CS353 Machine Learning Lab

Lab-2 (19/03/21)

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Task:

Perform logistic regression on a sample dataset.

Dataset

`Wine`

The wine dataset is a classic and very easy multi-class classification dataset avilable in sklearn standard library.

Importing Libraries

In [18]:
```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
from sklearn.datasets import load_wine
%matplotlib inline
```

Loading dataset

In [19]:
```
dataset = load_wine()
X, y = load_wine(return_X_y=True)
```

In [20]:
```
print("Features of first five values are: ")
print(X[0:5])
print("Classes of first five values are: ", y[0:5])
```

```
Features of first five values are:
[[1.423e+01 1.710e+00 2.430e+00 1.560e+01 1.270e+02 2.800e+00 3.060e+00
  2.800e-01 2.290e+00 5.640e+00 1.040e+00 3.920e+00 1.065e+03]
 [1.320e+01 1.780e+00 2.140e+00 1.120e+01 1.000e+02 2.650e+00 2.760e+00
  2.600e-01 1.280e+00 4.380e+00 1.050e+00 3.400e+00 1.050e+03]
 [1.316e+01 2.360e+00 2.670e+00 1.860e+01 1.010e+02 2.800e+00 3.240e+00
  3.000e-01 2.810e+00 5.680e+00 1.030e+00 3.170e+00 1.185e+03]
 [1.437e+01 1.950e+00 2.500e+00 1.680e+01 1.130e+02 3.850e+00 3.490e+00
  2.400e-01 2.180e+00 7.800e+00 0.600e-01 3.450e+00 1.480e+03]
 [1.324e+01 2.590e+00 2.870e+00 2.100e+01 1.180e+02 2.800e+00 2.690e+00
  3.900e-01 1.820e+00 4.320e+00 1.040e+00 2.930e+00 7.350e+02]]
Classes of first five values are:  [0 0 0 0 0]
```

In [21]:
```
df = pd.DataFrame(dataset.data, columns = dataset.feature_names)
df['Target'] = dataset.target
df.head()
```

Out[21]:

	alcohol	malic_acid	ash	alcalinity_of_ash	magnesium	total_phenols	flavanoids	nonflavanoid_phenols	proanthocyanins	color_inten
0	14.23	1.71	2.43	15.6	127.0	2.80	3.06	0.28	2.29	5
1	13.20	1.78	2.14	11.2	100.0	2.65	2.76	0.26	1.28	4
2	13.16	2.36	2.67	18.6	101.0	2.80	3.24	0.30	2.81	5
3	14.37	1.95	2.50	16.8	113.0	3.85	3.49	0.24	2.18	7
4	13.24	2.59	2.87	21.0	118.0	2.80	2.69	0.39	1.82	4

In [22]:
```
df.tail()
```

Out[22]:

	alcohol	malic_acid	ash	alcalinity_of_ash	magnesium	total_phenols	flavanoids	nonflavanoid_phenols	proanthocyanins	color_int
173	13.71	5.65	2.45	20.5	95.0	1.68	0.61	0.52	1.06	
174	13.40	3.91	2.48	23.0	102.0	1.80	0.75	0.43	1.41	
175	13.27	4.28	2.26	20.0	120.0	1.59	0.69	0.43	1.35	
176	13.17	2.59	2.37	20.0	120.0	1.65	0.68	0.53	1.46	
177	14.13	4.10	2.74	24.5	96.0	2.05	0.76	0.56	1.35	

In [23]:
```
df.describe()
```

Out[23]:

	alcohol	malic_acid	ash	alcalinity_of_ash	magnesium	total_phenols	flavanoids	nonflavanoid_phenols	proanthocyani
count	178.000000	178.000000	178.000000	178.000000	178.000000	178.000000	178.000000	178.000000	178.0000
mean	13.000618	2.336348	2.366517	19.494944	99.741573	2.295112	2.029270	0.361854	1.5908
std	0.811827	1.117146	0.274344	3.339564	14.282484	0.625851	0.998859	0.124453	0.5723
min	11.030000	0.740000	1.360000	10.600000	70.000000	0.980000	0.340000	0.130000	0.4100
25%	12.362500	1.602500	2.210000	17.200000	88.000000	1.742500	1.205000	0.270000	1.2500
50%	13.050000	1.865000	2.360000	19.500000	98.000000	2.355000	2.135000	0.340000	1.5550
75%	13.677500	3.082500	2.557500	21.500000	107.000000	2.800000	2.875000	0.437500	1.9500
max	14.830000	5.800000	3.230000	30.000000	162.000000	3.880000	5.080000	0.660000	3.5800

In [24]:
```
print("Dataset shape: ", df.shape)
print("Target classes: ", pd.unique(df['Target']))
print("Number of target classes: ", len(pd.unique(df['Target'])))
print("\n\n")
df.info()
```

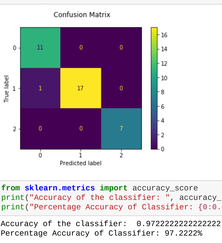
```
Dataset shape:  (178, 14)
Target classes:  [0 1 2]
Number of target classes:  3



<class 'pandas.core.frame.DataFrame'>
RangeIndex: 178 entries, 0 to 177
Data columns (total 14 columns):
 #   Column                        Non-Null Count  Dtype  
---  ------                        --------------  -----  
 0   alcohol                       178 non-null    float64
 1   malic_acid                    178 non-null    float64
 2   ash                           178 non-null    float64
 3   alcalinity_of_ash             178 non-null    float64
 4   magnesium                     178 non-null    float64
 5   total_phenols                 178 non-null    float64
 6   flavanoids                    178 non-null    float64
 7   nonflavanoid_phenols          178 non-null    float64
 8   proanthocyanins               178 non-null    float64
 9   color_intensity               178 non-null    float64
 10  hue                           178 non-null    float64
 11  od280/od315_of_diluted_wines  178 non-null    float64
 12  proline                       178 non-null    float64
 13  Target                        178 non-null    int64  
dtypes: float64(13), int64(1)
memory usage: 19.6 KB
```

In [25]:
```
# printing label's plot
import seaborn as sns
sns.countplot(x="Target", data=df)
```

Out[25]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f7542de2bd0>
```



Splitting Data

We are using X-y split method with test size 20 % and random state 5.

In [26]:
```
X = dataset.data
y = dataset.target
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=25)
```

Implementing Logistic regression

In [27]:
```
from sklearn.linear_model import LogisticRegression
```

In [28]:
```
log_reg = LogisticRegression()
log_reg.fit(X_train,y_train)
```

```
/home/shumbul/anaconda3/lib/python3.7/site-packages/sklearn/linear_model/_logistic.py:940: Convergenc
eWarning: 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[28]:
```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='auto', n_jobs=None, penalty='l2',
                   random_state=None, solver='lbfgs', tol=0.0001, verbose=0,
                   warm_start=False)
```

In [29]:
```
log_reg.coef_
```

Out[29]:
```
array([[-1.14459351e-01,  5.36838655e-02,  1.15923962e-01,
        -1.92026891e-01, -2.55766412e-02,  7.21772825e-02,
         3.47187510e-01, -1.87830187e-02,  8.46976656e-02,
        -4.28877695e-02, -1.01476803e-02,  2.22820710e-01,
         8.98308416e-03],
       [ 5.14084767e-01, -5.74794189e-01, -1.46149750e-01,
         1.49735020e-01,  3.25205654e-03,  3.65897542e-01,
         4.66051253e-01,  1.41354451e-02,  2.60985828e-01,
        -1.13051830e+00,  2.21753149e-01,  4.56981289e-01,
        -8.83814007e-03],
       [-3.99625417e-01,  5.21110324e-01,  3.02257937e-02,
         4.22918716e-02,  2.23245846e-02, -4.38074825e-01,
        -8.13238764e-01,  4.64757359e-03, -3.45683494e-01,
         1.17340607e+00, -2.11605468e-01, -6.79801999e-01,
        -1.44944096e-04]])
```

In [30]:
```
log_reg.intercept_
```

Out[30]:
```
array([-0.03548303,  0.08491677, -0.04943373])
```

In [31]:
```
y_pred = log_reg.predict(X_test)
y_pred
```

Out[31]:
```
array([1, 0, 0, 0, 1, 1, 0, 2, 1, 2, 1, 1, 0, 1, 1, 1, 2, 0, 1, 1, 2, 2,
       0, 0, 2, 0, 1, 0, 2, 0, 0, 1, 1, 1, 1, 1])
```

In [32]:
```
y_pred.shape
```

Out[32]:
```
(36,)
```

Analysis

In [33]:
```
from sklearn import metrics
import matplotlib.pyplot as plt
disp = metrics.plot_confusion_matrix(log_reg, X_test, y_test)
disp.figure_.suptitle("Confusion Matrix")
plt.show()
```


In [34]:
```
from sklearn.metrics import accuracy_score
print("Accuracy of the classifier: ", accuracy_score(y_test, y_pred))
print("Percentage Accuracy of Classifier: {0:0.4f}%".format(accuracy_score(y_test, y_pred)*100))
```

```
Accuracy of the classifier:  0.9722222222222222
Percentage Accuracy of Classifier: 97.2222%
```