Assignment 1

Name: Gautam Kumar

Roll Number: 21CS30020

```
# import all the necessary libraries here
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from numpy.linalg import inv
import matplotlib.pyplot as plt
from sklearn.metrics import confusion_matrix,ConfusionMatrixDisplay

df =
pd.read_excel('../../dataset/logistic-regression/Pumpkin_Seeds_Dataset
.xlsx')
print(df.shape)
```

```
(2500, 13)
```

```
df.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
```

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2500 entries, 0 to 2499
Data columns (total 13 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   Area               2500 non-null   int64  
 1   Perimeter          2500 non-null   float64
 2   Major_Axis_Length  2500 non-null   float64
 3   Minor_Axis_Length  2500 non-null   float64
 4   Convex_Area        2500 non-null   int64  
 5   Equiv_Diameter     2500 non-null   float64
 6   Eccentricity       2500 non-null   float64
 7   Solidity           2500 non-null   float64
 8   Extent             2500 non-null   float64
 9   Roundness          2500 non-null   float64
 10  Aspect_Ration      2500 non-null   float64
 11  Compactness        2500 non-null   float64
 12  Class              2500 non-null   object 
dtypes: float64(10), int64(2), object(1)
memory usage: 254.0+ KB
```

```
df.describe()
```

```
                Area    Perimeter  Major_Axis_Length  
Minor_Axis_Length  \
count    2500.000000  2500.000000        2500.000000  
2500.000000
mean    80658.220800  1130.279015         456.601840  
225.794921
std     13664.510228   109.256418          56.235704  
23.297245
min     47939.000000   868.485000         320.844600  
152.171800
25%     70765.000000  1048.829750         414.957850  
211.245925
50%     79076.000000  1123.672000         449.496600  
224.703100
75%     89757.500000  1203.340500         492.737650  
240.672875
max    136574.000000  1559.450000         661.911300  
305.818000
```

```
         Convex_Area  Equiv_Diameter  Eccentricity     Solidity
Extent  \
count    2500.000000     2500.000000   2500.000000  2500.000000
2500.000000
mean    81508.084400      319.334230      0.860879     0.989492
0.693205
std     13764.092788       26.891920      0.045167     0.003494
0.060914
min     48366.000000      247.058400      0.492100     0.918600
0.468000
25%     71512.000000      300.167975      0.831700     0.988300
0.658900
50%     79872.000000      317.305350      0.863700     0.990300
0.713050
75%     90797.750000      338.057375      0.897025     0.991500
0.740225
max    138384.000000      417.002900      0.948100     0.994400
0.829600

         Roundness  Aspect_Ration  Compactness
count  2500.000000    2500.000000  2500.000000
mean      0.791533       2.041702     0.704121
std       0.055924       0.315997     0.053067
min       0.554600       1.148700     0.560800
25%       0.751900       1.801050     0.663475
50%       0.797750       1.984200     0.707700
75%       0.834325       2.262075     0.743500
max       0.939600       3.144400     0.904900
```

```
print(df["Class"].unique())
```

```
['Çerçevelik' 'Ürgüp Sivrisi']
```

```
mapping = {'Çerçevelik': 0 , 'Ürgüp Sivrisi' : 1}
df.replace({'Class': mapping} , inplace=True)
df.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

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   Equiv_Diameter  Eccentricity  Solidity  Extent  Roundness
```

```
Aspect_Ration  \
0        267.6805        0.7376    0.9902  0.7453     0.8963
1.4809
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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      0
1       0.7487      0
2       0.6929      0
3       0.7624      0
4       0.7557      0
```

```
X = df.iloc[:,:-1].values
Y = df.iloc[:,-1].values
X_train , X,Y_train,Y =
train_test_split(X,Y,test_size=0.5,random_state=0)
X_val,X_test,Y_val,Y_test = train_test_split(X,Y,test_size =
0.4,random_state = 0)


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

print(X_train.shape, Y_train.shape)
print(X_val.shape, Y_val.shape)
print(X_test.shape, Y_test.shape)
```

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

```
class logistic_regression():
    def __init__(self, epoch= 15000, learning_rate = 0.001 ):
        self.epoch = epoch
        self.learning_rate = learning_rate
        self.cost = []
        self.init_weight = None
        self.final_weight = None

    def initialize_weight(self,n_feature):
        limit = np.sqrt(1/n_feature)
        weight = np.random.uniform(-limit,limit,(n_feature,1))
```

```
        b = 0
        self.init_weight = np.insert(weight,0,b,axis = 0)


    def train(self, X,Y,X_val,Y_val):
        n_sample ,n_feature = X.shape
        X = np.insert(X,0,1,axis = 1)
        Y = np.reshape(Y,(n_sample,1))
        nv_sample = X_val.shape[0];
        X_val = np.insert(X_val,0,1,axis = 1);
        Y_val = np.reshape(Y_val,(nv_sample,1));
        self.initialize_weight(n_feature)
        self.fit(X,Y,X_val,Y_val)


    def fit(self,X,Y,X_val,Y_val):
        _weight = self.init_weight.copy()
        y_pred = self.sigmoid(np.dot(X,_weight))
        self.cost.append(self.gradient_cost(X,Y,_weight))

        for iter in range(self.epoch):
            y_pred = self.sigmoid(np.dot(X,_weight))
            grad = np.dot(X.T, y_pred - Y)
            _weight = _weight - self.learning_rate*grad
            self.cost.append(self.gradient_cost(X,Y,_weight))
            if iter%100 ==0:
                print(f"The training cost for iteration ::{iter} is
_____________________________________________{np.squeeze(self.cost[
-1])}","\n......")
        self.final_weight = _weight
        return


    def predict(self,X):
        out = np.dot(X,self.final_weight)
        out = self.sigmoid(out)
        out = (out >= 0.5)*1
        return out

    def sigmoid(self,Y):
        sig = 1 + np.exp(-1*Y)
        sig = 1/sig
        return sig

    def gradient_cost(self,X,Y,_weight):
        y_pred = self.sigmoid(np.dot(X,_weight))
        return np.mean(-1*(Y*np.log(y_pred) + (1-Y)*np.log(1 -
y_pred)))
```

```
    def viswalize_loss(self):
        figure, ax = plt.subplots()
        nums = np.arange(len(self.cost))
        ax.plot(nums, np.array(self.cost).reshape((len(self.cost,))))
        ax.set_xlabel('Epoch')
        ax.set_ylabel('Cost')
        plt.show()

    def metrics_loss(self,X,Y):
        n_sample,n_feature = X.shape
        X = np.insert(X,0,1,axis = 1)
        Y = np.reshape(Y,(n_sample,1))
        y_pred = self.sigmoid(np.dot(X,self.final_weight))
        y_pred = (y_pred >= 0.5)
        con_matrix = confusion_matrix(Y,y_pred)
        cm_display = ConfusionMatrixDisplay(confusion_matrix =
con_matrix, display_labels = [False, True])
        cm_display.plot()
        plt.show()
        recall = con_matrix[1][1]/(con_matrix[1][0] + con_matrix[1]
[1])
        precison = con_matrix[1][1] /(con_matrix[1][1] + con_matrix[0]
[1])
        accuracy = (con_matrix[0][0] + con_matrix[1]
[1])/(con_matrix[0][0] + con_matrix[0][1] + con_matrix[1][0] +
con_matrix[1][1])
        df = pd.DataFrame([[recall, precison, accuracy]],
columns=['Recall','Precision', 'Mean Accuracy'])
        return df

    def print_loss(self):
        print(self.cost)



logistic_regressor = logistic_regression()

logistic_regressor.train(X_train,Y_train,X_val,Y_val)

The training cost for iteration ::0 is
_____________________________________________0.33958563353374965
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The training cost for iteration ::100 is
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The training cost for iteration ::200 is
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The training cost for iteration ::300 is
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The training cost for iteration ::400 is
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The training cost for iteration ::14500 is
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The training cost for iteration ::14600 is
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The training cost for iteration ::14700 is
_____0.29207706884221796
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The training cost for iteration ::14800 is
_____0.2920609396346169
......
The training cost for iteration ::14900 is
_____0.29204493736971576
......

logistic_regressor.viswalize_loss()
```
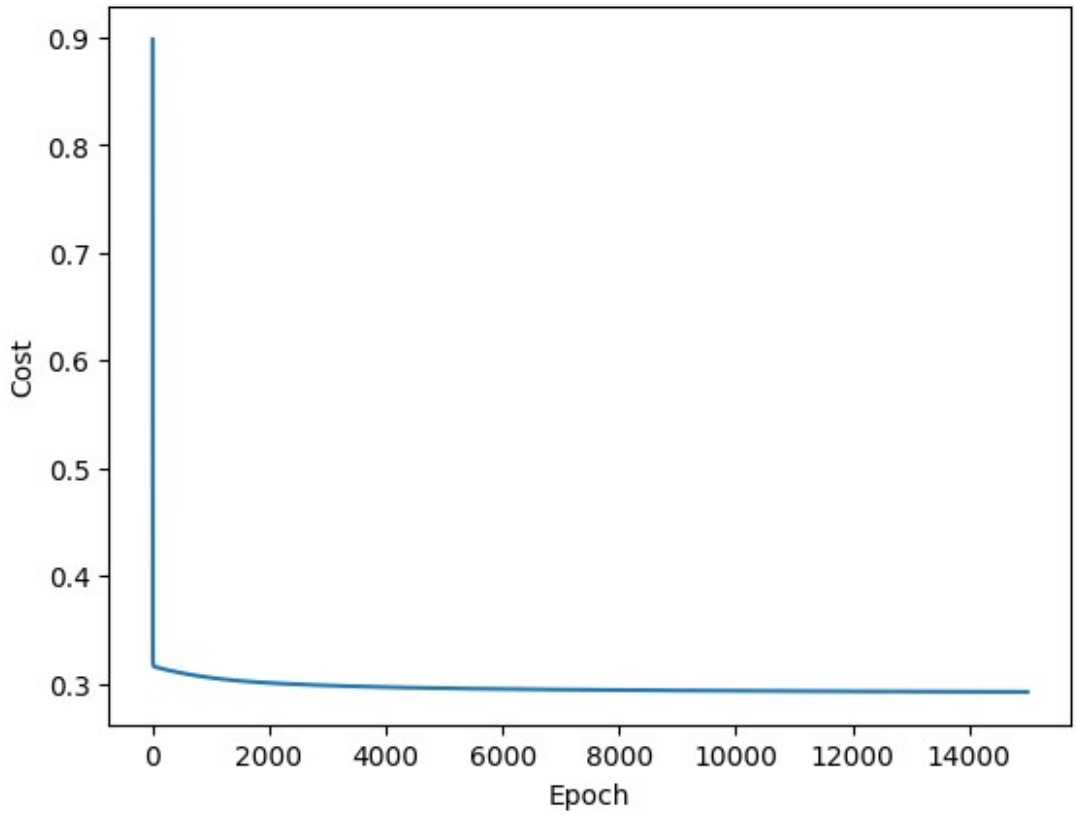
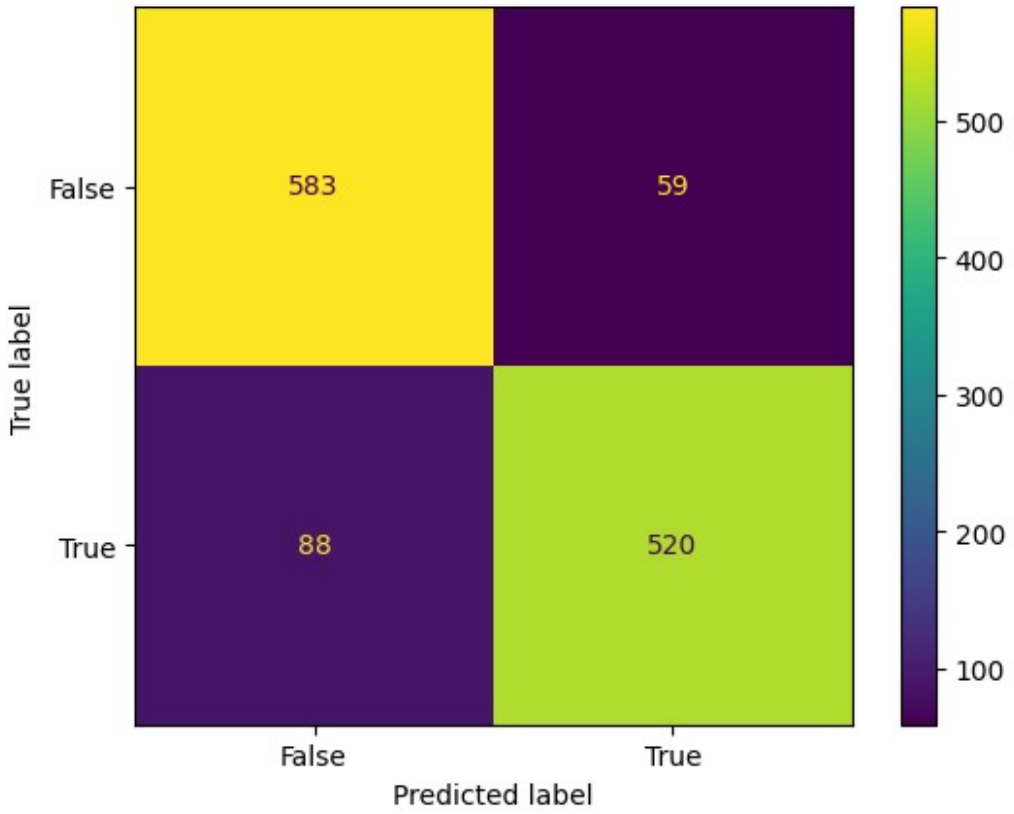



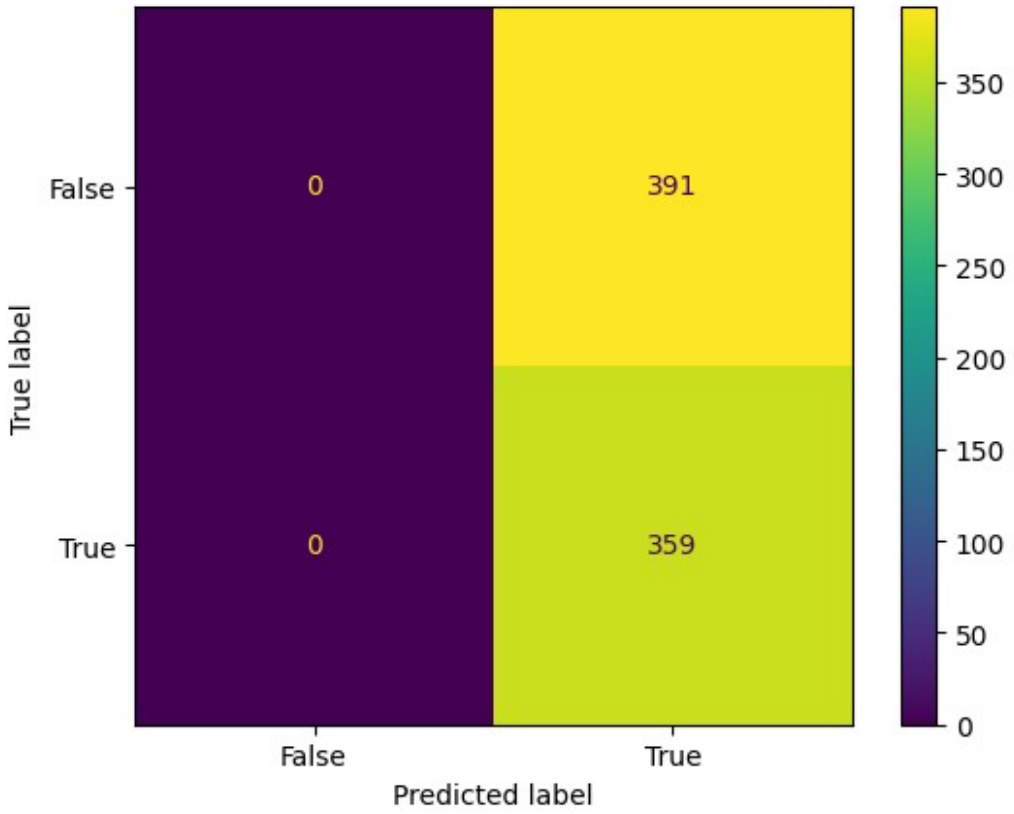

```
mat_loss_df = logistic_regressor.metrics_loss(X_train,Y_train)
mat_loss_df.rename(index={0:'Train_data'},inplace=True)
```




```
mat_loss_df
```

	Recall	Precision	Mean Accuracy
Train_data	0.855263	0.8981	0.8824

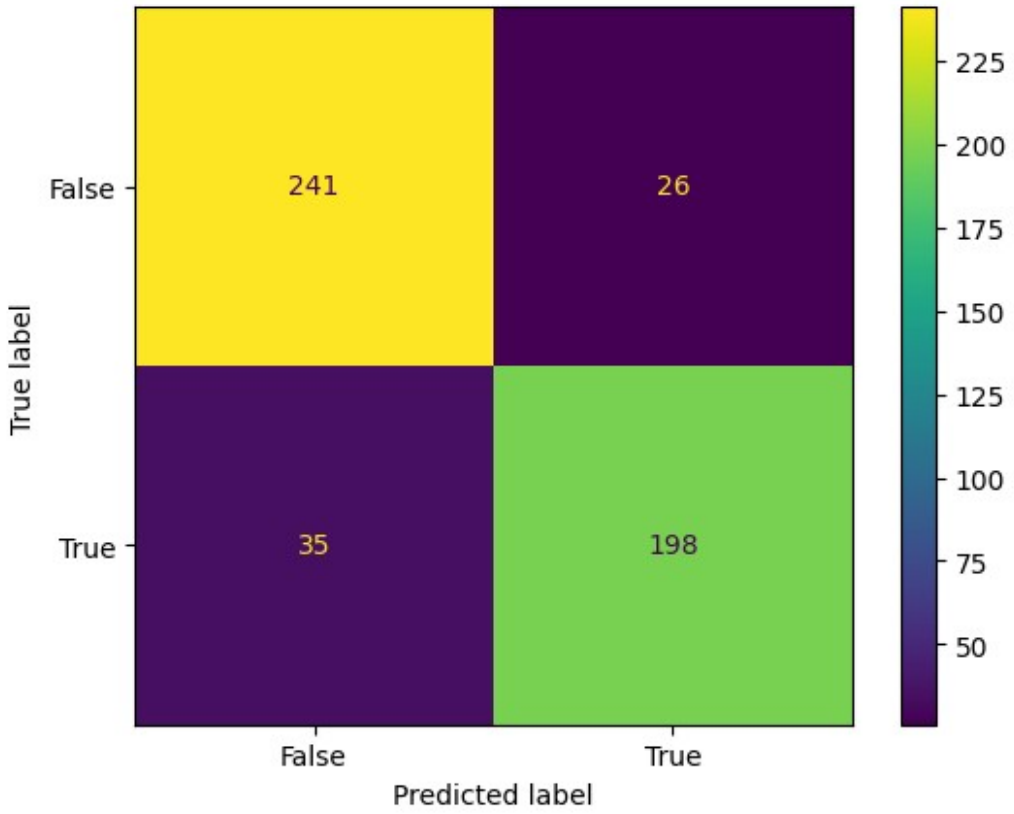
```
mat_loss_df = logistic_regressor.metrics_loss(X_val,Y_val)
mat_loss_df.rename(index={0:'Validation_data'},inplace=True)
```




```
mat_loss_df
```

	Recall	Precision	Mean Accuracy
Validation_data	1.0	0.478667	0.478667

```
mat_loss_df = logistic_regressor.metrics_loss(X_test,Y_test)
mat_loss_df.rename(index={0:'Test_data'},inplace=True)
```




```
mat_loss_df
```

	Recall	Precision	Mean Accuracy
Test_data	0.849785	0.883929	0.878