21/12/20

# EXPERIMENT NO. 10

1KS17CS030

**AIM:** Implementation of non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate dataset for your experiment & draw graphs.

## Algorithm:

consider the case of locally weighted regression in which the target function f is approximated near x, using a linear function of the form.

1. Minimize the squared error over just the k nearest neighbors:

$$E_1(x_q) \equiv \frac{1}{2} \sum_{x \in k \text{ nearest nbrs of } x_q} (f(x) - \hat{f}(x))^2$$

2. Minimize the squared error over the entire set D of training examples, while weighting the error of each training example by some decreasing function K of its distance from $x_q$:

$$E_2(x_q) \equiv \frac{1}{2} \sum_{x \in D} (f(x) - \hat{f}(x))^2 \; K(d(x_q, x))$$

3. Combine 1 and 2:

$$E_3(x_q) \equiv \frac{1}{2} \sum_{x \in k \text{ nearest nbrs of } x_q} (f(x) - \hat{f}(x))^2 \; K(d(x_q, x))$$

## Dataset:

```
sepal_length,sepal_width,petal_length,petal_width,species
5.1,3.5,1.4,0.2,setosa
4.9,3.0,1.4,0.2,setosa
4.7,3.2,1.3,0.2,setosa
4.6,3.1,1.5,0.2,setosa
5.0,3.6,1.4,0.2,setosa
5.4,3.9,1.7,0.4,setosa
4.6,3.4,1.4,0.3,setosa
5.0,3.4,1.5,0.2,setosa
4.4,2.9,1.4,0.2,setosa
4.9,3.1,1.5,0.1,setosa
5.4,3.7,1.5,0.2,setosa
4.8,3.4,1.6,0.2,setosa
4.8,3.0,1.4,0.1,setosa
4.3,3.0,1.1,0.1,setosa
5.8,4.0,1.2,0.2,setosa
5.7,4.4,1.5,0.4,setosa
5.4,3.9,1.3,0.4,setosa
5.1,3.5,1.4,0.3,setosa
5.7,3.8,1.7,0.3,setosa
5.1,3.8,1.5,0.3,setosa
5.4,3.4,1.7,0.2,setosa
5.1,3.7,1.5,0.4,setosa
4.6,3.6,1.0,0.2,setosa
5.1,3.3,1.7,0.5,setosa
4.8,3.4,1.9,0.2,setosa
5.0,3.0,1.6,0.2,setosa
5.0,3.4,1.6,0.4,setosa
5.2,3.5,1.5,0.2,setosa
5.2,3.4,1.4,0.2,setosa
4.7,3.2,1.6,0.2,setosa
4.8,3.1,1.6,0.2,setosa
5.4,3.4,1.5,0.4,setosa
5.2,4.1,1.5,0.1,setosa
5.5,4.2,1.4,0.2,setosa
4.9,3.1,1.5,0.1,setosa
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4.9,3.1,1.5,0.1,setosa
4.4,3.0,1.3,0.2,setosa
5.1,3.4,1.5,0.2,setosa
5.0,3.5,1.3,0.3,setosa
4.5,2.3,1.3,0.3,setosa
4.4,3.2,1.3,0.2,setosa
5.0,3.5,1.6,0.6,setosa
5.1,3.8,1.9,0.4,setosa
4.8,3.0,1.4,0.3,setosa
5.1,3.8,1.6,0.2,setosa
4.6,3.2,1.4,0.2,setosa
5.3,3.7,1.5,0.2,setosa
5.0,3.3,1.4,0.2,setosa
7.0,3.2,4.7,1.4,versicolor
6.4,3.2,4.5,1.5,versicolor
6.9,3.1,4.9,1.5,versicolor
5.5,2.3,4.0,1.3,versicolor
6.5,2.8,4.6,1.5,versicolor
5.7,2.8,4.5,1.3,versicolor
6.3,3.3,4.7,1.6,versicolor
4.9,2.4,3.3,1.0,versicolor
6.6,2.9,4.6,1.3,versicolor
5.2,2.7,3.9,1.4,versicolor
5.0,2.0,3.5,1.0,versicolor
5.9,3.0,4.2,1.5,versicolor
6.0,2.2,4.0,1.0,versicolor
6.1,2.9,4.7,1.4,versicolor
5.6,2.9,3.6,1.3,versicolor
6.7,3.1,4.4,1.4,versicolor
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```
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6.2,2.2,4.5,1.5,versicolor
5.6,2.5,3.9,1.1,versicolor
5.9,3.2,4.8,1.8,versicolor
6.1,2.8,4.0,1.3,versicolor
6.3,2.5,4.9,1.5,versicolor
6.1,2.8,4.7,1.2,versicolor
6.4,2.9,4.3,1.3,versicolor
6.6,3.0,4.4,1.4,versicolor
6.8,2.8,4.8,1.4,versicolor
6.7,3.0,5.0,1.7,versicolor
6.0,2.9,4.5,1.5,versicolor
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5.8,2.7,3.9,1.2,versicolor
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6.0,3.4,4.5,1.6,versicolor
6.7,3.1,4.7,1.5,versicolor
6.3,2.3,4.4,1.3,versicolor
5.6,3.0,4.1,1.3,versicolor
5.5,2.5,4.0,1.3,versicolor
5.5,2.6,4.4,1.2,versicolor
6.1,3.0,4.6,1.4,versicolor
5.8,2.6,4.0,1.2,versicolor
5.0,2.3,3.3,1.0,versicolor
5.6,2.7,4.2,1.3,versicolor
5.7,3.0,4.2,1.2,versicolor
5.7,2.9,4.2,1.3,versicolor
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5.7,2.8,4.1,1.3,versicolor
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5.8,2.7,5.1,1.9,virginica
7.1,3.0,5.9,2.1,virginica
6.3,2.9,5.6,1.8,virginica
6.5,3.0,5.8,2.2,virginica
7.6,3.0,6.6,2.1,virginica
4.9,2.5,4.5,1.7,virginica
7.3,2.9,6.3,1.8,virginica
6.7,2.5,5.8,1.8,virginica
7.2,3.6,6.1,2.5,virginica
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6.4,2.7,5.3,1.9,virginica
6.8,3.0,5.5,2.1,virginica
5.7,2.5,5.0,2.0,virginica
5.8,2.8,5.1,2.4,virginica
6.4,3.2,5.3,2.3,virginica
6.5,3.0,5.5,1.8,virginica
7.7,3.8,6.7,2.2,virginica
7.7,2.6,6.9,2.3,virginica
6.0,2.2,5.0,1.5,virginica
6.9,3.2,5.7,2.3,virginica
5.6,2.8,4.9,2.0,virginica
7.7,2.8,6.7,2.0,virginica
6.3,2.7,4.9,1.8,virginica
6.7,3.3,5.7,2.1,virginica
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6.7,3.3,5.7,2.1,virginica
7.2,3.2,6.0,1.8,virginica
6.2,2.8,4.8,1.8,virginica
6.1,3.0,4.9,1.8,virginica
6.4,2.8,5.6,2.1,virginica
7.2,3.0,5.8,1.6,virginica
7.4,2.8,6.1,1.9,virginica
7.9,3.8,6.4,2.0,virginica
6.4,2.8,5.6,2.2,virginica
6.3,2.8,5.1,1.5,virginica
6.1,2.6,5.6,1.4,virginica
7.7,3.0,6.1,2.3,virginica
6.3,3.4,5.6,2.4,virginica
6.4,3.1,5.5,1.8,virginica
6.0,3.0,4.8,1.8,virginica
6.9,3.1,5.4,2.1,virginica
6.7,3.1,5.6,2.4,virginica
6.9,3.1,5.1,2.3,virginica
5.8,2.7,5.1,1.9,virginica
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6.7,3.3,5.7,2.5,virginica
6.7,3.0,5.2,2.3,virginica
6.3,2.5,5.0,1.9,virginica
6.5,3.0,5.2,2.0,virginica
6.2,3.4,5.4,2.3,virginica
5.9,3.0,5.1,1.8,virginica
```

Program:

```
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np
def kernel(point, xmat, k):
    m,n= np.shape (xmat)
    weights = np.mat (np.eye((m)))
    for j in range(m):
        diff= point - X[j]
        weights[j,j] = np. 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= np.shape (xmat)
    ypred= np. zeros (m)
    for i in range(m):
        ypred[i]= xmat[i]* localWeight (xmat[i], xmat, ymat, k)
    return ypred
def graphPlot (X, ypred):
    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();

data = pd.read_csv('10data_tips.csv')
bill = np.array(data.total_bill)
tip = np.array(data.tip)
mbill = np.mat(bill)
mtip = np.mat(tip)
m = np.shape(mbill)[1]
one = np.mat(np.ones(m))
X = np.hstack((one.T, mbill.T))
ypred = localweightregression(X, mtip, 8)
graphPlot(X, ypred)
```

Output: