KNN

January 16, 2019

For the data set in the table below, please use the K-Nearest Neighbors algorithm for regression to predict the weights of new samples. Please use both the Euclidian and Manhattan distances and make a comparison on the results. Please determine the best K value for the data set. Upload a detail report on how you program the predictor and the running environment of the final program.

1 Use IPython - Jupyter Enviorment

2 1. Create Data

use training ID (0~9) to predict target (ID10) when Height = 5.5 , age = 38 , weight = ?

In [1]:
```
import pandas as pd
d= pd.DataFrame(columns=['Height','age','weight'],
                data=[[5,45,77],
                      [5.11,26,47],
                      [5.6,30,55],
                      [5.9,34,59],
                      [4.8,40,72],
                      [5.8,36,60],
                      [5.3,19,40],
                      [5.8,28,60],
                      [5.5,23,45],
                      [5.6,32,58]])
target = [5.5,38] # Forecast target
d
```

Out[1]:

	Height	age	weight
0	5.00	45	77
1	5.11	26	47
2	5.60	30	55
3	5.90	34	59
4	4.80	40	72
5	5.80	36	60
6	5.30	19	40
7	5.80	28	60
8	5.50	23	45
9	5.60	32	58

3 2. Determine Best K-Values

use GridSearchCV to tune best KNN parameters

```
In [2]: X = d[['Height','age']].values
        y = d['weight'].values

        from sklearn.neighbors import KNeighborsRegressor,kneighbors_graph
        from sklearn.model_selection import GridSearchCV
        params = {'n_neighbors':[1,2,3,4,5,6,7,8],
                  'weights':['distance'],
                  'algorithm' : ['auto', 'ball_tree', 'kd_tree', 'brute']
                  }
        neigh = KNeighborsRegressor()
        model = GridSearchCV(neigh, params, cv=5) # Auto-tune parameters
        model.fit(X,y)
        print("Best KNN params : ")
        print(model.best_params_)
```

```
Best KNN params :
{'algorithm': 'auto', 'n_neighbors': 3, 'weights': 'distance'}
```

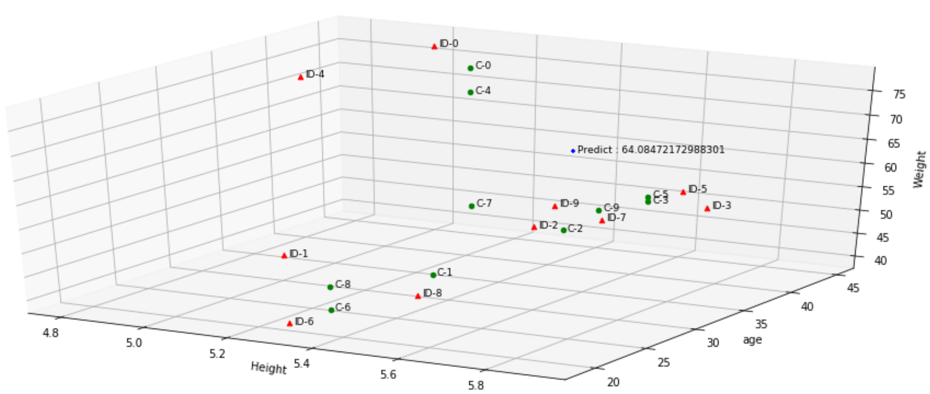
4 3. Use manhattan distance

This is the distance between real vectors using the sum of their absolute difference.

```
In [3]: neigh.set_params(metric ='manhattan',**model.best_params_)
        neigh.fit(X,y) # use manhattan to determine score

        distances, indices = neigh.kneighbors(X, return_distance=True)
        indices = pd.DataFrame(indices,columns=['Near-Idx1','Near-Idx2','Near-Idx3'])
        distances = pd.DataFrame(distances,columns=['Dist-Idx1','Dist-Idx2','Dist-Idx3'])

        ans = neigh.predict(target)[0] # predict score
        print(f"ID10 Weight = {ans}")
        print(f"Score = {neigh.score(X,y)}")

        centers=[]
        for i,l in enumerate(indices.values): # Find KNN centers (0~9)
            h = (d.Height[l[0]] + d.Height[l[1]]  + d.Height[l[2]]) / 3
            a = (d.age[l[0]] + d.age[l[1]]  + d.age[l[2]]) / 3
            w = (d.weight[l[0]] + d.weight[l[1]]  + d.weight[l[2]]) / 3
            centers.append([h,a,w])

        #  View the distribution of data sets
        %matplotlib inline
        import matplotlib.pyplot as plt
```

```
import numpy as np
from mpl_toolkits.mplot3d import Axes3D
fig = plt.figure(figsize=(18,7))
ax = fig.add_subplot(111, projection='3d')
ax.set_xlabel('Height')
ax.set_ylabel('age')
ax.set_zlabel('Weight')

plt.figure(figsize=(18,7), dpi=80)

#  Set the frame size
#  Generate dataset scatter plot
for i,coord in enumerate(X):
    ax.scatter(coord[0], coord[1], y[i], c='r', marker='^')
    ax.text(coord[0]+0.01, coord[1]+0.01,y[i]+0.01, "ID-"+str(i), fontsize=9)

#  Draw the center point
for i,coord in enumerate(centers):
    ax.scatter(coord[0], coord[1], y[i], c='g', marker='o')
    ax.text(coord[0]+0.01, coord[1]+0.01,y[i]+0.01, "C-"+str(i), fontsize=9)

#  Draw prediction points
ax.scatter(target[0], target[1], ans,c='b' ,marker='+')
ax.text(target[0]+0.01, target[1]+0.01, ans+0.01,f'Predict : {ans}', fontsize=9)

plt.show()
```

```
ID10 Weight = 64.08472172988301
Score = 1.0


D:\Program\Anaconda3\lib\site-packages\sklearn\utils\validation.py:395: DeprecationWarning: Pas
  DeprecationWarning)
```



```
<Figure size 1440x560 with 0 Axes>
```

```
In [4]: indices # neighbor index
```

Out[4]:

	Near-Idx1	Near-Idx2	Near-Idx3
0	0	4	5
1	1	7	8
2	2	9	7
3	3	5	9
4	4	5	0
5	5	3	9
6	6	8	1
7	7	2	1
8	8	1	6
9	9	2	3

```
In [5]: distances # neighbor index distance
```

Out[5]:

	Dist-Idx1	Dist-Idx2	Dist-Idx3
0	0.0	5.20	9.80
1	0.0	2.69	3.39
2	0.0	2.00	2.20
3	0.0	2.10	2.30
4	0.0	5.00	5.20
5	0.0	2.10	4.20
6	0.0	4.20	7.19
7	0.0	2.20	2.69
8	0.0	3.39	4.20
9	0.0	2.00	2.30

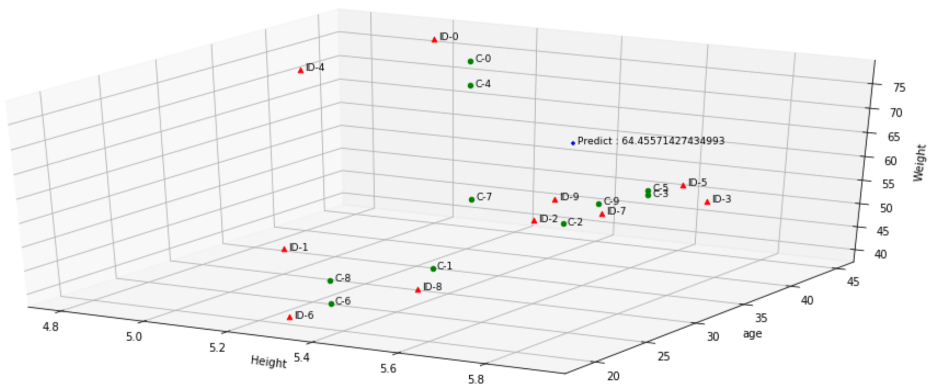
5 4. Use euclidean distance

Euclidean distance is calculated as the square root of the sum of the squared differences between a new point (x) and an existing point (y).

```
In [6]: neigh.set_params(metric ='euclidean',**model.best_params_)
        neigh.fit(X,y) # use euclidean to determine score

        distances, indices = neigh.kneighbors(X, return_distance=True)
        indices = pd.DataFrame(indices,columns=['Near-Idx1','Near-Idx2','Near-Idx3'])
        distances = pd.DataFrame(distances,columns=['Dist-Idx1','Dist-Idx2','Dist-Idx3'])

        ans = neigh.predict(target)[0] # predict score
        print(f"ID10 Weight = {ans}")
        print(f"Score = {neigh.score(X,y)}")

        centers=[]
```

```python
for i,l in enumerate(indices.values): # Find KNN centers (0~9)
    h = (d.Height[l[0]] + d.Height[l[1]]  + d.Height[l[2]]) / 3
    a = (d.age[l[0]] + d.age[l[1]]  + d.age[l[2]]) / 3
    w = (d.weight[l[0]] + d.weight[l[1]]  + d.weight[l[2]]) / 3
    centers.append([h,a,w])

#  View the distribution of data sets
%matplotlib inline
import matplotlib.pyplot as plt
import numpy as np
from mpl_toolkits.mplot3d import Axes3D
fig = plt.figure(figsize=(18,7))
ax = fig.add_subplot(111, projection='3d')
ax.set_xlabel('Height')
ax.set_ylabel('age')
ax.set_zlabel('Weight')

plt.figure(figsize=(18,7), dpi=80)

#  Set the frame size
#  Generate dataset scatter plot
for i,coord in enumerate(X):
    ax.scatter(coord[0], coord[1], y[i], c='r', marker='^')
    ax.text(coord[0]+0.01, coord[1]+0.01,y[i]+0.01, "ID-"+str(i), fontsize=9)

#  Draw the center point
for i,coord in enumerate(centers):
    ax.scatter(coord[0], coord[1], y[i], c='g', marker='o')
    ax.text(coord[0]+0.01, coord[1]+0.01,y[i]+0.01, "C-"+str(i), fontsize=9)

#  Draw prediction points
ax.scatter(target[0], target[1], ans,c='b' ,marker='+')
ax.text(target[0]+0.01, target[1]+0.01, ans+0.01,f'Predict : {ans}', fontsize=9)

plt.show()
```

```
D:\Program\Anaconda3\lib\site-packages\sklearn\utils\validation.py:395: DeprecationWarning: Pas
  DeprecationWarning)


ID10 Weight = 64.45571427434993
Score = 1.0
```



<Figure size 1440x560 with 0 Axes>

In [7]: indices # neighbor index

Out[7]:

	Near-Idx1	Near-Idx2	Near-Idx3
0	0	4	5
1	1	7	8
2	2	9	7
3	3	5	9
4	4	5	0
5	5	3	9
6	6	8	1
7	7	2	1
8	8	1	6
9	9	2	3

In [8]: distances # neighbor index distance

Out[8]:

	Dist-Idx1	Dist-Idx2	Dist-Idx3
0	0.0	5.003998	9.035486
1	0.0	2.115680	3.025244
2	0.0	2.000000	2.009975
3	0.0	2.002498	2.022375
4	0.0	4.123106	5.003998
5	0.0	2.002498	4.004997
6	0.0	4.004997	7.002578
7	0.0	2.009975	2.115680
8	0.0	3.025244	4.004997
9	0.0	2.000000	2.022375