#PROGRAM1 : Implement A* Search algorithm.

```
from collections import deque

class Graph:
    def __init__(self, adjac_lis):
        self.adjac_lis = adjac_lis

    def get_neighbors(self, v):
        return self.adjac_lis[v]

    # This is heuristic function which is having equal values for all nodes
    def h(self, n):
        H = {
            'A': 11,
            'B': 6,
            'C': 99,
            'D': 1,
            'E': 7,
            'G': 0,
        }

        return H[n]
     def a_star_algorithm(self, start, stop):
        # In this open_lst is a lisy of nodes which have been visited, but who's
        # neighbours haven't all been always inspected, It starts off with the start
 #node
        # And closed_lst is a list of nodes which have been visited
        # and who's neighbors have been always inspected
        open_lst = set([start])
```

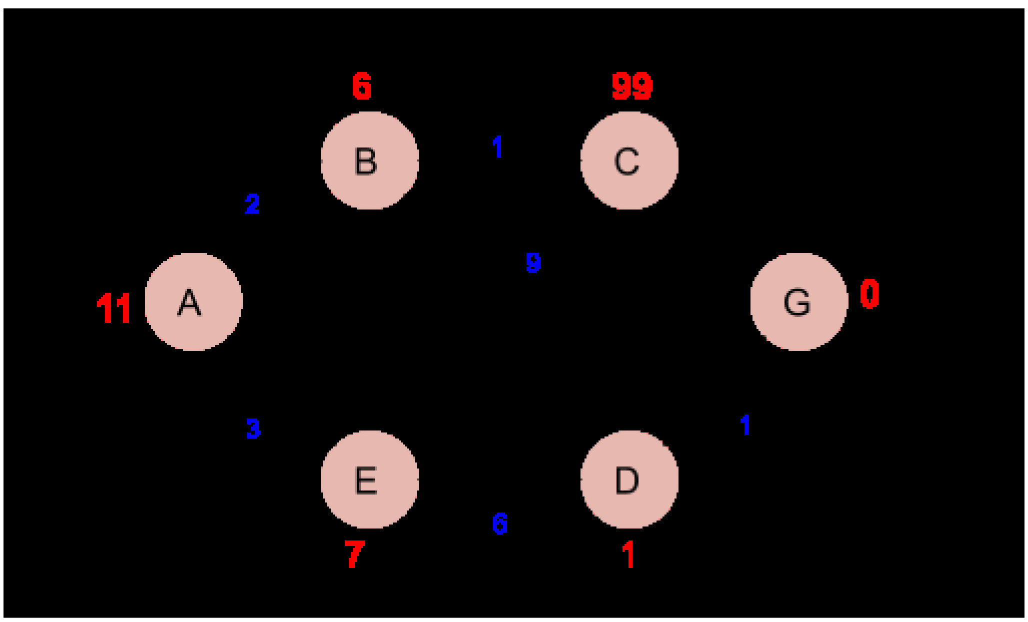
```
closed_lst = set([])

# poo has present distances from start to all other nodes
# the default value is +infinity
poo = {}
poo[start] = 0
 # par contains an adjac mapping of all nodes
par = {}
par[start] = start
 while len(open_lst) > 0:
    n = None
     # it will find a node with the lowest value of f() -
    for v in open_lst:
        if n == None or poo[v] + self.h(v) < poo[n] + self.h(n):
            n = v;
     if n == None:
        print('Path does not exist!')
        return None
     # if the current node is the stop
    # then we start again from start
    if n == stop:
        reconst_path = []

        while par[n] != n:
            reconst_path.append(n)
            n = par[n]

        reconst_path.append(start)

        reconst_path.reverse()
```

```
            print('Path found: {}'.format(reconst_path))
            return reconst_path
        # for all the neighbors of the current node do
        for (m, weight) in self.get_neighbors(n):
          # if the current node is not presentin both open_lst and closed_lst
            # add it to open_lst and note n as it's par
            if m not in open_lst and m not in closed_lst:
                open_lst.add(m)
                par[m] = n
                poo[m] = poo[n] + weight
             # otherwise, check if it's quicker to first visit n, then m
            # and if it is, update par data and poo data
            # and if the node was in the closed_lst, move it to open_lst
            else:
                if poo[m] > poo[n] + weight:
                    poo[m] = poo[n] + weight
                    par[m] = n

                    if m in closed_lst:
                        closed_lst.remove(m)
                        open_lst.add(m)
        # remove n from the open_lst, and add it to closed_lst
        # because all of his neighbors were inspected
        open_lst.remove(n)
        closed_lst.add(n)

    print('Path does not exist!')
    return None
```

```
adjac_lis = {
    'A': [('B', 2), ('E', 3)],
    'B': [('C', 1),('G', 9)],
    'C': None,
    'E': [('D', 6)],
    'D': [('G', 1)],
}
graph1 = Graph(adjac_lis)
graph1.a_star_algorithm('A', 'G')
```

OUTPUT:

```
Path found: ['A', 'E', 'D', 'G']
['A', 'E', 'D', 'G']
```



Program2: Implement AO* Search algorithm.

```
from collections import deque


class Graph:
    def __init__(self, adjac_lis):
        self.adjac_lis = adjac_lis


    def get_neighbors(self, v):
        return self.adjac_lis[v]


    # This is heuristic function which is having equal values for all nodes
    def h(self, n):
        H = {
            'S': 14,
            'A': 7,
            'B': 12,
            'C': 13,
            'D': 5,
            'E': 6,
            'G': 7,
            'F': 5,
            'H': 2
        }

        return H[n]


    def a_star_algorithm(self, start, stop):
        # In this open_lst is a lisy of nodes which have been visited, but who's
        # neighbours haven't all been always inspected, It starts off with the start
```

```
#node
    # And closed_lst is a list of nodes which have been visited
    # and who's neighbors have been always inspected
    open_lst = set([start])
    closed_lst = set([])

    # poo has present distances from start to all other nodes
    # the default value is +infinity
    poo = {}
    poo[start] = 0

    # par contains an adjac mapping of all nodes
    par = {}
    par[start] = start

    while len(open_lst) > 0:
      n = None

      # it will find a node with the lowest value of f() -
      for v in open_lst:
        if n == None or poo[v] + self.h(v) < poo[n] + self.h(n):
          n = v;

      if n == None:
        print('Path does not exist!')
        return None

      # if the current node is the stop
      # then we start again from start
      if n == stop:
```

```
        reconst_path = []

        while par[n] != n:
            reconst_path.append(n)
            n = par[n]

        reconst_path.append(start)

        reconst_path.reverse()

        print('Path found: {}'.format(reconst_path))
        return reconst_path

    # for all the neighbors of the current node do
    for (m, weight) in self.get_neighbors(n):
      # if the current node is not presentin both open_lst and closed_lst
        # add it to open_lst and note n as it's par
        if m not in open_lst and m not in closed_lst:
            open_lst.add(m)
            par[m] = n
            poo[m] = poo[n] + weight

        # otherwise, check if it's quicker to first visit n, then m
        # and if it is, update par data and poo data
        # and if the node was in the closed_lst, move it to open_lst
        else:
            if poo[m] > poo[n] + weight:
                poo[m] = poo[n] + weight
                par[m] = n
```

```
                if m in closed_lst:
                    closed_lst.remove(m)
                    open_lst.add(m)

        # remove n from the open_lst, and add it to closed_lst
        # because all of his neighbors were inspected
        open_lst.remove(n)
        closed_lst.add(n)

    print('Path does not exist!')
    return None
adjac_lis = {
  'S': [('A', 1), ('B', 1),('C', 1)],
  'A': [('D', 1),('E', 1)],
  'C': [('F', 1), ('G', 1)],
  'D': [('H', 1)],
}
graph1 = Graph(adjac_lis)
graph1.a_star_algorithm('S', 'H')
```

OUTPUT:

```
Path found: ['S', 'A', 'D', 'H']
['S', 'A', 'D', 'H']
```

AO* Algorithm

AO* Algorithm basically based on problem decompositon (Breakdown problem into small pieces) When a problem can be divided into a set of sub problems, where each sub problem can be solved separately and a combination of these will be a solution, **AND-OR graphs** or **AND - OR trees** are used for representing the solution.

The decomposition of the problem or problem reduction generates AND arcs.

AND-OR Graph

The figure shows an AND-OR graph

1. To pass any exam, we have two options, either cheating or hard work.
2. In this graph we are given two choices, first do cheating **or (The red line)** work hard and **(The arc)** pass.
3. When we have more than one choice and we have to pick one, we apply **OR condition** to

choose one.(That's what we did here).

- Basically the **ARC** here denote **AND condition**.
- Here we have replicated the arc between the work hard and the pass because by doing the hard work possibility of passing an exam is more than cheating.

A* Vs AO*

1. Both are part of informed search technique and use heuristic values to solve the problem.
2. The solution is guaranteed in both algorithm.
3. A* **always** gives an **optimal solution** (shortest path with low cost) But It is not guaranteed to that **AO*** always provide **an optimal solutions**.
4. **Reason:** Because AO* does not explore all the solution path once it got solution

Program3: #CANDIDATE ELIMINATION ALGORITHM PROGRAM3

```
#Importing Important Libraries
import numpy as np
import pandas as pd
data = pd.DataFrame(data=pd.read_csv('D:\\Jyoti W\\2020-21 ML Program\\enjoysport.csv'))
print(data)
concepts = np.array(data.iloc[:,0:-1])
target = np.array(data.iloc[:,-1])                                                    +
print(target)
print(concepts)
#Defining Model (Candidate Elimination algorithm concepts)
def learn(concepts, target):
    specific_h = concepts[0].copy()
    print("Initialization of specific_h and general_h")
    print("specific_h: ",specific_h)
    general_h = [["?" for i in range(len(specific_h))] for i in range(len(specific_h))]
    print("general_h: ",general_h)
    print("concepts: ",concepts)
    for i, h in enumerate(concepts):
        if target[i] == "yes":
            for x in range(len(specific_h)):
                #print("h[x]",h[x])
                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("\nSteps of Candidate Elimination Algorithm: ",i+1)
    print("Specific_h: ",i+1)
    print(specific_h,"\n")
    print("general_h :", i+1)
    print(general_h)
    indices = [i for i, val in enumerate(general_h) if val == ['?', '?', '?', '?', '?', '?']]
    print("\nIndices",indices)
    for i in indices:
        general_h.remove(['?', '?', '?', '?', '?', '?'])
    return specific_h, general_h
s_final, g_final = learn(concepts, target)


print("\nFinal Specific_h:",s_final)
print("Final General_h:",g_final)
```

OUTPUT:

```
sky airtemp humidity    wind water forcast 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
['yes' 'yes' 'no' 'yes']
[['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
 ['sunny' 'warm' 'high' 'strong' 'warm' 'same']
 ['rainy' 'cold' 'high' 'strong' 'warm' 'change']
 ['sunny' 'warm' 'high' 'strong' 'cool' 'change']]
Initialization of specific_h and general_h
specific_h:  ['sunny' 'warm' 'normal' 'strong' 'warm' 'same']
general_h:  [['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'
], ['?', '?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?'], ['?', '
?', '?', '?', '?', '?'], ['?', '?', '?', '?', '?', '?']]
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']]

Steps of Candidate Elimination Algorithm:  4
Specific_h:  4
['sunny' 'warm' '?' 'strong' '?' '?']

general_h : 4
```

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

Indices [2, 3, 4, 5]

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

Date set:

enjoysport.csv

Sky,AirTemp,Humidity,Wind,Water,Forecast,EnjoySport

Sunny,Warm,Normal,Strong,Warm,Same,1

Sunny,Warm,High,Strong,Warm,Same,1

Rainy,Cold,High,Strong,Warm,Change,0

Sunny,Warm,High,Strong,Cool,Change,1

Program4: #ID3 ALGORITHM PROGRAM4

```
import pandas as pd
from sklearn import tree
from sklearn.preprocessing import LabelEncoder
from sklearn.tree import DecisionTreeClassifier
from sklearn.externals.six import StringIO

data = pd.read_csv('C:\\Users\\LAB\\Desktop\\SKSVMACET LAB MANUAL1\\data(csv files)\\tennis.csv')
print("The first 5 values of data is \n",data.head())

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

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",X.head())
le_PlayTennis = LabelEncoder()
y =  le_PlayTennis.fit_transform(y)
print("\nNow the Train data is\n",y)

classifier = DecisionTreeClassifier()
classifier.fit(X,y)
def labelEncoderForInput(list1):
   list1[0] =  le_outlook.transform([list1[0]])[0]
   list1[1] =  le_Temperature.transform([list1[1]])[0]
   list1[2] =  le_Humidity.transform([list1[2]])[0]
```

```
    list1[3] =  le_Windy.transform([list1[3]])[0]
    return [list1]

inp = ["Rainy","Mild","High","False"]
inp1=["Rainy","Cool","High","False"]
pred1 = labelEncoderForInput(inp1)
y_pred = classifier.predict(pred1)
print("\nfor input {0}, we obtain {1}".format(inp1, le_PlayTennis.inverse_transform(y_pred[0])))
```

OUTPUT:

```
Outlook
    overcast
       b'yes'
    rain
       Wind
          b'strong'
             b'no'
          b'weak'
             b'yes'
    sunny
       Humidity
          b'high'
             b'no'
          b'normal'
             b'yes'
```

{'Outlook': {'overcast': 'yes', 'rain': {'Wind': {'weak': 'yes', 'strong': 'no'}}, 'sunny': {'Humidity': {'high': 'no', 'normal': 'yes'}}}}

Date Set:

#tennisdata.csv

```
Outlook,Temperature,Humidity,Windy,PlayTennis
Sunny,Hot,High,FALSE,No
Sunny,Hot,High,TRUE,No
Overcast,Hot,High,FALSE,Yes
Rainy,Mild,High,FALSE,Yes
Rainy,Cool,Normal,FALSE,Yes
Rainy,Cool,Normal,TRUE,No
Overcast,Cool,Normal,TRUE,Yes
Sunny,Mild,High,FALSE,No
Sunny,Cool,Normal,FALSE,Yes
```

Rainy,Mild,Normal,FALSE,Yes

Sunny,Mild,Normal,TRUE,Yes

Overcast,Mild,High,TRUE,Yes

Overcast,Hot,Normal,FALSE,Yes

Rainy,Mild,High,TRUE,No

#PROGRAM.No.5 Implementation of Back propagation Algorithm

```
import numpy as np
X = np.array(([2, 9], [1, 5], [3, 6]), dtype=float)
y = np.array(([.92], [.86], [.89]), dtype=float)
X = X/np.amax(X, axis=0)
def sigmoid(x):
   return 1 / (1 + np.exp(-x))
def der_sigmoid(x):
   return x * (1 - x)
epoch = 5000
lr = 0.01
neurons_i = 2
neurons_h = 3
neurons_o = 1
weight_h = np.random.uniform(size=(neurons_i, neurons_h))
bias_h = np.random.uniform(size=(1, neurons_h))
weight_o = np.random.uniform(size=(neurons_h, neurons_o))
bias_o = np.random.uniform(size=(1, neurons_o))
for i in range(epoch):
   inp_h = np.dot(X, weight_h) + bias_h
out_h = sigmoid(inp_h)
inp_o = np.dot(out_h, weight_o) + bias_o
out_o = sigmoid(inp_o)
err_o = y - out_o
grad_o = der_sigmoid(out_o)
delta_o = err_o * grad_o
err_h = delta_o.dot(weight_o.T)
grad_h = der_sigmoid(out_h)
delta_h = err_h * grad_h
weight_o += out_h.T.dot(delta_o) * lr
weight_h += X.T.dot(delta_h) * lr
print('Input: ', X)
```

```
print('Actual: ', y)

print('Predicted: ', out_o)
```

OUTPUT:

```
Input:  [[0.66666667 1.        ]
 [0.33333333 0.55555556]
 [1.         0.66666667]]
Actual:  [[0.92]
 [0.86]
 [0.89]]
Predicted:  [[0.91842143]
 [0.90887464]
 [0.9184287 ]]
```

#PROGRAM.NO.6 Naive bayes Classifier

```
import pandas as pd

msg=pd.read_csv('C:\\Users\\LAB\\Desktop\\SKSVMACET LAB MANUAL1\\data(csv files)\\naivetext.csv',names=['message','label'])

print('The dimensions of the dataset',msg.shape)

msg['labelnum']=msg.label.map({'pos':1,'neg':0})

X=msg.message

y=msg.labelnum

print(X)

print(y)

from sklearn.model_selection import train_test_split

xtrain,xtest,ytrain,ytest=train_test_split(X,y)

print(xtest.shape)

print(xtrain.shape)

print(ytest.shape)

print(ytrain.shape)


from sklearn.feature_extraction.text import CountVectorizer

count_vect = CountVectorizer()

xtrain_dtm = count_vect.fit_transform(xtrain)

xtest_dtm=count_vect.transform(xtest)

from sklearn.naive_bayes import MultinomialNB

clf = MultinomialNB().fit(xtrain_dtm,ytrain)

predicted = clf.predict(xtest_dtm)

from sklearn import metrics

print('Accuracy metrics')

print('Accuracy of the classifer is',metrics.accuracy_score(ytest,predicted))

print('Confusion matrix')

print(metrics.confusion_matrix(ytest,predicted))

print('Recall and Precison ')

print(metrics.recall_score(ytest,predicted))

print(metrics.precision_score(ytest,predicted))
```

output:

```
The dimensions of the dataset (18, 2)
0                        I love this sandwich
1                    This is an amazing place
2          I feel very good about these beers
3                        This is my best work
4                        What an awesome view
5               I do not like this restaurant
6                    I am tired of this stuff
7                      I can't deal with this
8                        He is my sworn enemy
9                         My boss is horrible
10                   This is an awesome place
11    I do not like the taste of this juice
12                            I love to dance
13          I am sick and tired of this place
14                       What a great holiday
15             That is a bad locality to stay
16             We will have good fun tomorrow
17           I went to my enemy's house today
Name: message, dtype: object
0     1
1     1
2     1
3     1
4     1
5     0
6     0
7     0
8     0
9     0
10    1
11    0
12    1
13    0
14    1
15    0
16    1
17    0
Name: labelnum, dtype: int64
(5,)
(13,)
(5,)
(13,)
Accuracy metrics
Accuracy of the classifer is 0.8
Confusion matrix
[[2 0]
 [1 2]]
Recall and Precison
0.6666666666666666
1.0
```

Date set: naivetext.csv

I love this sandwich,pos

This is an amazing place,pos

I feel very good about these beers,pos

This is my best work,pos

What an awesome view,pos

I do not like this restaurant,neg

I am tired of this stuff,neg

I can't deal with this,neg

He is my sworn enemy,neg

My boss is horrible,neg

This is an awesome place,pos

I do not like the taste of this juice,neg

I love to dance,pos

I am sick and tired of this place,neg

What a great holiday,pos

That is a bad locality to stay,neg

We will have good fun tomorrow,pos

I went to my enemy's house today,neg

#PROGRAM .No.7 KNN Algorithm

```
import numpy as np

import pandas as pd

from matplotlib import pyplot as plt

from sklearn.mixture import GaussianMixture

from sklearn.cluster import KMeans

data = pd.read_csv('C:\\Users\\LAB\\Desktop\\ANEEL-ML LAB\\SKSVMACET LAB MANUAL\\DATA-SET\\data(csv files)\\ex.csv')

f1 = data['V1'].values

f2 = data['V2'].values

X = np.array(list(zip(f1, f2)))

print("x: ", X)

print('Graph for whole dataset')

plt.scatter(f1, f2, c='black') # size can be set by adding s=size as param

plt.show()

kmeans = KMeans(2)

labels = kmeans.fit(X).predict(X)

print("labels for kmeans:", labels)

print('Graph using Kmeans Algorithm')

plt.scatter(f1, f2, c=labels)

centroids = kmeans.cluster_centers_

print("centroids:", centroids)

plt.scatter(centroids[:, 0], centroids[:, 1], marker='*', c='red')

plt.show()

gmm = GaussianMixture(2)

labels = gmm.fit(X).predict(X)

print("Labels for GMM: ", labels)

print('Graph using EM Algorithm')

plt.scatter(f1, f2, c=labels)

plt.show()
```

output:

```
x:  [[1.  1. ]
 [1.5 2. ]
 [3.  4. ]
 [5.  7. ]
 [3.5 5. ]
 [4.5 5. ]
 [3.5 4.5]]
Graph for whole dataset
<Figure size 640x480 with 1 Axes>
labels for kmeans: [0 0 1 1 1 1 1]
Graph using Kmeans Algorithm
centroids: [[1.25 1.5 ]
 [3.9  5.1 ]]
<Figure size 640x480 with 1 Axes>
Labels for GMM:  [1 1 0 0 0 0 0]
Graph using EM Algorithm
<Figure size 640x480 with 1 Axes>
```

Date set: ex.csv

n,V1,V2

1,1,1

2,1.5,2

3,3,4

4,5,7

5,3.5,5

6,4.5,5

7,3.5,4.5

#PROGRAM8: EM algorithm

```
from sklearn.datasets import load_iris

from sklearn.neighbors import KNeighborsClassifier

from sklearn.model_selection import train_test_split

import numpy as np

dataset=load_iris()

#print(dataset)

X_train,X_test,y_train,y_test=train_test_split(dataset["data"],dataset["target"],random_state=0)

kn=KNeighborsClassifier(n_neighbors=1)

kn.fit(X_train,y_train)

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,dataset["target
_names"][prediction])

print(kn.score(X_test,y_test))
```

OUTPUT:

```
Class : number
setosa : 0
versicolor : 1
virginica : 2
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
```

PROGRAM .NO .9(Locally Weighted Regression Algorithm)

```
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('D:\\Jyoti W\\2020-21 ML Program\\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:

GRAPH will generate

Date set: tips.csv (enjoying the particular party bill)

```
total_bill,tip,sex,smoker,day,time,size
16.99,1.01,Female,No,Sun,Dinner,2
10.34,1.66,Male,No,Sun,Dinner,3
21.01,3.5,Male,No,Sun,Dinner,3
23.68,3.31,Male,No,Sun,Dinner,2
24.59,3.61,Female,No,Sun,Dinner,4
```

25.29,4.71,Male,No,Sun,Dinner,4

8.77,2,Male,No,Sun,Dinner,2

26.88,3.12,Male,No,Sun,Dinner,4

15.04,1.96,Male,No,Sun,Dinner,2

14.78,3.23,Male,No,Sun,Dinner,2

10.27,1.71,Male,No,Sun,Dinner,2

35.26,5,Female,No,Sun,Dinner,4

15.42,1.57,Male,No,Sun,Dinner,2

18.43,3,Male,No,Sun,Dinner,4

14.83,3.02,Female,No,Sun,Dinner,2

21.58,3.92,Male,No,Sun,Dinner,2

10.33,1.67,Female,No,Sun,Dinner,3

16.29,3.71,Male,No,Sun,Dinner,3

16.97,3.5,Female,No,Sun,Dinner,3

20.65,3.35,Male,No,Sat,Dinner,3

17.92,4.08,Male,No,Sat,Dinner,2

20.29,2.75,Female,No,Sat,Dinner,2

15.77,2.23,Female,No,Sat,Dinner,2

39.42,7.58,Male,No,Sat,Dinner,4

19.82,3.18,Male,No,Sat,Dinner,2

17.81,2.34,Male,No,Sat,Dinner,4

13.37,2,Male,No,Sat,Dinner,2

12.69,2,Male,No,Sat,Dinner,2

21.7,4.3,Male,No,Sat,Dinner,2

19.65,3,Female,No,Sat,Dinner,2

9.55,1.45,Male,No,Sat,Dinner,2

18.35,2.5,Male,No,Sat,Dinner,4