VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“JnanaSangama”, Belgaum -590014, Karnataka.

LAB REPORT
on

COURSE TITLE

Submitted by

MD IBADUDDIN SAFFAN (1BM19CS085)

in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

B.M.S. COLLEGE OF ENGINEERING
(Autonomous Institution under VTU)
BENGALURU-560019
May-2022 to July-2022

B. M. S. College of Engineering,
Bull Temple Road, Bangalore 560019
(Affiliated To Visvesvaraya Technological University, Belgaum)
Department of Computer Science and Engineering

CERTIFICATE

This is to certify that the Lab work entitled "LAB COURSE **MACHINE LEARNING**" carried out by **MD IBADUDDIN SAFFAN (1BM19CS085),** who is bonafide student of **B. M. S. College of Engineering.** It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2022. The Lab report has been approved as it satisfies the academic requirements in respect of a **MACHINE LEARNING - 20CS6PCMAL** work prescribed for the said degree.

Name of the Lab-Incharge	
Designation	PROF Saritha A N
Department of CSE	Department of CSE
BMSCE, Bengaluru	BMSCE, Bengaluru

`

Index Sheet

Course Outcome

CO1	Ability to apply the different learning algorithms.
CO2	Ability to analyze the learning techniques for given dataset.
CO3	Ability to design a model using machine learning to solve a problem.
CO4	Ability to conduct practical experiments to solve problems using appropriate machine learning techniques.

1. Find S

Code:

Implementation 1:

```
import pandas as pd
import numpy as np
df=pd.read_csv('./doc.csv')
d=np.array(df)

h=['!']*(m-1)

for i in range(len(d)):
    for j in range(len(d[0])):
        if(d[i][j]!=hypo[j]):
            hypo[j]="?"
print(h)
```

DATASET:

	Time	Weather	Temperature	Company	Humidity	Wind	Goes
0	Morning	Sunny	Warm	Yes	Mild	Strong	Yes
1	Evening	Rainy	Cold	No	Mild	Normal	No
2	Morning	Sunny	Moderate	Yes	Normal	Normal	Yes
3	Evening	Sunny	Cold	Yes	High	Strong	Yes

OUTPUT:

```
['?' 'Sunny' '?' 'Yes' '?' '?']
```

Implementation 2

```
import pandas as pd
import numpy as np
n=int(input("Enter number of rows:"))
columns=['Time','Weather','Temperature','humidity','Enjoying?']
d=[]
print("Enter the data:\n")
for i in range(n):
    print("Enter Hypothesis:",i+1,"\n")
    temp=[]
    for x in columns:
```

```
        t=input("Enter value for: "+x+": ")
        temp.append(t)
    d.append(temp)
for x in d:
    print(x)
hypo=[]
for i in range(len(d[0])):
    hypo.append("?")
for i in range(len(d)):
    if d[i][len(d[0])-1]=='yes':
        hypo=d[i]
for i in range(len(d)):
    if d[i][len(d[0])-1]=='yes':
        for j in range(len(d[0])):
            if(d[i][j]!=hypo[j]):
                hypo[j]="?"
print(hypo)
```

DATASET:

	Time	Weather	Temperature	Company	Humidity	Wind	Goes
0	Morning	Sunny	Warm	Yes	Mild	Strong	Yes
1	Evening	Rainy	Cold	No	Mild	Normal	No
2	Morning	Sunny	Moderate	Yes	Normal	Normal	Yes
3	Evening	Sunny	Cold	Yes	High	Strong	Yes

OUTPUT:

```
['?' 'Sunny' '?' 'Yes' '?' '?']
```

2. Candidate Elimination Algorithm

CODE

```
import numpy as np
import pandas as pd

data = pd.read_csv("testdemo.csv")
concepts = np.array(data.iloc[:,0:-1])
target = np.array(data.iloc[:,-1])

def learn(concepts, target):
    specific_h = concepts[0].copy()
    print("\nSpecific Boundary: ", specific_h)
    general_h = [["?" for i in range(len(specific_h))] for i in
range(len(specific_h))]
    print("\nGeneric Boundary: ",general_h)

    for i, h in enumerate(concepts):
        print("\nInstance", i+1 , "is ", h)
        if target[i] == "yes":
            for x in range(len(specific_h)):
                if h[x]!= specific_h[x]:
                    specific_h[x] ='?'
                    general_h[x][x] ='?'

        if target[i] == "no":
            for x in range(len(specific_h)):
                if h[x]!= specific_h[x]:
                    general_h[x][x] = specific_h[x]
                else:
                    general_h[x][x] = '?'

        print("Specific Boundary = ", specific_h)
        print("Generic Boundary = ", general_h)
        print("\n")

    indices = [i for i, val in enumerate(general_h) if val == ['?', '?', '?',
'?', '?', '?']]
    for i in indices:
        general_h.remove(['?', '?', '?', '?', '?', '?'])
    return specific_h, general_h


s_final, g_final = learn(concepts, target)

print(" The Final Specific_h : ", s_final, sep="\n")
print("The Final General_h : ", g_final, sep="\n")
```

OUTPUT:

```
Specific Boundary:  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']

Generic Boundary:  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]

Instance 1 is  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
Specific Boundary =  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
Generic Boundary =  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]


Instance 2 is  ['sunny' 'warm' 'high' 'strong' 'warm' 'same']
Specific Boundary =  ['sunny' 'warm' '?' 'strong' 'warm' 'same']
Generic Boundary =  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]


Instance 3 is  ['rainy' 'cold' 'high' 'strong' 'warm' 'change']
Specific Boundary =  ['sunny' 'warm' '?' 'strong' 'warm' 'same']
Generic Boundary =  [['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', 'same']]


Instance 4 is  ['sunny' 'warm' 'high' 'strong' 'cool' 'change']
Specific Boundary =  ['sunny' 'warm' '?' 'strong' '?' '?']
Generic Boundary =  [['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]

 The Final Specific_h :
['sunny' 'warm' '?' 'strong' '?' '?']
The Final General_h :
[['sunny', '?', '?', '?', '?', '?'], ['?', 'warm', '?', '?', '?', '?']]
```

3. ID3

IMPLEMENTATION 1:

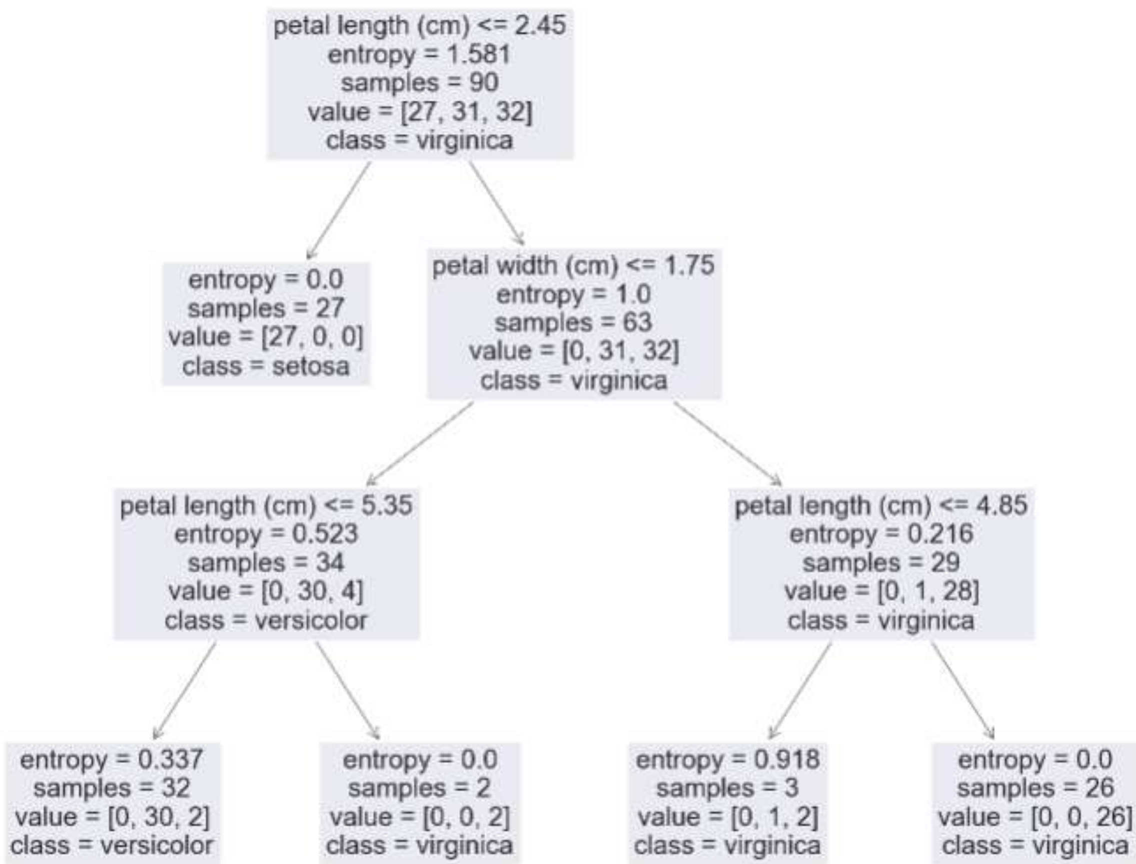
CODE:

```
import pandas as pd

import numpy as np
import matplotlib.pyplot as plt

from sklearn.datasets import load_iris

data = load_iris()
df = pd.DataFrame(data.data, columns = data.feature_names)
df.head()
df['Species'] = data.target

#replace this with the actual names

target = np.unique(data.target)

target_names = np.unique(data.target_names)

targets = dict(zip(target, target_names))

df['Species'] = df['Species'].replace(targets)
x = df.drop(columns="Species")

y = df["Species"]
feature_names = x.columns
labels = y.unique()
from sklearn.model_selection import train_test_split

X_train, test_x, y_train, test_lab = train_test_split(x,y,test_size =
0.4,random_state = 42)


from sklearn.tree import DecisionTreeClassifier
 clf = DecisionTreeClassifier(max_depth =3, random_state =
42,criterion='entropy')
clf.fit(X_train, y_train)


DecisionTreeClassifier(criterion='entropy', max_depth=3, random_state=42)
test_pred = clf.predict(test_x)
clf.score(test_x,test_lab)
```

```
from sklearn import tree
fig = plt.figure(figsize=(25,20))
_ = tree.plot_tree(clf,
                   feature_names=data.feature_names,
                   class_names=data.target_names)
```

OUTPUT:

Accuracy: 0.9833333333333333



IMPLEMENTATION 2:

```
import math
import csv
```

In [2]:

```
def load_csv(filename):
    lines=csv.reader(open(filename,"r"));
    dataset = list(lines)
    headers = dataset.pop(0)
    return dataset,headers

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

In [3]:

```
def subtables(data,col,delete):
    dic={}
    coldata=[row[col] for row in data]
    attr=list(set(coldata))

    counts=[0]*len(attr)
    r=len(data)
    c=len(data[0])
    for x in range(len(attr)):
        for y in range(r):
            if data[y][col]==attr[x]:
                counts[x]+=1
    for x in range(len(attr)):
        dic[attr[x]]=[[0 for i in range(c)] for j in range(counts[x])]
        pos=0
        for y in range(r):
            if data[y][col]==attr[x]:
                if delete:
                    del data[y][col]
                dic[attr[x]][pos]=data[y]
                pos+=1
    return attr,dic
```

In [4]:

```
def entropy(S):
    attr=list(set(S))
    if len(attr)==1:
        return 0

    counts=[0,0]
    for i in range(2):
        counts[i]=sum([1 for x in S if attr[i]==x])/(len(S)*1.0)

    sums=0
    for cnt in counts:
```

```
        sums+=-1*cnt*math.log(cnt,2)
    return sums
```

In [5]:

```
def compute_gain(data,col):
    attr,dic = subtables(data,col,delete=False)

    total_size=len(data)
    entropies=[0]*len(attr)
    ratio=[0]*len(attr)

    total_entropy=entropy([row[-1] for row in data])
    for x in range(len(attr)):
        ratio[x]=len(dic[attr[x]])/(total_size*1.0)
        entropies[x]=entropy([row[-1] for row in dic[attr[x]]])
        total_entropy-=ratio[x]*entropies[x]
    return total_entropy
```

In [6]:

```
def build_tree(data,features):
    lastcol=[row[-1] for row in data]
    if(len(set(lastcol)))==1:
        node=Node("")
        node.answer=lastcol[0]
        return node

    n=len(data[0])-1
    gains=[0]*n
    for col in range(n):
        gains[col]=compute_gain(data,col)
    split=gains.index(max(gains))
    node=Node(features[split])
    fea = features[:split]+features[split+1:]
    attr,dic=subtables(data,split,delete=True)

    for x in range(len(attr)):
        child=build_tree(dic[attr[x]],fea)
        node.children.append((attr[x],child))
    return node
```

In [7]:

```
def print_tree(node,level):
    if node.answer!="":
        print("  "*level,node.answer)
        return

    print("  "*level,node.attribute)
    for value,n in node.children:
        print("  "*(level+1),value)
        print_tree(n,level+2)
```

In [8]:

```
def classify(node,x_test,features):
    if node.answer!="":
```

```
        print(node.answer)
        return
    pos=features.index(node.attribute)
    for value, n in node.children:
        if x_test[pos]==value:
            classify(n,x_test,features)
```

In [9]:

```
'''Main program'''
dataset,features=load_csv("data.csv")
node1=build_tree(dataset,features)

print("The decision tree for the dataset using ID3 algorithm is")
print_tree(node1,0)
testdata,features=load_csv("data.csv")
for xtest in testdata:
    print("The test instance:",xtest)
    print("The label for test instance:",end=" ")
    classify(node1,xtest,features)
```

OUTPUT:

```
The decision tree for the dataset using ID3 algorithm is
 Outlook
   rain
     Wind
       strong
         no
       weak
         yes
   sunny
     Humidity
       high
         no
       normal
         yes
   overcast
     yes
The test instance: ['sunny', 'hot', 'high', 'weak', 'no']
The label for test instance: no
The test instance: ['sunny', 'hot', 'high', 'strong', 'no']
The label for test instance: no
The test instance: ['overcast', 'hot', 'high', 'weak', 'yes']
The label for test instance: yes
The test instance: ['rain', 'mild', 'high', 'weak', 'yes']
The label for test instance: yes
The test instance: ['rain', 'cool', 'normal', 'weak', 'yes']
The label for test instance: yes
The test instance: ['rain', 'cool', 'normal', 'strong', 'no']
The label for test instance: no
```

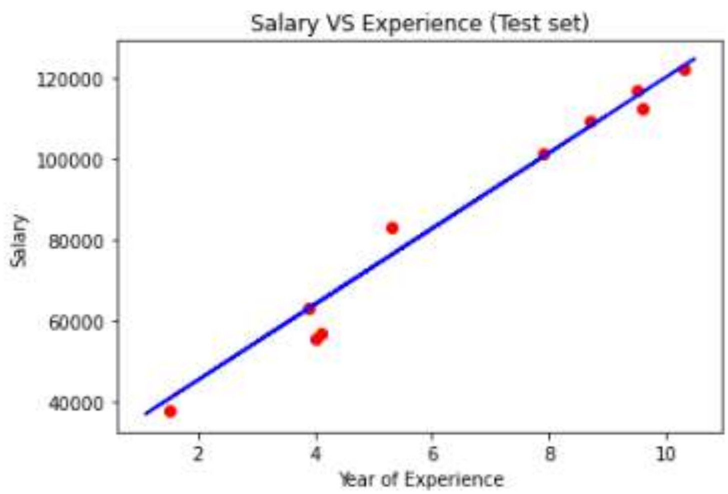
4. Linear Regression

CODE:

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


dataset = pd.read_csv('salary_data.csv')
X = dataset.iloc[:, :-1].values
y = dataset.iloc[:, 1].values


from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=1/3,
random_state=0)



# Fitting Simple Linear Regression to the Training set
from sklearn.linear_model import LinearRegression
regressor = LinearRegression()
regressor.fit(X_train, y_train)
LinearRegression()
# Predicting the Test set results
y_pred = regressor.predict(X_test)



# Visualizing the Training set results
viz_train = plt
viz_train.scatter(X_train, y_train, color='red')
viz_train.plot(X_train, regressor.predict(X_train), color='blue')
viz_train.title('Salary VS Experience (Training set)')
viz_train.xlabel('Year of Experience')
viz_train.ylabel('Salary')
viz_train.show()


# Visualizing the Test set results
viz_test = plt
viz_test.scatter(X_test, y_test, color='red')
viz_test.plot(X_train, regressor.predict(X_train), color='blue')
viz_test.title('Salary VS Experience (Test set)')
viz_test.xlabel('Year of Experience')
viz_test.ylabel('Salary')
viz_test.show()
```

OUTPUT:


Salary VS Experience (Training set)
Salary
Year of Experience


Salary VS Experience (Test set)
Salary
Year of Experience

5. Naive Bayes Classifier

CODE:

IMPLEMENTATION 1:

```
import numpy as np
import pandas as pd
import csv
from pgmpy.estimators import MaximumLikelihoodEstimator
from pgmpy.models import BayesianModel
from pgmpy.inference import VariableElimination
#read Cleveland Heart Disease data
heartDisease = pd.read_csv('heart.csv')
heartDisease = heartDisease.replace('?',np.nan)
#display the data
print('Sample instances from the dataset are given below')
print(heartDisease.head())
#display the Attributes names and datatyes
print('\n Attributes and datatypes')
print(heartDisease.dtypes)
#Creat Model- Bayesian Network
model = BayesianModel([('age','heartdisease'),('sex','heartdisease'),(
'exang','heartdisease'),('cp','heartdisease'),('heartdisease',
'restecg'),('heartdisease','chol')])
#Learning CPDs using Maximum Likelihood Estimators
print('\n Learning CPD using Maximum likelihood estimators')
model.fit(heartDisease,estimator=MaximumLikelihoodEstimator)
# Inferencing with Bayesian Network
print('\n Inferencing with Bayesian Network:')
HeartDiseasetest_infer = VariableElimination(model)
```

#computing the Probability of HeartDisease given restecg

print('\n 1.Probability of HeartDisease given evidence= restecg :1')

q1=HeartDiseasetest_infer.query(variables=['heartdisease'],evidence={'restecg':1})

print(q1)

#computing the Probability of HeartDisease given cp

print('\n 2.Probability of HeartDisease given evidence= cp:2 ')

q2=HeartDiseasetest_infer.query(variables=['heartdisease'],evidence={'cp':2})

print(q2)

Implementation 2:

```
import numpy as np
import pandas as pd
from sklearn.model_selection import train_test_split
from sklearn.naive_bayes import GaussianNB
from sklearn import metrics

df = pd.read_csv("pima_indian.csv")
feature_col_names = ['num_preg', 'glucose_conc', 'diastolic_bp', 'thickness',
'insulin', 'bmi', 'diab_pred', 'age']
predicted_class_names = ['diabetes']
X = df[feature_col_names].values
y = df[predicted_class_names].values
xtrain,xtest,ytrain,ytest=train_test_split(X,y,test_size=0.33)
```

In [19]:

```
df.head()
clf = GaussianNB().fit(xtrain,ytrain.ravel())
predicted = clf.predict(xtest)
predictTestData= clf.predict([[6,148,72,35,0,33.6,0.627,50]])
```

In [30]:

```
metrics.confusion_matrix(ytest,predicted)
```

Out[30]:

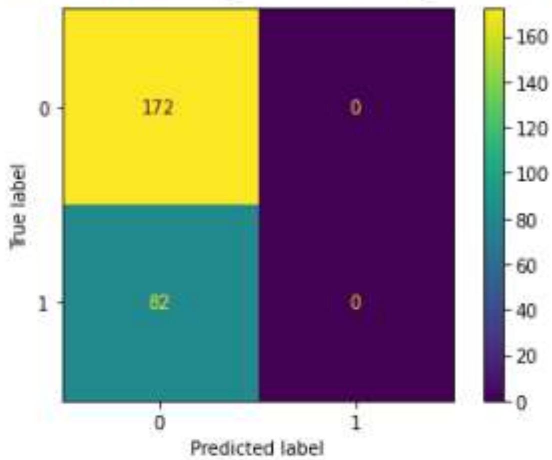
```
array([[139,  26],
       [ 33,  56]], dtype=int64)
```

In [28]:

```
print('\nConfusion matrix')

print(metrics.plot_confusion_matrix(clf,ytest,predicted))
print(metrics.classification_report(ytest,predicted))


print("Predicted Value for individual Test Data:", predictTestData)
```

OUTPUT

```
Confusion matrix
<sklearn.metrics._plot.confusion_matrix.ConfusionMatrixDisplay
```




```
              precision    recall  f1-score   support

           0       0.81      0.84      0.82       165
           1       0.68      0.63      0.65        89

    accuracy                           0.77       254
   macro avg       0.75      0.74      0.74       254
weighted avg       0.76      0.77      0.77       254
```

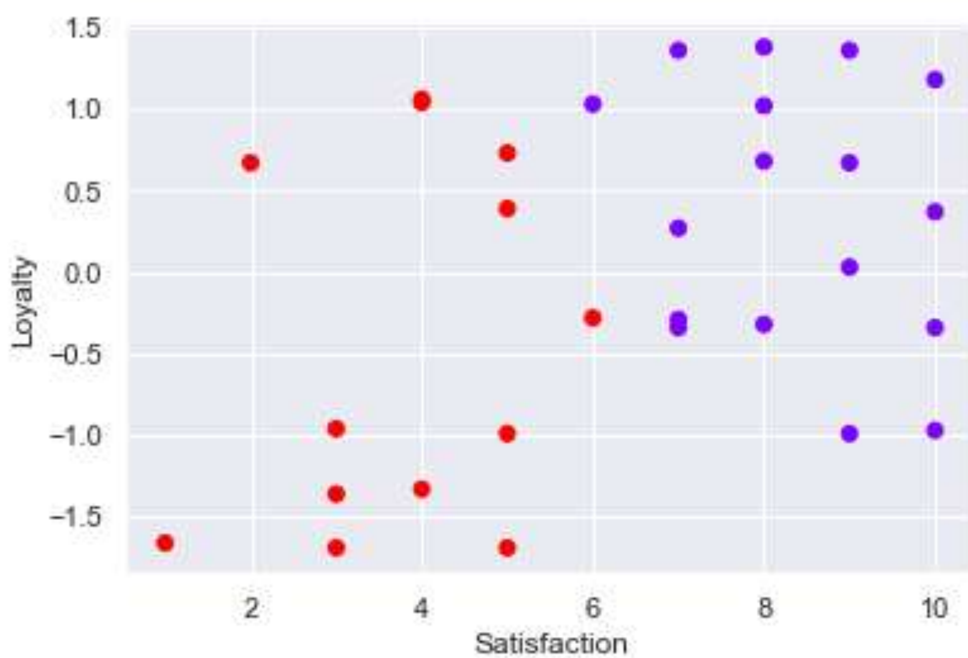
6 K-Means Algorithm

Code:

```
import numpy as np

import pandas as pd

import matplotlib.pyplot as plt

import seaborn as sns

sns.set()

from sklearn.cluster import KMeans

data = pd.read_csv('sample.csv')

data

plt.scatter(data['Satisfaction'],data['Loyalty'])

plt.xlabel('Satisfaction')

plt.ylabel('Loyalty')

plt.show()

x=data.copy()

kmean=KMeans(2)

kmean.fit(x)


clusters=x.copy()

clusters['cluster_pred']=kmean.fit_predict(x)

plt.scatter(clusters['Satisfaction'],clusters['Loyalty'],c=clusters['cluster_pred'],cmap='rainbow')

plt.xlabel('Satisfaction')

plt.ylabel('Loyalty')

plt.ylabel('Loyalty')

plt.show()
```

Output:

	Satisfaction	Loyalty
0	4	-1.33
1	6	-0.28
2	5	-0.99
3	7	-0.29
4	4	1.06
5	1	-1.66
6	10	-0.97
7	8	-0.32
8	8	1.02
9	8	0.68
10	10	-0.34



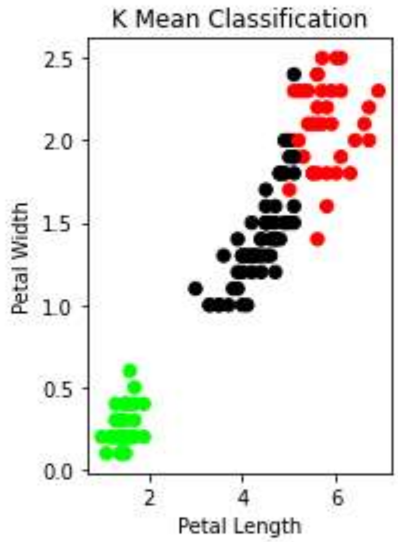
7 EM ALGORITHM

CODE:

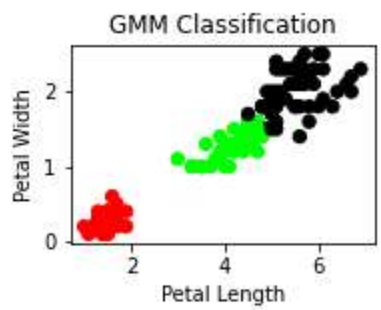
```
import matplotlib.pyplot as plt
from sklearn import datasets
from sklearn.cluster import KMeans
import sklearn.metrics as sm
import pandas as pd
import numpy as np
iris = datasets.load_iris()

X = pd.DataFrame(iris.data)
X.columns = ['Sepal_Length','Sepal_Width','Petal_Length','Petal_Width']

y = pd.DataFrame(iris.target)
y.columns = ['Targets']
model = KMeans(n_clusters=3)
model.fit(X)



plt.figure(figsize=(14,7))

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')
plt.xlabel('Petal Length')
```

```
plt.ylabel('Petal Width')

# 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')
plt.xlabel('Petal Length')
plt.ylabel('Petal Width')
print('The accuracy score of K-Mean: ',sm.accuracy_score(y, model.labels_))
print('The Confusion matrixof K-Mean:\n',sm.confusion_matrix(y, model.labels_))
from sklearn import preprocessing
scaler = preprocessing.StandardScaler()
scaler.fit(X)
xsa = scaler.transform(X)
xs = pd.DataFrame(xsa, columns = X.columns)
#xs.sample(5)
from sklearn.mixture import GaussianMixture
gmm = GaussianMixture(n_components=3)
gmm.fit(xs)

y_gmm = gmm.predict(xs)
plt.subplot(2, 2, 3)
plt.scatter(X.Petal_Length, X.Petal_Width, c=colormap[y_gmm], s=40)
plt.title('GMM Classification')
plt.xlabel('Petal Length')
plt.ylabel('Petal Width')
```

OUTPUT:




```
Out[9]: Text(0, 0.5, 'Petal Width')
```



8 LOCALLY WEIGHTED LINEAR REGRESSION

CODE:

```
import numpy as np

from bokeh.plotting import figure, show, output_notebook

from bokeh.layouts import gridplot

from bokeh.io import push_notebook


def local_regression(x0, X, Y, tau):# add bias term

 x0 = np.r_[1, x0] # Add one to avoid the loss in information

 X = np.c_[np.ones(len(X)), X]


 # fit model: normal equations with kernel

 xw = X.T * radial_kernel(x0, X, tau) # XTranspose * W


 beta = np.linalg.pinv(xw @ X) @ xw @ Y #@ Matrix Multiplication or Dot Product



 # predict value

 return x0 @ beta # @ Matrix Multiplication or Dot Product for prediction

def radial_kernel(x0, X, tau):

 return np.exp(np.sum((X - x0) ** 2, axis=1) / (-2 * tau * tau))

# Weight or Radial Kernal Bias Function


n = 1000

# generate dataset

X = np.linspace(-3, 3, num=n)

print("The Data Set ( 10 Samples) X :\n",X[1:10])

Y = np.log(np.abs(X ** 2 - 1) + .5)
```

```
print("The Fitting Curve Data Set (10 Samples) Y :\n",Y[1:10])
# jitter X
X += np.random.normal(scale=.1, size=n)
print("Normalised (10 Samples) X :\n",X[1:10])

domain = np.linspace(-3, 3, num=300)
print(" Xo Domain Space(10 Samples) :\n",domain[1:10])
def plot_lwr(tau):
 # prediction through regression
 prediction = [local_regression(x0, X, Y, tau) for x0 in domain]
 plot = figure(plot_width=400, plot_height=400)
 plot.title.text='tau=%g' % tau
 plot.scatter(X, Y, alpha=.3)
 plot.line(domain, prediction, line_width=2, color='red')
 return plot

show(gridplot([
 [plot_lwr(10.), plot_lwr(1.)],
 [plot_lwr(0.1), plot_lwr(0.01)]]))
from numpy import *
from os import listdir
import matplotlib
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np1
import numpy.linalg as np
from scipy.stats.stats import pearsonr

def kernel(point,xmat, k):
```

```
    m,n = np1.shape(xmat)
    weights = np1.mat(np1.eye((m)))
    for j in range(m):
        diff = point - X[j]
        weights[j,j] = np1.exp(diff*diff.T/(-2.0*k**2))
    return weights

def localWeight(point,xmat,ymat,k):
    wei = kernel(point,xmat,k)
    W = (X.T*(wei*X)).I*(X.T*(wei*ymat.T))
    return W

def localWeightRegression(xmat,ymat,k):
    m,n = np1.shape(xmat)
    ypred = np1.zeros(m)
    for i in range(m):
        ypred[i] = xmat[i]*localWeight(xmat[i],xmat,ymat,k)
    return ypred

# load data points
data = pd.read_csv('tips.csv')
bill = np1.array(data.total_bill)
tip = np1.array(data.tip)

#preparing and add 1 in bill
mbill = np1.mat(bill)
mtip = np1.mat(tip) # mat is used to convert to n dimesiona to 2 dimensional array form
m= np1.shape(mbill)[1]
# print(m) 244 data is stored in m
```

```
one = np1.mat(np1.ones(m))

X= np1.hstack((one.T,mbill.T)) # create a stack of bill from ONE

#print(X)

#set k here

ypred = localWeightRegression(X,mtip,0.3)

SortIndex = X[:,1].argsort(0)

xsort = X[SortIndex][:,0]


fig = plt.figure()

ax = fig.add_subplot(1,1,1)

ax.scatter(bill,tip, color='green')

ax.plot(xsort[:,1],ypred[SortIndex], color = 'red', linewidth=5)

plt.xlabel('Total bill')

plt.ylabel('Tip')

plt.show();
```

OUTPUT:

```
The Data Set ( 10 Samples) X :
 [-2.99399399 -2.98798799 -2.98198198 -2.97597598 -2.96996997 -2.96396396
 -2.95795796 -2.95195195 -2.94594595]
The Fitting Curve Data Set (10 Samples) Y :
 [2.13582188 2.13156806 2.12730467 2.12303166 2.11874898 2.11445659
 2.11015444 2.10584249 2.10152068]
Normalised (10 Samples) X :
 [-3.02708669 -3.11655981 -2.97394141 -2.85838644 -2.79557593 -2.90905326
 -2.87075128 -2.95418771 -2.96439921]
 Xo Domain Space(10 Samples) :
 [-2.97993311 -2.95986622 -2.93979933 -2.91973244 -2.89966555 -2.87959866
 -2.85953177 -2.83946488 -2.81939799]
```

9 Bayesian Network

Code:

```
import bayespy as bp
import numpy as np
import csv
from colorama import init
from colorama import Fore, Back, Style
init()

# Define Parameter Enum values
# Age
ageEnum = {'SuperSeniorCitizen': 0, 'SeniorCitizen': 1,
        'MiddleAged': 2, 'Youth': 3, 'Teen': 4}
# Gender
genderEnum = {'Male': 0, 'Female': 1}
# FamilyHistory
familyHistoryEnum = {'Yes': 0, 'No': 1}
# Diet(Calorie Intake)
dietEnum = {'High': 0, 'Medium': 1, 'Low': 2}
# LifeStyle
lifeStyleEnum = {'Athlete': 0, 'Active': 1, 'Moderate': 2, 'Sedetary': 3}
# Cholesterol
cholesterolEnum = {'High': 0, 'BorderLine': 1, 'Normal': 2}
# HeartDisease
heartDiseaseEnum = {'Yes': 0, 'No': 1}
#print("Sample Probability")
```

#print("Probability(HeartDisease|Age=SuperSeniorCitizen, Gender=Female, FamilyHistory=Yes, DietIntake=Medium, LifeStyle=Sedetary, Cholesterol=High)")

#print(bp.nodes.MultiMixture([ageEnum['SuperSeniorCitizen'], genderEnum['Female'], familyHistoryEnum['Yes'], dietEnum['Medium'], lifeStyleEnum['Sedetary'], cholesterolEnum['High']], bp.nodes.Categorical, p_heartdisease).get_moments()[0] [heartDiseaseEnum['Yes']])

Interactive Test

m = 0

while m == 0:

print("\n")

res = bp.nodes.MultiMixture([int(input('Enter Age: ' + str(ageEnum))), int(input('Enter Gender: ' + str(genderEnum))), int(input('Enter FamilyHistory: ' + str(familyHistoryEnum))), int(input('Enter dietEnum: ' + str(

dietEnum))), int(input('Enter LifeStyle: ' + str(lifeStyleEnum))), int(input('Enter Cholesterol: ' + str(cholesterolEnum)))], bp.nodes.Categorical, p_heartdisease).get_moments()[0][heartDiseaseEnum['Yes']]

print("Probability(HeartDisease) = " + str(res))

print(Style.RESET_ALL)

m = int(input("Enter for Continue:0, Exit :1 "))

Output:

```
Enter Age: {'SuperSeniorCitizen': 0, 'SeniorCitizen': 1, 'MiddleAged': 2, 'Youth': 3, 'Teen': 4}1
Enter Gender: {'Male': 0, 'Female': 1}1
Enter FamilyHistory: {'Yes': 0, 'No': 1}1
Enter dietEnum: {'High': 0, 'Medium': 1, 'Low': 2}1
Enter LifeStyle: {'Athlete': 0, 'Active': 1, 'Moderate': 2, 'Sedetary': 3}2
Enter Cholesterol: {'High': 0, 'BorderLine': 1, 'Normal': 2}2
Probability(HeartDisease) = 0.5
Enter for Continue:0, Exit :1 0


Enter Age: {'SuperSeniorCitizen': 0, 'SeniorCitizen': 1, 'MiddleAged': 2, 'Youth': 3, 'Teen': 4}2
Enter Gender: {'Male': 0, 'Female': 1}0
Enter FamilyHistory: {'Yes': 0, 'No': 1}0
Enter dietEnum: {'High': 0, 'Medium': 1, 'Low': 2}1
Enter LifeStyle: {'Athlete': 0, 'Active': 1, 'Moderate': 2, 'Sedetary': 3}2
Enter Cholesterol: {'High': 0, 'BorderLine': 1, 'Normal': 2}1
Probability(HeartDisease) = 0.5
Enter for Continue:0, Exit :1 1
```

10 KNN ALGORITHM

CODE:

```
x_train, x_test, y_train, y_test = train_test_split(x,y,test_size=0.3)


#To Training the model and Nearest nighbors K=5

classifier = KNeighborsClassifier(n_neighbors=5)

classifier.fit(x_train, y_train)


#to make predictions on our test data

y_pred=classifier.predict(x_test)


print('Confusion Matrix')

print(confusion_matrix(y_test,y_pred))

print('Accuracy Metrics')

print(classification_report(y_test,y_pred))
```

OUTPUT:

```
 sepal-length sepal-width petal-length petal-width
[[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]
 [5.4 3.9 1.3 0.4]
 [5.1 3.5 1.4 0.3]
```

```
Confusion Matrix
[[17  0  0]
 [ 0 16  2]
 [ 0  0 10]]
Accuracy Metrics
              precision    recall  f1-score   support

           0       1.00      1.00      1.00        17
           1       1.00      0.89      0.94        18
           2       0.83      1.00      0.91        10

    accuracy                           0.96        45
   macro avg       0.94      0.96      0.95        45
weighted avg       0.96      0.96      0.96        45
```