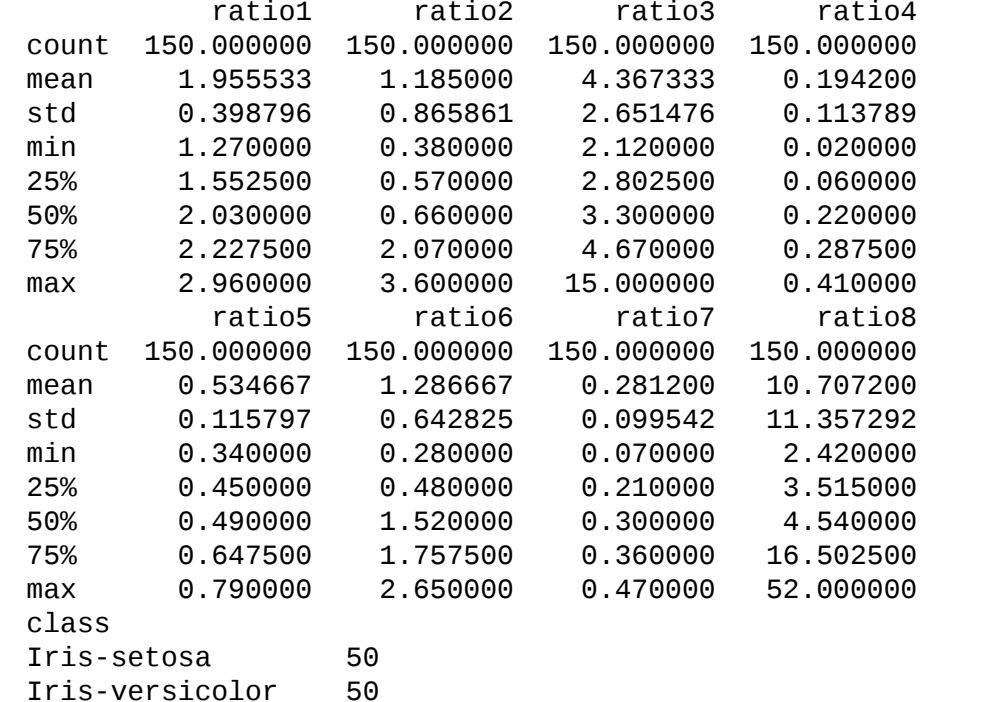
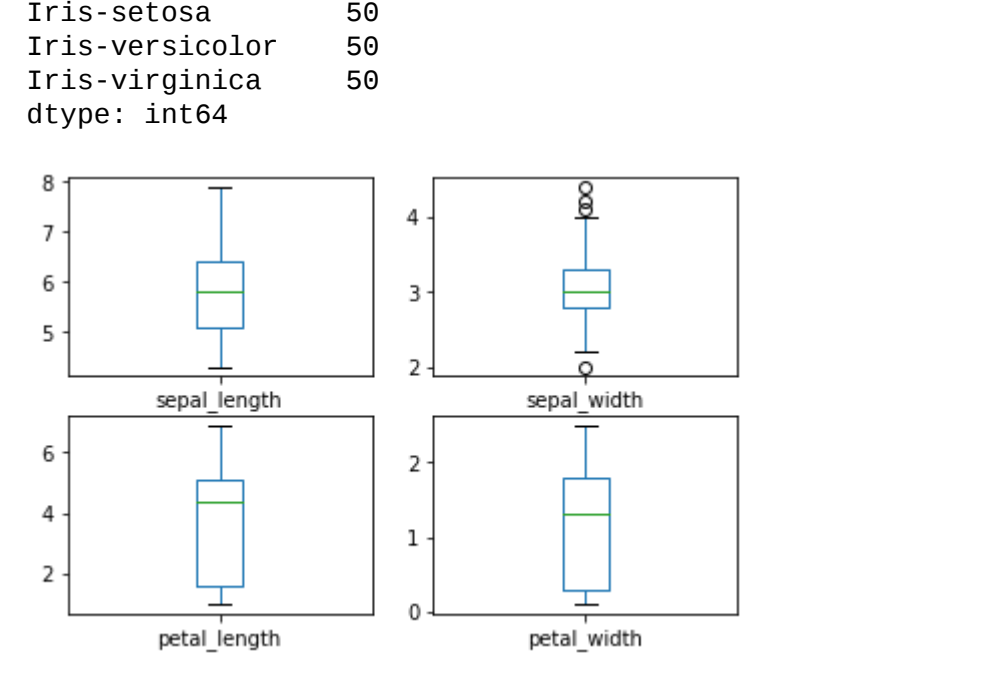
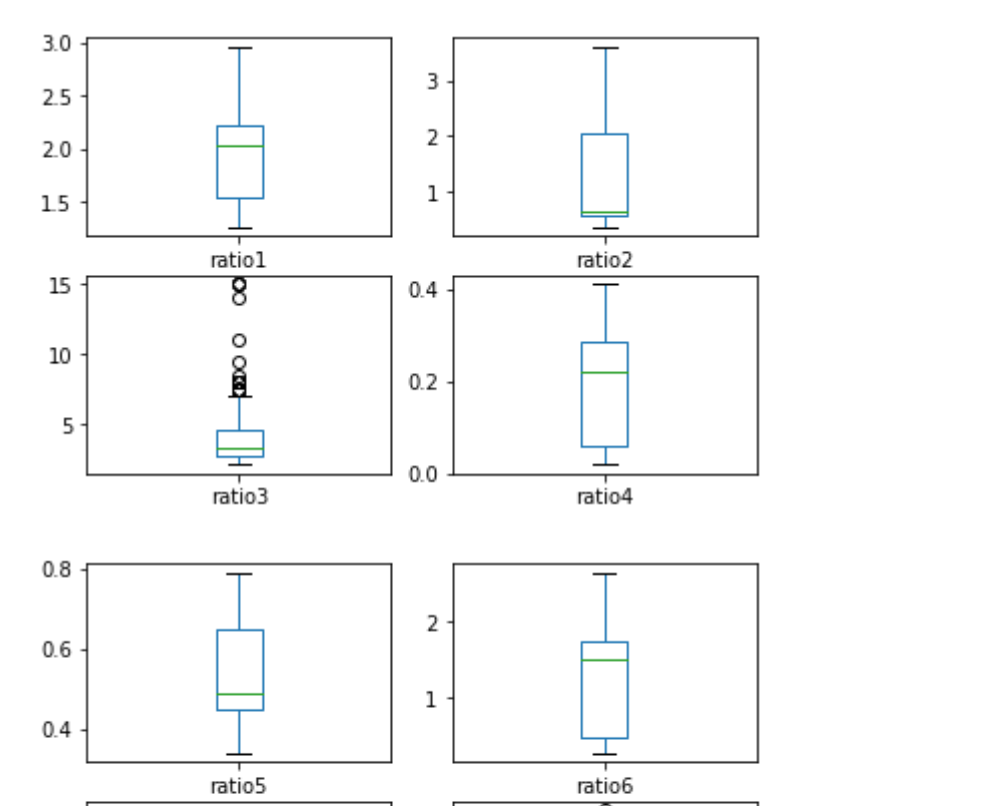
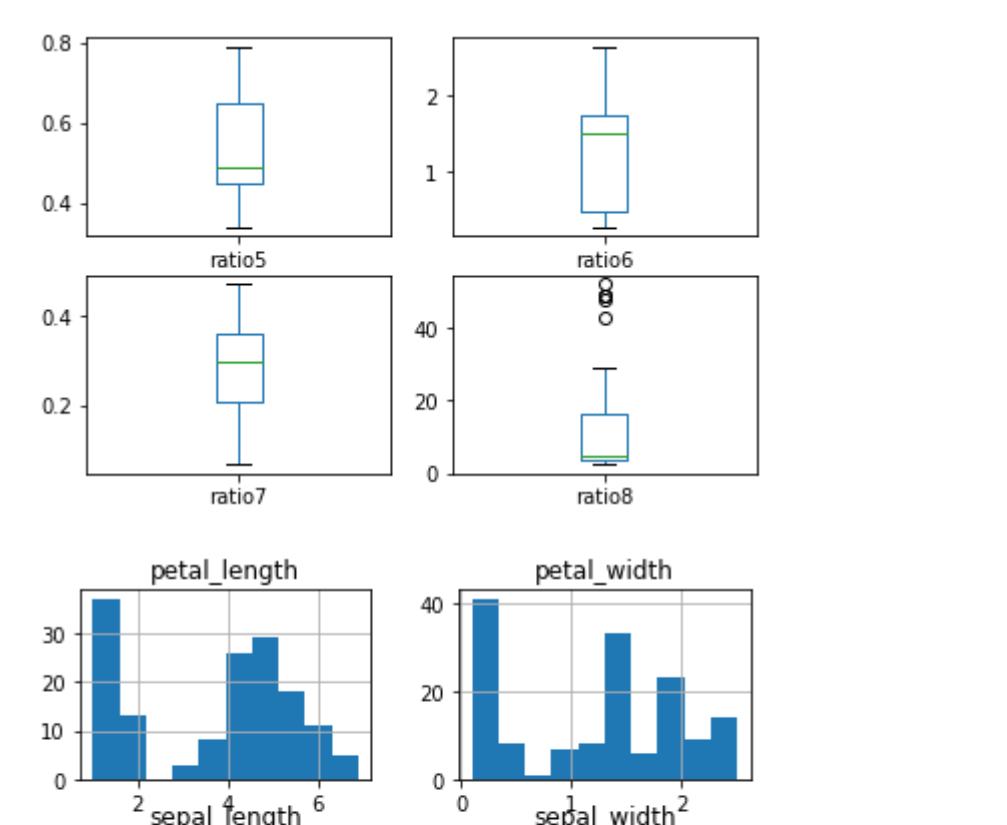
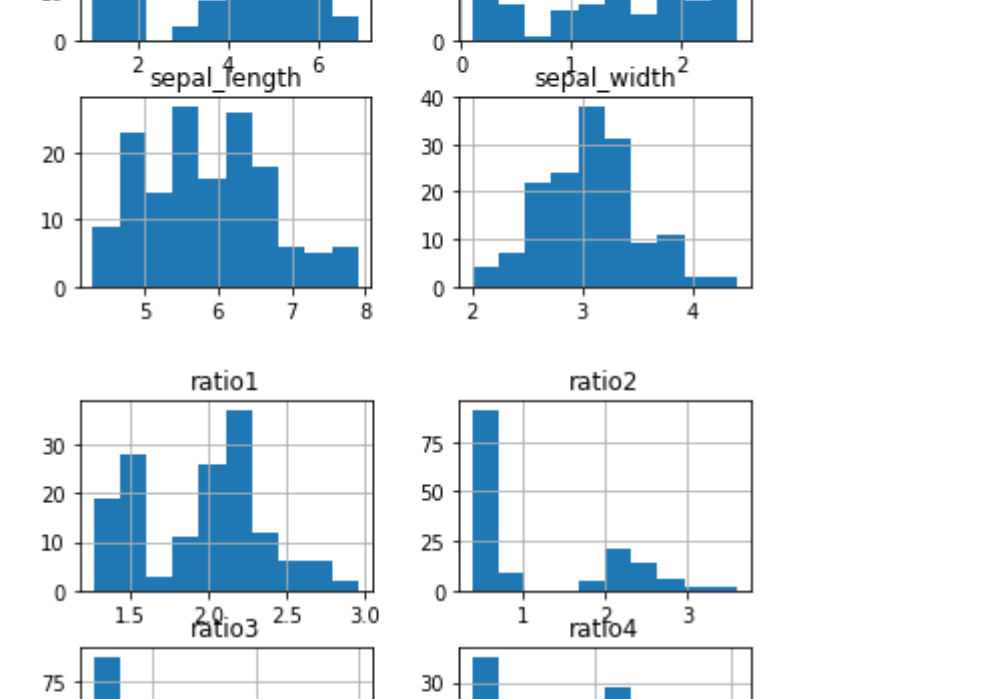
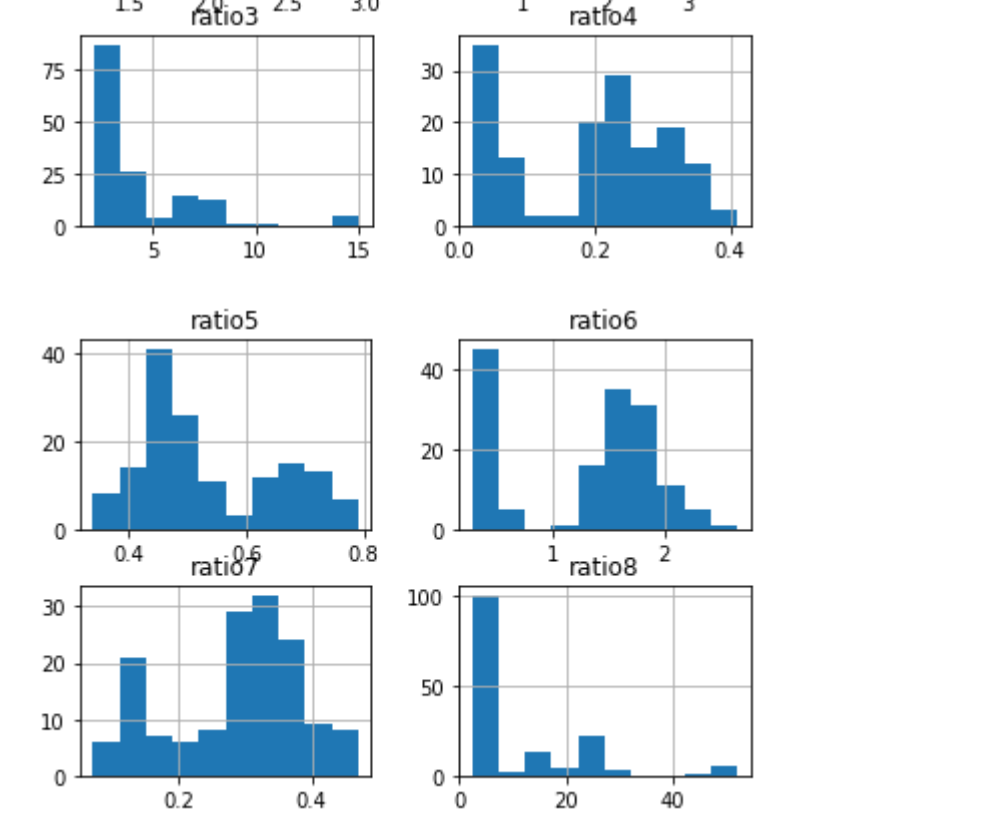
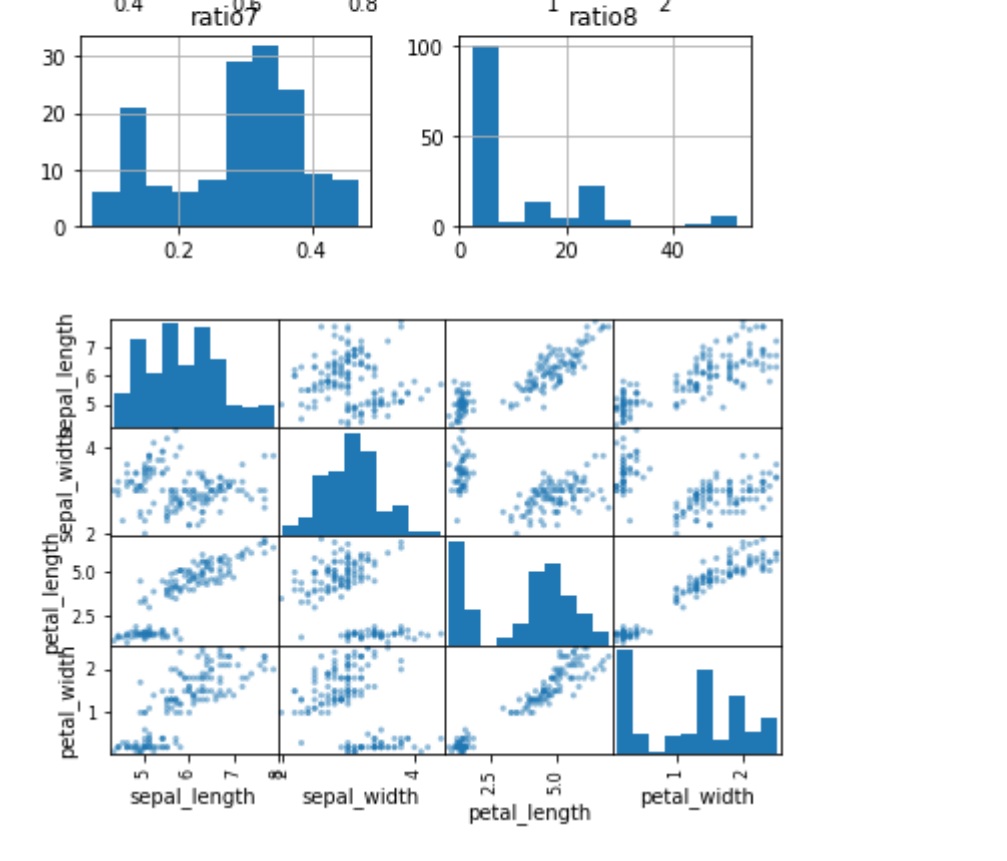
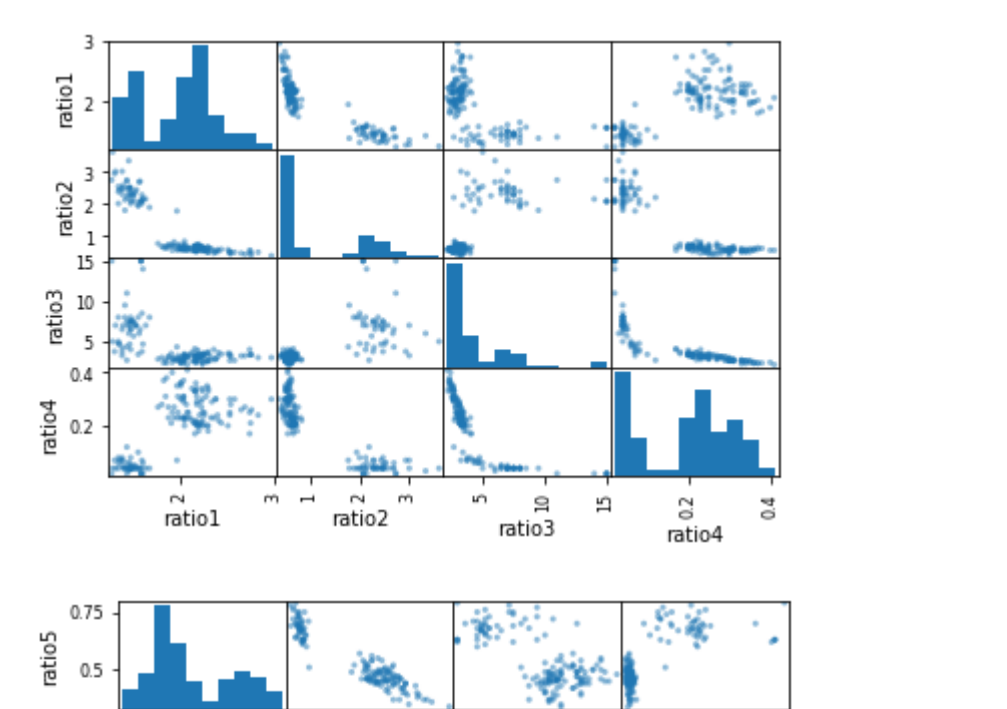
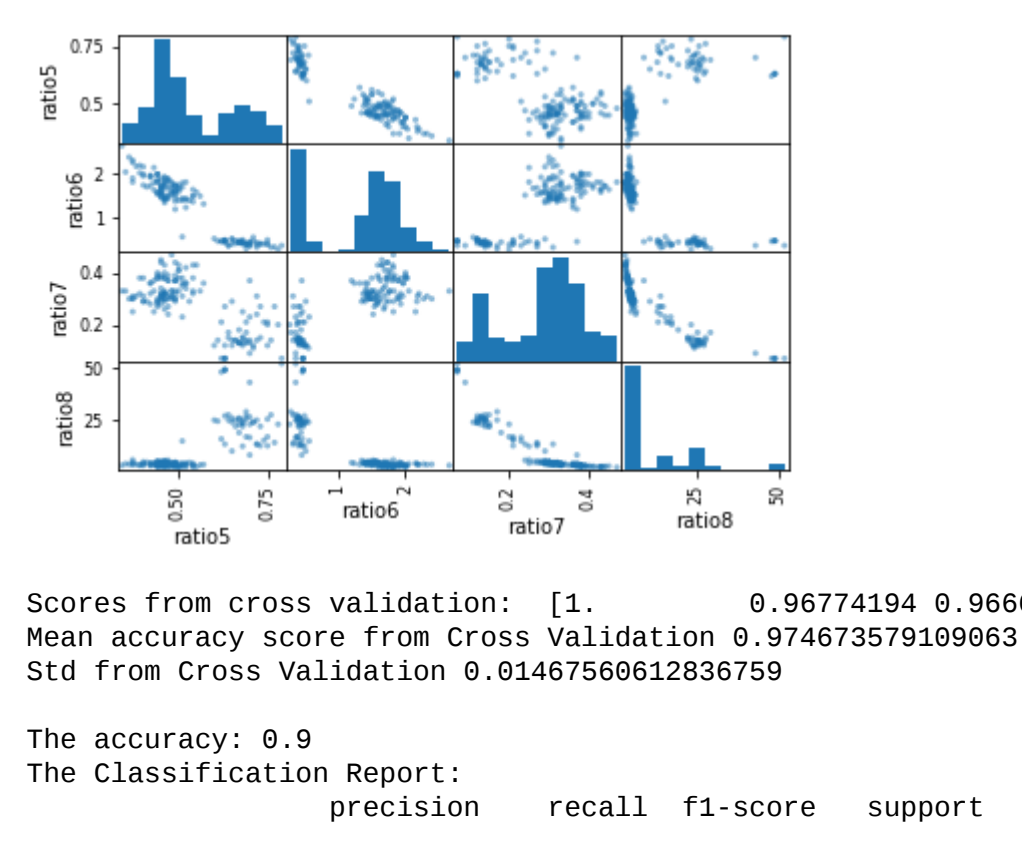
In [2]:

```python
import warnings
warnings.filterwarnings("ignore")

# 1. Load necessary libraries
import sqlalchemy as sa
import pandas as pd
import pickle as pk
from pandas.plotting import scatter_matrix
from matplotlib import pyplot
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import cross_val_score
from sklearn.metrics import accuracy_score
from sklearn.metrics import classification_report
from sklearn.metrics import confusion_matrix

##Load DataSet from CSV file
def loadFrCSVFile(filename):
    print(filename)
    col_names = ['sepal_length', 'sepal_width', 'petal_length', 'petal_width', 'class']
    dataset = pd.read_csv(filename, names=col_names)
    return dataset

##Import DataSet to a MySQL Database
def import2MySQL(dataset):
    engine_str = (
            'mysql+pymysql://{user}:{password}@{server}/{database}'.format(
            user      =  'root',
            password  =  'root888',
            server    =  'localhost',
            database  =  'DataScienceRecipes'))

    engine = sa.create_engine(engine_str)
    conn = engine.connect()

    #check whether connection is Successful or not
    #if (conn): print("MySQL Connection is Successful ... ... ...")
    #else:      print("MySQL Connection is not Successful ... ... ...")

    dataset.to_sql(name='irisdata', con=engine, schema='datasciencerecipes',
                   if_exists = 'replace', chunksize = 1000, index=False)
    conn.close()

##Load DataSet from MySQL Database to Pandas a DataFrame
def loadDataSetFrMySQLTable():
    engine_str = (
            'mysql+pymysql://{user}:{password}@{server}/{database}'.format(
            user      =  'root',
            password  =  'root888',
            server    =  'localhost',
            database  =  'datasciencerecipes'))

    engine = sa.create_engine(engine_str)
    conn = engine.connect()

    #check whether connection is Successful or not
    #if (conn): print("MySQL Connection is Successful ... ... ...")
    #else:      print("MySQL Connection is not Successful ... ... ...")

    # MySQL Query with few generated Attributes/Features
    query = '''
    SELECT  sepal_length,
            sepal_width,
            petal_length,
            petal_width,
            round(sepal_length/sepal_width,2) as ratio1,
            round(sepal_width/petal_length,2) as ratio2,
            round(petal_length/petal_width,2) as ratio3,
            round(petal_width/sepal_length,2) as ratio4,
            round(sepal_width/sepal_length,2) as ratio5,
            round(petal_length/sepal_width,2) as ratio6,
            round(petal_width/petal_length,2) as ratio7,
            round(sepal_length/petal_width,2) as ratio8,
            class
    FROM irisdata;
    '''
    query_result = conn.execute(query)
    dataset =  pd.DataFrame(query_result.fetchall(),
                            columns =  query_result.keys())
    print('DataFrame Size',dataset.shape);
    print('ROW',dataset.shape[0]);print('COLUMN',dataset.shape[1]);
    conn.close()
    return dataset

## Data Summarisation (Descriptive Statistics)
def summariseDataset(dataset):
    cols1 = ['sepal_length','sepal_width','petal_length','petal_width']
    cols2 = ['ratio1','ratio2','ratio3','ratio4']
    cols3 = ['ratio5','ratio6','ratio7','ratio8']
    # shape
    print(dataset[cols1].shape)
    print(dataset[cols2].shape)
    print(dataset[cols3].shape)
    # head
    print(dataset[cols1].head(5))
    print(dataset[cols2].head(5))
    print(dataset[cols3].head(5))
    # descriptions
    print(dataset[cols1].describe())
    print(dataset[cols2].describe())
    print(dataset[cols3].describe())
    # class distribution
    print(dataset.groupby('class').size())

## Data Visualisation to understand Data
def visualiseDataset(dataset):
    cols1 = ['sepal_length','sepal_width','petal_length','petal_width']
    cols2 = ['ratio1','ratio2','ratio3','ratio4']
    cols3 = ['ratio5','ratio6','ratio7','ratio8']

    # box and whisker plots
    dataset[cols1].plot(kind='box', subplots=True, layout=(2,2), sharex=False, sharey=False)
    pyplot.show()
    dataset[cols2].plot(kind='box', subplots=True, layout=(2,2), sharex=False, sharey=False)
    pyplot.show()
    dataset[cols3].plot(kind='box', subplots=True, layout=(2,2), sharex=False, sharey=False)
    pyplot.show()
    # histograms
    dataset[cols1].hist()
    pyplot.show()
    dataset[cols2].hist()
    pyplot.show()
    dataset[cols3].hist()
    pyplot.show()
    # scatter plot matrix
    scatter_matrix(dataset[cols1])
    pyplot.show()
    scatter_matrix(dataset[cols2])
    pyplot.show()
    scatter_matrix(dataset[cols3])
    pyplot.show()

## Data Pre-Processing
def preProcessingData(dataset):

    # 1. Data Cleaning
      # There is no missing value.
      # We could "Outlier treatment" but nothing was done here.

    # 2. Feature Selection
    cols_X = ['sepal_length','sepal_width','petal_length','petal_width',
              'ratio1','ratio2','ratio3','ratio4',
              'ratio5','ratio6','ratio7','ratio8']
    cols_Y = 'class'
    seed = 7

    # 3. Data Transform - Split out train : test datasets
    train_X, test_X, train_Y, test_Y = train_test_split(dataset.loc[:, cols_X],
                                                        dataset.loc[:, cols_Y],
                                                        test_size=0.20,
                                                        random_state = seed
                                                        )
    return train_X, test_X, train_Y, test_Y

## Applied Machine Learning Algorithm ... ... ...
def evaluateAlgorithm(train_X, test_X, train_Y, test_Y):

    ##Machine Lreaning Algorithm, Parameter setting
    model_LR = LogisticRegression()

    ##Cross Validation
    cv_results = cross_val_score(model_LR, train_X, train_Y, cv = 4,
                                 scoring='accuracy', n_jobs = -1, verbose = 0)

    print("\nScores from cross validation: ", cv_results)
    print("Mean accuracy score from Cross Validation", cv_results.mean())
    print("Std from Cross Validation", cv_results.std())

    ##Training & Fitting Algorithm with training Dataset
    trained_Model = model_LR.fit(train_X, train_Y)

    ##Evaluation of trained Algorithm (or Model) and result
    pred_Class          = trained_Model.predict(test_X)
    acc         = accuracy_score(test_Y, pred_Class)
    classReport = classification_report(test_Y, pred_Class)
    confMatrix  = confusion_matrix(test_Y, pred_Class)
    print('\nThe accuracy: {}'.format(acc))
    print('The Classification Report:\n {}'.format(classReport))
    print('The Confusion Matrix:\n {}'.format(confMatrix))

    #Save the trained Model
    with open('trainedModel_LR.pickle', 'wb') as f:
        pk.dump(trained_Model, f)

## Load a (new or existing ) dataset to make prediction
def loadPredictionDataset():
    engine_str = (
            'mysql+pymysql://{user}:{password}@{server}/{database}'.format(
            user      =  'root',
            password  =  'root888',
            server    =  'localhost',
            database  =  'datasciencerecipes'))

    engine = sa.create_engine(engine_str)
    conn = engine.connect()

    #check whether connection is Successful or not
    #if (conn): print("MySQL Connection is Successful ... ... ...")
    #else:      print("MySQL Connection is not Successful ... ... ...")

    # MySQL Query - New Query is required for Prediction DataSet
    query = '''
    SELECT  sepal_length,
            sepal_width,
            petal_length,
            petal_width,
            round(sepal_length/sepal_width,2) as ratio1,
            round(sepal_width/petal_length,2) as ratio2,
            round(petal_length/petal_width,2) as ratio3,
            round(petal_width/sepal_length,2) as ratio4,
            round(sepal_width/sepal_length,2) as ratio5,
            round(petal_length/sepal_width,2) as ratio6,
            round(petal_width/petal_length,2) as ratio7,
            round(sepal_length/petal_width,2) as ratio8
    FROM irisdata;
    '''
    query_result = conn.execute(query)
    dataset =  pd.DataFrame(query_result.fetchall(),
                            columns =  query_result.keys())
    conn.close()
    return dataset

## Load the trained model and make prediction
def loadTrainedModelForPrediction(pred_dataset):
    f = open('trainedModel_LR.pickle', 'rb')
    model = pk.load(f); f.close();
    pred_Class = model.predict(pred_dataset)
    pred_dataset.loc[:, 'classResult'] = pred_Class
    return pred_dataset

## Finalise the results and update the audiance
def finaliseResult(result):

    #Save Result in a CSV file
    print("Save Result in a CSV file ... ... ...")
    result.to_csv('finalResult.csv', index = False)

    #Save Result in a MySQl Table
    engine_str = (
            'mysql+pymysql://{user}:{password}@{server}/{database}'.format(
            user      =  'root',
            password  =  'root888',
            server    =  'localhost',
            database  =  'datasciencerecipes'))

    engine = sa.create_engine(engine_str)
    conn = engine.connect()

    #check whether connection is Successful or not
    #if (conn): print("MySQL Connection is Successful ... ... ...")
    #else:      print("MySQL Connection is not Successful ... ... ...")

    print("Save Result in a MySQl Table ... ... ...")
    result.to_sql(name='irisresult', con=engine, schema='datasciencerecipes',
                  if_exists = 'replace', chunksize = 1000, index=False)
    conn.close()

# End-to-End Applied Machine Learning Recipes for Beginners and App-Developers
if __name__ == '__main__':
    filename = 'iris.data.csv'

    # 2. Load Dataset to which Machine Learning Algorithm to be applied
    dataset = loadFrCSVFile(filename)
    import2MySQL(dataset)
    dataset = loadDataSetFrMySQLTable()

    # 3. Summarisation of Data to understand dataset (Descriptive Statistics)
    summariseDataset(dataset)

    # 4. Visualisation of Data to understand dataset (Plots, Graphs etc.)
    visualiseDataset(dataset)

    # 5. Data pre-processing and Data transformation (split into train-test datasets)
    train_X, test_X, train_Y, test_Y = preProcessingData(dataset)

    # 6. Application of a Machine Learning Algorithm to training dataset
    evaluateAlgorithm(train_X, test_X, train_Y, test_Y)

    # 7. Load the saved model and apply it to new dataset for prediction
    pred_Dataset = loadPredictionDataset()
    result = loadTrainedModelForPrediction(pred_Dataset)
    finaliseResult(result)

    print('\nEnd-to-End Applied Machine Learning Recipes for Developers\n')
```

```
iris.data.csv
DataFrame Size (150, 13)
ROW 150
COLUMN 13
(150, 4)
(150, 4)
(150, 4)
   sepal_length  sepal_width  petal_length  petal_width
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
   ratio1  ratio2  ratio3  ratio4
0    1.46    2.50     7.0    0.04
1    1.63    2.14     7.0    0.04
2    1.47    2.46     6.5    0.04
3    1.48    2.07     7.5    0.04
4    1.39    2.57     7.0    0.04
   ratio5  ratio6  ratio7  ratio8
0    0.69    0.40    0.14    25.5
1    0.61    0.47    0.14    24.5
2    0.68    0.41    0.15    23.5
3    0.67    0.48    0.13    23.0
4    0.72    0.39    0.14    25.0
       sepal_length  sepal_width  petal_length  petal_width
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
           ratio1      ratio2      ratio3      ratio4
count  150.000000  150.000000  150.000000  150.000000
mean     1.955533    1.185000    4.367333    0.194200
std      0.398796    0.865861    2.651476    0.113789
min      1.270000    0.380000    2.120000    0.020000
25%      1.552500    0.570000    2.802500    0.060000
50%      2.030000    0.660000    3.300000    0.220000
75%      2.227500    2.070000    4.670000    0.287500
max      2.960000    3.600000   15.000000    0.410000
           ratio5      ratio6      ratio7      ratio8
count  150.000000  150.000000  150.000000  150.000000
mean     0.534667    1.286667    0.281200   10.707200
std      0.115797    0.642825    0.099542   11.357292
min      0.340000    0.280000    0.070000    2.420000
25%      0.450000    0.480000    0.210000    3.515000
50%      0.490000    1.520000    0.300000    4.540000
75%      0.647500    1.757500    0.360000   16.502500
max      0.790000    2.650000    0.470000   52.000000
class
Iris-setosa        50
Iris-versicolor    50
Iris-virginica     50
dtype: int64
```

```
Scores from cross validation:  [1.         0.96774194 0.96666667 0.96428571]
Mean accuracy score from Cross Validation 0.974673579109063
Std from Cross Validation 0.01467560612836759

The accuracy: 0.9
The Classification Report:
                  precision    recall  f1-score   support

    Iris-setosa       1.00      1.00      1.00         7
Iris-versicolor       0.91      0.83      0.87        12
 Iris-virginica       0.83      0.91      0.87        11

      micro avg       0.90      0.90      0.90        30
      macro avg       0.91      0.91      0.91        30
   weighted avg       0.90      0.90      0.90        30

The Confusion Matrix:
 [[ 7  0  0]
 [ 0 10  2]
 [ 0  1 10]]
Save Result in a CSV file ... ... ...
Save Result in a MySQl Table ... ... ...

End-to-End Applied Machine Learning Recipes for Developers
```

In [ ]: