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Batch : 3CS10

```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.datasets import load_iris
```

Question 1

```
iris_data = load_iris()
iris_df = pd.DataFrame(data=np.c_[iris_data['data'],
iris_data['target']], columns=iris_data['feature_names']+['target'])
iris_df.head()
```

```
   sepal length (cm)  sepal width (cm)  petal length (cm)  petal width
(cm)  \
0                5.1               3.5                1.4
0.2
1                4.9               3.0                1.4
0.2
2                4.7               3.2                1.3
0.2
3                4.6               3.1                1.5
0.2
4                5.0               3.6                1.4
0.2

   target
0     0.0
1     0.0
2     0.0
3     0.0
4     0.0
```

```
iris_df.loc[(iris_df["target"])>0] = 1
```

```
iris_df["target"].unique()
```

```
array([0., 1.])
```

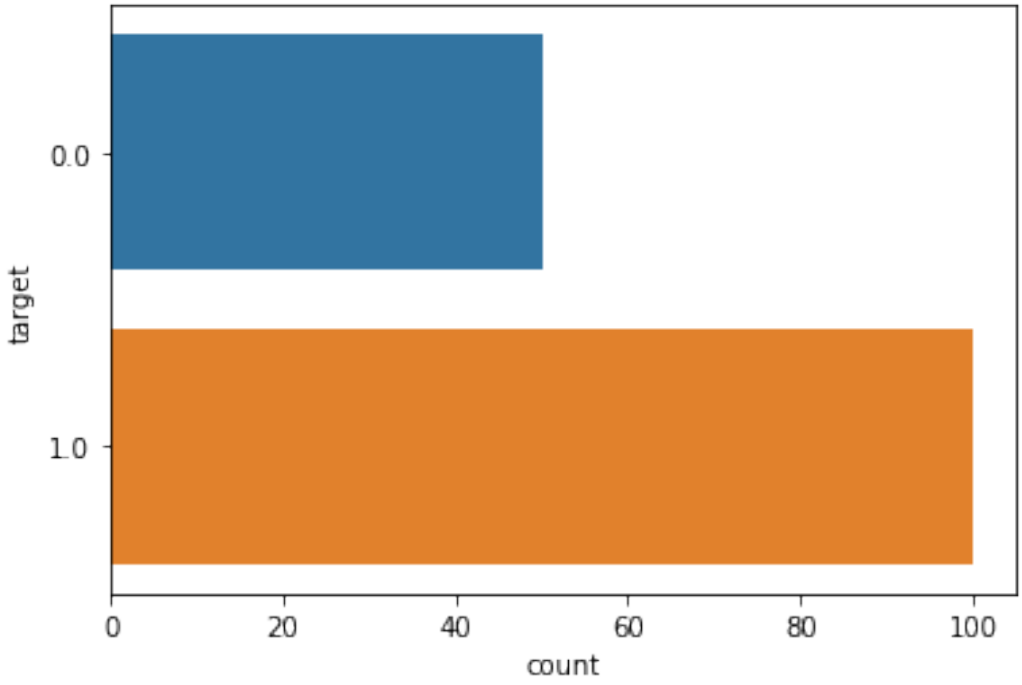
```
iris_df.isna().sum()
```

```
sepal length (cm)    0
sepal width (cm)     0
petal length (cm)    0
petal width (cm)     0
```

```
target                0
dtype: int64
```

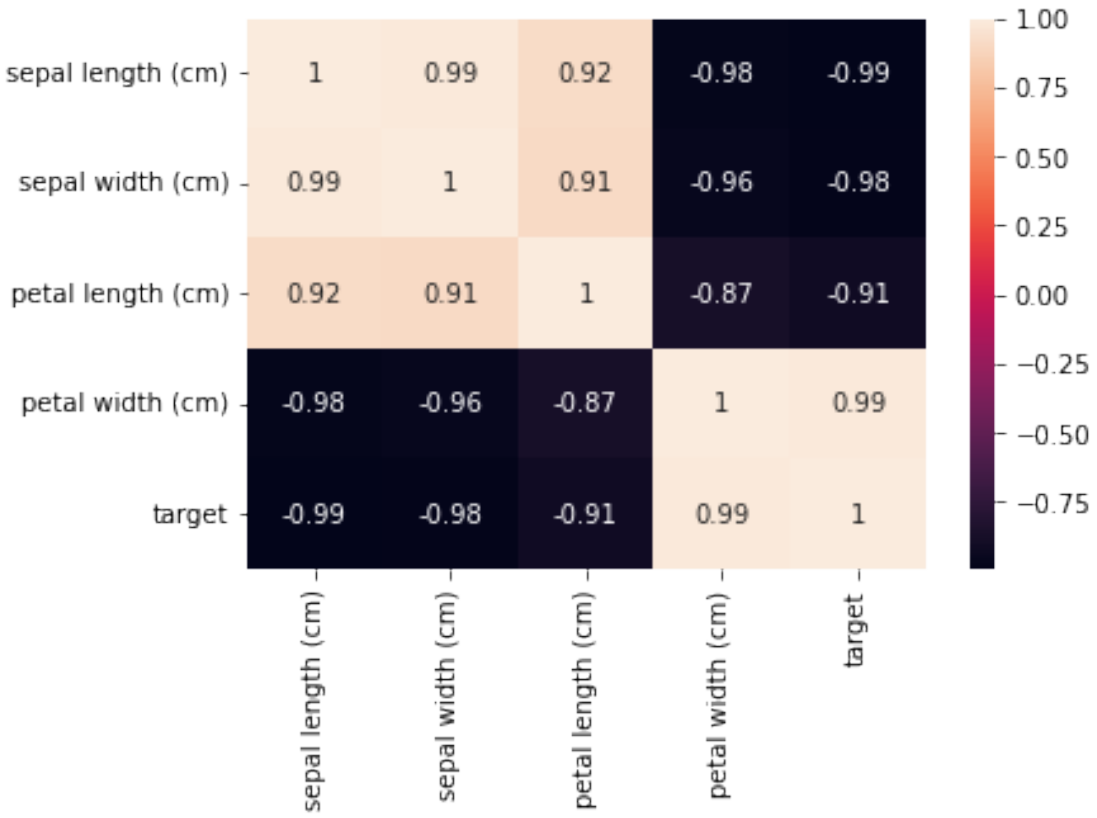
```
sns.countplot(y=iris_df.iloc[:,4], data=iris_df)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f61e7546bd0>
```




```
sns.heatmap(iris_df.corr(), annot=True)
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x7f61e6fdb610>
```




```
X = iris_df.drop("target", axis=1)
Y = iris_df.iloc[:,4]

from sklearn.preprocessing import StandardScaler
ss = StandardScaler()
X_scaled = ss.fit_transform(X)
X_scaled=np.insert(X_scaled,0,values=1,axis=1)

from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(X_scaled, Y,
test_size=0.3, random_state=42)
print("x_train.shape = ", x_train.shape)
print("x_test.shape = ", x_test.shape)
print("y_train.shape = ", y_train.shape)
print("y_test.shape = ", y_test.shape)

x_train.shape =  (105, 5)
x_test.shape =  (45, 5)
y_train.shape =  (105,)
y_test.shape =  (45,)

n = 1000
alpha = 0.01
m,k = x_train.shape
beta = np.zeros(k)
for i in range(n):
```

```
    cost_gradient = np.zeros(k)
    z = x_train.dot(beta)
    predicted = 1/(1+np.exp(-z))
    difference = predicted - y_train
    for j in range(k):
        cost_gradient[j] = np.sum(difference.dot(x_train[:,j]))
    for j in range(k):
        beta[j] = beta[j] - (alpha/m)*cost_gradient[j]
print(beta)
```

```
[ 0.64222568 -0.92443656 -0.89968101 -0.8190506   0.93144237]
```

```
y_pred = 1/(1+np.exp(-(x_test.dot(beta))))
y_label = np.zeros(len(y_pred))
for i in range(len(y_pred)):
    if(y_pred[i]>=0.5):
        y_label[i]=1

tp = 0
tn = 0
fp = 0
fn = 0
y_test = np.array(y_test).reshape(-1,1)
for i in range(len(y_label)):
    if(y_test[i]==1 and y_label[i]==1):
        tp+=1
    if(y_test[i]==1 and y_label[i]==0):
        fn+=1
    if(y_test[i]==0 and y_label[i]==0):
        tn+=1
    if(y_test[i]==0 and y_label[i]==1):
        fp+=1

print("True Positive = ", tp)
print("True Negative = ", tn)
print("False Positive = ", fp)
print("False Negative = ", fn)
```

```
True Positive =  26
True Negative =  19
False Positive =  0
False Negative =  0
```

```
accuracy=(tp+tn)/(tp+tn+fp+fn)
print("Accuracy = ", accuracy)

precision_pos = tp/(tp+fp)
recall_pos = tp/(tp+fn)
f1_score_pos = 2*precision_pos*recall_pos/(precision_pos+recall_pos)
print("Precision Positive = ", precision_pos)
print("Recall Positive = ", recall_pos)
```

```
print("F1_Score Positive = ", f1_score_pos)
```

```
precision_neg = tn/(tn+fn)
recall_neg = tn/(tn+fp)
f1_score_neg = 2*precision_neg*recall_neg/(precision_neg+recall_neg)
print("Precision Negative = ", precision_neg)
print("Recall Negative = ", recall_neg)
print("F1_Score Negative = ", f1_score_pos)
```

```
Accuracy =  1.0
Precision Positive =  1.0
Recall Positive =  1.0
F1_Score Positive =  1.0
Precision Negative =  1.0
Recall Negative =  1.0
F1_Score Negative =  1.0
```

```
macro_precision = (precision_pos + precision_neg)/2
macro_recall = (recall_pos + recall_neg)/2
macro_f1_score = (f1_score_pos + f1_score_neg)/2
print("Macro Precision = ", macro_precision)
print("Macro Recall = ", macro_recall)
print("Macro F1_Score = ", macro_f1_score)
```

```
Macro Precision =  1.0
Macro Recall =  1.0
Macro F1_Score =  1.0
```

```
l1 = len(y_test[y_test==0])
l2 = len(y_test[y_test==1])
weighted_precision = (l1*precision_neg + l2*precision_pos)/(l1+l2)
weighted_recall = (l1*recall_neg + l2*recall_pos)/(l1+l2)
weighted_f1_score = (l1*f1_score_neg + l2*f1_score_pos)/(l1+l2)
print("Weighted Precision = ", weighted_precision)
print("Weighted Recall = ", weighted_recall)
print("Weighted F1_Score = ", weighted_f1_score)
```

```
Weighted Precision =  1.0
Weighted Recall =  1.0
Weighted F1_Score =  1.0
```

Question 2

```
from google.colab import drive
drive.mount('/content/drive')
```

```
Mounted at /content/drive
```

```
headers = ["col1", "col2", "target"]
```

```
exam_df = pd.read_table("/content/drive/MyDrive/ML
Lab/Lab_05/exam6.txt", sep=",", names=headers)
exam_df.head()
```

```
       col1     col2  target
0  0.051267  0.69956       1
1 -0.092742  0.68494       1
2 -0.213710  0.69225       1
3 -0.375000  0.50219       1
4 -0.513250  0.46564       1
```

```
exam_df.isna().sum()
```

```
exam_df.describe()
```

```
sns.scatterplot(data=exam_df, x="col1", y="col2", hue="target")
```

```
X = exam_df.drop("target", axis=1)
Y = exam_df.iloc[:,-1]
```

```
ss = StandardScaler()
X_scaled = ss.fit_transform(X)
X_scaled=np.insert(X_scaled,0,values=1,axis=1)
```

```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(X_scaled, Y,
test_size=0.3, random_state=42)
```

```
from sklearn.preprocessing import PolynomialFeatures
poly = PolynomialFeatures(degree = 6, interaction_only=False,
include_bias=False)
x_train = poly.fit_transform(x_train)
x_test = poly.fit_transform(x_test)
```

```
print("x_train.shape = ", x_train.shape)
print("x_test.shape = ", x_test.shape)
print("y_train.shape = ", y_train.shape)
print("y_test.shape = ", y_test.shape)
```

Question 2 Part 1

```
n = 1000
alpha = 10
m,k = x_train.shape
beta = np.zeros(k)
for i in range(n):
    cost_gradient = np.zeros(k)
    z = x_train.dot(beta)
    predicted = 1/(1+np.exp(-z))
    difference = predicted - y_train
    for j in range(k):
        cost_gradient[j] = np.sum(difference.dot(x_train[:,j]))
    for j in range(k):
```

```
        beta[j] = beta[j] - (alpha/m)*cost_gradient[j]
print(beta)

y_pred = 1/(1+np.exp(-(x_test.dot(beta))))
y_label = np.zeros(len(y_pred))
for i in range(len(y_pred)):
    if(y_pred[i]>=0.5):
        y_label[i]=1

tp = 0
tn = 0
fp = 0
fn = 0
y_test = np.array(y_test).reshape(-1,1)
for i in range(len(y_label)):
    if(y_test[i]==1 and y_label[i]==1):
        tp+=1
    if(y_test[i]==1 and y_label[i]==0):
        fn+=1
    if(y_test[i]==0 and y_label[i]==0):
        tn+=1
    if(y_test[i]==0 and y_label[i]==1):
        fp+=1

print("True Positive = ", tp)
print("True Negative = ", tn)
print("False Positive = ", fp)
print("False Negative = ", fn)

accuracy=(tp+tn)/(tp+tn+fp+fn)
print("Accuracy = ", accuracy)

precision_pos = tp/(tp+fp)
recall_pos = tp/(tp+fn)
f1_score_pos = 2*precision_pos*recall_pos/(precision_pos+recall_pos)
print("Precision Positive = ", precision_pos)
print("Recall Positive = ", recall_pos)
print("F1_Score Positive = ", f1_score_pos)


precision_neg = tn/(tn+fn)
recall_neg = tn/(tn+fp)
f1_score_neg = 2*precision_neg*recall_neg/(precision_neg+recall_neg)
print("Precision Negative = ", precision_neg)
print("Recall Negative = ", recall_neg)
print("F1_Score Negative = ", f1_score_pos)

macro_precision = (precision_pos + precision_neg)/2
macro_recall = (recall_pos + recall_neg)/2
macro_f1_score = (f1_score_pos + f1_score_neg)/2
print("Macro Precision = ", macro_precision)
```

```
print("Macro Recall = ", macro_recall)
print("Macro F1_Score = ", macro_f1_score)
```

Question 2 Part 2

```
lambda_val = 0.2
A = x_train.T.dot(x_train)
I = np.identity(A.shape[0])
B = A + lambda_val * I
C = np.linalg.inv(B)
D = C.dot(x_train.T)
beta = D.dot(y_train)

n = 1000
alpha = 10
m,k = x_train.shape
# beta = np.zeros(k)
for i in range(n):
    cost_gradient = np.zeros(k)
    z = x_train.dot(beta)
    predicted = 1/(1+np.exp(-z))
    difference = predicted - y_train
    for j in range(k):
        cost_gradient[j] = np.sum(difference.dot(x_train[:,j]))
    for j in range(k):
        beta[j] = beta[j] - (alpha/m)*cost_gradient[j]
print(beta)

y_pred = 1/(1+np.exp(-(x_test.dot(beta))))
y_label = np.zeros(len(y_pred))
for i in range(len(y_pred)):
    if(y_pred[i]>=0.5):
        y_label[i]=1

tp = 0
tn = 0
fp = 0
fn = 0
y_test = np.array(y_test).reshape(-1,1)
for i in range(len(y_label)):
    if(y_test[i]==1 and y_label[i]==1):
        tp+=1
    if(y_test[i]==1 and y_label[i]==0):
        fn+=1
    if(y_test[i]==0 and y_label[i]==0):
        tn+=1
    if(y_test[i]==0 and y_label[i]==1):
        fp+=1

print("True Positive = ", tp)
print("True Negative = ", tn)
```

```
print("False Positive = ", fp)
print("False Negative = ", fn)

accuracy=(tp+tn)/(tp+tn+fp+fn)
print("Accuracy = ", accuracy)

precision_pos = tp/(tp+fp)
recall_pos = tp/(tp+fn)
f1_score_pos = 2*precision_pos*recall_pos/(precision_pos+recall_pos)
print("Precision Positive = ", precision_pos)
print("Recall Positive = ", recall_pos)
print("F1_Score Positive = ", f1_score_pos)


precision_neg = tn/(tn+fn)
recall_neg = tn/(tn+fp)
f1_score_neg = 2*precision_neg*recall_neg/(precision_neg+recall_neg)
print("Precision Negative = ", precision_neg)
print("Recall Negative = ", recall_neg)
print("F1_Score Negative = ", f1_score_pos)

macro_precision = (precision_pos + precision_neg)/2
macro_recall = (recall_pos + recall_neg)/2
macro_f1_score = (f1_score_pos + f1_score_neg)/2
print("Macro Precision = ", macro_precision)
print("Macro Recall = ", macro_recall)
print("Macro F1_Score = ", macro_f1_score)
```