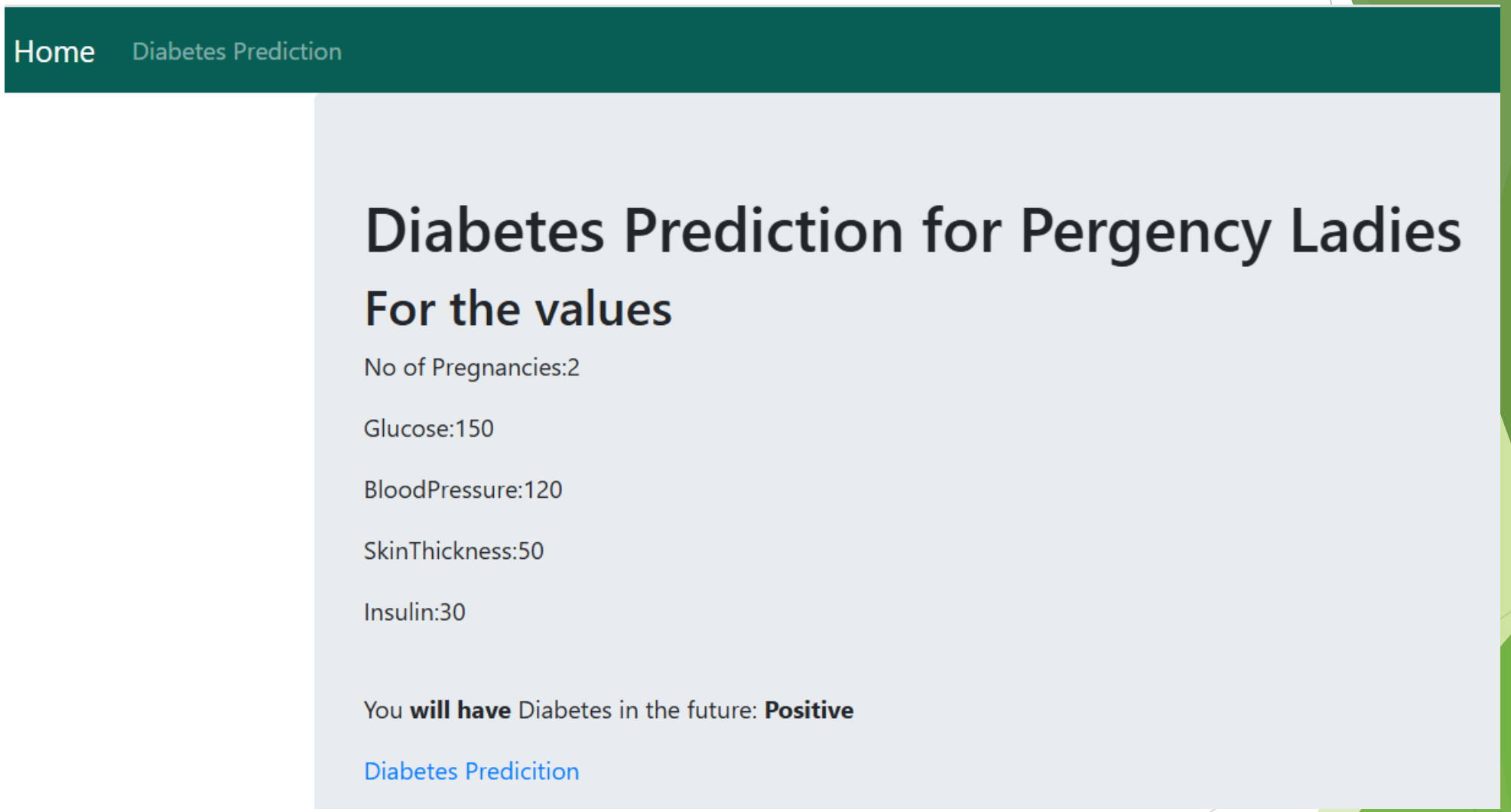
PREGNANT LADIES DIABETES PREDICTION ML MODEL


Home
Diabetes Prediction
Diabetes Prediction for Pergency Ladies
For the values
No of Pregnancies:2
Glucose:150
BloodPressure:120
SkinThickness:50
Insulin:30
You will have Diabetes in the future: Positive
Diabetes Predicition

GOAL OF PREDICTION

Develop a machine learning model to accurately predict diabetes range and prevent abnormal circumstances for pregnant women.

Tools and Methods

- Python, Pandas, Scikit-Learn, Matplotlib, Seaborn

Models

- SVC, Decision Tree, Random Forest, Logistic Regression, KNN, Gaussian NB, Bernoulli NB

Feature Selection

- SelectKBest (chi2)

Evaluation

- Accuracy, Confusion Matrix, ROC-AUC

Model Optimization

- GridSearchCV for hyperparameter tuning

Model Comparison

Algorithm	Accuracy
SVC	0.78
Decision Tree	0.75
Random Forest	0.77
Logistic Regression	0.78
KNN	0.72
Gaussian NB	0.76
Bernoulli NB	0.73

Best Model

Based on accuracy scores, all models are performed average. Among them, SVC with tuned parameters using GridSearchCV (Linear Kernel) emerged as the best performing model.

Deployment Workflow

- Model Trained and saved using pickle
- User input standardized for predict the Diabetes range
- Integrated with Django as a Web-Based Prediction application


LET'S GET
INTO
CODING

Data Preprocessing

[1]:
```
# Import neccessary Libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sea
from sklearn.feature_selection import chi2
import warnings
warnings.filterwarnings("ignore")
```

[2]:
```
# Import Dataset
dataset = pd.read_csv('Pergency Ladies Diabetes Prediction.csv')
dataset
```

[2]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1
...	...	...	...	...	...	...	...	...	...
763	10	101	76	48	180	32.9	0.171	63	0
764	2	122	70	27	0	36.8	0.340	27	0
765	5	121	72	23	112	26.2	0.245	30	0
766	1	126	60	0	0	30.1	0.349	47	1

[3]:
```
dataset.isnull().sum()
```

[3]:
```
Pregnancies                 0
Glucose                     0
BloodPressure               0
SkinThickness               0
Insulin                     0
BMI                         0
DiabetesPedigreeFunction    0
Age                         0
Outcome                     0
dtype: int64
```

Best Algorithm Selection

[7]:
```
input = dataset[['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin',
       'BMI', 'DiabetesPedigreeFunction', 'Age']]

output = dataset[['Outcome']]
```

[8]:
```
from sklearn.model_selection import train_test_split
X_train,X_test,y_train,y_test = train_test_split(input,output,test_size=0.3,random_state=0)
```

[9]:
```
# Standard Scaler

from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

[10]:
```
# SVMC
from sklearn.model_selection import GridSearchCV
from sklearn.svm import SVC
#Param_grid = {'kernel':['linear', 'poly', 'rbf', 'sigmoid'], 'gamma':['scale', 'auto'],'C':[10,100,1000,2000,300]}
Param_grid = {'kernel':['linear','rbf', 'sigmoid'], 'gamma':['scale', 'auto'],'C':[10,100,1000,2000,300]}
grid=GridSearchCV(SVC(probability=True),Param_grid,refit=True,verbose=3,n_jobs=-1,scoring='f1_weighted')
grid.fit(X_train,y_train)


prnt = grid.cv_results_
SVM_grid_prediction = grid.predict(X_test)
from sklearn.metrics import confusion_matrix
SVM_class = confusion_matrix(y_test,SVM_grid_prediction)
from sklearn.metrics import classification_report
SVM_class_report = classification_report (y_test,SVM_grid_prediction)
print(SVM_class,SVM_class_report)

from sklearn.metrics import roc_auc_score
roc_auc_score = roc_auc_score(y_test,grid.predict_proba(X_test)[:,1])
print('roc_auc_score: ',roc_auc_score)
```

```
Fitting 5 folds for each of 30 candidates, totalling 150 fits
[[141  16]
 [ 34  40]]              precision    recall  f1-score   support

           0       0.81      0.90      0.85       157
           1       0.71      0.54      0.62        74

    accuracy                           0.78       231
   macro avg       0.76      0.72      0.73       231
weighted avg       0.78      0.78      0.77       231

roc_auc_score:  0.8330177311069031
```

[11]:
```
# Decission Tree

from sklearn.model_selection import GridSearchCV
from sklearn.tree import DecisionTreeClassifier
Param_grid = {'criterion':['gini','entropy','log_loss'],'splitter':['best','random'],'max_features':['sqrt','log2']}
DT_grid=GridSearchCV(DecisionTreeClassifier(),Param_grid,refit=True,verbose=3,n_jobs=-1,scoring='f1_weighted')
DT_grid.fit(X_train,y_train)

prnt = DT_grid.cv_results_

DT_grid_prediction = DT_grid.predict(X_test)
from sklearn.metrics import confusion_matrix
DT_class = confusion_matrix(y_test,DT_grid_prediction)
from sklearn.metrics import classification_report
DT_class_report = classification_report (y_test,DT_grid_prediction)
print(DT_class,DT_class_report)

from sklearn.metrics import roc_auc_score
roc_auc_score = roc_auc_score(y_test,DT_grid.predict_proba(X_test)[:,1])
print('roc_auc_score: ', roc_auc_score)
```

```
Fitting 5 folds for each of 12 candidates, totalling 60 fits
[[125  32]
 [ 25  49]]              precision    recall  f1-score   support

           0       0.83      0.80      0.81       157
           1       0.60      0.66      0.63        74

    accuracy                           0.75       231
   macro avg       0.72      0.73      0.72       231
weighted avg       0.76      0.75      0.76       231

roc_auc_score:  0.7291702530556035
```

[12]:
```
# Random Forest

from sklearn.model_selection import GridSearchCV
from sklearn.ensemble import RandomForestClassifier
param_grid = {'criterion':['gini','entropy','log_loss'],'max_features':['sqrt','log2']}
RF_grid = GridSearchCV(RandomForestClassifier(),param_grid,refit=True,verbose=3,n_jobs=-3,scoring='f1_weighted')
RF_grid.fit(X_train,y_train)

#print(RF_grid.cv_results_)

RF_grid_prediction = RF_grid.predict(X_test)
from sklearn.metrics import confusion_matrix
RF_class = confusion_matrix(y_test,RF_grid_prediction)
from sklearn.metrics import classification_report
RF_class_report = classification_report (y_test,RF_grid_prediction)
print(RF_class,RF_class_report)

from sklearn.metrics import roc_auc_score
roc_auc_score = roc_auc_score(y_test,RF_grid_prediction)
print('roc_auc_score: ',roc_auc_score)
```

```
Fitting 5 folds for each of 6 candidates, totalling 30 fits
[[139  18]
 [ 35  39]]              precision    recall  f1-score   support

           0       0.80      0.89      0.84       157
           1       0.68      0.53      0.60        74

    accuracy                           0.77       231
   macro avg       0.74      0.71      0.72       231
weighted avg       0.76      0.77      0.76       231

roc_auc_score:  0.7061886727491823
```

[13]:
```
# LogisticRegression

from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import GridSearchCV
param_grid  = {'solver':['lbfgs', 'liblinear', 'newton-cg', 'newton-cholesky','sag','saga'], 'penalty':['l1', 'l2', 'elasticnet'] }
LR_grid = GridSearchCV(LogisticRegression(),param_grid,refit=True,verbose=3,n_jobs=-1,scoring='f1_weighted')
LR_grid.fit(X_train,y_train)

#print = LR_grid.cv_results_

LR_grid_prediction = LR_grid.predict(X_test)
from sklearn.metrics import confusion_matrix
LR_class = confusion_matrix(y_test,LR_grid_prediction)
from sklearn.metrics import classification_report
LR_class_report = classification_report(y_test,LR_grid_prediction)
print(LR_class,LR_class_report)

from sklearn.metrics import roc_auc_score
roc_auc_score = roc_auc_score(y_test,LR_grid_prediction)
print('roc_auc_score: ',roc_auc_score)
```

```
Fitting 5 folds for each of 18 candidates, totalling 90 fits
[[142  15]
 [ 35  39]]              precision    recall  f1-score   support

           0       0.80      0.90      0.85       157
           1       0.72      0.53      0.61        74

    accuracy                           0.78       231
   macro avg       0.76      0.72      0.73       231
weighted avg       0.78      0.78      0.77       231

roc_auc_score:  0.7157428128765708
```

[14]:

```
# KNN

from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import GridSearchCV
param_grid = {'n_neighbors':[5], 'weights':['uniform','distance'], 'algorithm':['auto','ball_tree', 'kd_tree', 'brute'], 'metric':['minkowski']}
KNN_grid = GridSearchCV(KNeighborsClassifier(),param_grid,refit=True,verbose=3,n_jobs=-1,scoring='f1_weighted')
KNN_grid.fit(X_train,y_train)

#print = KNN_grid.cv_results_

KNN_grid_prediction = KNN_grid.predict(X_test)
from sklearn.metrics import confusion_matrix
KNN_class = confusion_matrix(y_test,KNN_grid_prediction)
KNN_class


from sklearn.metrics import classification_report
KNN_class_report = classification_report(y_test,KNN_grid_prediction)
KNN_class_report

from sklearn.metrics import roc_auc_score
roc_auc_score = roc_auc_score(y_test,KNN_grid_prediction)
print('roc_auc_score: ',roc_auc_score)
```

```
Fitting 5 folds for each of 8 candidates, totalling 40 fits
roc_auc_score:  0.7208641762781891
```

[15]:
```
# Naive Byes

from sklearn.naive_bayes import GaussianNB
G_NB = GaussianNB()
G_NB.fit(X_train,y_train)

G_NB_pred = G_NB.predict(X_test)
from sklearn.metrics import confusion_matrix
NB_class = confusion_matrix(y_test,G_NB_pred)
from sklearn.metrics import classification_report
NB_class_report = classification_report(y_test,G_NB_pred)

from sklearn.metrics import roc_auc_score
roc_auc_score = roc_auc_score(y_test,G_NB_pred)
print(NB_class,NB_class_report,'\nroc_auc_score:',roc_auc_score)
```

```
[[138  19]
 [ 36  38]]              precision    recall  f1-score   support

           0       0.79      0.88      0.83       157
           1       0.67      0.51      0.58        74

    accuracy                           0.76       231
   macro avg       0.73      0.70      0.71       231
weighted avg       0.75      0.76      0.75       231

roc_auc_score: 0.6962472026166294
```

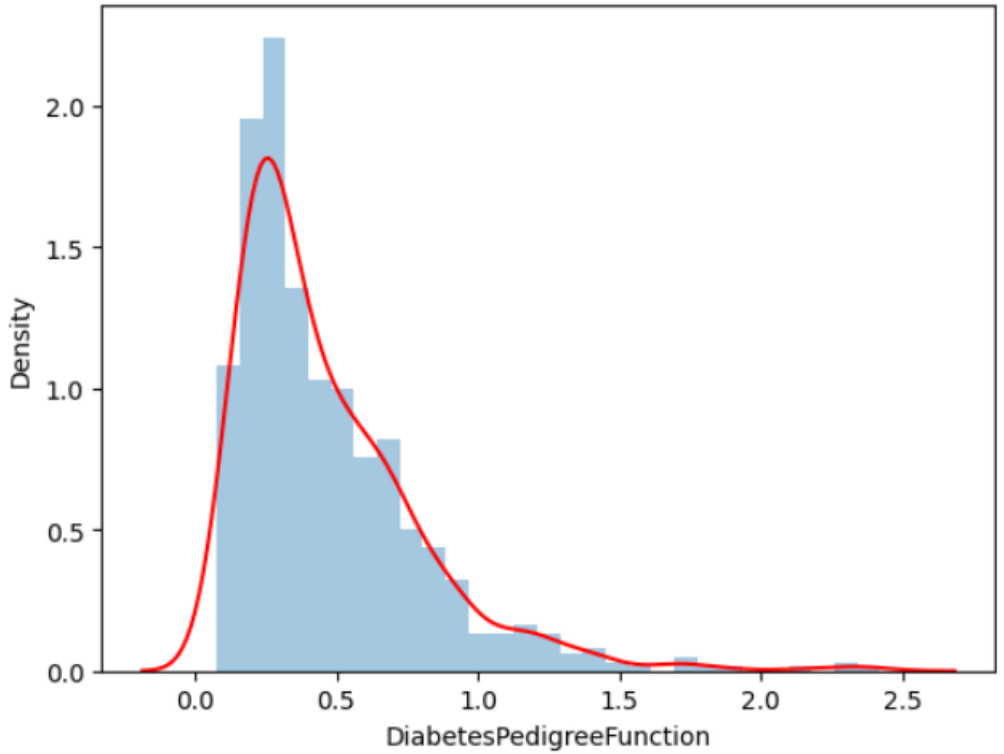
[16]:
```
# Bernoulli Byes

from sklearn.naive_bayes import BernoulliNB

M_NB = BernoulliNB()
M_NB.fit(X_train,y_train)

M_NB_pred = M_NB.predict(X_test)
from sklearn.metrics import confusion_matrix
M_NB_class = confusion_matrix(y_test,M_NB_pred)
from sklearn.metrics import classification_report
M_NB_class_report = classification_report(y_test,M_NB_pred)

from sklearn.metrics import roc_auc_score
roc_auc_score = roc_auc_score(y_test,M_NB_pred)
print(M_NB_class,M_NB_class_report,'\nroc_auc_score:',roc_auc_score)
```

```
[[130  27]
 [ 36  38]]              precision    recall  f1-score   support

           0       0.78      0.83      0.80       157
           1       0.58      0.51      0.55        74

    accuracy                           0.73       231
   macro avg       0.68      0.67      0.68       231
weighted avg       0.72      0.73      0.72       231

roc_auc_score: 0.67076949561026
```

Data Analysis

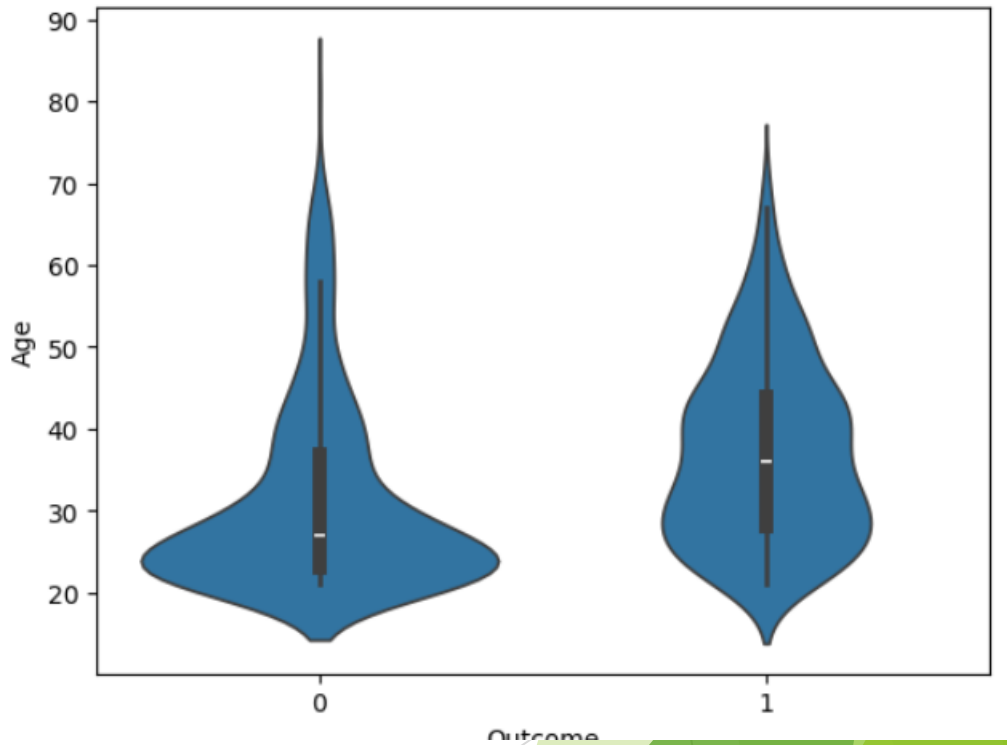
```
[17]: sea.distplot(dataset['DiabetesPedigreeFunction'],kde=True,kde_kws={'color':'red'})
```

```
[17]: <Axes: xlabel='DiabetesPedigreeFunction', ylabel='Density'>
```




```
[18]: sea.violinplot(x='Outcome',y='Age',data=dataset)
```

```
[18]: <Axes: xlabel='Outcome', ylabel='Age'>
```



Feature Selection

[19]:
```
# Select K best

from sklearn.feature_selection import SelectKBest
def selectkbest(inp,out,n):
        test = SelectKBest(score_func=chi2, k=n)
        fit1= test.fit(inp,out)
        selectk_features = fit1.transform(inp)
        return selectk_features
```

[20]:
```
def logistic(X_train,y_train,X_test):
        # Fitting K-NN to the Training set
        from sklearn.linear_model import LogisticRegression
        classifier = LogisticRegression(random_state = 0)
        classifier.fit(X_train, y_train)
        classifier,Accuracy,report,X_test,y_test,cm=cm_prediction(classifier,X_test)
        return  classifier,Accuracy,report,X_test,y_test,cm
```

[21]:
```
def cm_prediction(classifier,X_test):
     y_pred = classifier.predict(X_test)

        # Making the Confusion Matrix
     from sklearn.metrics import confusion_matrix
     cm = confusion_matrix(y_test, y_pred)

     from sklearn.metrics import accuracy_score
     from sklearn.metrics import classification_report
        #from sklearn.metrics import confusion_matrix
        #cm = confusion_matrix(y_test, y_pred)

     Accuracy=accuracy_score(y_test, y_pred )

     report=classification_report(y_test, y_pred)
     return  classifier,Accuracy,report,X_test,y_test,cm
```

[22]:
```
def svm_linear(X_train,y_train,X_test):

        from sklearn.svm import SVC
        classifier = SVC(kernel = 'linear', random_state = 0)
        classifier.fit(X_train, y_train)
        classifier,Accuracy,report,X_test,y_test,cm=cm_prediction(classifier,X_test)
        return  classifier,Accuracy,report,X_test,y_test,cm
```

[23]:
```
def svm_NL(X_train,y_train,X_test):

        from sklearn.svm import SVC
        classifier = SVC(kernel = 'rbf', random_state = 0)
        classifier.fit(X_train, y_train)
        classifier,Accuracy,report,X_test,y_test,cm=cm_prediction(classifier,X_test)
        return  classifier,Accuracy,report,X_test,y_test,cm
```

[24]:
```
def Navie(X_train,y_train,X_test):
        # Fitting K-NN to the Training set
        from sklearn.naive_bayes import GaussianNB
        classifier = GaussianNB()
        classifier.fit(X_train, y_train)
        classifier,Accuracy,report,X_test,y_test,cm=cm_prediction(classifier,X_test)
        return  classifier,Accuracy,report,X_test,y_test,cm
```

[25]:
```
def knn(X_train,y_train,X_test):

        # Fitting K-NN to the Training set
        from sklearn.neighbors import KNeighborsClassifier
        classifier = KNeighborsClassifier(n_neighbors = 5, metric = 'minkowski', p = 2)
        classifier.fit(X_train, y_train)
        classifier,Accuracy,report,X_test,y_test,cm=cm_prediction(classifier,X_test)
        return  classifier,Accuracy,report,X_test,y_test,cm
```

[26]:
```
def Decision(X_train,y_train,X_test):

        # Fitting K-NN to the Training set
        from sklearn.tree import DecisionTreeClassifier
        classifier = DecisionTreeClassifier(criterion = 'entropy', random_state = 0)
        classifier.fit(X_train, y_train)
        classifier,Accuracy,report,X_test,y_test,cm=cm_prediction(classifier,X_test)
        return  classifier,Accuracy,report,X_test,y_test,cm
```

[27]:
```
def random(X_train,y_train,X_test):

        # Fitting K-NN to the Training set
        from sklearn.ensemble import RandomForestClassifier
        classifier = RandomForestClassifier(n_estimators = 10, criterion = 'entropy', random_state = 0)
        classifier.fit(X_train, y_train)
        classifier,Accuracy,report,X_test,y_test,cm=cm_prediction(classifier,X_test)
        return  classifier,Accuracy,report,X_test,y_test,cm
```

[28]:
```
def selectk_Classification(acclog,accsvml,accsvmnl,accknn,accnav,accdes,accrf):

    dataframe=pd.DataFrame(index=['ChiSquare'],columns=['Logistic','SVMl','SVMnl','KNN','Navie','Decision','Random'])
    for number,idex in enumerate(dataframe.index):
        dataframe['Logistic'][idex]=acclog[number]
        dataframe['SVMl'][idex]=accsvml[number]
        dataframe['SVMnl'][idex]=accsvmnl[number]
        dataframe['KNN'][idex]=accknn[number]
        dataframe['Navie'][idex]=accnav[number]
        dataframe['Decision'][idex]=accdes[number]
        dataframe['Random'][idex]=accrf[number]
    return dataframe
```

[29]:
```
kbest=selectkbest(input,output,5)

acclog=[]
accsvml=[]
accsvmnl=[]
accknn=[]
accnav=[]
accdes=[]
accrf=[]
```

[30]:
```
kbest
```

[30]:
```
array([[  6. , 148. ,   0. ,  33.6,  50. ],
       [  1. ,  85. ,   0. ,  26.6,  31. ],
       [  8. , 183. ,   0. ,  23.3,  32. ],
       ...,
       [  5. , 121. , 112. ,  26.2,  30. ],
       [  1. , 126. ,   0. ,  30.1,  47. ],
       [  1. ,  93. ,   0. ,  30.4,  23. ]])
```

[31]:
```
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
def split_scalar(input,output):
        X_train, X_test, y_train, y_test = train_test_split(input, output, test_size = 0.25, random_state = 0)
        sc = StandardScaler()
        X_train = sc.fit_transform(X_train)
        X_test = sc.transform(X_test)
        return X_train, X_test, y_train, y_test
```

[32]:
```
X_train, X_test, y_train, y_test=split_scalar(kbest,output)


classifier,Accuracy,report,X_test,y_test,cm=logistic(X_train,y_train,X_test)
acclog.append(Accuracy)

classifier,Accuracy,report,X_test,y_test,cm=svm_linear(X_train,y_train,X_test)
accsvml.append(Accuracy)

classifier,Accuracy,report,X_test,y_test,cm=svm_NL(X_train,y_train,X_test)
accsvmnl.append(Accuracy)

classifier,Accuracy,report,X_test,y_test,cm=knn(X_train,y_train,X_test)
accknn.append(Accuracy)

classifier,Accuracy,report,X_test,y_test,cm=Navie(X_train,y_train,X_test)
accnav.append(Accuracy)

classifier,Accuracy,report,X_test,y_test,cm=Decision(X_train,y_train,X_test)
accdes.append(Accuracy)

classifier,Accuracy,report,X_test,y_test,cm=random(X_train,y_train,X_test)
accrf.append(Accuracy)

result=selectk_Classification(acclog,accsvml,accsvmnl,accknn,accnav,accdes,accrf)
```

[33]:
```
result
```

[33]:

	Logistic	SVMl	SVMnl	KNN	Navie	Decision	Random
ChiSquare	0.786458	0.78125	0.770833	0.796875	0.765625	0.760417	0.765625

Save the best model

[34]:
```
# Save the best model

import pickle
filename = "Capstone_project.sav"
```

[35]:
```
pickle.dump(classifier,open(filename,'wb'))
```

Deployment Phase

[34]:
```
# Save the best model

import pickle
filename = "Capstone_project.sav"
```

[35]:
```
pickle.dump(classifier,open(filename,'wb'))
```

[36]:
```
# load the saved model for test

Load_model=pickle.load(open("Capstone_project.sav",'rb'))
Result=Load_model.predict([[6,100,50,40,30]])
print("Outcome: ",Result[0])
```

```
Outcome:  1
```

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