

```
In [1]: import pandas as pd
from matplotlib import pyplot as plt
from sklearn import metrics
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report
from sklearn.metrics import accuracy_score
from sklearn.metrics import confusion_matrix
import seaborn as sns
```

```
In [2]: pwd
```

```
Out[2]: 'C:\\\\Users\\\\USER'
```

```
In [3]: cd C:\\Users\\USER\\Downloads
```

```
C:\\Users\\USER\\Downloads
```

```
In [4]: pwd
```

```
Out[4]: 'C:\\\\Users\\\\USER\\\\Downloads'
```

```
In [5]: df=pd.read_csv("pima-indians-diabetes1.csv")
```

```
In [6]: df.head()
```

```
Out[6]:
```

|   | preg | plas  | pres | skin | insu | mass | pedi  | Age  | Class |
|---|------|-------|------|------|------|------|-------|------|-------|
| 0 | 5    | 148.0 | 72.0 | 35.0 | 0.0  | 33.6 | 0.627 | 50.0 | 1.0   |
| 1 | 6    | 85.0  | 66.0 | 29.0 | 0.0  | 26.6 | 0.351 | 31.0 | 0.0   |
| 2 | 1    | 183.0 | 64.0 | 0.0  | 0.0  | 23.3 | 0.672 | 32.0 | 1.0   |
| 3 | 8    | 89.0  | 66.0 | 23.0 | 94.0 | 28.1 | 0.167 | 21.0 | 0.0   |

|   | preg | plas  | pres | skin | insu  | mass | pedi  | Age  | Class |
|---|------|-------|------|------|-------|------|-------|------|-------|
| 4 | 1    | 137.0 | 40.0 | 35.0 | 168.0 | 43.1 | 2.288 | 33.0 | 1.0   |

```
In [7]: df.columns
```

```
Out[7]: Index(['preg', 'plas', 'pres', 'skin', 'insu', 'mass', 'pedi', 'Age', 'Class'], dtype='object')
```

```
In [8]: df.rename(columns={'mass':'BMI'},inplace=True)
```

```
In [9]: df.columns
```

```
Out[9]: Index(['preg', 'plas', 'pres', 'skin', 'insu', 'BMI', 'pedi', 'Age', 'Class'], dtype='object')
```

```
In [10]: df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 769 entries, 0 to 768
Data columns (total 9 columns):
 #   Column   Non-Null Count  Dtype  
--- 
 0   preg      769 non-null    int64  
 1   plas      768 non-null    float64 
 2   pres      768 non-null    float64 
 3   skin      768 non-null    float64 
 4   insu      768 non-null    float64 
 5   BMI       768 non-null    float64 
 6   pedi      768 non-null    float64 
 7   Age       768 non-null    float64 
 8   Class     768 non-null    float64 
dtypes: float64(8), int64(1)
memory usage: 54.2 KB
```

```
In [11]: df.describe()
```

```
Out[11]:
```

|       | preg       | plas       | pres       | skin       | insu       | BMI        | pedi       |            |
|-------|------------|------------|------------|------------|------------|------------|------------|------------|
| count | 769.000000 | 768.000000 | 768.000000 | 768.000000 | 768.000000 | 768.000000 | 768.000000 | 768.000000 |
| mean  | 3.846554   | 120.894531 | 69.105469  | 20.536458  | 79.799479  | 31.992578  | 0.471876   | 33.244630  |
| std   | 3.367641   | 31.972618  | 19.355807  | 15.952218  | 115.244002 | 7.884160   | 0.331329   | 11.130718  |
| min   | 0.000000   | 0.000000   | 0.000000   | 0.000000   | 0.000000   | 0.000000   | 0.078000   | 21.000000  |
| 25%   | 1.000000   | 99.000000  | 62.000000  | 0.000000   | 0.000000   | 27.300000  | 0.243750   | 24.000000  |
| 50%   | 3.000000   | 117.000000 | 72.000000  | 23.000000  | 30.500000  | 32.000000  | 0.372500   | 29.000000  |
| 75%   | 6.000000   | 140.250000 | 80.000000  | 32.000000  | 127.250000 | 36.600000  | 0.626250   | 41.000000  |
| max   | 17.000000  | 199.000000 | 122.000000 | 99.000000  | 846.000000 | 67.100000  | 2.420000   | 81.000000  |

In [12]: `df.isna().any()`

Out[12]:

```
preg      False
plas      True
pres      True
skin      True
insu      True
BMI       True
pedi      True
Age       True
Class     True
dtype: bool
```

**df=df.astype({'Age':int})**

In [13]: `df.fillna(method='pad',inplace=True)`

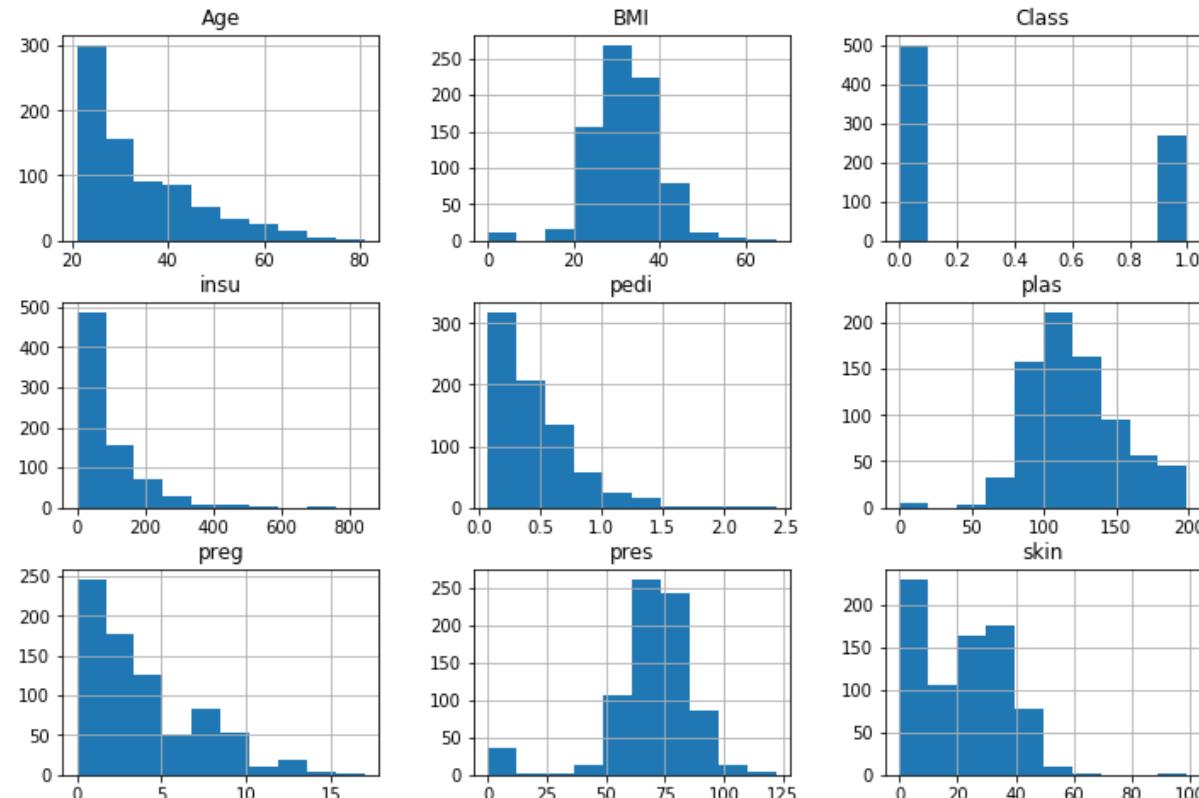
In [14]: `df.isna().any()`

Out[14]:

```
preg      False
plas      False
```

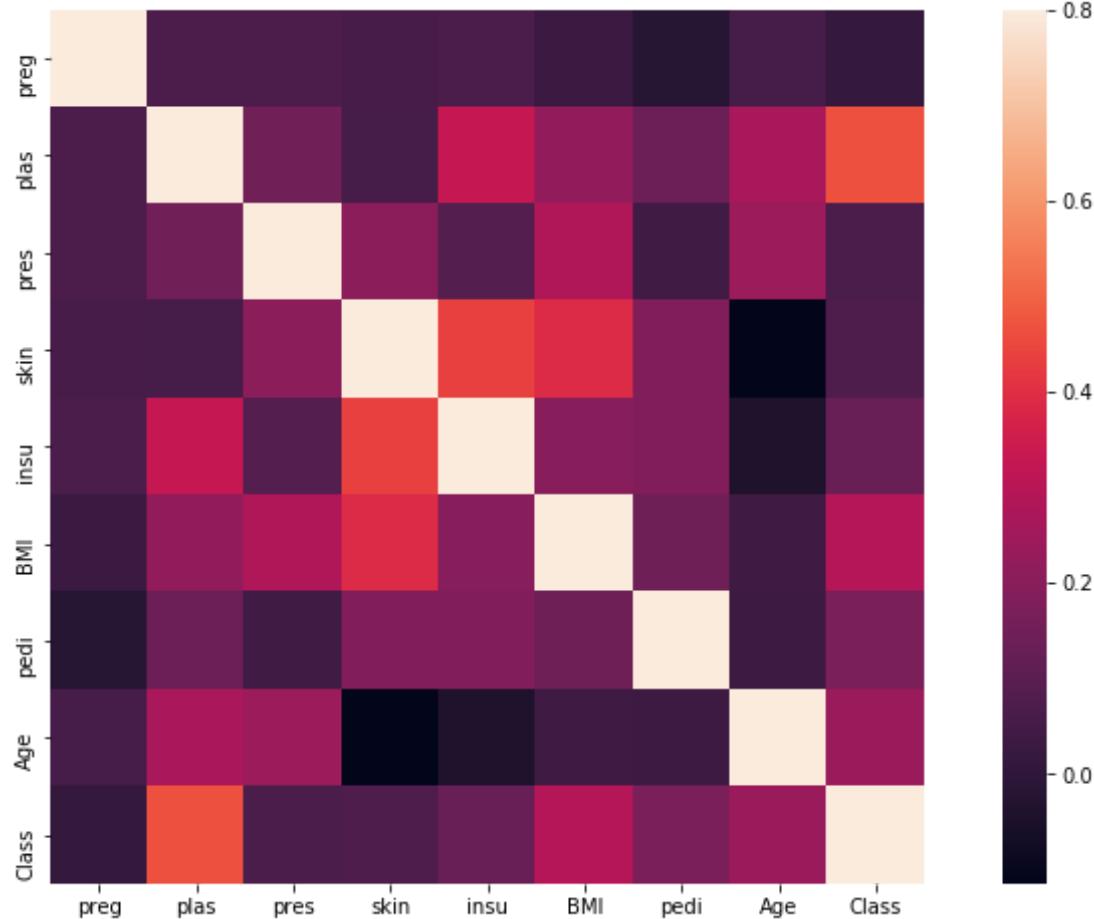
```
pres    False
skin    False
insu    False
BMI     False
pedi    False
Age     False
Class   False
dtype: bool
```

```
In [15]: df.hist(figsize=(12,8))
plt.show()
```



```
In [16]: data_correlation=df.corr()
fig=plt.figure(figsize=(14,8))
```

```
sns.heatmap(data_correlation,vmax=0.8,square=True)  
plt.show()
```



```
In [17]: no_sugar=0.0  
result=df['Class']  
for i in range(len(result)):  
    print()  
    if result[i]==0.0:  
        no_sugar=no_sugar+1.0  
    print(no_sugar)
```

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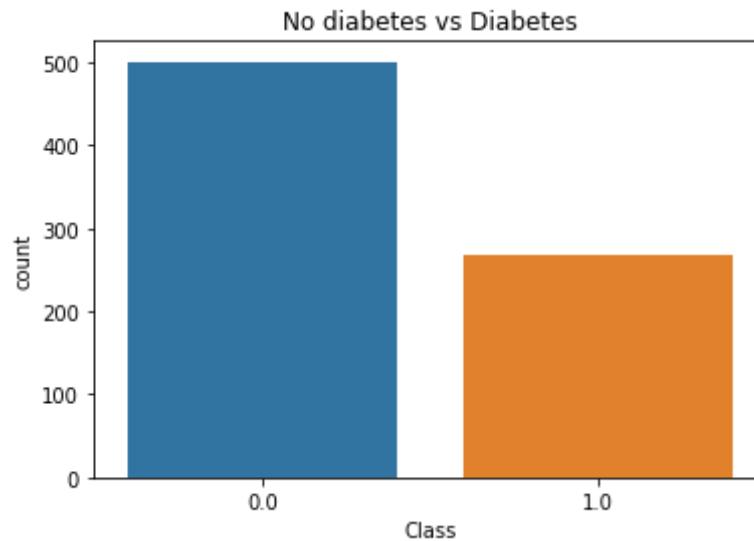
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In [18]: `sns.countplot(x=df.Class)  
plt.title("No diabetes vs Diabetes")`

Out[18]: `Text(0.5, 1.0, 'No diabetes vs Diabetes')`



```
In [19]: fig,ax=plt.subplots(figsize=(16,8))
ax.scatter(df['Age'],df['Class'])
ax.set_xlabel('Pregnancies')
ax.set_ylabel('Class')
plt.show()
```



```
In [20]: from sklearn.model_selection import train_test_split  
x=df.drop(['Class'],axis=1)  
y=df['Class']  
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.3,random  
_state=42)
```

```
In [21]: logreg=LogisticRegression()
```

```
In [22]: logreg
```

```
Out[22]: LogisticRegression()
```

```
In [23]: logreg.fit(x_train,y_train)
```

```
C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\linear_model\_logis  
tic.py:764: ConvergenceWarning: lbfgs failed to converge (status=1):  
STOP: TOTAL NO. OF ITERATIONS REACHED LIMIT.
```

Increase the number of iterations (`max_iter`) or scale the data as shown

```
in:  
    https://scikit-learn.org/stable/modules/preprocessing.html  
Please also refer to the documentation for alternative solver options:  
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-  
regression  
    extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG)
```

Out[23]: LogisticRegression()

In [24]: y\_pred=logreg.predict(x\_test)

In [25]: cMatrix=metrics.confusion\_matrix(y\_pred,y\_test)

In [26]: print(cMatrix)

```
[[123  31]  
 [ 27  50]]
```

In [27]: accuracy=accuracy\_score(y\_test,y\_pred)  
print('Accuracy of this model is:',accuracy\*100,'%')

Accuracy of this model is: 74.89177489177489 %

In [46]: from sklearn.svm import SVC

In [47]: svm = SVC()  
svm.fit(x\_train, y\_train)  
svm\_yhat = svm.predict(x\_test)

In [49]: accuracy=accuracy\_score(y\_test,svm\_yhat)  
accuracy

Out[49]: 0.7359307359307359

In [30]: from sklearn.model\_selection import GridSearchCV

```
In [34]: import numpy as np
##c_space = np.logspace(-5, 8, 15)
##penalty=['l1','l2','elasticnet','none']
param_grid = [{ 'C': np.logspace(-5, 8, 15), 'penalty':['l2','elasticnet'],
    'solver':['lbfgs','newton-cg','liblinear'], 'max_iter':[100,1000,2500] }]
```

```
In [35]: logreg_cv = GridSearchCV(logreg, param_grid, cv = 5,verbose=True)
```

```
In [36]: logreg_cv.fit(x_train,y_train)
```

Fitting 5 folds for each of 270 candidates, totalling 1350 fits

[Parallel(n\_jobs=1)]: Using backend SequentialBackend with 1 concurrent workers.

C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\model\_selection\\_validation.py:552: FitFailedWarning: Estimator fit failed. The score on this train-test partition for these parameters will be set to nan. Details:

Traceback (most recent call last):

```
  File "C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\model_selection\_validation.py", line 531, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
```

```
  File "C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\linear_model\_logistic.py", line 1304, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
```

```
  File "C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\linear_model\_logistic.py", line 443, in _check_solver
    "got %s penalty." % (solver, penalty))
```

ValueError: Solver lbfgs supports only 'l2' or 'none' penalties, got elasticnet penalty.

FitFailedWarning)

C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\model\_selection\\_validation.py:552: FitFailedWarning: Estimator fit failed. The score on this train-test partition for these parameters will be set to nan. Details:

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    "got %s penalty." % (solver, penalty))
ValueError: Solver newton-cg supports only 'l2' or 'none' penalties, go t elasticnet penalty.

      FitFailedWarning)
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  File "C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\linear_model\_logistic.py", line 450, in _check_solver
    " got solver={}'.format(solver))"
ValueError: Only 'saga' solver supports elasticnet penalty, got solver= liblinear.

      FitFailedWarning)
C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\model_selection\_validation.py:552: FitFailedWarning: Estimator fit failed. The score on t his train-test partition for these parameters will be set to nan. Detai ls:
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```

```
        solver = _check_solver(self.solver, self.penalty, self.dual)
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  File "C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\linear_model\_logistic.py", line 450, in _check_solver
    " got solver={}'.format(solver))
```

```
ValueError: Only 'saga' solver supports elasticnet penalty, got solver=liblinear.

      FitFailedWarning)
C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\model_selection\_validation.py:552: FitFailedWarning: Estimator fit failed. The score on this train-test partition for these parameters will be set to nan. Details:
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      FitFailedWarning)
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      FitFailedWarning)
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Increase the number of iterations (max\_iter) or scale the data as shown  
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Increase the number of iterations (max\_iter) or scale the data as shown in:

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Increase the number of iterations (max\_iter) or scale the data as shown in:

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    self._fit(X_train, y_train, **fit_params)
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https://scikit-learn.org/stable/modules/linear\_model.html#logistic-regression
extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG)
C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\model_selection\_validation.py:552: FitFailedWarning: Estimator fit failed. The score on this train-test partition for these parameters will be set to nan. Details:
Traceback (most recent call last):
  File "C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\model_selection\_validation.py", line 531, in _fit_and_score
    estimator.fit(X_train, y_train, **fit_params)
  File "C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\linear_model\_logistic.py", line 1304, in fit
    solver = _check_solver(self.solver, self.penalty, self.dual)
  File "C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\linear_model\_logistic.py", line 443, in _check_solver
```

```
        "got %s penalty." % (solver, penalty))
ValueError: Solver lbfsgs supports only 'l2' or 'none' penalties, got el
asticnet penalty.

      FitFailedWarning)
C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\model_selection\_va
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    " got solver={}.format(solver))"
ValueError: Only 'saga' solver supports elasticnet penalty, got solver=
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```

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    File "C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\linear_model\logistic.py", line 450, in _check_solver
        " got solver={}'.format(solver))"
ValueError: Only 'saga' solver supports elasticnet penalty, got solver=liblinear.

        FitFailedWarning)
[Parallel(n_jobs=1)]: Done 1350 out of 1350 | elapsed: 30.6s finished
C:\Users\USER\anaconda3.x\lib\site-packages\sklearn\linear_model\logistic.py:764: ConvergenceWarning: lbfsgs failed to converge (status=1):
STOP: TOTAL NO. OF ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear\_model.html#logistic-
```

```
regression
extra_warning_msg=_LOGISTIC_SOLVER_CONVERGENCE_MSG)
```

```
Out[36]: GridSearchCV(cv=5, estimator=LogisticRegression(),
param_grid=[{'C': array([1.0000000e-05, 8.48342898e-05,
7.19685673e-04, 6.10540230e-03,
5.17947468e-02, 4.39397056e-01, 3.72759372e+00, 3.16227766e+01,
2.68269580e+02, 2.27584593e+03, 1.93069773e+04, 1.63789371e+05,
1.38949549e+06, 1.17876863e+07, 1.00000000e+08]),
'max_iter': [100, 1000, 2500],
'penalty': ['l2', 'elasticnet'],
'solver': ['lbfgs', 'newton-cg', 'liblinea
r']}],  
verbose=True)
```





```
In [37]: logreg_cv.best_score_
```

```
Out[37]: 0.7750432675666321
```

```
In [38]: logreg_cv.best_params_
```

```
Out[38]: {'C': 11787686.347935867, 'max_iter': 100, 'penalty': 'l2', 'solver': 'lbfgs'}
```

```
In [43]: y_predcv=logreg_cv.predict(x_test)
```

```
In [44]: accuracy1=accuracy_score(y_test,y_predcv)
```

```
In [45]: accuracy1
```

```
Out[45]: 0.7532467532467533
```

```
In [42]: logreg_cv.best_estimator_
```

```
Out[42]: LogisticRegression(C=11787686.347935867)
```

```
In [ ]:
```