ST. JOSEPH'S UNIVERSITY

BANGALORE-560027

ESTD-1882

COMPUTER SCIENCE

PRACTICAL RECORD

(MACHINE LEARNING USING PYTHON)

SUBMITTED BY:

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ST. JOSEPH'S UNIVERSITY

BANGALORE

LABORATORY CERTIFICATE

This is to certify that Smt. / Sri. Adelicia Sequeira has satisfactorily completed the course of laboratory assignments in Machine Learning Using Python prescribed by St. Joseph's University for the 2nd Semester Master's degree course in MSc. Computer Science for the year 2022-23.

Teacher In-Charge

PG Coordinator

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Date of Exam: 17.04.2023

INDEX

1. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.

```
import csv

a = []

print("\n The Given Training Data Set")

with open('enjoysport.csv', 'r') as csvFile:
    reader = csv.reader(csvFile)
    for row in reader:
        a.append (row)
        print(row)

num_attributes = len(a[0])-1

print("\n The initial value of hypothesis: ")

S = ['0'] * num_attributes

G = ['?'] * num_attributes

print ("\n The most specific hypothesis S0 : [0,0,0,0,0,0]")

print (" \n The most general hypothesis G0 : [?,?,?,?,?,?]")

for j in range(0,num_attributes):
    S[j]=a[0][j]

print("\n Candidate Elimination algorithm Hypotheses Version Space
Computation\n")

temp=[]

for i in range(0,len(a)):
    if a[i][num_attributes]=='Yes':
        for j in range(0,num_attributes):
            if a[i][j]!=S[j]:
                S[j]='?'
        for j in range(0,num_attributes):
            for k in range(1,len(temp)):
                if temp[k][j]!='?' and temp[k][j]!=S[j]:
                    del temp[k]
```

```
        print("------------------------------------------------------------------
----------- ")
        print(" For Training Example No :{0} the hypothesis is S{0}
".format(i+1),S)
        if (len(temp)==0):
            print(" For Training Example No :{0} the hypothesis is G{0}
".format(i+1),G)
        else:
            print(" For  Positive Training Example No :{0} the hypothesis is
G{0}".format(i+1),temp)
    if a[i][num_attributes]=='No':
        for j in range(0,num_attributes):
            if S[j] != a[i][j] and S[j]!= '?':
                G[j]=S[j]
                temp.append(G)
                G = ['?'] * num_attributes

        print("------------------------------------------------------------------
----------- ")

        print(" For Training Example No :{0} the hypothesis is S{0}
".format(i+1),S)

        print(" For Training Example No :{0} the hypothesis is
G{0}".format(i+1),temp)
```

Output

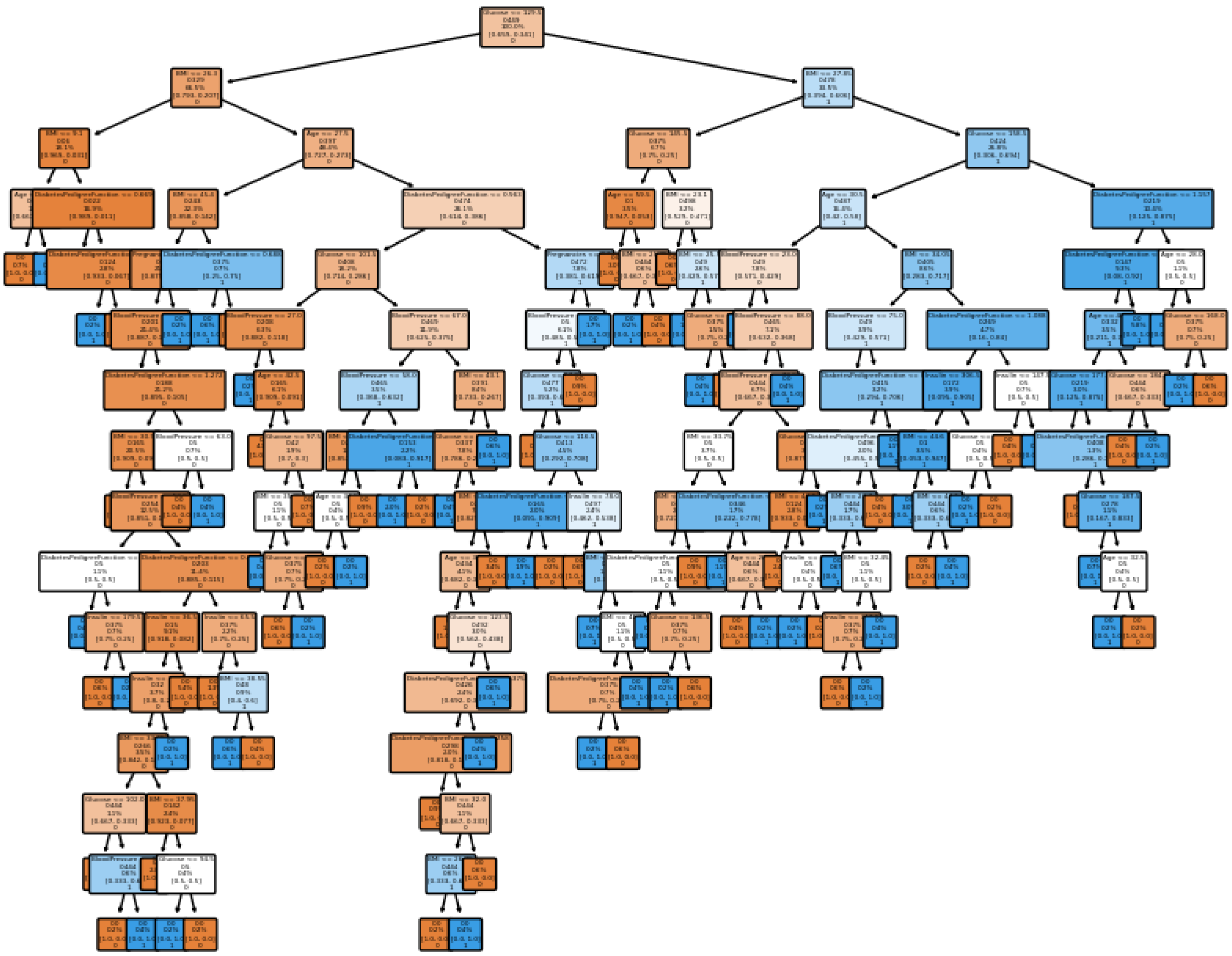
```
The Given Training Data Set
['sunny', 'warm', 'normal', 'strong', 'warm', 'same', 'Yes']
['sunny', 'warm', 'high', 'strong', 'warm', 'same', 'Yes']
['rainy', 'cold', 'high', 'strong', 'warm', 'change', 'No']
['sunny', 'warm', 'high', 'strong', 'cool', 'change', 'Yes']

 The initial value of hypothesis:

 The most specific hypothesis S0 : [0,0,0,0,0,0]

 The most general hypothesis G0 : [?,?,?,?,?,?]

 Candidate Elimination algorithm Hypotheses Version Space Computation

----------------------------------------------------------------------------
 For Training Example No :1 the hypothesis is S1  ['sunny', 'warm', 'normal',
'strong', 'warm', 'same']
 For Training Example No :1 the hypothesis is G1  ['?', '?', '?', '?', '?', '?']
----------------------------------------------------------------------------
 For Training Example No :2 the hypothesis is S2  ['sunny', 'warm', '?',
'strong', 'warm', 'same']
 For Training Example No :2 the hypothesis is G2  ['?', '?', '?', '?', '?', '?']
----------------------------------------------------------------------------
 For Training Example No :3 the hypothesis is S3  ['sunny', 'warm', '?',
'strong', 'warm', 'same']
 For Training Example No :3 the hypothesis is G3 [['sunny', '?', '?', '?', '?',
'?'], ['?', 'warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', 'same']]
----------------------------------------------------------------------------
 For Training Example No :4 the hypothesis is S4  ['sunny', 'warm', '?',
'strong', '?', '?']
 For  Positive Training Example No :4 the hypothesis is G4 [['sunny', '?', '?',
'?', '?', '?'], ['?', 'warm', '?', '?', '?', '?']]
```

2. Demonstrate the working of the <u>Decision Tree</u>. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

```
import pandas as pd # Load libraries
from sklearn.tree import DecisionTreeClassifier # Import Decision Tree Classifier
from sklearn.model_selection import train_test_split # Import train_test_split
function
from sklearn import metrics #Import scikit-learn metrics module for accuracy
calculation
from sklearn import tree #Import scikit-learn tree module for plotting
import matplotlib.pyplot as plt #Import matplotlib for plotting

# load dataset
pima = pd.read_csv("diabetes.csv")
pima.columns

#split dataset in features and target variable
feature_cols = ['Pregnancies', 'Insulin', 'BMI', 'Age', 'Glucose',
'BloodPressure', 'DiabetesPedigreeFunction']
X = pima[feature_cols] # Features
y = pima.Outcome # Target variable

# Split dataset into training set and test set
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,
random_state=1) # 70% training and 30% test

# Create Decision Tree classifer object
clf = DecisionTreeClassifier()

# Train Decision Tree Classifer
clf = clf.fit(X_train,y_train)

#Predict the response for test dataset
y_pred = clf.predict(X_test)

# Model Accuracy, how often is the classifier correct?
print("Accuracy:",metrics.accuracy_score(y_test, y_pred))

plt.figure(figsize=(10,8))
tree.plot_tree(clf, feature_names=feature_cols, class_names=['0','1'], label=all,
filled=True, proportion=True, rounded=True, fontsize=3)
print('Number of correct predictions are')
diff = list(y_pred - y_test)
print(diff.count(0)," out of ",len(diff))
```

Output

```
Index(['Pregnancies', 'Glucose', 'BloodPressure', 'SkinThickness', 'Insulin',
       'BMI', 'DiabetesPedigreeFunction', 'Age', 'Outcome'],
      dtype='object')

Accuracy: 0.683982683982684
```



3. *Build an __Artificial Neural Network__ by testing the same using appropriate data sets.*

```
import numpy as np
import pandas as pd
from matplotlib import pyplot as plt

data = pd.read_csv('digit-recognizer/train.csv')

data = np.array(data)
m, n = data.shape
np.random.shuffle(data) # shuffle before splitting into dev and training sets

data_dev = data[0:1000].T
Y_dev = data_dev[0]
X_dev = data_dev[1:n]
X_dev = X_dev / 255.

data_train = data[1000:m].T
Y_train = data_train[0]
X_train = data_train[1:n]
X_train = X_train / 255.
_,m_train = X_train.shape

Y_train

def init_params():
    W1 = np.random.rand(10, 784) - 0.5
    b1 = np.random.rand(10, 1) - 0.5
    W2 = np.random.rand(10, 10) - 0.5
    b2 = np.random.rand(10, 1) - 0.5
    return W1, b1, W2, b2

def ReLU(Z):
    return np.maximum(Z, 0)

def softmax(Z):
    A = np.exp(Z) / sum(np.exp(Z))
    return A

def forward_prop(W1, b1, W2, b2, X):
    Z1 = W1.dot(X) + b1
    A1 = ReLU(Z1)
    Z2 = W2.dot(A1) + b2
    A2 = softmax(Z2)
```

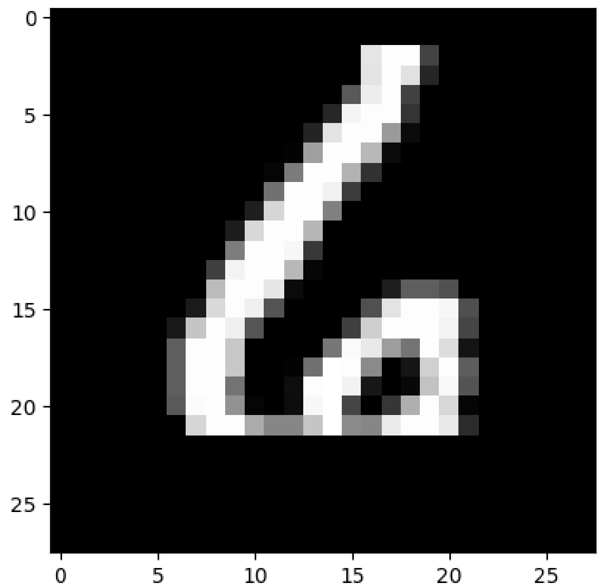
```
    return Z1, A1, Z2, A2

def ReLU_deriv(Z):
    return Z > 0

def one_hot(Y):
    one_hot_Y = np.zeros((Y.size, Y.max() + 1))
    one_hot_Y[np.arange(Y.size), Y] = 1
    one_hot_Y = one_hot_Y.T
    return one_hot_Y

def backward_prop(Z1, A1, Z2, A2, W1, W2, X, Y):
    one_hot_Y = one_hot(Y)
    dZ2 = A2 - one_hot_Y
    dW2 = 1 / m * dZ2.dot(A1.T)
    db2 = 1 / m * np.sum(dZ2)
    dZ1 = W2.T.dot(dZ2) * ReLU_deriv(Z1)
    dW1 = 1 / m * dZ1.dot(X.T)
    db1 = 1 / m * np.sum(dZ1)
    return dW1, db1, dW2, db2

def update_params(W1, b1, W2, b2, dW1, db1, dW2, db2, alpha):
    W1 = W1 - alpha * dW1
    b1 = b1 - alpha * db1
    W2 = W2 - alpha * dW2
    b2 = b2 - alpha * db2
    return W1, b1, W2, b2

def get_predictions(A2):
    return np.argmax(A2, 0)

def get_accuracy(predictions, Y):
    print(predictions, Y)
    return np.sum(predictions == Y) / Y.size

def gradient_descent(X, Y, alpha, iterations):
    W1, b1, W2, b2 = init_params()
    for i in range(iterations):
        Z1, A1, Z2, A2 = forward_prop(W1, b1, W2, b2, X)
        dW1, db1, dW2, db2 = backward_prop(Z1, A1, Z2, A2, W1, W2, X, Y)
        W1, b1, W2, b2 = update_params(W1, b1, W2, b2, dW1, db1, dW2, db2, alpha)
        if i % 10 == 0:
            print("Iteration: ", i)
            predictions = get_predictions(A2)
            print(get_accuracy(predictions, Y))
```

```
    return W1, b1, W2, b2
W1, b1, W2, b2 = gradient_descent(X_train, Y_train, 0.10, 500)

def make_predictions(X, W1, b1, W2, b2):
    _, _, _, A2 = forward_prop(W1, b1, W2, b2, X)
    predictions = get_predictions(A2)
    return predictions

def test_prediction(index, W1, b1, W2, b2):
    current_image = X_train[:, index, None]
    prediction = make_predictions(X_train[:, index, None], W1, b1, W2, b2)
    label = Y_train[index]
    print("Prediction: ", prediction)
    print("Label: ", label)

    current_image = current_image.reshape((28, 28)) * 255
    plt.gray()
    plt.imshow(current_image, interpolation='nearest')
    plt.show()

test_prediction(0, W1, b1, W2, b2)
test_prediction(1, W1, b1, W2, b2)
test_prediction(2, W1, b1, W2, b2)
test_prediction(3, W1, b1, W2, b2)

dev_predictions = make_predictions(X_dev, W1, b1, W2, b2)
get_accuracy(dev_predictions, Y_dev)
```

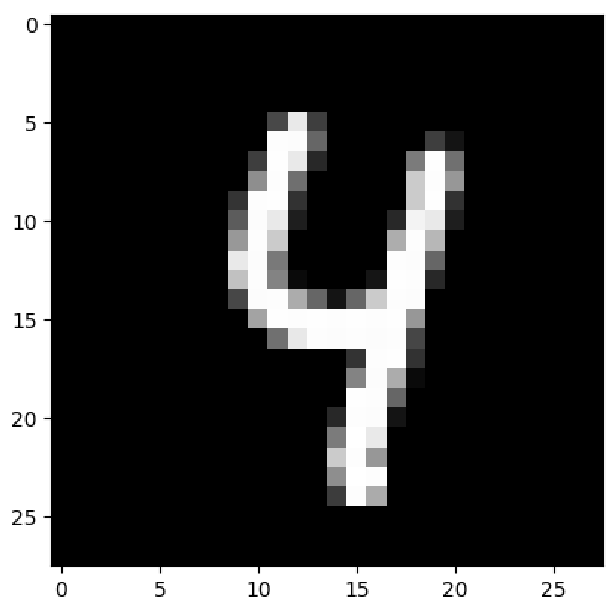
Output

```
array([6, 4, 7, ..., 4, 1, 0], dtype=int64)

Output exceeds the size limit. Open the full output data in a text editor
Iteration:  0
[6 2 6 ... 6 6 6] [6 4 7 ... 4 1 0]
0.09565853658536586
Iteration:  10
[4 8 9 ... 8 9 1] [6 4 7 ... 4 1 0]
0.1646829268292683
Iteration:  20
[4 8 9 ... 8 6 0] [6 4 7 ... 4 1 0]
0.2276829268292683
Iteration:  30
[4 8 9 ... 8 6 0] [6 4 7 ... 4 1 0]
0.2939512195121951
Iteration:  40
[4 4 9 ... 8 6 0] [6 4 7 ... 4 1 0]
0.3631951219512195
Iteration:  50
[4 4 3 ... 8 6 0] [6 4 7 ... 4 1 0]
0.4305121951219512
Iteration:  60
[6 4 3 ... 7 6 0] [6 4 7 ... 4 1 0]
0.48236585365853657
Iteration:  70
[6 4 3 ... 9 6 0] [6 4 7 ... 4 1 0]
0.5249512195121951
Iteration:  80
...
0.8472439024390244
Iteration:  490
[6 4 2 ... 9 8 0] [6 4 7 ... 4 1 0]
0.8479756097560975
```

```
Prediction:  [6]
Label:  6
```




```
Prediction:  [4]
Label:  4
```



```
[8 2 8 6 3 9 5 3 5 6 1 4 6 0 9 0 7 5 1 1 9 3 3 3 1 2 1 4 2 7 4 8 9 4 6 7 1
 7 9 7 5 1 1 3 9 1 1 9 1 5 2 4 8 4 3 6 8 6 6 9 8 9 7 6 9 1 8 1 6 4 4 6 5 3
 6 5 1 3 2 5 9 1 9 7 6 3 4 3 4 3 5 6 2 2 2 6 9 6 5 5 8 1 5 7 0 9 6 5 0 2 2
 3 5 5 0 8 6 7 2 2 1 9 8 9 9 2 1 2 8 4 8 6 0 8 8 0 5 7 7 4 9 3 5 1 9 6 2 1
 9 9 5 4 1 1 2 0 2 7 3 1 6 5 7 3 6 4 0 2 4 1 3 1 5 9 0 6 9 9 8 7 8 6 7 3 1
 2 2 2 4 5 8 4 3 1 0 2 9 1 0 4 4 2 0 8 4 8 3 5 0 9 2 2 0 1 9 7 2 6 2 0 7 1
 8 6 8 1 9 8 9 4 9 5 1 1 4 5 4 9 2 1 3 0 8 9 2 6 8 3 8 1 4 0 2 4 0 8 3 7 8
 3 6 2 8 3 1 8 7 9 4 7 7 4 8 9 3 0 7 4 0 5 4 3 7 2 6 1 2 0 5 0 6 9 0 6 6 1
 1 8 7 3 4 1 3 4 6 5 2 0 3 6 4 7 1 6 4 9 5 7 8 8 6 1 2 2 4 4 9 2 3 6 6 0 6
 9 1 8 2 2 8 9 9 5 7 8 2 9 9 7 6 0 7 1 6 6 0 6 6 7 6 2 6 3 8 2 6 0 3 8 0 1
 2 0 3 0 4 1 0 7 1 2 4 6 3 4 8 3 7 2 8 4 8 6 2 1 0 3 2 9 6 0 7 6 6 0 4 9 3
 6 1 8 4 5 6 0 9 4 0 7 6 7 5 9 4 7 6 9 2 2 5 5 6 2 6 4 7 5 2 6 3 3 4 3 3 4
 5 2 8 6 2 7 7 1 2 7 7 1 7 3 3 0 1 1 0 8 7 4 7 8 9 5 1 5 2 6 9 8 7 7 3 1 8
 4 6 0 3 4 2 5 2 7 6 5 1 6 2 5 8 7 4 1 3 1 7 3 9 4 0 8 9 5 8 1 8 8 3 3 1 9
 3 8 2 7 4 8 8 5 6 3 2 4 8 3 7 0 0 5 6 7 1 0 8 2 8 5 8 8 2 4 3 1 7 5 2 6 1
 6 7 8 5 9 6 3 6 2 7 2 1 0 4 1 3 6 0 6 1 0 7 7 6 9 0 8 2 0 4 3 6 7 3 1 4 0
 9 6 3 7 1 1 3 5 8 2 6 8 8 4 2 8 7 2 8 0 9 9 4 7 7 6 5 1 1 8 2 3 6 1 3 8 6
 4 1 7 8 1 2 2 7 3 4 2 3 5 6 9 4 6 0 1 7 1 1 2 6 4 7 1 7 7 8 8 9 8 3 0 4 8
 8 3 4 4 4 1 7 2 6 2 1 9 7 4 7 7 4 5 2 4 1 7 1 5 0 2 8 2 4 5 8 9 4 0 0 1 8
 7 7 9 7 1 7 7 2 9 4 4 7 2 0 9 1 6 6 2 0 2 2 4 8 1 8 2 4 0 5 5 3 6 8 9 0 6
 1 2 6 1 8 5 9 0 7 6 4 0 6 2 4 3 1 5 0 9 7 7 3 6 4 8 5 2 8 7 4 8 3 9 9 1 6
 1 2 1 5 7 7 7 8 3 9 4 7 0 5 4 9 6 4 2 1 0 3 9 7 9 9 4 4 9 6 4 6 4 5 4 6 2
 3 5 9 6 8 4 9 0 9 6 1 3 8 0 0 7 4 1 5 5 2 1 0 7 5 0 8 5 0 6 7 1 0 3 8 6 7
 0 5 7 7 5 5 5 4 0 2 8 6 1 9 8 4 3 9 4 6 3 0 5 2 2 0 6 9 1 8 4 3 8 4 8 1 7
 2 3 7 3 1 8 1 6 5 3 4 0 9 8 7 3 6 6 8 9 3 1 5 3 1 6 7 9 2 6 1 0 0 3 9 1 8
...
 2 3 7 3 1 3 1 6 5 3 4 0 9 8 7 5 6 6 2 9 5 1 5 3 1 3 7 9 2 6 1 0 0 3 7 1 8
 3 6 0 6 0 9 9 5 9 1 4 8 7 8 1 4 7 0 3 7 4 2 1 1 6 4 7 4 5 1 6 7 0 5 1 5 1
 6 1 1 0 9 8 8 5 6 6 2 7 7 5 1 0 2 0 8 7 0 4 4 6 1 8 1 7 3 1 7 2 1 6 0 9 7
 1]

0.843
```

4. Implement the <u>Naïve Bayesian Classifier</u> for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

```
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB

X, y = load_iris(return_X_y=True)
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,
random_state=0)

X

y

model = GaussianNB()
y_pred = model.fit(X_train, y_train).predict(X_test)
y_pred

y_test

diff = y_pred - y_test
diff

print('Number of incorrect classifications are: ',len(y_pred) -
list(diff).count(0))
```

Output

```
array([[5.1, 3.5, 1.4, 0.2],
       [4.9, 3. , 1.4, 0.2],
       [4.7, 3.2, 1.3, 0.2],
       [4.6, 3.1, 1.5, 0.2],
       [5. , 3.6, 1.4, 0.2],
       [5.4, 3.9, 1.7, 0.4],
       [4.6, 3.4, 1.4, 0.3],
       [5. , 3.4, 1.5, 0.2],
       [4.4, 2.9, 1.4, 0.2],
       [4.9, 3.1, 1.5, 0.1],
       [5.4, 3.7, 1.5, 0.2],
       [4.8, 3.4, 1.6, 0.2],
       [4.8, 3. , 1.4, 0.1],
       [4.3, 3. , 1.1, 0.1],
       [5.8, 4. , 1.2, 0.2],
       [5.7, 4.4, 1.5, 0.4],
...
       [6.7, 3. , 5.2, 2.3],
       [6.3, 2.5, 5. , 1.9],
       [6.5, 3. , 5.2, 2. ],
       [6.2, 3.4, 5.4, 2.3],
       [5.9, 3. , 5.1, 1.8]])

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

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

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

array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0])

Number of incorrect classifications are:  0
```

5. Implement <u>Find S Algorithm</u>.

```
import csv

def read_csv(filename):
    with open(filename, 'r') as csvfile:
        datareader = csv.reader(csvfile, delimiter=',')
        traindata = []
        for row in datareader:
            traindata.append(row)
        print(traindata)
    return traindata

attributes = ['Sky', 'Temp', 'Humidity', 'Wind', 'Water', 'Forecast']
print("Attributes: ",attributes)
num_attributes = len(attributes)

dataset = read_csv("EnjoySport.csv")

dataset

len(dataset)

hypothesis = ['0']*len(attributes)
hypothesis

print("Initial Hypothesis: ",hypothesis)

for j in range(0, num_attributes):
    hypothesis[j] = dataset[0][j]

print("Find S: Finding a Maximally Specific Hypothesis")
for i in range(len(dataset)):
    if dataset[i][num_attributes] == "Yes":
        for j in range(num_attributes):
            if dataset[i][j] != hypothesis[j]:
                hypothesis[j] = "?"
    else:
        continue

i

print("Hypothesis")
print(hypothesis)
```

Output

```
Attributes:  ['Sky', 'Temp', 'Humidity', 'Wind', 'Water', 'Forecast']
[['sunny', 'warm', 'normal', 'strong', 'warm', 'same', 'Yes'], ['sunny', 'warm',
'high', 'strong', 'warm', 'same', 'Yes'], ['rainy', 'cold', 'high', 'strong',
'warm', 'change', 'No'], ['sunny', 'warm', 'high', 'strong', 'cool', 'change',
'Yes']]

Initial Hypothesis:  ['0', '0', '0', '0', '0', '0']

Find S: Finding a Maximally Specific Hypothesis

Hypothesis
['sunny', 'warm', '?', 'strong', '?', '?']
```

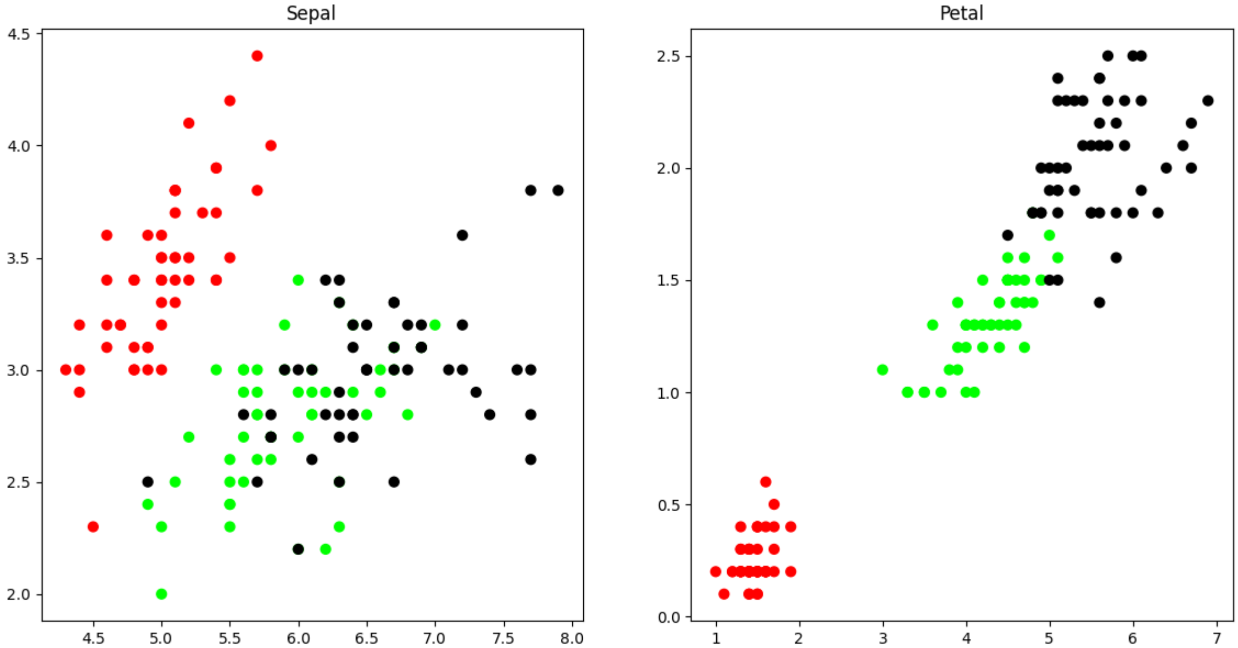
6. Apply <u>K-Means Clustering</u> algorithm to cluster data stored in a .CSV file.

```
import matplotlib.pyplot as plt
from sklearn import datasets
from sklearn.cluster import KMeans
import sklearn.metrics as sm
import pandas as pd
import numpy as np

# import some data to play with
iris = datasets.load_iris()

# print("\n IRIS DATA :",iris.data);
# print("\n IRIS FEATURES :\n",iris.feature_names)
# print("\n IRIS TARGET :\n",iris.target)
# print("\n IRIS TARGET NAMES:\n",iris.target_names)

# Store the inputs as a Pandas Dataframe and set the column names
X = pd.DataFrame(iris.data)
X.columns = ['Sepal_Length','Sepal_Width','Petal_Length','Petal_Width']

y = pd.DataFrame(iris.target)
y.columns = ['Targets']

# Set the size of the plot
plt.figure(figsize=(14,7))

# Create a colormap
colormap = np.array(['red', 'lime', 'black'])

# Plot Sepal
plt.subplot(1, 2, 1)
plt.scatter(X.Sepal_Length,X.Sepal_Width, c=colormap[y.Targets], s=40)
plt.title('Sepal')

plt.subplot(1, 2, 2)
plt.scatter(X.Petal_Length,X.Petal_Width, c=colormap[y.Targets], s=40)
plt.title('Petal')

# K Means Cluster
model = KMeans(n_clusters=3, n_init='auto')
model.fit(X)

model.labels_
```

```python
# View the results
# Set the size of the plot
plt.figure(figsize=(14,7))

# Create a colormap
colormap = np.array(['red', 'lime', 'black'])

# Plot the Original Classifications
plt.subplot(1, 2, 1)
plt.scatter(X.Petal_Length, X.Petal_Width, c=colormap[y.Targets], s=40)
plt.title('Real Classification')

# Plot the Models Classifications
plt.subplot(1, 2, 2)
plt.scatter(X.Petal_Length, X.Petal_Width, c=colormap[model.labels_], s=40)
plt.title('K Mean Classification')
```

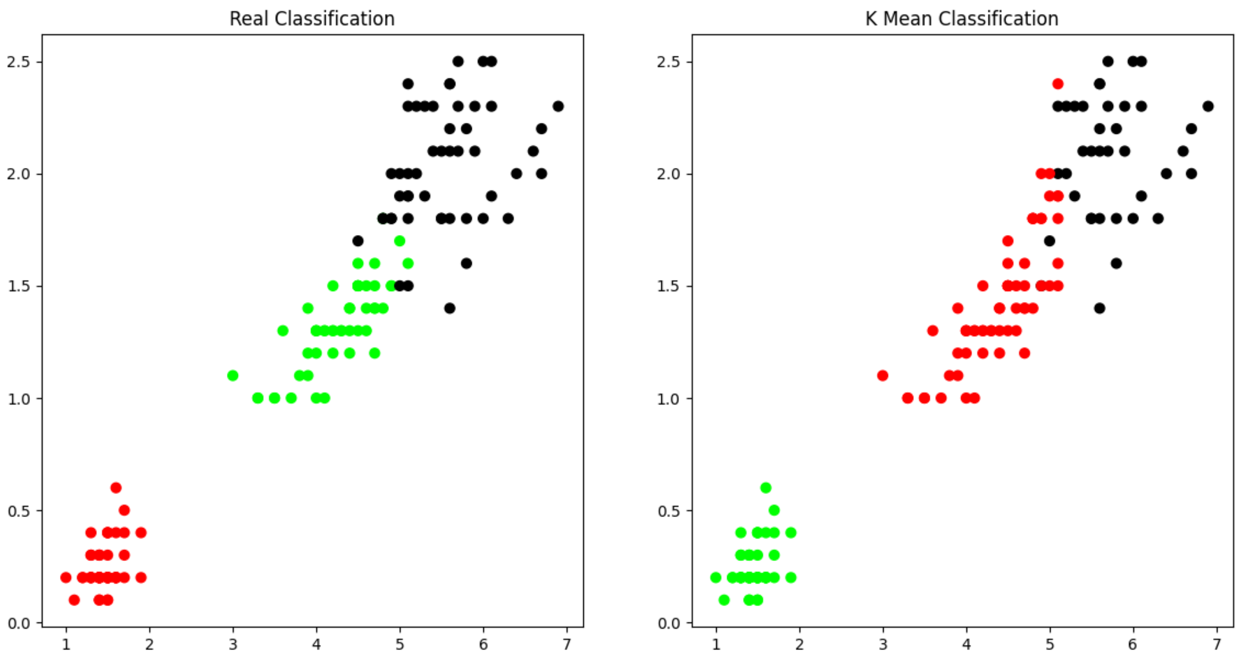
Output

Before K Means Clustering



After K Means Clustering

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



7. Implement <u>k-Nearest Neighbour</u> algorithm to classify the iris data set. Print both correct and wrong predictions.

```
import pandas as pd
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
from sklearn.datasets import load_iris
import numpy as np

df = pd.read_csv('iris.csv')
df.head()
df['variety'].unique()

x = df[['sepal.length','sepal.width','petal.length','petal.width']]
y = df['variety'].replace({'Setosa':1, 'Versicolor':2, 'Virginica':3 })
train_x, test_x , train_y, test_y=
train_test_split(x,y,test_size=0.1,random_state=3, shuffle=True)
knn = KNeighborsClassifier(n_neighbors=3)
knn.fit(train_x,train_y)
pred_y = knn.predict(test_x)
print('The prediction is',pred_y)

print('Actual expected results are:', list(test_y))

print('Number of incorrect classifications are')
diff = np.array(pred_y) - np.array(test_y)
print(len(diff) - list(diff).count(0))
```

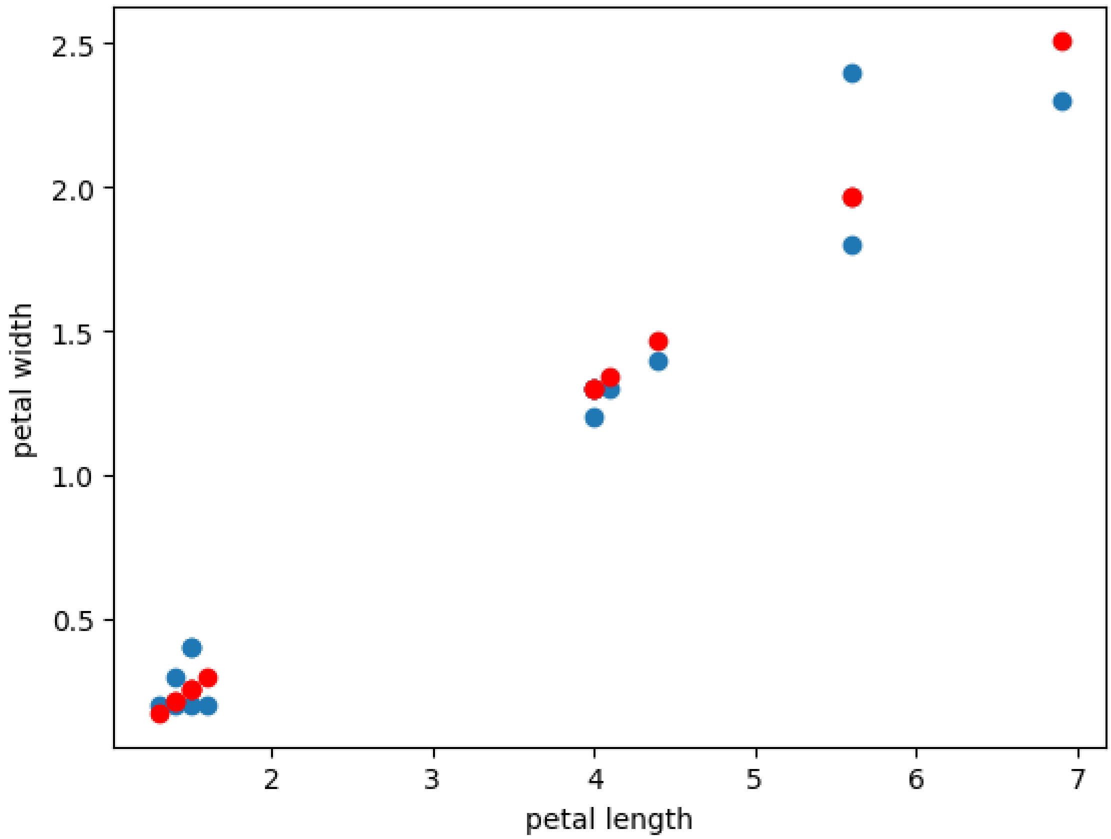
Output

```
array(['Setosa', 'Versicolor', 'Virginica'], dtype=object)

The prediction is [1 1 1 1 1 3 2 1 3 2 2 1 2 2 3]

Actual expected results are: [1, 1, 1, 1, 1, 3, 2, 1, 3, 2, 2, 1, 2, 2, 3]

Number of incorrect classifications are
0
```

8. Implement the parametric <u>Linear Regression</u> algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
from sklearn.model_selection import train_test_split
from sklearn import linear_model

df = pd.read_csv('iris.csv')

newdf = df[['petal.length','petal.width']]
train_x, test_x , train_y, test_y=
train_test_split(newdf['petal.length'],newdf['petal.width'],test_size=0.1,random_
state=3, shuffle=True)
train_x = np.array(train_x).reshape(-1,1)
test_x = np.array(test_x).reshape(-1,1)
train_y = np.array(train_y).reshape(-1,1)
test_y = np.array(test_y).reshape(-1,1)

lr = linear_model.LinearRegression()
lr.fit(train_x,train_y)

import matplotlib.pyplot as plt
plt.scatter(test_x,test_y)
y_predict = lr.predict(test_x)
plt.scatter(test_x,y_predict,color = 'red')
plt.xlabel("petal length")
plt.ylabel("petal width")

from sklearn.metrics import mean_squared_error
sd = (10/4)**0.5
se = sd/(5**0.5)
print('Standard Error ',se )
print('Mean Square Error ', mean_squared_error(test_y,y_predict))
```

Output




```
Standard Error  0.7071067811865476
Mean Square Error  0.022523547640619812
```