```
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score,confusion_matrix
from sklearn.tree import DecisionTreeClassifier
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import GridSearchCV
from sklearn.ensemble import RandomForestClassifier
import xgboost as xg
from sklearn.model_selection import train_test_split
```

```
from google.colab import files
uploaded=files.upload()
```

Choose Files Iris.csv

- **Iris.csv**(text/csv) - 5116 bytes, last modified: 8/10/2023 - 100% done

```
Saving Iris.csv to Iris.csv
```

```
df =pd.read_csv('Iris.csv')
df_copy=df.copy()
```

```
df_copy
```

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	1	5.1	3.5	1.4	0.2	Iris-setosa
1	2	4.9	3.0	1.4	0.2	Iris-setosa
2	3	4.7	3.2	1.3	0.2	Iris-setosa
3	4	4.6	3.1	1.5	0.2	Iris-setosa
4	5	5.0	3.6	1.4	0.2	Iris-setosa
...	...	...	...	...	...	...
145	146	6.7	3.0	5.2	2.3	Iris-virginica
146	147	6.3	2.5	5.0	1.9	Iris-virginica
147	148	6.5	3.0	5.2	2.0	Iris-virginica
148	149	6.2	3.4	5.4	2.3	Iris-virginica
149	150	5.9	3.0	5.1	1.8	Iris-virginica

150 rows × 6 columns

```
df_copy.drop(columns=['Id'],axis=0,inplace=True)
```

```
df_copy.dtypes
```

```
SepalLengthCm    float64
SepalWidthCm     float64
PetalLengthCm    float64
PetalWidthCm     float64
Species           object
dtype: object
```

```
df_copy.shape
print('Rows ---->',df.shape[0])
print('Columns ---->',df.shape[1])
```

```
Rows ----> 150
Columns ----> 6
```

```
df_copy.describe()
```

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
count	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.054000	3.758667	1.198667
std	0.828066	0.433594	1.764420	0.763161
min	4.300000	2.000000	1.000000	0.100000
25%	5.100000	2.800000	1.600000	0.300000
50%	5.800000	3.000000	4.350000	1.300000

```
df_copy.size
```

```
750
```

```
df_copy.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 5 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   SepalLengthCm  150 non-null    float64
 1   SepalWidthCm   150 non-null    float64
 2   PetalLengthCm  150 non-null    float64
 3   PetalWidthCm   150 non-null    float64
 4   Species        150 non-null    object 
dtypes: float64(4), object(1)
memory usage: 6.0+ KB
```

```
df_copy.columns = ['sl','sw','pl','pw','species']
df_split_iris=df_copy.species.str.split('-',n=-1,expand=True) #Remove prefix 'Iris-' from species col
df_split_iris.drop(columns=0,axis=1,inplace=True)#Drop 'Iris-' col
df_split_iris
```

	1
0	setosa
1	setosa
2	setosa
3	setosa
4	setosa
...	...
145	virginica
146	virginica
147	virginica
148	virginica
149	virginica

150 rows × 1 columns

```
df3_full=df_copy.join(df_split_iris)
df3_full
```

	sl	sw	pl	pw	species	1
0	5.1	3.5	1.4	0.2	Iris-setosa	setosa
1	4.9	3.0	1.4	0.2	Iris-setosa	setosa
2	4.7	3.2	1.3	0.2	Iris-setosa	setosa
3	4.6	3.1	1.5	0.2	Iris-setosa	setosa

```
df3_full.rename({1:'species1'},axis=1,inplace=True) #Rename column
df3_full
```

	sl	sw	pl	pw	species	species1
0	5.1	3.5	1.4	0.2	Iris-setosa	setosa
1	4.9	3.0	1.4	0.2	Iris-setosa	setosa
2	4.7	3.2	1.3	0.2	Iris-setosa	setosa
3	4.6	3.1	1.5	0.2	Iris-setosa	setosa
4	5.0	3.6	1.4	0.2	Iris-setosa	setosa
...	...	...	...	...	...	...
145	6.7	3.0	5.2	2.3	Iris-virginica	virginica
146	6.3	2.5	5.0	1.9	Iris-virginica	virginica
147	6.5	3.0	5.2	2.0	Iris-virginica	virginica
148	6.2	3.4	5.4	2.3	Iris-virginica	virginica
149	5.9	3.0	5.1	1.8	Iris-virginica	virginica

150 rows × 6 columns

```
df3_full.drop(columns='species',axis=1,inplace=True) #Drop excessive column
```

```
df3_full
```

	sl	sw	pl	pw	species1
0	5.1	3.5	1.4	0.2	setosa
1	4.9	3.0	1.4	0.2	setosa
2	4.7	3.2	1.3	0.2	setosa
3	4.6	3.1	1.5	0.2	setosa
4	5.0	3.6	1.4	0.2	setosa
...	...	...	...	...	...
145	6.7	3.0	5.2	2.3	virginica
146	6.3	2.5	5.0	1.9	virginica
147	6.5	3.0	5.2	2.0	virginica
148	6.2	3.4	5.4	2.3	virginica
149	5.9	3.0	5.1	1.8	virginica

150 rows × 5 columns

```
df3_full.shape
```

```
(150, 5)
```

```
df3_full.isna()
```

	sl	sw	pl	pw	species1
0	False	False	False	False	False
1	False	False	False	False	False
2	False	False	False	False	False
3	False	False	False	False	False
4	False	False	False	False	False
...	...	...	...	...	...
145	False	False	False	False	False

```
df3_full.isna().sum()
```

```
sl          0
sw          0
pl          0
pw          0
species1    0
dtype: int64
```

```
df3_full.corr()
```

```
<ipython-input-20-92a0b66522fe>:1: FutureWarning: The default value of numeric_only in D
  df3_full.corr()
```

	sl	sw	pl	pw
sl	1.000000	-0.109369	0.871754	0.817954
sw	-0.109369	1.000000	-0.420516	-0.356544
pl	0.871754	-0.420516	1.000000	0.962757
pw	0.817954	-0.356544	0.962757	1.000000

```
df3_full.describe()
```

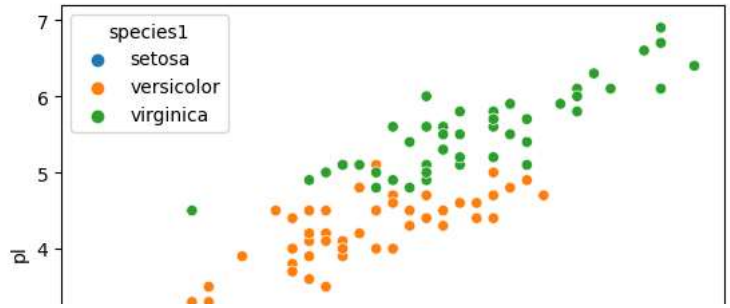
	sl	sw	pl	pw
count	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.054000	3.758667	1.198667
std	0.828066	0.433594	1.764420	0.763161
min	4.300000	2.000000	1.000000	0.100000
25%	5.100000	2.800000	1.600000	0.300000
50%	5.800000	3.000000	4.350000	1.300000
75%	6.400000	3.300000	5.100000	1.800000
max	7.900000	4.400000	6.900000	2.500000

```
df3_full.species1.value_counts()
```

```
setosa        50
versicolor    50
virginica     50
Name: species1, dtype: int64
```

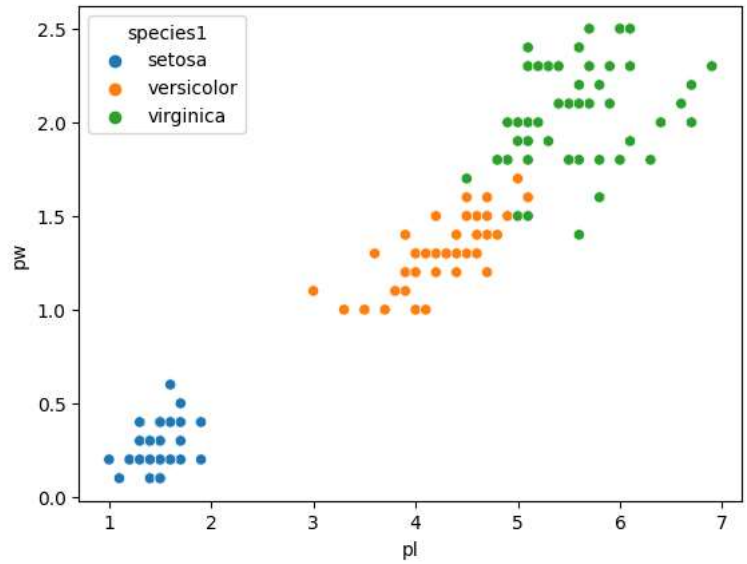
```
sns.scatterplot(x=df3_full.sl,y=df3_full.pl,hue=df3_full.species1)
```

```
<Axes: xlabel='sl', ylabel='pl'>
```



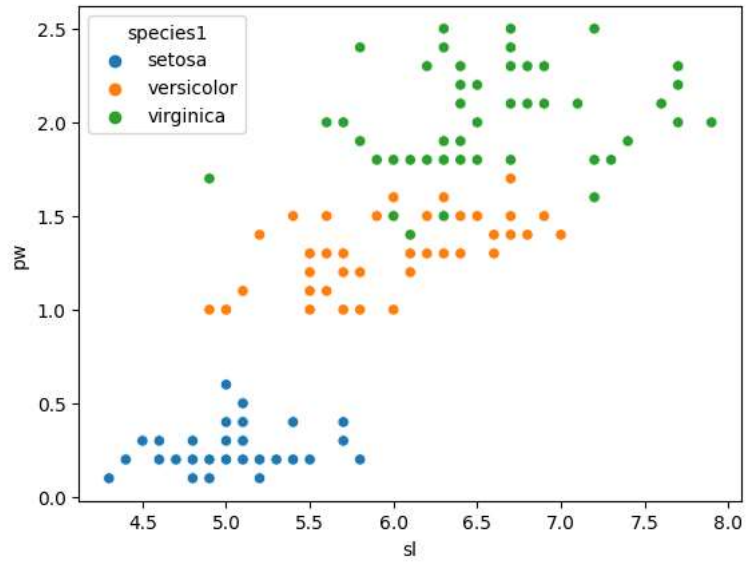

```
sns.scatterplot(x=df3_full.pl,y=df3_full.pw,hue=df3_full.species1)
```

```
<Axes: xlabel='pl', ylabel='pw'>
```



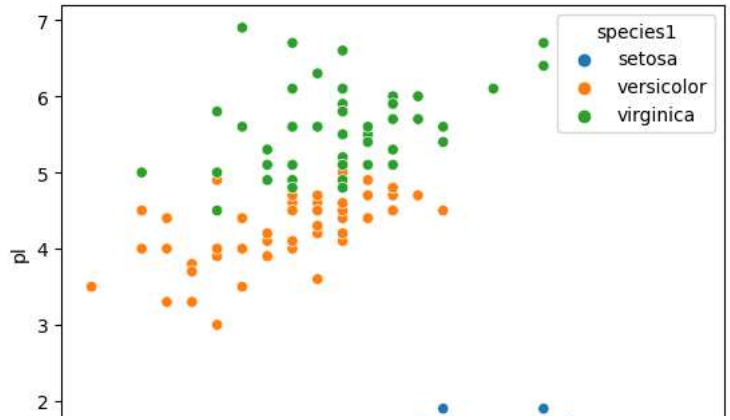

```
sns.scatterplot(x=df3_full.sl,y=df3_full.pw,hue=df3_full.species1)
```

```
<Axes: xlabel='sl', ylabel='pw'>
```




```
sns.scatterplot(x=df3_full.sw,y=df3_full.pl,hue=df3_full.species1)
```

```
<Axes: xlabel='sw', ylabel='pl'>
```

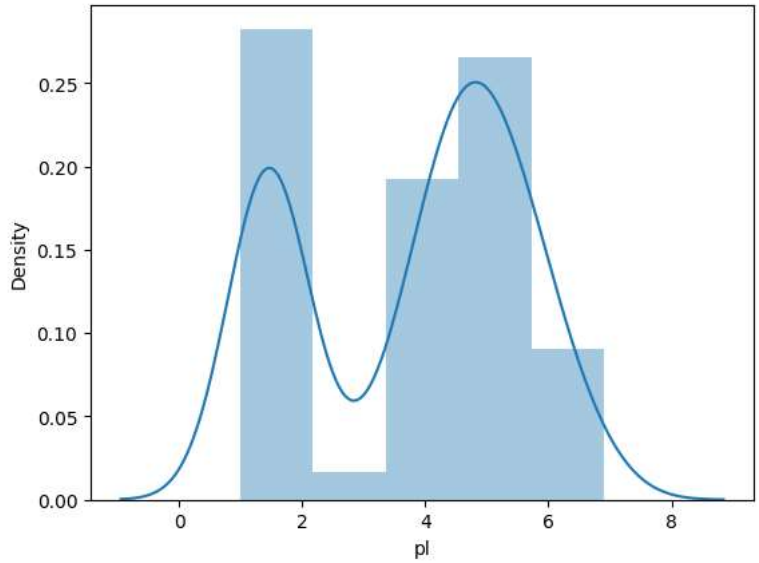



```
df3_full.columns
```

```
Index(['sl', 'sw', 'pl', 'pw', 'species1'], dtype='object')
```

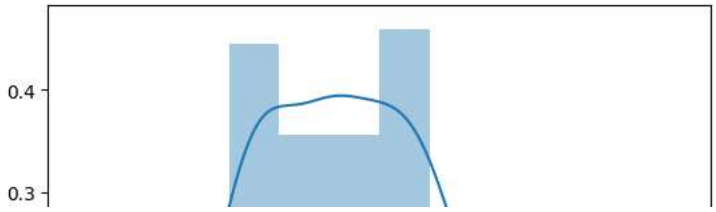

```
sns.distplot(df3_full.pl)
```

```
<ipython-input-33-201e00e1f558>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df3_full.pl)
<Axes: xlabel='pl', ylabel='Density'>
```



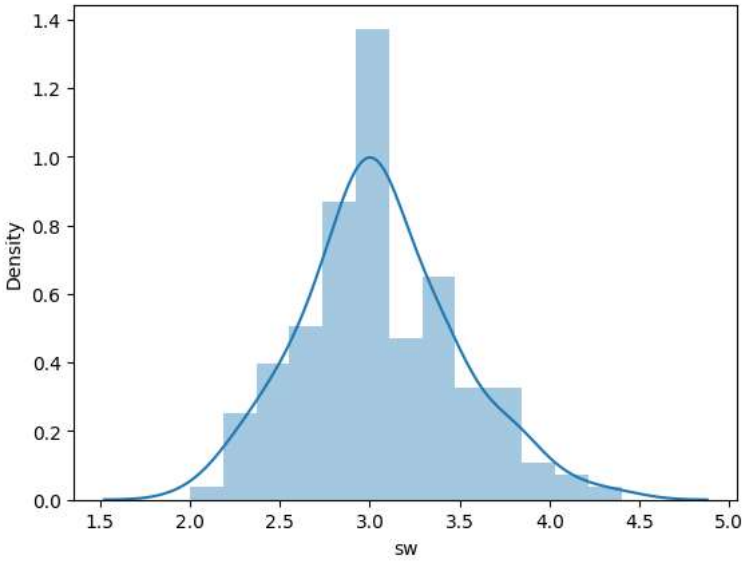

```
sns.distplot(df3_full.sl)
```

```
<ipython-input-34-38c844479287>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df3_full.sl)
<Axes: xlabel='sl', ylabel='Density'>
```




```
sns.distplot(df3_full.sw)
```

```
<ipython-input-35-8390f5d4cf4b>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df3_full.sw)
<Axes: xlabel='sw', ylabel='Density'>
```

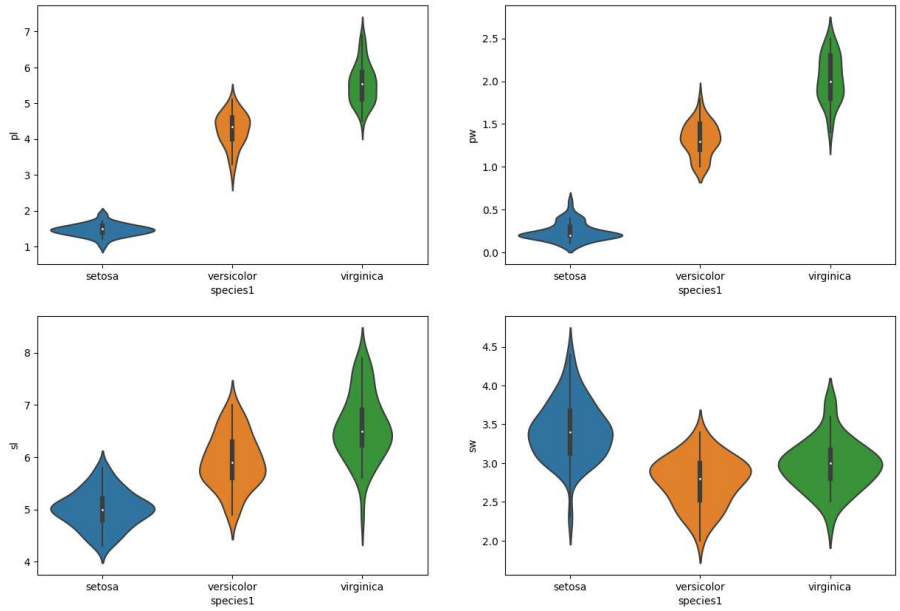



```
sns.distplot(df3_full.pw)
```

```
<ipython-input-36-4c6ab44689b9>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df3_full.pw)
<Axes: xlabel='pw', ylabel='Density'>
```

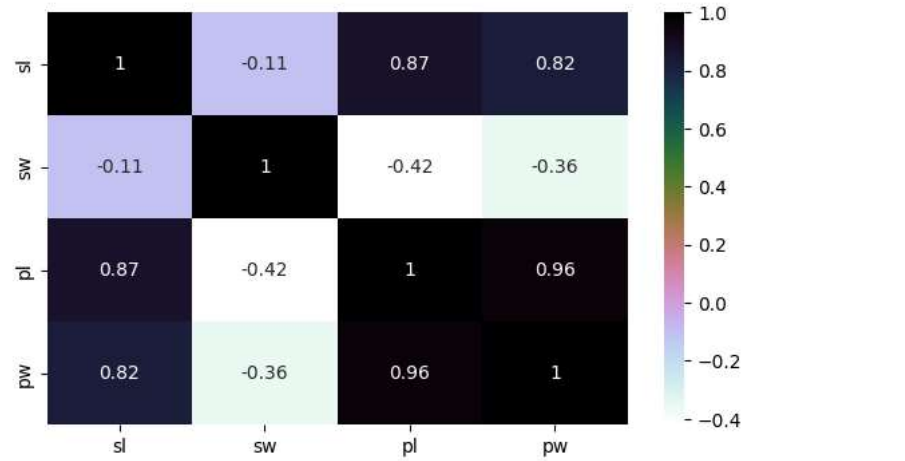

```
plt.figure(figsize=(15,10))
plt.subplot(2,2,1)
sns.violinplot(x='species1',y='pl',data=df3_full)
plt.subplot(2,2,2)
sns.violinplot(x='species1',y='pw',data=df3_full)
plt.subplot(2,2,3)
sns.violinplot(x='species1',y='sl',data=df3_full)
plt.subplot(2,2,4)
sns.violinplot(x='species1',y='sw',data=df3_full)
```

```
<Axes: xlabel='species1', ylabel='sw'>
```



```
plt.figure(figsize=(7,4))
sns.heatmap(df3_full.corr(),annot=True,cmap='cubehelix_r')
plt.show()
```

```
<ipython-input-38-7018bda15ca7>:2: FutureWarning: The default value of numeric_only in D
  sns.heatmap(df3_full.corr(),annot=True,cmap='cubehelix_r')
```




```
from sklearn.preprocessing import LabelEncoder

# Creating a instance of label Encoder.
le = LabelEncoder()

# Using .fit_transform function to fit label
# encoder and return encoded label
le.fit_transform(df3_full['species1'])
df3_full['species1']=le.fit_transform(df3_full['species1'])
df3_full
```

	sl	sw	pl	pw	species1
0	5.1	3.5	1.4	0.2	0
1	4.9	3.0	1.4	0.2	0
2	4.7	3.2	1.3	0.2	0
3	4.6	3.1	1.5	0.2	0
4	5.0	3.6	1.4	0.2	0
...	...	...	...	...	...
145	6.7	3.0	5.2	2.3	2
146	6.3	2.5	5.0	1.9	2
147	6.5	3.0	5.2	2.0	2
148	6.2	3.4	5.4	2.3	2
149	5.9	3.0	5.1	1.8	2

150 rows × 5 columns

```
df3_full
```

	sl	sw	pl	pw	species1
0	5.1	3.5	1.4	0.2	0
1	4.9	3.0	1.4	0.2	0
2	4.7	3.2	1.3	0.2	0
3	4.6	3.1	1.5	0.2	0

```
x = df3_full.iloc[:,:-1]
x
```

	sl	sw	pl	pw
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
...	...	...	...	...
145	6.7	3.0	5.2	2.3
146	6.3	2.5	5.0	1.9
147	6.5	3.0	5.2	2.0
148	6.2	3.4	5.4	2.3
149	5.9	3.0	5.1	1.8

150 rows × 4 columns

```
y = df3_full.iloc[:,-1]
y
```

```
0      0
1      0
2      0
3      0
4      0
      ..
145    2
146    2
147    2
148    2
149    2
Name: species1, Length: 150, dtype: int64
```

```
df3_full.species1.unique()
```

```
array([0, 1, 2])
```

```
from sklearn.model_selection import train_test_split
xtrain,xtest,ytrain,ytest = train_test_split(x,y,test_size=0.3,random_state=20)
```

```
xtrain.shape
```

```
(105, 4)
```

```
ytrain.shape
```

```
(105,)
```

```
xtest.shape
```

```
(45, 4)
```

```
ytest.shape
```

```
(45,)
```

```
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score,confusion_matrix
logi = LogisticRegression()
logi.fit(xtrain,ytrain)
logi_prediction = logi.predict(xtest)
logi_prediction
```

```
array([0, 1, 1, 2, 1, 1, 2, 0, 2, 0, 2, 1, 1, 0, 0, 2, 0, 1, 2, 1, 1, 2,
       2, 0, 1, 1, 1, 0, 2, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1, 2, 1, 2, 0, 1,
       1])
```

```
print(logi.score(xtrain,ytrain)*100)
print(logi.score(xtest,ytest)*100)
```

```
97.14285714285714
93.33333333333333
```

```
accuracy_score(ytest,logi_prediction)*100
```

```
93.33333333333333
```

```
from sklearn.model_selection import GridSearchCV
```

```
para = {'penalty':['l1','l2','elasticnet'],
        'C':[1,2,3,4,5,6,10,20,30,40,50,1.5,2.3,1.6,1.9],
        'max_iter':[100,200,300,50,70,60,50]
        }
```

```
classifier_logistic = GridSearchCV(logi,param_grid = para,scoring='accuracy',cv=5)
```

```
classifier_logistic.fit(xtrain,ytrain)
```

```
classifier_logistic.best_estimator_
```

```
▾ LogisticRegression
LogisticRegression(C=20, max_iter=50)
```

```
classifier_logistic.best_params_
```

```
{'C': 20, 'max_iter': 50, 'penalty': 'l2'}
```

```
classifier_logistic.best_score_
```

```
0.9714285714285715
```

```
prediction = classifier_logistic.predict(xtest)
prediction
```

```
array([0, 1, 1, 2, 1, 1, 2, 0, 2, 0, 2, 1, 1, 0, 0, 2, 0, 1, 2, 1, 1, 2,
       2, 0, 1, 1, 1, 0, 2, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1, 2, 1, 1, 0, 1,
       1])
```

```
from sklearn.metrics import accuracy_score,classification_report
grid_logi_accuracy_score1 = accuracy_score(ytest,prediction)
grid_logi_accuracy_score1=(np.round(grid_logi_accuracy_score1*100))
grid_logi_accuracy_score1
```

```
91.0
```

```
confusion_matrix(ytest,prediction)
```

```
array([[13,  0,  0],
       [ 0, 18,  0],
       [ 0,  4, 10]])
```

```
class_pre_rec = classification_report(ytest,prediction)
print(class_pre_rec)
```

```
                  precision    recall  f1-score   support

               0       1.00      1.00      1.00        13
               1       0.82      1.00      0.90        18
               2       1.00      0.71      0.83        14

        accuracy                           0.91        45
       macro avg       0.94      0.90      0.91        45
    weighted avg       0.93      0.91      0.91        45
```

```
from sklearn.tree import DecisionTreeClassifier
```

```
tree_classifier = DecisionTreeClassifier(criterion='gini',
    splitter='best',
    max_depth=5,
    min_samples_split=2,
    min_samples_leaf=1,
    max_features=1,
    random_state=1,
    max_leaf_nodes=2,
    class_weight='balanced',
    ccp_alpha=0.01,)
```

```
tree_classifier.fit(xtrain,ytrain)
```

```
▾                          DecisionTreeClassifier
DecisionTreeClassifier(ccp_alpha=0.01, class_weight='balanced', max_depth=5,
                       max_features=1, max_leaf_nodes=2, random_state=1)
```

```
tree_classifier.score(xtrain,ytrain)
```

```
0.6571428571428571
```

```
tree_classifier.score(xtest,ytest)
```

```
0.6888888888888889
```

```
tree_classifier.predict(xtest)
```

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

```
tree_pred=tree_classifier.predict(xtest)
```

```
from sklearn.metrics import confusion_matrix,classification_report
```

```
confusion_matrix(ytest,tree_pred)
```

```
array([[13,  0,  0],
       [ 0, 18,  0],
       [ 0, 14,  0]])
```

```
print(classification_report(ytest,tree_pred))
```

```
                  precision    recall  f1-score   support

               0       1.00      1.00      1.00        13
               1       0.56      1.00      0.72        18
               2       0.00      0.00      0.00        14

        accuracy                           0.69        45
       macro avg       0.52      0.67      0.57        45
    weighted avg       0.51      0.69      0.58        45

/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-d
  _warn_prf(average, modifier, msg_start, len(result))
/usr/local/lib/python3.10/dist-packages/sklearn/metrics/_classification.py:1344: UndefinedMetricWarning: Precision and F-score are ill-d
  _warn_prf(average, modifier, msg_start, len(result))
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  _warn_prf(average, modifier, msg_start, len(result))
```

```
import sklearn
```

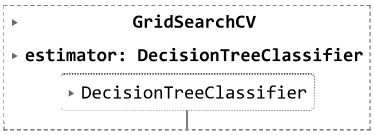
```
sklearn.metrics.get_scorer_names()
```

```
['accuracy',
 'adjusted_mutual_info_score',
 'adjusted_rand_score',
 'average_precision',
 'balanced_accuracy',
 'completeness_score',
 'explained_variance',
 'f1',
 'f1_macro',
 'f1_micro',
 'f1_samples',
 'f1_weighted',
 'fowlkes_mallows_score',
 'homogeneity_score',
 'jaccard',
 'jaccard_macro',
 'jaccard_micro',
 'jaccard_samples',
 'jaccard_weighted',
 'matthews_corrcoef',
 'max_error',
 'mutual_info_score',
 'neg_brier_score',
 'neg_log_loss',
 'neg_mean_absolute_error',
 'neg_mean_absolute_percentage_error',
 'neg_mean_gamma_deviance',
 'neg_mean_poisson_deviance',
 'neg_mean_squared_error',
 'neg_mean_squared_log_error',
 'neg_median_absolute_error',
 'neg_negative_likelihood_ratio',
 'neg_root_mean_squared_error',
 'normalized_mutual_info_score',
 'positive_likelihood_ratio',
 'precision',
 'precision_macro',
 'precision_micro',
 'precision_samples',
 'precision_weighted',
 'r2',
 'rand_score',
 'recall',
 'recall_macro',
 'recall_micro',
 'recall_samples',
 'recall_weighted',
 'roc_auc',
 'roc_auc_ovo',
 'roc_auc_ovo_weighted',
 'roc_auc_ovr',
 'roc_auc_ovr_weighted',
 'top_k_accuracy',
 'v_measure_score']
```

```
param_dict = {"criterion":['gini','entropy'],"max_depth":[1,2,3,4,5,6,7,None]}
```

```
from sklearn.model_selection import GridSearchCV
```

```
grid = GridSearchCV(tree_classifier,param_grid=param_dict,n_jobs=-1)
grid
```




```
grid.fit(xtrain,ytrain)
```

```
GridSearchCV
estimator: DecisionTreeClassifier
DecisionTreeClassifier
```

```
grid.best_params_
```

```
{'criterion': 'gini', 'max_depth': 1}
```

```
grid.best_score_
```

```
0.6761904761904761
```

```
grid_pred2=grid.predict(xtest)
```

```
accuracy_score(ytest,grid_pred2)*100
```

```
68.88888888888889
```

```
from sklearn.metrics import confusion_matrix,classification_report
```

```
confusion_matrix(ytest,grid_pred2)
```

```
array([[13,  0,  0],
       [ 0, 18,  0],
       [ 0, 14,  0]])
```

```
print(classification_report(ytest,grid_pred2))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        13
           1       0.56      1.00      0.72        18
           2       0.00      0.00      0.00        14

    accuracy                           0.69        45
   macro avg       0.52      0.67      0.57        45
weighted avg       0.51      0.69      0.58        45

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```

```
from sklearn.neighbors import KNeighborsClassifier
```

```
knn = KNeighborsClassifier(n_neighbors=5,
    weights='uniform',
    algorithm='kd_tree',
    leaf_size=30,
    p=2,
    metric='minkowski',
    n_jobs=-1)
```

```
knn.fit(xtrain,ytrain)
```

```
KNeighborsClassifier
KNeighborsClassifier(algorithm='kd_tree', n_jobs=-1)
```

```
knn.score(xtrain,ytrain)
```

```
0.9809523809523809
```

```
knn.score(xtest,ytest)
```

```
0.9555555555555556
```

```
knn_pred=knn.predict(xtest)
```

```
accuracy_score(ytest,knn_pred)
```

```
0.9555555555555556
```

```
confusion_matrix(ytest,knn_pred)
```

```
array([[13,  0,  0],
       [ 0, 17,  1],
       [ 0,  1, 13]])
```

```
accuracy_score(ytest,knn_pred)
```

```
0.9555555555555556
```

```
print(classification_report(ytest,knn_pred))
```

```
                  precision    recall  f1-score   support

               0       1.00      1.00      1.00        13
               1       0.94      0.94      0.94        18
               2       0.93      0.93      0.93        14

        accuracy                           0.96        45
       macro avg       0.96      0.96      0.96        45
    weighted avg       0.96      0.96      0.96        45
```

```
from sklearn.ensemble import RandomForestClassifier
```

```
RFC=RandomForestClassifier(n_estimators=300,criterion='gini',
    max_depth=17,
    min_samples_split=2,
    min_samples_leaf=1,
    max_features='sqrt',
    max_leaf_nodes=2,
    min_impurity_decrease=0.1,
    bootstrap=True,
    oob_score=False,
    n_jobs=-1,
    random_state=1,
    ccp_alpha=0.01,
    max_samples=3)
```

```
RFC.fit(xtrain,ytrain)
```

```
▾                        RandomForestClassifier
RandomForestClassifier(ccp_alpha=0.01, max_depth=17, max_leaf_nodes=2,
                       max_samples=3, min_impurity_decrease=0.1,
                       n_estimators=300, n_jobs=-1, random_state=1)
```

```
RFC.score(xtrain,ytrain)
```

```
0.9333333333333333
```

```
RFC.score(xtest,ytest)
```

```
0.7777777777777778
```

```
RFC.get_params()
```

```
{'bootstrap': True,
 'ccp_alpha': 0.01,
 'class_weight': None,
 'criterion': 'gini',
 'max_depth': 17,
 'max_features': 'sqrt',
 'max_leaf_nodes': 2,
 'max_samples': 3,
 'min_impurity_decrease': 0.1,
 'min_samples_leaf': 1,
```

```
 'min_samples_split': 2,
 'min_weight_fraction_leaf': 0.0,
 'n_estimators': 300,
 'n_jobs': -1,
 'oob_score': False,
 'random_state': 1,
 'verbose': 0,
 'warm_start': False}
```

```
RFC_pred = RFC.predict(xtest)
```

```
accuracy_score(ytest,RFC_pred)
```

```
0.7777777777777778
```

```
confusion_matrix(ytest,RFC_pred)
```

```
array([[13,  0,  0],
       [ 0, 10,  8],
       [ 0,  2, 12]])
```

```
print(classification_report(ytest,RFC_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        13
           1       0.83      0.56      0.67        18
           2       0.60      0.86      0.71        14

    accuracy                           0.78        45
   macro avg       0.81      0.80      0.79        45
weighted avg       0.81      0.78      0.78        45
```

```
import xgboost as xg
```

```
xg_model = xg.XGBClassifier(gamma=0.01,
             learning_rate=0.01, max_bin=4,
             max_depth=15,
             max_leaves=2, min_child_weight=2,n_estimators=300, n_jobs=-1,objective='multi:softprob',
            random_state=1)
```

```
xg_model.fit(xtrain,ytrain)
```

```
▾                                XGBClassifier
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None, feature_types=None,
              gamma=0.01, gpu_id=None, grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=0.01, max_bin=4,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=15, max_leaves=2,
              min_child_weight=2, missing=nan, monotone_constraints=None,
              n_estimators=300, n_jobs=-1, num_parallel_tree=None,
              objective='multi:softprob', predictor=None, ...)
```

```
xg_model.score(xtrain,ytrain)
```

```
0.9904761904761905
```

```
xg_model.score(xtest,ytest)
```

```
0.8888888888888888
```

```
xg_pred =xg_model.predict(xtest)
```

```
accuracy_score(ytest,xg_pred)
```

```
0.8888888888888888
```

```
confusion_matrix(ytest,xg_pred)
```

```
array([[13,  0,  0],
       [ 0, 18,  0],
       [ 0,  5,  9]])
```

```
print(classification_report(ytest,xg_pred))
```

```
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        13
           1       0.78      1.00      0.88        18
           2       1.00      0.64      0.78        14

    accuracy                           0.89        45
   macro avg       0.93      0.88      0.89        45
weighted avg       0.91      0.89      0.88        45
```

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