Artificial Intelligence Masterclass

K – Nearest Neighbors (KNN)

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K- Nearest Neighbors

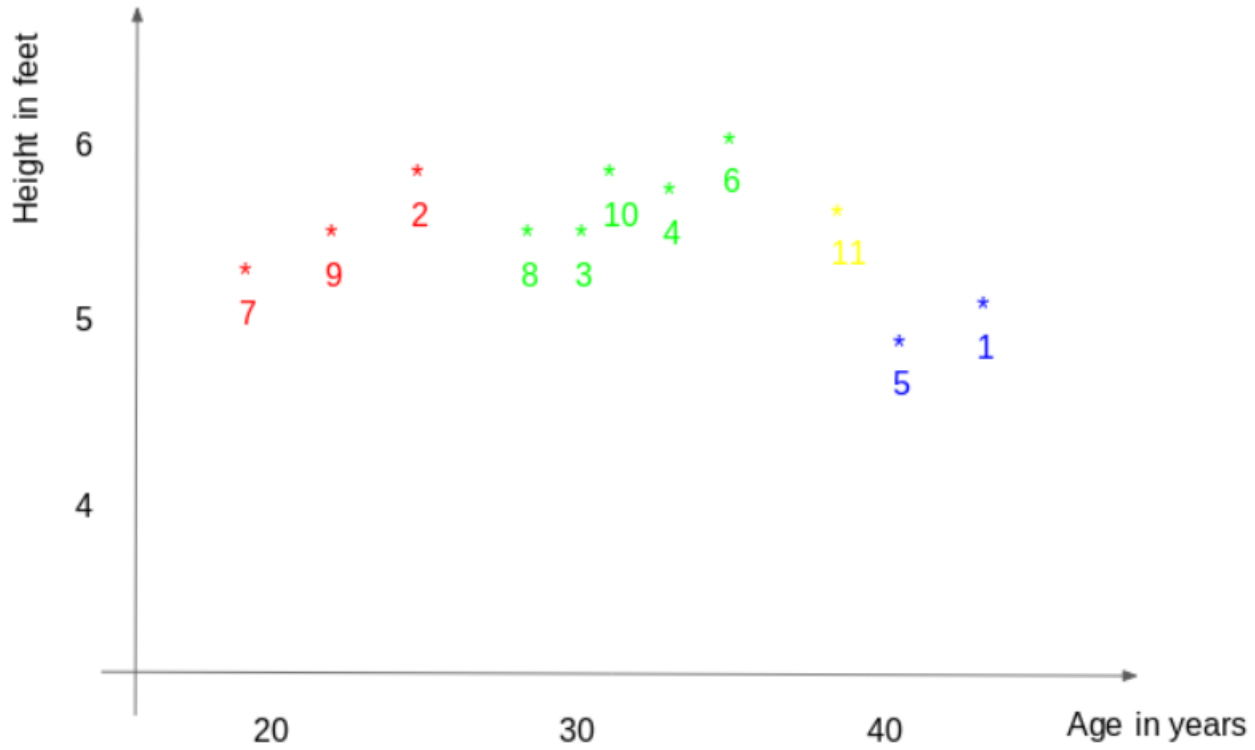
Consider the following example. Think that we are going to fit a model using Height and Age for the response variable Weight.

ID	Height	Age	Weight
1	5	45	77
2	5.11	26	47
3	5.6	30	55
4	5.9	34	59
5	4.8	40	72
6	5.8	36	60
7	5.3	19	40
8	5.8	28	60
9	5.5	23	45
10	5.6	32	58
11	5.5	38	?

Think that we need to find the Weight for observation 11 using the given data.

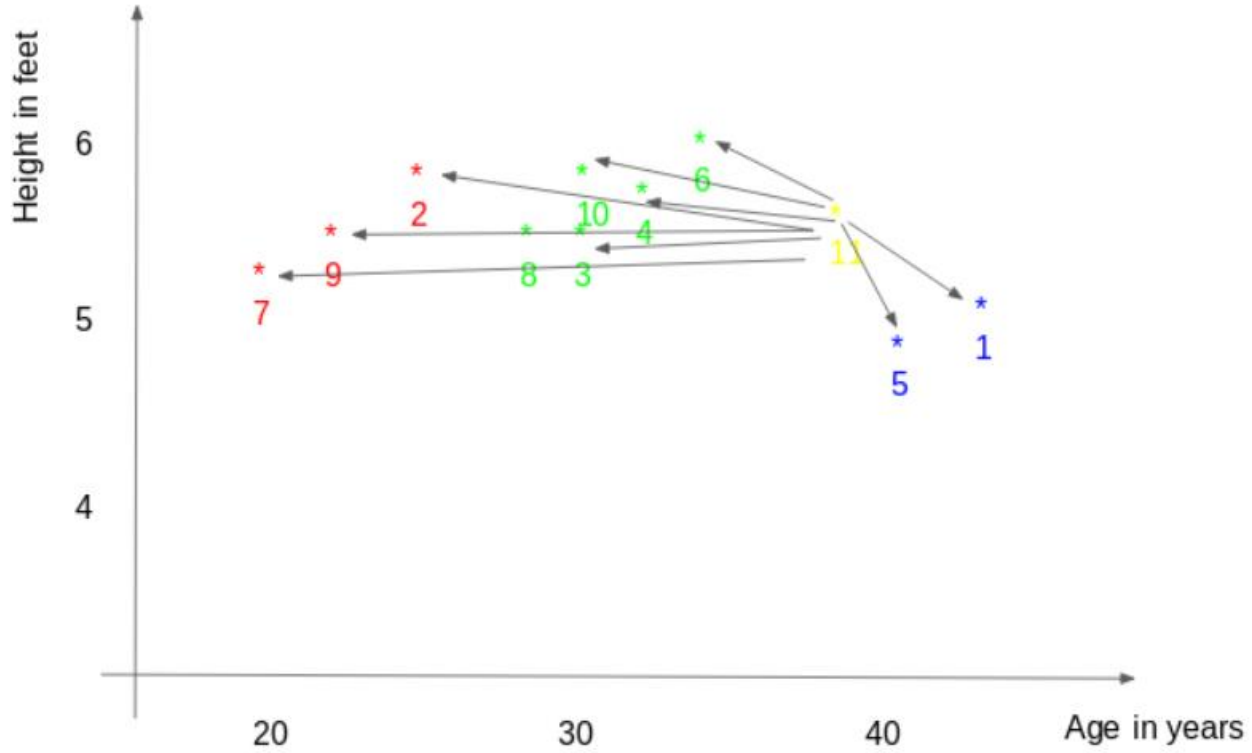
K- Nearest Neighbors

If we plot this,



K- Nearest Neighbors

First, the distance between the new point and each training point is calculated.



K- Nearest Neighbors

For this distance calculations we can use 3 types of distances.

- 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).

$$\sqrt{\sum_{i=1}^{k}(x_i - y_i)^2}$$

- Manhattan Distance: This is the distance between real vectors using the sum of their absolute difference.

$$\sum_{i=1}^{k}|x_i - y_i|$$

- Hamming Distance: It is used for categorical variables. If the value (x) and the value (y) are the same, the distance D will be equal to 0 . Otherwise D=1.

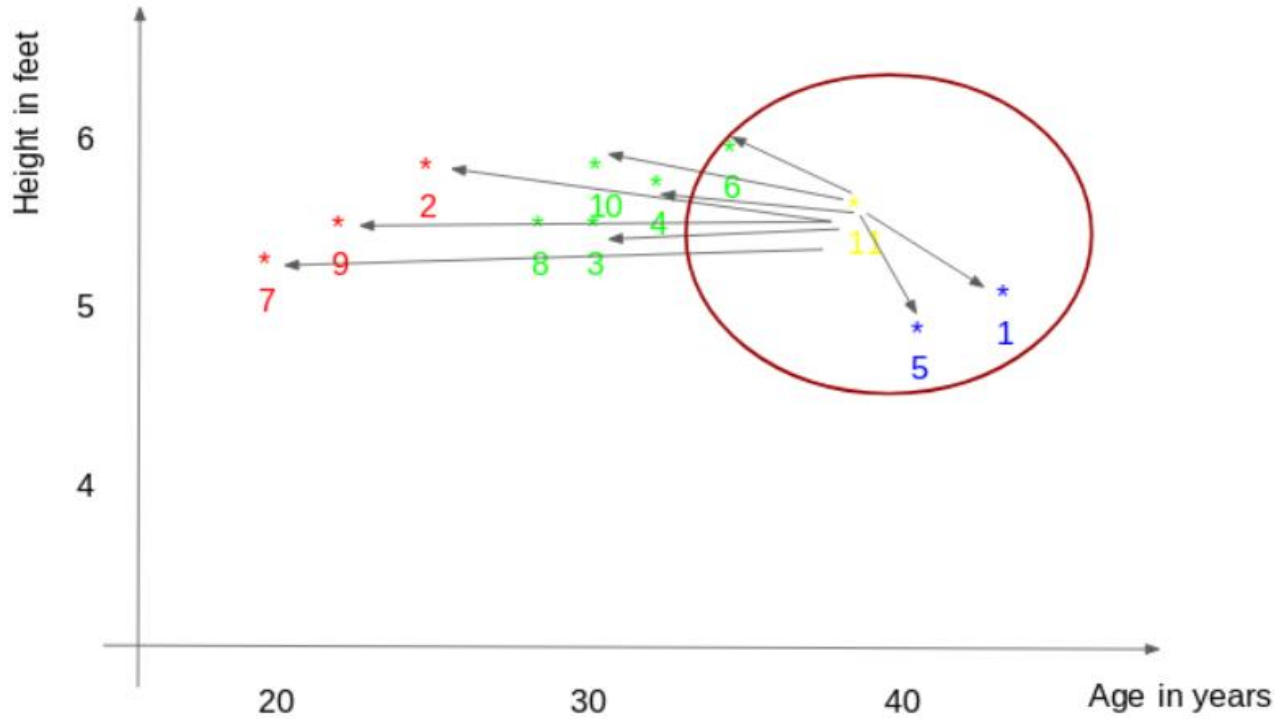
$$D_H = \sum_{i=1}^{k}|x_i - y_i|$$

$$x = y \Rightarrow D = 0$$

$$x \neq y \Rightarrow D = 1$$

K- Nearest Neighbors

The closest k data points are selected (based on the distance). Consider here k=3, so in this example, points 1, 5, 6 will be selected if the value of k is 3.



Then the average of these data points is the final prediction for the new point. Here, we have weight of ID11 is (77+72+60)/3 = 69.66 kg. If we have a classification case, the most frequent category will be chosen to assign.

K- Nearest Neighbors

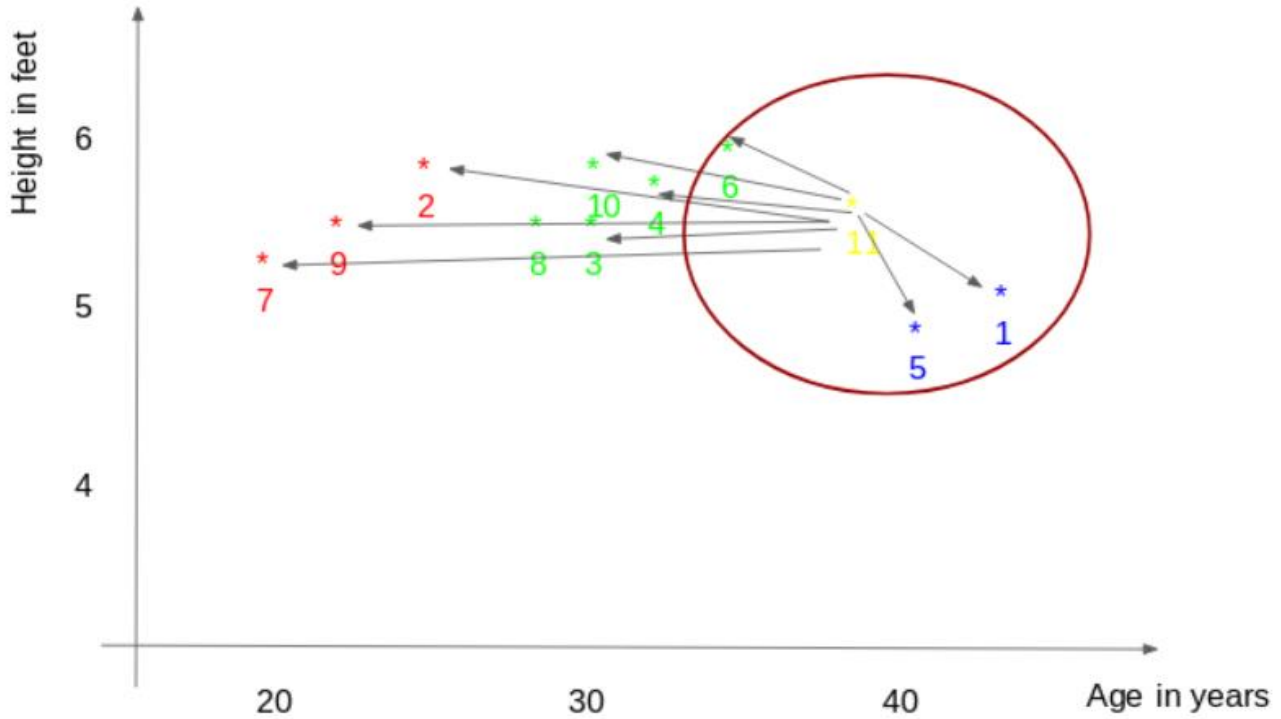
Consider the following example. Think that we are going to fit a model using Height and Age for the response variable Weight.

ID	Height	Age	Weight	Class
1	5	45	77	A
2	5.11	26	47	A
3	5.6	30	55	B
4	5.9	34	59	C
5	4.8	40	72	B
6	5.8	36	60	A
7	5.3	19	40	C
8	5.8	28	60	A
9	5.5	23	45	B
10	5.6	32	58	C
11	5.5	38	?	

Think that we need to find the Class for observation 11 using the given data.

K- Nearest Neighbors

The closest k data points are selected (based on the distance). Consider here k=3, so in this example, points 1, 5, 6 will be selected if the value of k is 3.



If we have a classification case, the most frequent category will be chosen to assign. 11th observation belongs to Class A.

K- Nearest Neighbors

To select the optimum k for the algorithm, we can use the Validation Set or Cross Validation approaches. Consider following graphs. Training & validation errors have been measured for several k values.