LAB 2

January 13, 2021

1 MACHINE LEARNING LAB - 2 (Candidate - Elimination Algorithm)

2. 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.

[1]:

```
import numpy as np
import pandas as pd
```

[2]:

```
# Loading Data from a CSV File
data = pd.DataFrame(data=pd.read_csv('trainingdata.csv'))
print(data)
```

```
     sky airTemp humidity    wind water forecast enjoySport
0  Sunny    Warm   Normal  Strong  Warm     Same        Yes
1  Sunny    Warm     High  Strong  Warm     Same        Yes
2  Rainy    Cold     High  Strong  Warm   Change         No
3  Sunny    Warm     High  Strong  Cool   Change        Yes
```

[3]:

```
# Separating concept features from Target
concepts = np.array(data.iloc[:,0:-1])
print(concepts)
```

```
[['Sunny' 'Warm' 'Normal' 'Strong' 'Warm' 'Same']
 ['Sunny' 'Warm' 'High' 'Strong' 'Warm' 'Same']
 ['Rainy' 'Cold' 'High' 'Strong' 'Warm' 'Change']
 ['Sunny' 'Warm' 'High' 'Strong' 'Cool' 'Change']]
```

[4]:

```
# Isolating target into a separate DataFrame
# copying last column to target array
target = np.array(data.iloc[:,-1])
print(target)
```

```
['Yes' 'Yes' 'No' 'Yes']
```

[7]:
```
def learn(concepts, target):

    '''
    learn() function implements the learning method of the Candidate␣
↪elimination algorithm.
    Arguments:
        concepts - a data frame with all the features
        target - a data frame with corresponding output values
    '''

    # Initialise S0 with the first instance from concepts
    # .copy() makes sure a new list is created instead of just pointing to the␣
↪same memory location
    specific_h = concepts[0].copy()
    print("\nInitialization of specific_h and general_h")
    print(specific_h)
    #h=["#" for i in range(0,5)]
    #print(h)

    general_h = [["?" for i in range(len(specific_h))] for i in␣
↪range(len(specific_h))]
    print(general_h)
    # The learning iterations
    for i, h in enumerate(concepts):

        # Checking if the hypothesis has a positive target
        if target[i] == "Yes":
            for x in range(len(specific_h)):

                # Change values in S & G only if values change
                if h[x] != specific_h[x]:
                    specific_h[x] = '?'
                    general_h[x][x] = '?'

        # Checking if the hypothesis has a positive target
        if target[i] == "No":
            for x in range(len(specific_h)):
                # For negative hyposthesis change values only  in G
                if h[x] != specific_h[x]:
                    general_h[x][x] = specific_h[x]
                else:
                    general_h[x][x] = '?'

        print("\nSteps of Candidate Elimination Algorithm",i+1)
        print(specific_h)
        print(general_h)
    # find indices where we have empty rows, meaning those that are unchanged
    indices = [i for i, val in enumerate(general_h) if val == ['?', '?', '?', '?
↪', '?', '?']]
    for i in indices:
        # remove those rows from general_h
        general_h.remove(['?', '?', '?', '?', '?', '?'])
    # Return final values
    return specific_h, general_h
```

[8]:

```
s_final, g_final = learn(concepts, target)
print("\nFinal Specific_h:", s_final, sep="\n")
print("\nFinal General_h:", g_final, sep="\n")
```

```
Initialization of specific_h and general_h
['Sunny' 'Warm' 'Normal' 'Strong' 'Warm' 'Same']
[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?',
'?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'],
['?', '?', '?', '?', '?', '?']]

Steps of Candidate Elimination Algorithm 1
['Sunny' 'Warm' 'Normal' 'Strong' 'Warm' 'Same']
[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?',
'?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'],
['?', '?', '?', '?', '?', '?']]

Steps of Candidate Elimination Algorithm 2
['Sunny' 'Warm' '?' 'Strong' 'Warm' 'Same']
[['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?',
'?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'],
['?', '?', '?', '?', '?', '?']]

Steps of Candidate Elimination Algorithm 3
['Sunny' 'Warm' '?' 'Strong' 'Warm' 'Same']
[['Sunny', '?', '?', '?', '?', '?'], ['?', 'Warm', '?', '?', '?', '?'], ['?',
'?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?',
'?', '?'], ['?', '?', '?', '?', '?', 'Same']]

Steps of Candidate Elimination Algorithm 4
['Sunny' 'Warm' '?' 'Strong' '?' '?']
[['Sunny', '?', '?', '?', '?', '?'], ['?', 'Warm', '?', '?', '?', '?'], ['?',
'?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?',
'?', '?'], ['?', '?', '?', '?', '?', '?']]

Final Specific_h:
['Sunny' 'Warm' '?' 'Strong' '?' '?']

Final General_h:
```

```
[['Sunny', '?', '?', '?', '?', '?'], ['?', 'Warm', '?', '?', '?', '?']]
```

[ ]:

```

```

LAB 3

January 13, 2021

1 MACHINE LEARNING LAB - 3 (ID3 Algorithm)

3. Write a program to demonstrate the working of the decision tree based ID3 Algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

[1]:
```
import numpy as np
import math
import csv
```

[2]:
```
def read_data(filename):
    with open(filename, 'r') as csvfile:
        datareader = csv.reader(csvfile, delimiter=',')
        headers = next(datareader)
        metadata = []
        traindata = []
        for name in headers:
            metadata.append(name)
        for row in datareader:
            traindata.append(row)

    return (metadata, traindata)
```

[3]:
```
class Node:
    def __init__(self, attribute):
        self.attribute = attribute
        self.children = []
        self.answer = ""

    def __str__(self):
        return self.attribute
```

[4]:
```
def subtables(data, col, delete):
    dict = {}
    items = np.unique(data[:, col])
    count = np.zeros((items.shape[0], 1), dtype=np.int32)

    for x in range(items.shape[0]):
        for y in range(data.shape[0]):
            if data[y, col] == items[x]:
                count[x] += 1

    for x in range(items.shape[0]):
        dict[items[x]] = np.empty((int(count[x]), data.shape[1]), dtype="|S32")
        pos = 0
        for y in range(data.shape[0]):
            if data[y, col] == items[x]:
                dict[items[x]][pos] = data[y]
                pos += 1
        if delete:
            dict[items[x]] = np.delete(dict[items[x]], col, 1)

    return items, dict
```

[5]:

```
def entropy(S):
    items = np.unique(S)

    if items.size == 1:
        return 0

    counts = np.zeros((items.shape[0], 1))
    sums = 0

    for x in range(items.shape[0]):
        counts[x] = sum(S == items[x]) / (S.size * 1.0)

    for count in counts:
        sums += -1 * count * math.log(count, 2)
    return sums
```

[6]:

```
def gain_ratio(data, col):
    items, dict = subtables(data, col, delete=False)

    total_size = data.shape[0]
    entropies = np.zeros((items.shape[0], 1))
    intrinsic = np.zeros((items.shape[0], 1))

    for x in range(items.shape[0]):
        ratio = dict[items[x]].shape[0]/(total_size * 1.0)
        entropies[x] = ratio * entropy(dict[items[x]][:, -1])
        intrinsic[x] = ratio * math.log(ratio, 2)

    total_entropy = entropy(data[:, -1])
    iv = -1 * sum(intrinsic)

    for x in range(entropies.shape[0]):
        total_entropy -= entropies[x]
```

```python
    return total_entropy / iv
```

[7]:

```python
def create_node(data, metadata):
    if (np.unique(data[:, -1])).shape[0] == 1:
        node = Node("")
        node.answer = np.unique(data[:, -1])[0]
        return node

    gains = np.zeros((data.shape[1] - 1, 1))

    for col in range(data.shape[1] - 1):
        gains[col] = gain_ratio(data, col)

    split = np.argmax(gains)

    node = Node(metadata[split])
    metadata = np.delete(metadata, split, 0)

    items, dict = subtables(data, split, delete=True)

    for x in range(items.shape[0]):
        child = create_node(dict[items[x]], metadata)
        node.children.append((items[x], child))

    return node
```

[8]:

```python
def empty(size):
    s = ""
    for x in range(size):
        s += "   "
    return s

def print_tree(node, level):
    if node.answer != "":
        print(empty(level), node.answer)
        return
    print(empty(level), node.attribute)
    for value, n in node.children:
        print(empty(level + 1), value)
        print_tree(n, level + 2)
```

[9]:

```python
metadata, traindata = read_data("tennisdata.csv")
data = np.array(traindata)
node = create_node(data, metadata)
print_tree(node, 0)
```

```
Outlook
   Overcast
   b'Yes'
Rainy
   Windy
      b'False'
         b'Yes'
      b'True'
         b'No'
Sunny
   Humidity
      b'High'
         b'No'
      b'Normal'
         b'Yes'
```

LAB 4

January 13, 2021

1 MACHINE LEARNING LAB - 4 (Backpropagation Algorithm)

4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

[ ]:

```python
import numpy as np

X = np.array(([2, 9], [1, 5], [3, 6]), dtype=float)     # X = (hours sleeping, hours studying)
y = np.array(([92], [86], [89]), dtype=float)           # y = score on test

# scale units
X = X/np.amax(X, axis=0)        # maximum of X array
y = y/100                       # max test score is 100
```

[ ]:

```python
class Neural_Network(object):
    def __init__(self):
                            # Parameters
        self.inputSize = 2
        self.outputSize = 1
        self.hiddenSize = 3
                             # Weights
        self.W1 = np.random.randn(self.inputSize, self.hiddenSize)        # (3x2) weight matrix from input to hidden layer
        self.W2 = np.random.randn(self.hiddenSize, self.outputSize)       # (3x1) weight matrix from hidden to output layer

    def forward(self, X):
                             #forward propagation through our network
        self.z = np.dot(X, self.W1)               # dot product of X (input) and first set of 3x2 weights
        self.z2 = self.sigmoid(self.z)            # activation function
        self.z3 = np.dot(self.z2, self.W2)        # dot product of hidden layer (z2) and second set of 3x1 weights
        o = self.sigmoid(self.z3)                 # final activation function
        return o

    def sigmoid(self, s):
        return 1/(1+np.exp(-s))     # activation function

    def sigmoidPrime(self, s):
        return s * (1 - s)          # derivative of sigmoid

    def backward(self, X, y, o):
                                    # backward propgate through the network
        self.o_error = y - o        # error in output
        self.o_delta = self.o_error*self.sigmoidPrime(o) # applying derivative␣
↪of sigmoid to
        self.z2_error = self.o_delta.dot(self.W2.T)    # z2 error: how much our␣
↪hidden layer weights contributed to output error
        self.z2_delta = self.z2_error*self.sigmoidPrime(self.z2) # applying␣
↪derivative of sigmoid to z2 error
        self.W1 += X.T.dot(self.z2_delta)       # adjusting first set (input␣
↪--> hidden) weights
        self.W2 += self.z2.T.dot(self.o_delta)  # adjusting second set (hidden␣
↪--> output) weights

    def train (self, X, y):
        o = self.forward(X)
        self.backward(X, y, o)
```

[ ]:

```
NN = Neural_Network()
for i in range(1000): # trains the NN 1,000 times
    print ("\nInput: \n" + str(X))
    print ("\nActual Output: \n" + str(y))
    print ("\nPredicted Output: \n" + str(NN.forward(X)))
    print ("\nLoss: \n" + str(np.mean(np.square(y - NN.forward(X)))))     #␣
↪mean sum squared loss)
    NN.train(X, y)
```

LAB 5

January 13, 2021

1 MACHINE LEARNING LAB - 5 (naïve Bayesian Classifier)

5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.

[13]:
```
# import necessary libarities
import pandas as pd
from sklearn import tree
from sklearn.preprocessing import LabelEncoder
from sklearn.naive_bayes import GaussianNB

# load data from CSV
data = pd.read_csv('tennisdata.csv')
print("THe first 5 values of data is :\n",data.head())
```

```
THe first 5 values of data is :
     Outlook Temperature Humidity  Windy PlayTennis
0     Sunny         Hot     High  False         No
1     Sunny         Hot     High   True         No
2  Overcast         Hot     High  False        Yes
3     Rainy        Mild     High  False        Yes
4     Rainy        Cool   Normal  False        Yes
```

[14]:
```
# obtain Train data and Train output
X = data.iloc[:,:-1]
print("\nThe First 5 values of train data is\n",X.head())
```

```

The First 5 values of train data is
     Outlook Temperature Humidity  Windy
0     Sunny         Hot     High  False
1     Sunny         Hot     High   True
2  Overcast         Hot     High  False
3     Rainy        Mild     High  False
4     Rainy        Cool   Normal  False
```

[15]:

```
y = data.iloc[:,-1]
print("\nThe first 5 values of Train output is\n",y.head())
```

```

The first 5 values of Train output is
 0     No
1     No
2    Yes
3    Yes
4    Yes
Name: PlayTennis, dtype: object
```

[16]:

```
# Convert then in numbers
le_outlook = LabelEncoder()
X.Outlook = le_outlook.fit_transform(X.Outlook)

le_Temperature = LabelEncoder()
X.Temperature = le_Temperature.fit_transform(X.Temperature)

le_Humidity = LabelEncoder()
X.Humidity = le_Humidity.fit_transform(X.Humidity)

le_Windy = LabelEncoder()
X.Windy = le_Windy.fit_transform(X.Windy)

print("\nNow the Train data is :\n",X.head())
```

```

Now the Train data is :
    Outlook  Temperature  Humidity  Windy
0        2            1         0      0
1        2            1         0      1
2        0            1         0      0
3        1            2         0      0
4        1            0         1      0
```

[17]:

```
le_PlayTennis = LabelEncoder()
y = le_PlayTennis.fit_transform(y)
print("\nNow the Train output is\n",y)
```

```

Now the Train output is
 [0 0 1 1 1 0 1 0 1 1 1 1 1 0]
```

[18]:

```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size=0.20)
```

```

classifier = GaussianNB()
classifier.fit(X_train,y_train)

from sklearn.metrics import accuracy_score
print("Accuracy is:",accuracy_score(classifier.predict(X_test),y_test))
```

```
Accuracy is: 1.0
```

LAB 6

January 13, 2021

1 MACHINE LEARNING LAB - 6 (naïve Bayesian Classifier (using API))

6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

[1]:

```
import pandas as pd
msg = pd.read_csv('document.csv', names=['message', 'label'])
print("Total Instances of Dataset: ", msg.shape[0])
msg['labelnum'] = msg.label.map({'pos': 1, 'neg': 0})
```

```
Total Instances of Dataset:  18
```

[2]:

```
X = msg.message
y = msg.labelnum
from sklearn.model_selection import train_test_split
Xtrain, Xtest, ytrain, ytest = train_test_split(X, y)
from sklearn.feature_extraction.text import CountVectorizer

count_v = CountVectorizer()
Xtrain_dm = count_v.fit_transform(Xtrain)
Xtest_dm = count_v.transform(Xtest)
```

[3]:

```
df = pd.DataFrame(Xtrain_dm.toarray(),columns=count_v.get_feature_names())
print(df[0:5])
```

```
   about  am  an  and  awesome  bad  beers  best  boss  can  ...  tired  to  \
0      0   1   0    1        0    0      0     0     0    0  ...      1   0
1      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
3      0   0   0    0        0    0      0     0     0    1  ...      0   0
4      0   0   0    0        0    0      0     0     0    0  ...      0   0

   today  tomorrow  very  we  went  will  with  work
0      0         0     0   0     0     0     0     0
1      0         0     0   0     0     0     0     0
```

```
2       0         0     0   0     0     0     0     0
3       0         0     0   0     0     0     1     0
4       0         0     0   0     0     0     0     0

[5 rows x 49 columns]
```

[4]:

```python
from sklearn.naive_bayes import MultinomialNB
clf = MultinomialNB()
clf.fit(Xtrain_dm, ytrain)
pred = clf.predict(Xtest_dm)
```

[5]:

```python
for doc, p in zip(Xtrain, pred):
    p = 'pos' if p == 1 else 'neg'
    print("%s -> %s" % (doc, p))
```

```
I am sick and tired of this place -> pos
I do not like the taste of this juice -> neg
I love this sandwich -> neg
I can't deal with this -> pos
I do not like this restaurant -> neg
```

[6]:

```python
from sklearn.metrics import accuracy_score, confusion_matrix, precision_score,␣
 ↪recall_score
print('Accuracy Metrics: \n')
print('Accuracy: ', accuracy_score(ytest, pred))
print('Recall: ', recall_score(ytest, pred))
print('Precision: ', precision_score(ytest, pred))
print('Confusion Matrix: \n', confusion_matrix(ytest, pred))
```

```
Accuracy Metrics:

Accuracy:  0.6
Recall:  0.5
Precision:  1.0
Confusion Matrix:
 [[1 0]
 [2 2]]
```

LAB 7

January 13, 2021

1 MACHINE LEARNING LAB - 7 (Bayesian Network)

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.

[1]:

```
import pandas as pd
data=pd.read_csv("heartdisease.csv")
heart_disease=pd.DataFrame(data)
print(heart_disease)
```

```
    age  Gender  Family  diet  Lifestyle  cholestrol  heartdisease
0     0       0       1     1          3           0             1
1     0       1       1     1          3           0             1
2     1       0       0     0          2           1             1
3     4       0       1     1          3           2             0
4     3       1       1     0          0           2             0
5     2       0       1     1          1           0             1
6     4       0       1     0          2           0             1
7     0       0       1     1          3           0             1
8     3       1       1     0          0           2             0
9     1       1       0     0          0           2             1
10    4       1       0     1          2           0             1
11    4       0       1     1          3           2             0
12    2       1       0     0          0           0             0
13    2       0       1     1          1           0             1
14    3       1       1     0          0           1             0
15    0       0       1     0          0           2             1
16    1       1       0     1          2           1             1
17    3       1       1     1          0           1             0
18    4       0       1     1          3           2             0
```

[2]:

```
from pgmpy.models import BayesianModel
model=BayesianModel([
('age','Lifestyle'),
('Gender','Lifestyle'),
('Family','heartdisease'),
('diet','cholestrol'),
('Lifestyle','diet'),
('cholestrol','heartdisease'),
('diet','cholestrol')
])

from pgmpy.estimators import MaximumLikelihoodEstimator
model.fit(heart_disease, estimator=MaximumLikelihoodEstimator)

from pgmpy.inference import VariableElimination
HeartDisease_infer = VariableElimination(model)
```

[7]:

```
print('For age Enter { SuperSeniorCitizen:0, SeniorCitizen:1, MiddleAged:2,␣
 ↪Youth:3, Teen:4 }')
print('For Gender Enter { Male:0, Female:1 }')
print('For Family History Enter { yes:1, No:0 }')
print('For diet Enter { High:0, Medium:1 }')
print('For lifeStyle Enter { Athlete:0, Active:1, Moderate:2, Sedentary:3 }')
print('For cholesterol Enter { High:0, BorderLine:1, Normal:2 }')

q = HeartDisease_infer.query(variables=['heartdisease'], evidence={
    'age':int(input('Enter age :')),
    'Gender':int(input('Enter Gender :')),
    'Family':int(input('Enter Family history :')),
    'diet':int(input('Enter diet :')),
    'Lifestyle':int(input('Enter Lifestyle :')),
    'cholestrol':int(input('Enter cholestrol :'))
    })

# print(q['heartdisease'])
print(q)
```

```
For age Enter { SuperSeniorCitizen:0, SeniorCitizen:1, MiddleAged:2, Youth:3,
Teen:4 }
For Gender Enter { Male:0, Female:1 }
For Family History Enter { yes:1, No:0 }
For diet Enter { High:0, Medium:1 }
For lifeStyle Enter { Athlete:0, Active:1, Moderate:2, Sedentary:3 }
For cholesterol Enter { High:0, BorderLine:1, Normal:2 }
Enter age :0
Enter Gender :1
Enter Family history :0
Enter diet :1
Enter Lifestyle :0
Enter cholestrol :1
```

```
Finding Elimination Order: : : 0it [00:00, ?it/s]
```

```
+-----------------+---------------------+
| heartdisease    |   phi(heartdisease) |
+=================+=====================+
| heartdisease(0) |              0.0000 |
+-----------------+---------------------+
| heartdisease(1) |              1.0000 |
+-----------------+---------------------+
```

[ ]:

```
```

LAB 8

January 13, 2021

1 MACHINE LEARNING LAB - 8 (k-Means Algorithm)

8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.

[1]:

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

[2]:

```
dataset=load_iris()
# print(dataset)
```

[3]:

```
X=pd.DataFrame(dataset.data)
X.columns=['Sepal_Length','Sepal_Width','Petal_Length','Petal_Width']
y=pd.DataFrame(dataset.target)
y.columns=['Targets']
# print(X)
```

[4]:

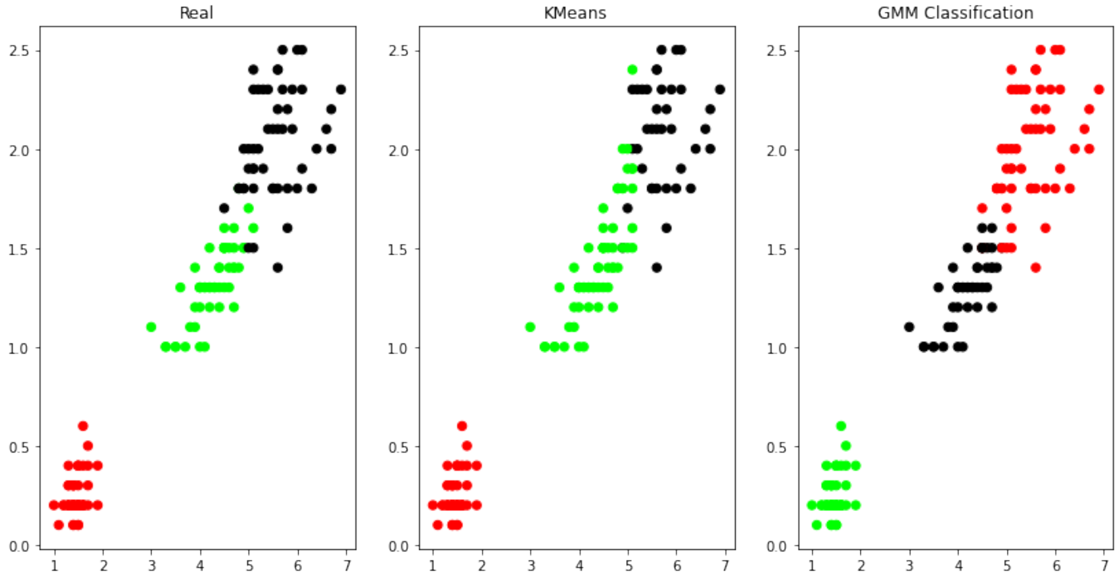
```
plt.figure(figsize=(14,7))
colormap=np.array(['red','lime','black'])

# REAL PLOT
plt.subplot(1,3,1)
plt.scatter(X.Petal_Length,X.Petal_Width,c=colormap[y.Targets],s=40)
plt.title('Real')

# K-PLOT
plt.subplot(1,3,2)
model=KMeans(n_clusters=3)
model.fit(X)
predY=np.choose(model.labels_,[0,1,2]).astype(np.int64)
plt.scatter(X.Petal_Length,X.Petal_Width,c=colormap[predY],s=40)
plt.title('KMeans')
```

```
# GMM PLOT
scaler=preprocessing.StandardScaler()
scaler.fit(X)
xsa=scaler.transform(X)
xs=pd.DataFrame(xsa,columns=X.columns)
gmm=GaussianMixture(n_components=3)
gmm.fit(xs)
y_cluster_gmm=gmm.predict(xs)
plt.subplot(1,3,3)
plt.scatter(X.Petal_Length,X.Petal_Width,c=colormap[y_cluster_gmm],s=40)
plt.title('GMM Classification')
```

```
[4]: Text(0.5, 1.0, 'GMM Classification')
```



LAB 9

January 13, 2021

1 MACHINE LEARNING LAB - 9 (k-Nearest Neighbour Algorithm)

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.

[1]:
```
from sklearn.datasets import load_iris
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import train_test_split
import numpy as np
```

[2]:
```
dataset=load_iris()
#print(dataset)
X_train,X_test,y_train,y_test=train_test_split(dataset["data"],dataset["target"],random_state=
```

[3]:
```
kn=KNeighborsClassifier(n_neighbors=1)
kn.fit(X_train,y_train)
```

[3]:
```
KNeighborsClassifier(n_neighbors=1)
```

[4]:
```
for i in range(len(X_test)):
    x=X_test[i]
    x_new=np.array([x])
    prediction=kn.predict(x_new)
   ␣
 ↪print("TARGET=",y_test[i],dataset["target_names"][y_test[i]],"PREDICTED=",prediction,datase
print(kn.score(X_test,y_test))
```

```
TARGET= 2 virginica PREDICTED= [2] ['virginica']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 2 virginica PREDICTED= [2] ['virginica']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 2 virginica PREDICTED= [2] ['virginica']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 2 virginica PREDICTED= [2] ['virginica']
```

```
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 2 virginica PREDICTED= [2] ['virginica']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 2 virginica PREDICTED= [2] ['virginica']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 2 virginica PREDICTED= [2] ['virginica']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 2 virginica PREDICTED= [2] ['virginica']
TARGET= 2 virginica PREDICTED= [2] ['virginica']
TARGET= 1 versicolor PREDICTED= [1] ['versicolor']
TARGET= 0 setosa PREDICTED= [0] ['setosa']
TARGET= 1 versicolor PREDICTED= [2] ['virginica']
0.9736842105263158
```

LAB 10

January 13, 2021

1 MACHINE LEARNING LAB - 10 (Locally Weighted Regression Algorithm)

10. Implement the non-parametric Locally Weighted Regression Algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

[1]:

```
from math import ceil
import numpy as np
from scipy import linalg
```

[2]:

```
def lowess(x, y, f, iterations):
    n = len(x)
    r = int(ceil(f * n))
    h = [np.sort(np.abs(x - x[i]))[r] for i in range(n)]
    w = np.clip(np.abs((x[:, None] - x[None, :]) / h), 0.0, 1.0)
    w = (1 - w ** 3) ** 3
    yest = np.zeros(n)
    delta = np.ones(n)
    for iteration in range(iterations):
        for i in range(n):
            weights = delta * w[:, i]
            b = np.array([np.sum(weights * y), np.sum(weights * y * x)])
            A = np.array([[np.sum(weights), np.sum(weights * x)],[np.
 ↪sum(weights * x), np.sum(weights * x * x)]])
            beta = linalg.solve(A, b)
            yest[i] = beta[0] + beta[1] * x[i]

        residuals = y - yest
        s = np.median(np.abs(residuals))
        delta = np.clip(residuals / (6.0 * s), -1, 1)
        delta = (1 - delta ** 2) ** 2

    return yest
```

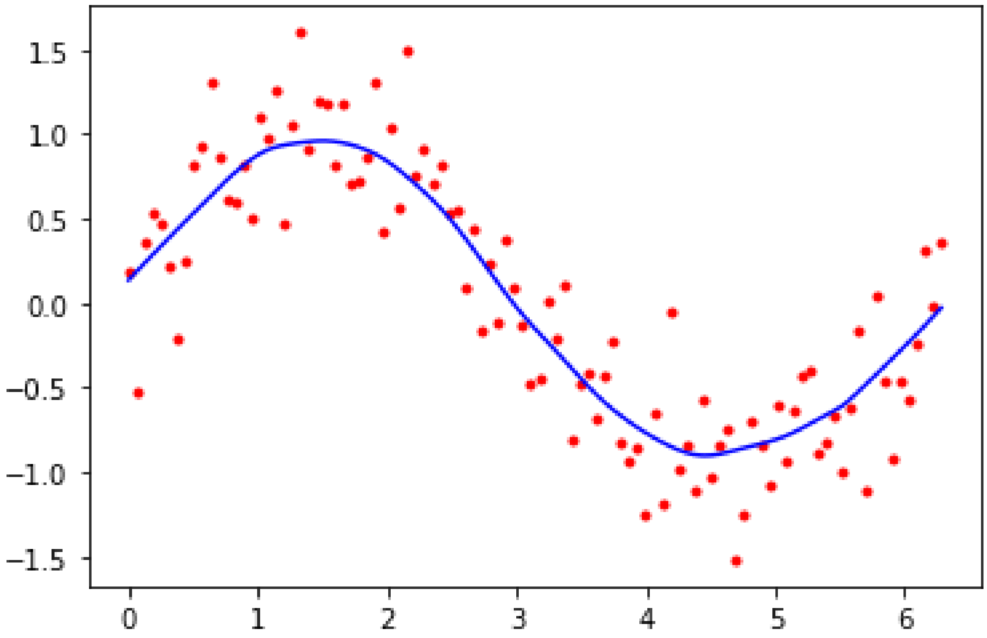
[3]:

```
import math
n = 100
x = np.linspace(0, 2 * math.pi, n)
y = np.sin(x) + 0.3 * np.random.randn(n)
```

```
f =0.25
iterations=3
yest = lowess(x, y, f, iterations)

import matplotlib.pyplot as plt
plt.plot(x,y,"r.")
plt.plot(x,yest,"b-")
```

```
[3]: [<matplotlib.lines.Line2D at 0x1a378339a90>]
```


1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
0
1
2
3
4
5
6