Library Import

```
import numpy as np
import pandas as pd
from numpy import log,dot,exp,shape
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
sns.set()
```

Logistic Regression

```
class LogisticRegression:
    def sigmoid(self,z):
        return 1/(1+exp(-z))
    def setDefault(self,X):
        W=np.random.randn(1,X.shape[1])/np.sqrt(X.shape[0])
        return W
    def train(self,X,Y,X_Val,Y_Val,alpha=0.01,epoch=400):
        W=self.setDefault(X)
        train_loss=[]
        val_loss=[]
        epochs=[]
        def updateWeight(A,W):
            t=A-Y.T
            m=X.shape[0]
            t=np.reshape(t,m)
            dW = np.dot(X.T,t)/m
            W=W-(alpha*dW)
            return W
        def loss(Y,Y_Pred):
            v=0
            for i in range(len(Y)):
                v+=Y[i]*log(Y_Pred[i])
            t=-v/X.shape[0]
            return t
        for i in range(epoch):
            z=W.dot(X.T)
            A=self.sigmoid(z)
            W=updateWeight(A,W)
            epochs.append(i)
            Y_Train_Pred=[]
            Y_Val_Pred=[]
            Z=(W.dot(X.T))
            for z in Z[0]:
                Y_Train_Pred.append(self.sigmoid(z))
            Z=(W.dot(X_Val.T))
            for z in Z[0]:
                Y_Val_Pred.append(self.sigmoid(z))
```

```
            train_loss.append(loss(Y,Y_Train_Pred))
            val_loss.append(loss(Y_Val,Y_Val_Pred))
        self.W=W
        return epochs,train_loss,val_loss,W
    def predict(self,X,W):
        Z=(W.dot(X.T))
        y=[]
        for z in Z[0]:
            y.append(self.sigmoid(z))
        Y_Pred=[]
        for i in y:
            if i>0.5:
                Y_Pred.append(1)
            else:
                Y_Pred.append(0)
        return Y_Pred
```

F1 Score, Recall, Accuracy, Precision

```
def F1_Score(Y,Y_Pred):
    TP,TN,FP,FN = 0,0,0,0
    for i in range(len(Y)):
        if Y[i]==1 and Y_Pred[i]==1:
            TP+=1
        elif Y[i]==1 and Y_Pred[i]==0:
            FN+=1
        elif Y[i]==0 and Y_Pred[i]==1:
            FP+=1
        elif Y[i]==0 and Y_Pred[i]==0:
            TN+=1
    precision = TP/(TP+FP)
    recall = TP/(TP+FN)
    accuracy=(TP+TN)/(TP+FP+FN+TN)
    f1_score = 2*precision*recall/(precision+recall)
    return accuracy,precision,recall,f1_score
```

Dataset Import

```
data =
pd.read_csv('Datasets/LogisticRegression/Pumpkin_Seeds_Dataset_1.csv')

data.head()
```

```
    Area  Perimeter  Major_Axis_Length  Minor_Axis_Length  Convex_Area
\
0  56276    888.242           326.1485           220.2388        56831

1  76631   1068.146           417.1932           234.2289        77280
```

```
2  71623   1082.987           435.8328           211.0457        72663

3  66458    992.051           381.5638           222.5322        67118

4  66107    998.146           383.8883           220.4545        67117


   Equiv_Diameter  Eccentricity  Solidity  Extent  Roundness
Aspect_Ration  \
0        267.6805        0.7376    0.9902  0.7453     0.8963
1.4809
1        312.3614        0.8275    0.9916  0.7151     0.8440
1.7811
2        301.9822        0.8749    0.9857  0.7400     0.7674
2.0651
3        290.8899        0.8123    0.9902  0.7396     0.8486
1.7146
4        290.1207        0.8187    0.9850  0.6752     0.8338
1.7413

   Compactness       Class
0       0.8207  Çerçevelik
1       0.7487  Çerçevelik
2       0.6929  Çerçevelik
3       0.7624  Çerçevelik
4       0.7557  Çerçevelik
```

Data Pre-Processing

```
data['Class']=pd.factorize(data.Class)[0]

data['Class'].value_counts()

Class
0    1300
1    1200
Name: count, dtype: int64
```

Normalizing to avoid overflow

```
def normalize(X):
    for column in X:
        mean=np.mean(X[column])
        std=np.std(X[column])
        X[column]=(X[column]-mean)/std
    return X
```

Randomizing the sample

```
data=data.sample(frac=1)

data.shape
```

```
(2500, 13)
```

```
x=data.iloc[:,:12]
y=data.iloc[:,12]

x=normalize(x)
```

Train Test Validation Split

```
X_Train,X_Test,Y_Train,Y_Test=train_test_split(x,y,test_size=0.2,rando
m_state=1)
X_Train,X_Val,Y_Train,Y_Val=train_test_split(X_Train,Y_Train,test_size
=0.375,random_state=1)

print(X_Train.shape)
print(X_Test.shape)
print(X_Val.shape)
print(Y_Train.shape)
print(Y_Test.shape)
print(Y_Val.shape)
```

```
(1250, 12)
(500, 12)
(750, 12)
(1250,)
(500,)
(750,)
```

Verifying if the dataset is balanced

```
print(Y_Train.value_counts())
print(Y_Test.value_counts())
print(Y_Val.value_counts())
```

```
Class
0    638
1    612
Name: count, dtype: int64
Class
0    273
1    227
Name: count, dtype: int64
Class
0    389
1    361
Name: count, dtype: int64
```

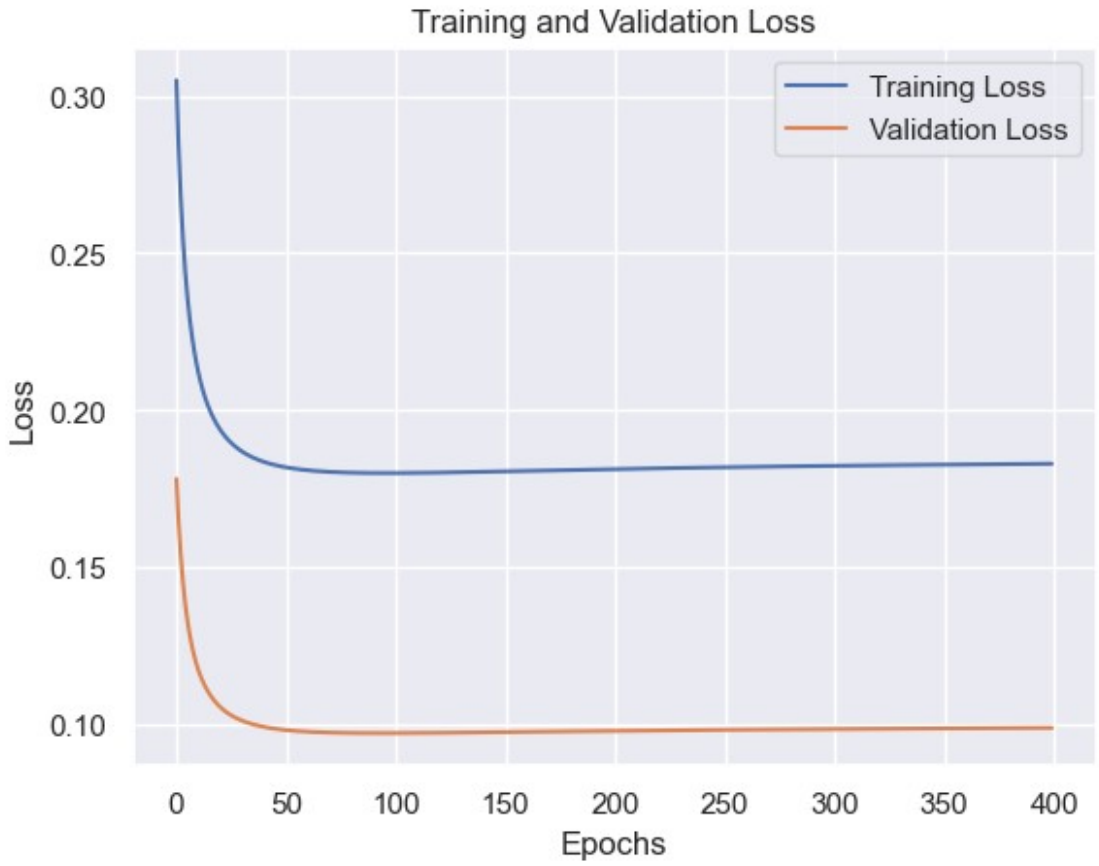
```
X_Train=X_Train.to_numpy()
X_Test=X_Test.to_numpy()
X_Val=X_Val.to_numpy()
Y_Train=Y_Train.to_numpy()
Y_Test=Y_Test.to_numpy()
Y_Val=Y_Val.to_numpy()
```

Model Training

```
model=LogisticRegression()

epoch,train_loss,val_loss,W=model.train(X_Train,Y_Train,X_Val,Y_Val,al
pha=0.1,epoch=400)

plt.plot(epoch,train_loss,label='Training Loss')
plt.plot(epoch,val_loss,label='Validation Loss')
plt.title('Training and Validation Loss')
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend(loc='best')
plt.show()
```



```
Y_Test_Pred=model.predict(X_Test,W)
Y_Train_Pred=model.predict(X_Train,W)

accuracy_train,precision_train,recall_train,f1_score_train=F1_Score(Y_
Train_Pred,Y_Train)
accuracy_test,precision_test,recall_test,f1_score_test=F1_Score(Y_Test
_Pred,Y_Test)

print("Train Accuracy: ",accuracy_train)
print("Train Precision: ",precision_train)
print("Train Recall: ",recall_train)
print("Train F1 Score: ",f1_score_train)
```

```
Train Accuracy:  0.8672
Train Precision:  0.8513071895424836
Train Recall:  0.8741610738255033
Train F1 Score:  0.8625827814569537
```

```
print("Test Accuracy: ",accuracy_test)
print("Test Precision: ",precision_test)
print("Test Recall: ",recall_test)
print("Test F1 Score: ",f1_score_test)
```

```
Test Accuracy:  0.874
Test Precision:  0.8590308370044053
Test Recall:  0.8628318584070797
Test F1 Score:  0.8609271523178808
```