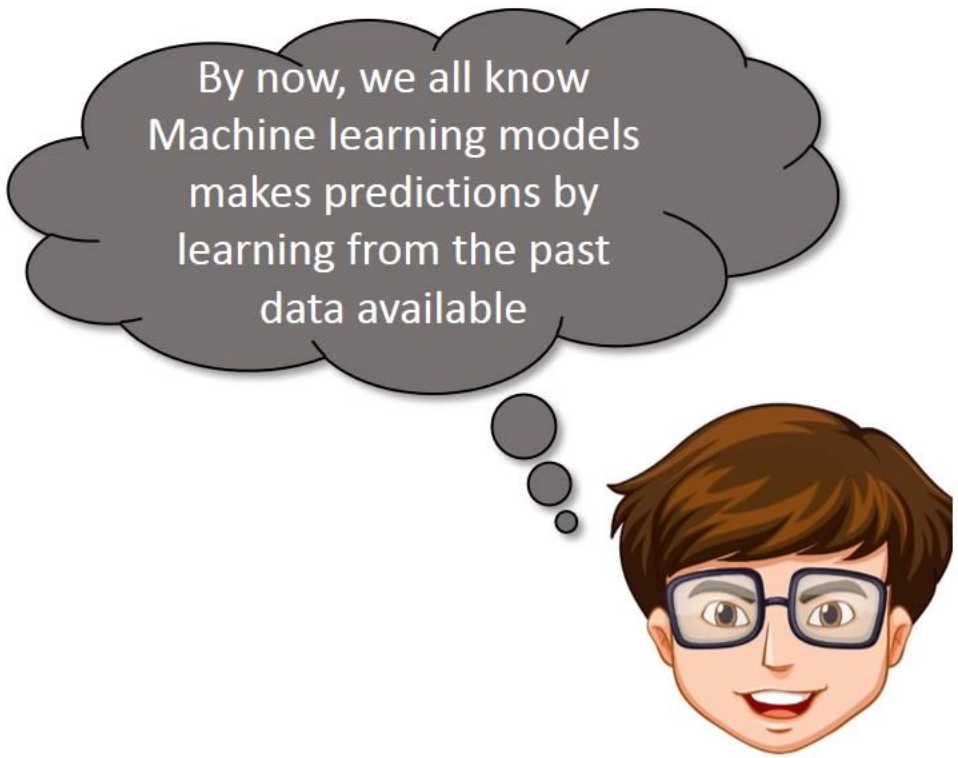
k-nearest neighbors

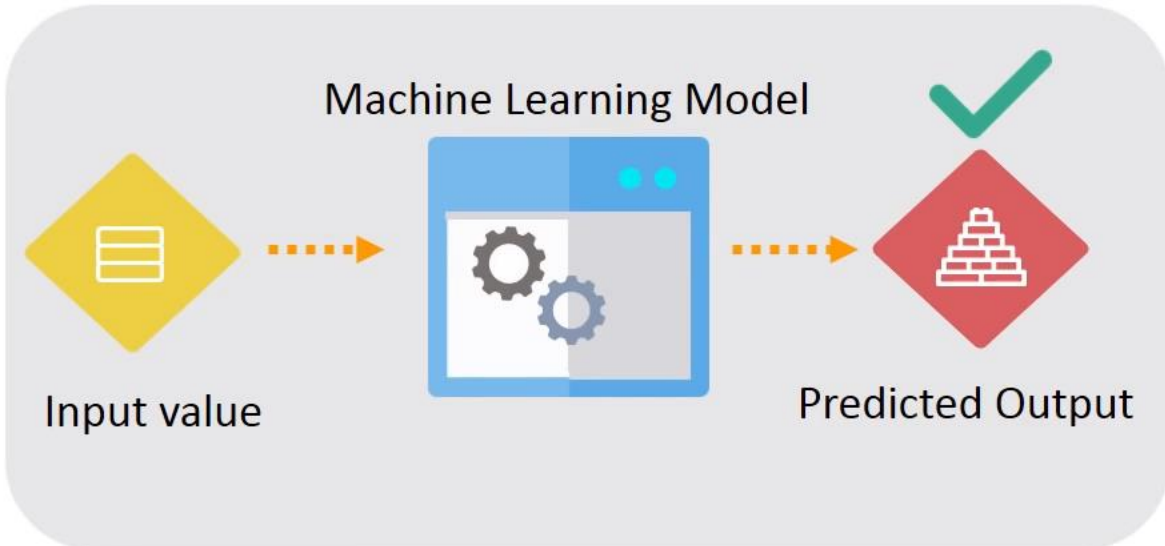
(knn)

What's in it for you?

- Why do we need KNN?
- What is KNN?
- How do we choose the factor 'K'?
- When do we use KNN?
- How does KNN Algorithm work?

Why KNN?


By now, we all know
Machine learning models
makes predictions by
learning from the past
data available

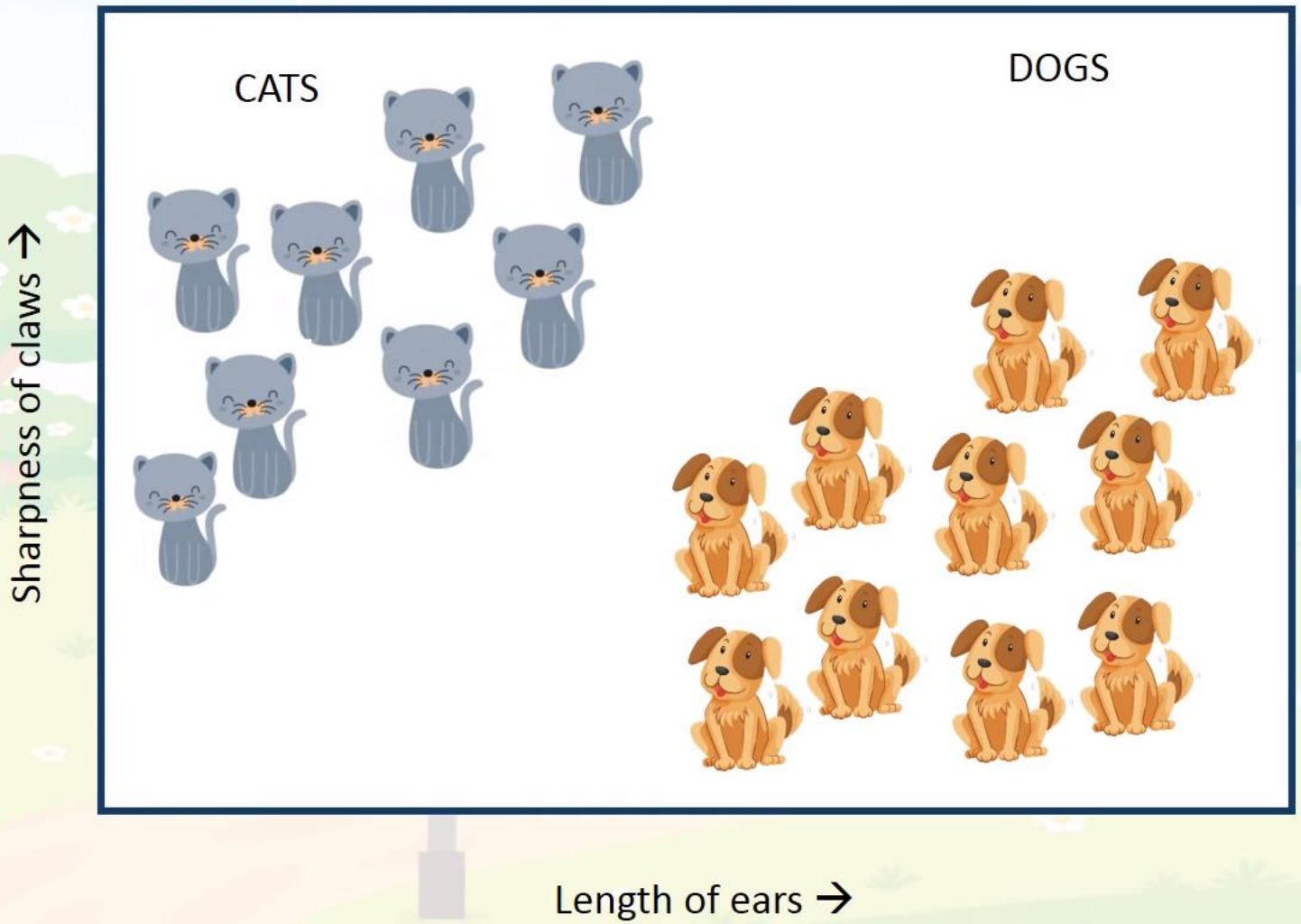

Machine Learning Model
Input value
Predicted Output


Is that a dog?

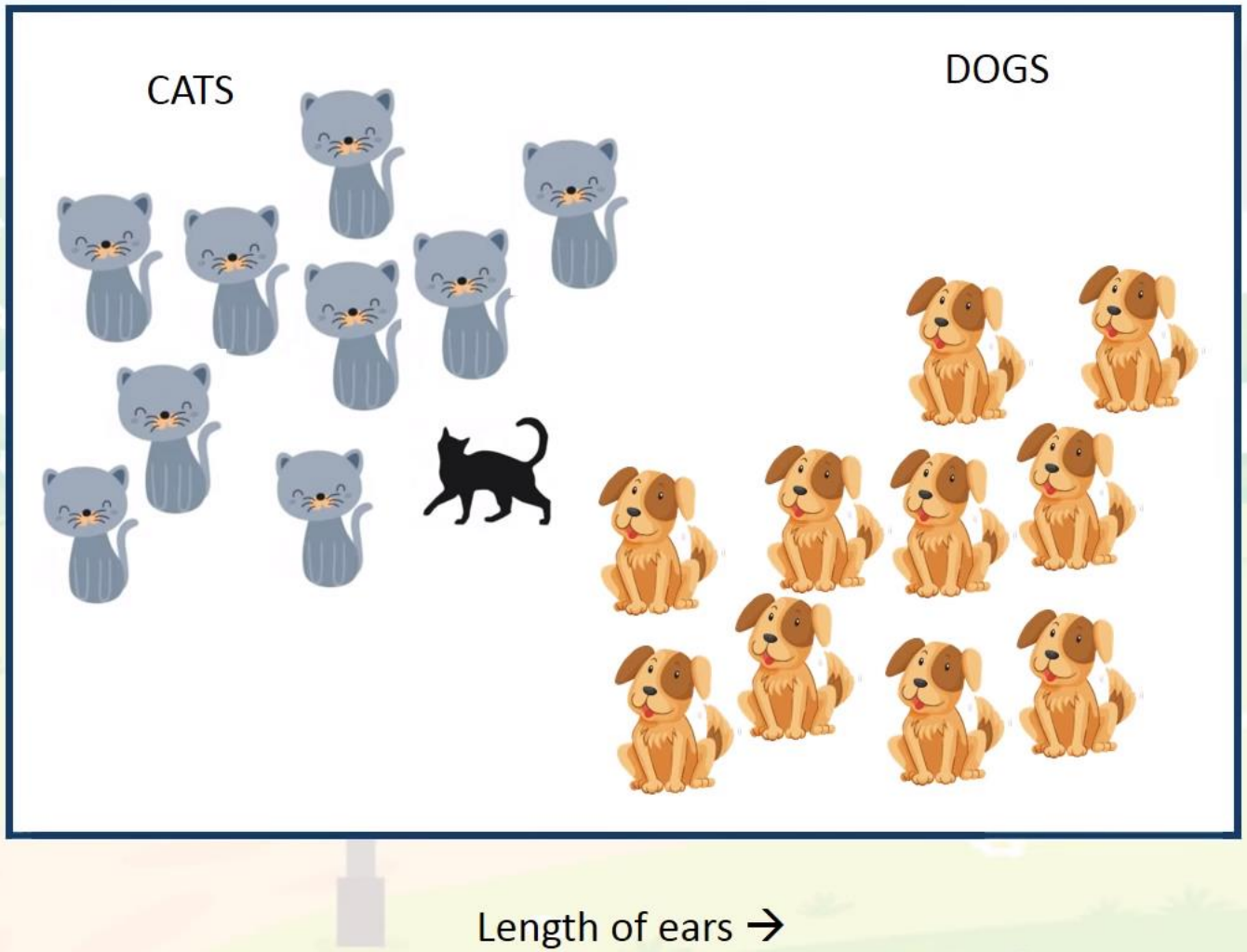
No dear, you can differentiate between a cat and a dog based on their characteristics

CATS	DOGS
	
Sharp Claws, uses to climb	Dull Claws
Smaller length of ears	Bigger length of ears
Meows and purrs	Barks
Doesn't love to play around	Loves to run around

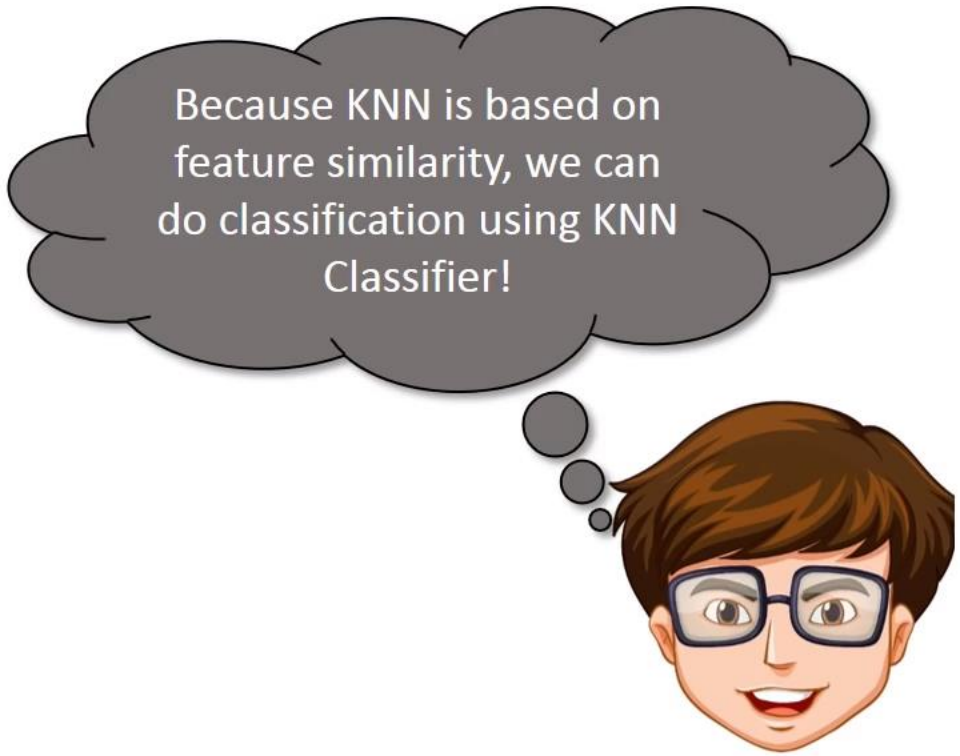
No dear, you can differentiate between a cat and a dog based on their characteristics

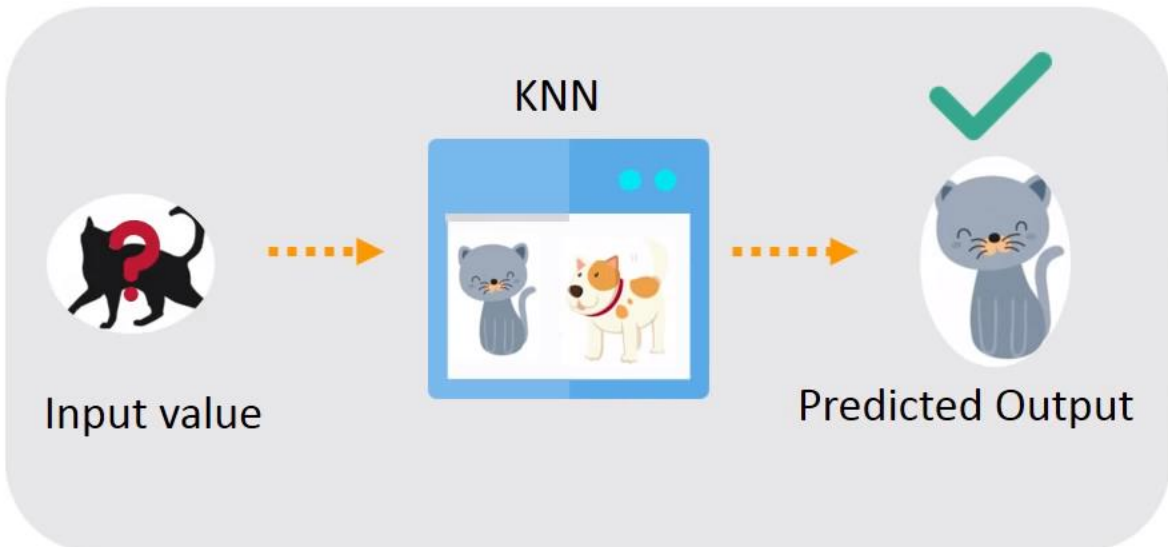


Now tell me if it's a cat or a dog?



Why KNN?


Because KNN is based on feature similarity, we can do classification using KNN Classifier!


KNN
Input value
Predicted Output

What is KNN Algorithm?

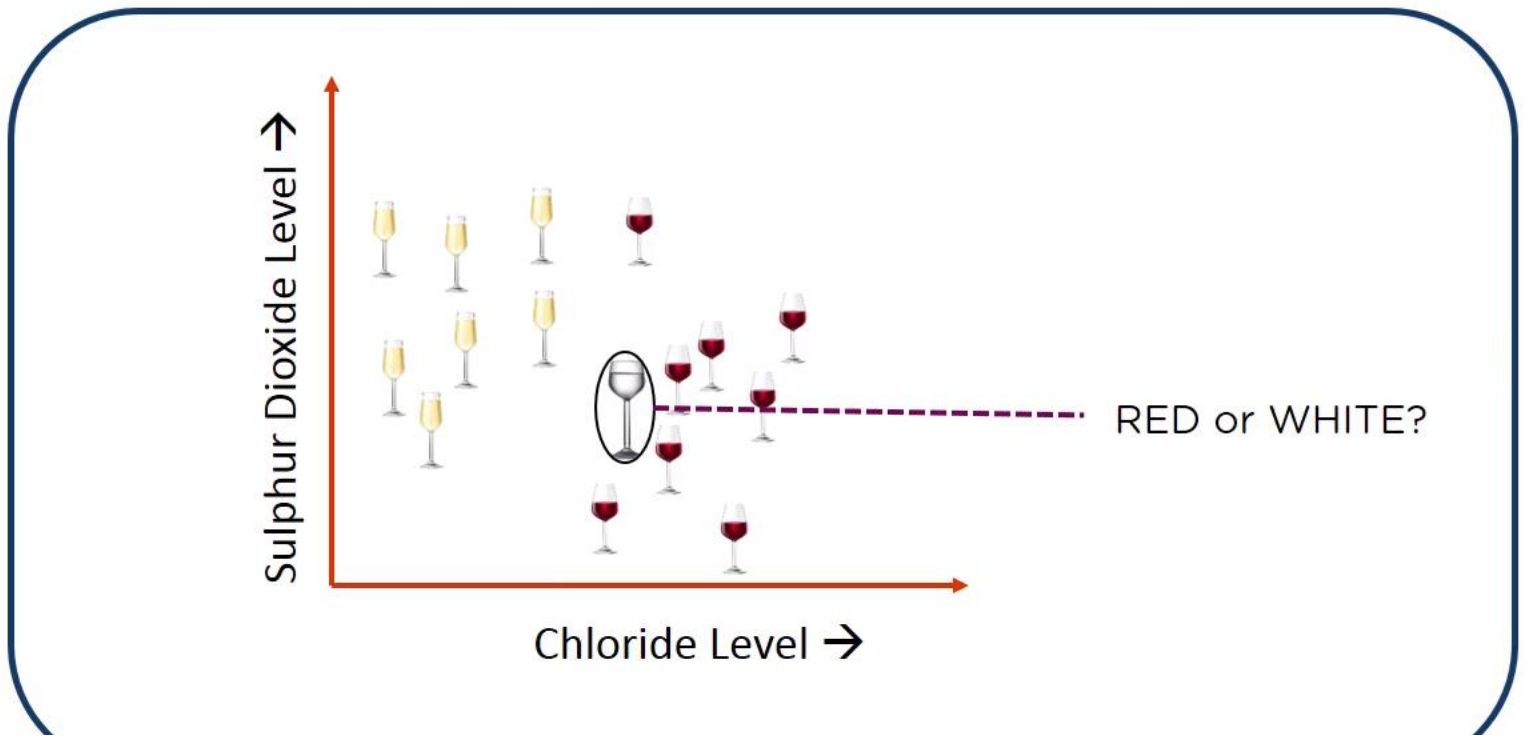
KNN – K Nearest Neighbors, is one of the simplest **Supervised** Machine Learning algorithm mostly used for

Classification

It classifies a data point based on how its neighbors are classified

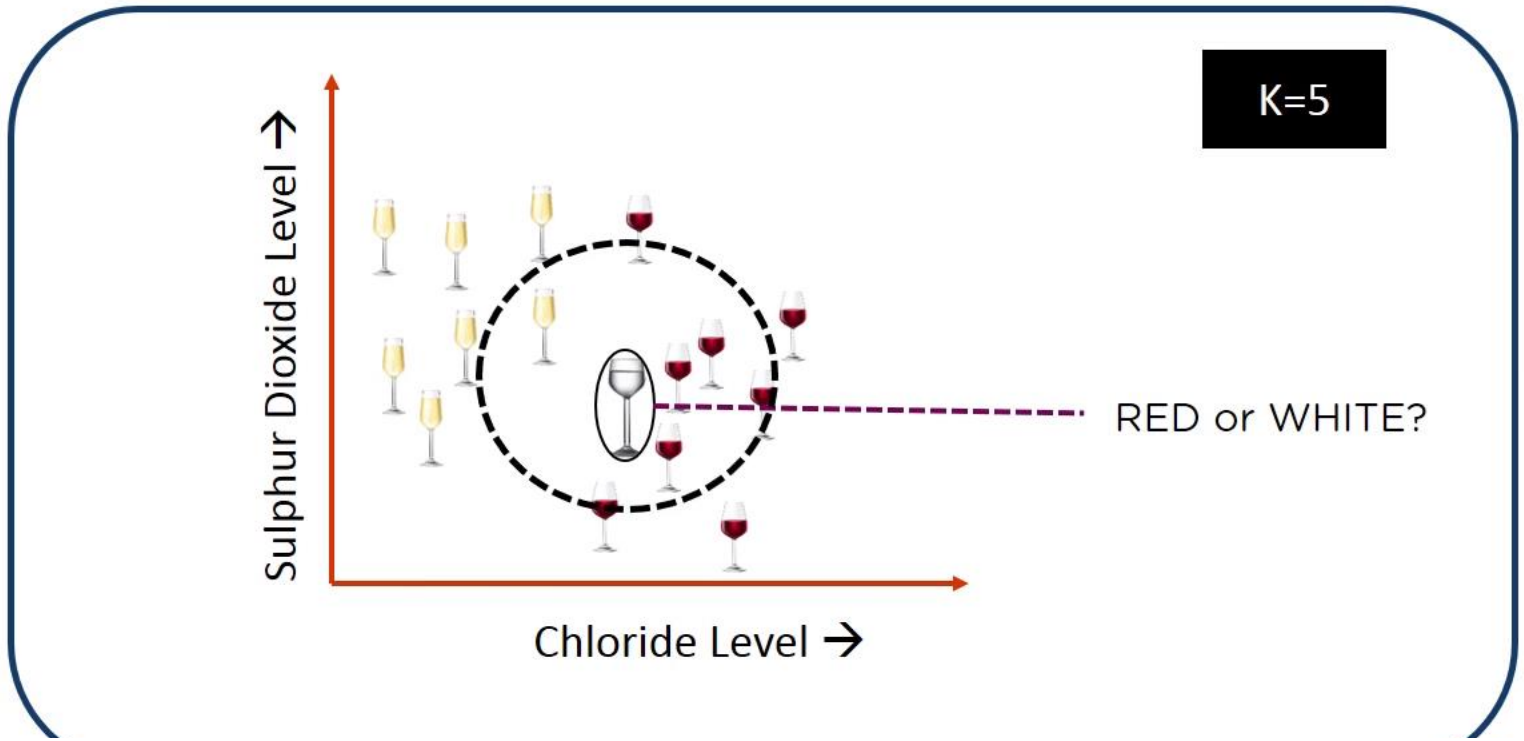
What is KNN Algorithm?

KNN stores all available cases and classifies new cases based on a similarity measure



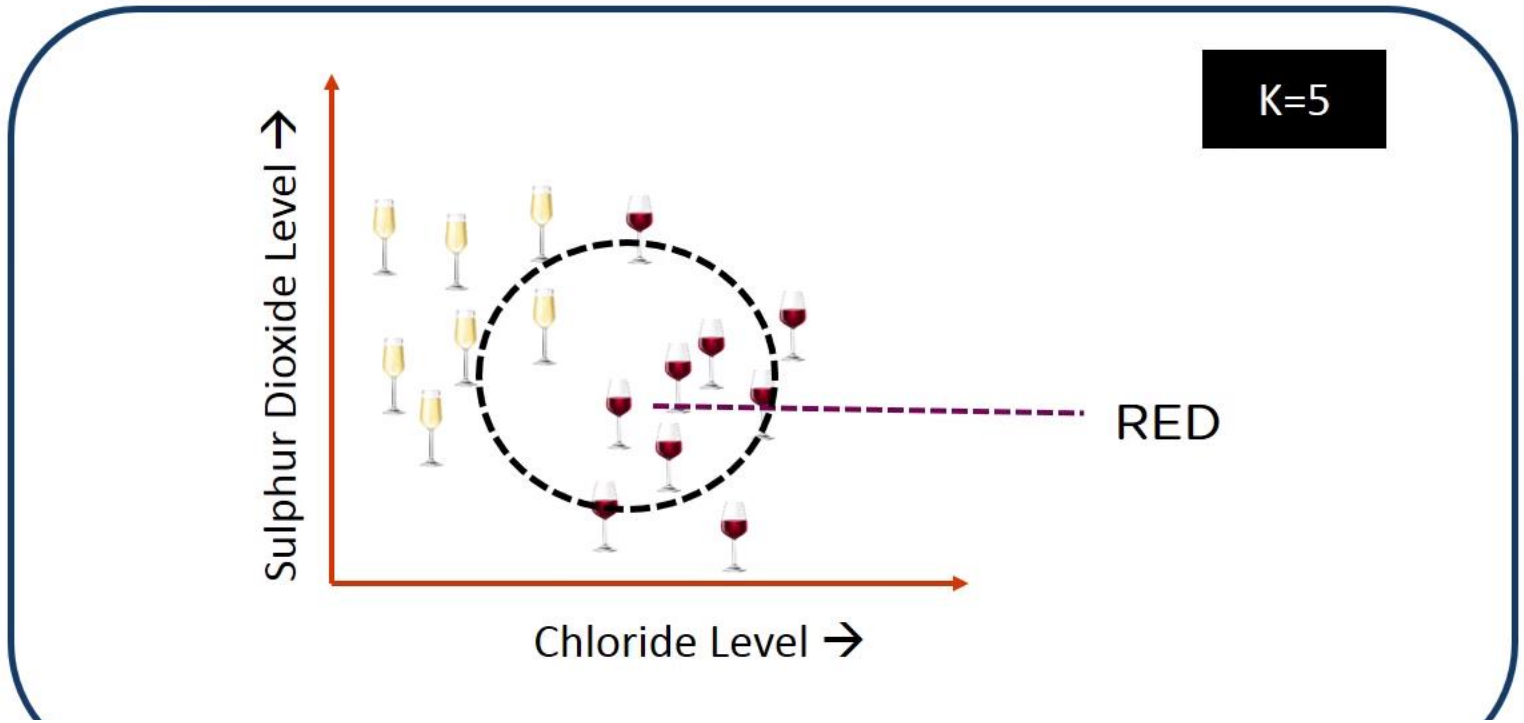
What is KNN Algorithm?

k in **KNN** is a parameter that refers to the number of nearest neighbors to include in the majority voting process



What is KNN Algorithm?

Here, the unknown point would be classified as red, since 4 out of 5 neighbors are red

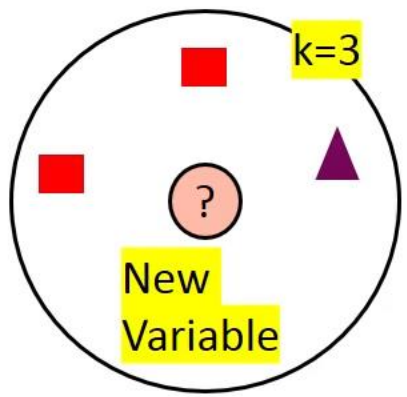


How do we choose the factor ‘k’?

KNN Algorithm is based on **feature similarity**: Choosing the right value of *k* is a process called parameter tuning, and is important for better accuracy

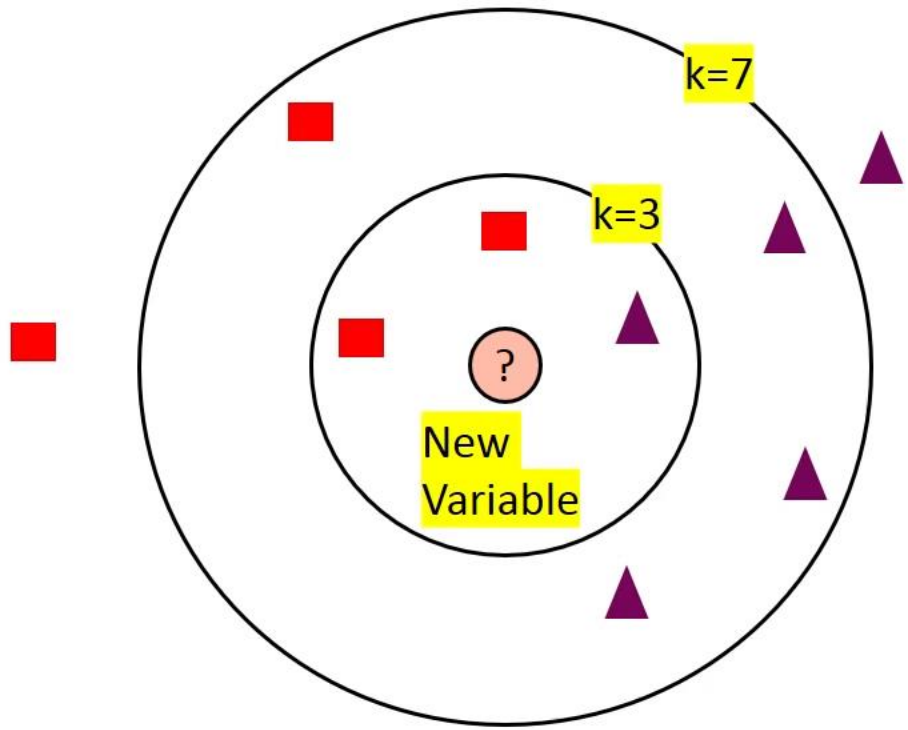
How do we choose the factor ‘k’?

KNN Algorithm is based on **feature similarity**: Choosing the right value of *k* is a process called parameter tuning, and is important for better accuracy



How do we choose the factor ‘k’?

KNN Algorithm is based on **feature similarity**: Choosing the right value of *k* is a process called parameter tuning, and is important for better accuracy



How do we choose the factor ‘k’?

The class of unknown data point was ■ at k=3 but changed at k=7, so which k should we choose?

How do we choose the factor ‘k’?

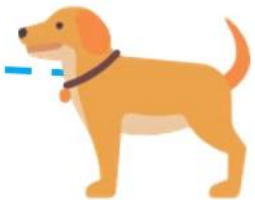
To choose a value of k:

- Sqrt(n), where n is the total number of data points
- Odd value of K is selected to avoid confusion between two classes of data

When do we use KNN Algorithm?

We can use KNN when

Data is labeled



Dog

Dataset is small

Because KNN is a 'lazy learner' i.e. doesn't learn a discriminative function from the training set

Data is noise free

Weight(x2)	Height(y2)	Class
51	167	Underweight
62	182	one-fourty
69	176	23
64	173	hello kitty
65	172	Normal

Noise

How does KNN Algorithm work?

Consider a dataset having two variables: height (cm) & weight (kg) and each point is classified as Normal or Underweight

Weight(x2)	Height(y2)	Class
51	167	Underweight
62	182	Normal
69	176	Normal
64	173	Normal
65	172	Normal
56	174	Underweight
58	169	Normal
57	173	Normal
55	170	Normal

How does KNN Algorithm work?

On the basis of the given data we have to classify the below set as Normal or Underweight using KNN

57 kg	170 cm	?

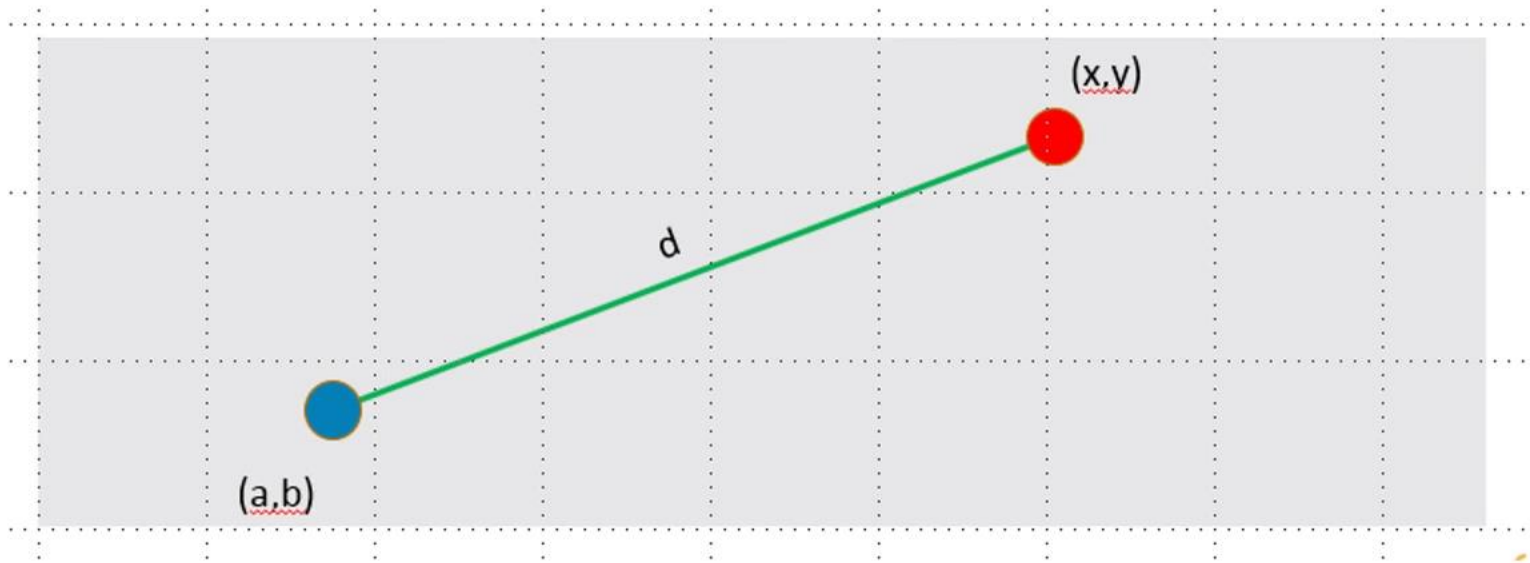
How does KNN Algorithm work?

To find the nearest neighbors, we will calculate Euclidean distance

How does KNN Algorithm work?

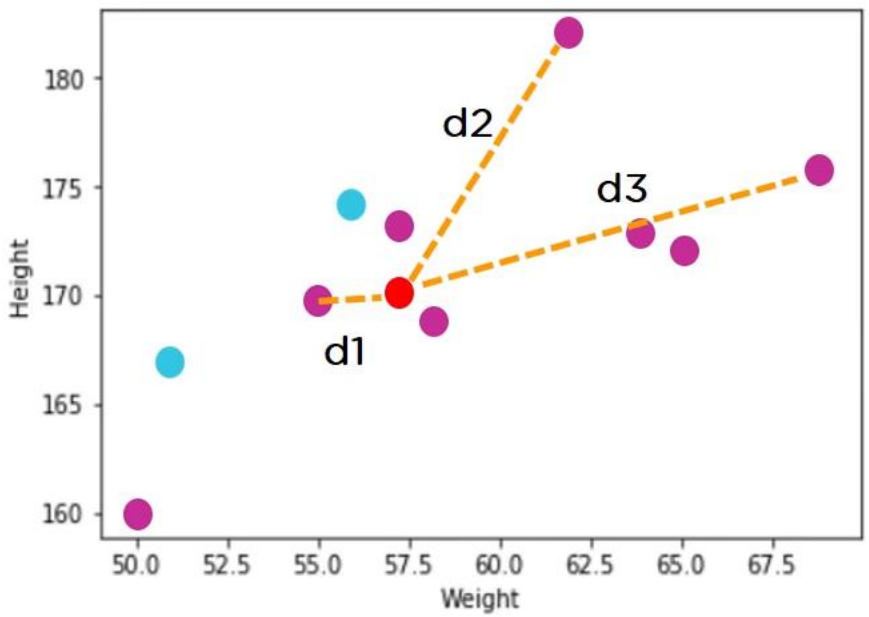
According to the **Euclidean distance** formula, the **distance** between two points in the plane with coordinates (x, y) and (a, b) is given by:

$$dist(d) = \sqrt{(x - a)^2 + (y - b)^2}$$



How does KNN Algorithm work?

Let's calculate it to understand clearly:



dist(**d1**)= √(170-167)² + (57-51)² ~= 6.7

dist(**d2**)= √(170-182)² + (57-62)² ~= 13

dist(**d3**)= √(170-176)² + (57-69)² ~= 13.4

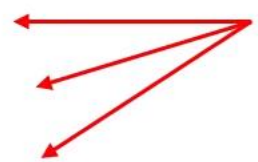
Similarly, we will calculate Euclidean distance of unknown data point from all the points in the dataset

● Unknown data point

How does KNN Algorithm work?

Now, lets calculate the nearest neighbor at k=3

Weight(x2)	Height(y2)	Class	Euclidean Distance
51	167	Underweight	6.7
62	182	Normal	13
69	176	Normal	13.4
64	173	Normal	7.6
65	172	Normal	8.2
56	174	Underweight	4.1
58	169	Normal	1.4
57	173	Normal	3
55	170	Normal	2

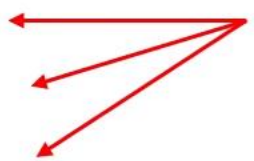


k = 3

57 kg	170 cm	?

How does KNN Algorithm work?

Class	Euclidean Distance
Underweight	6.7
Normal	13
Normal	13.4
Normal	7.6
Normal	8.2
Underweight	4.1
Normal	1.4
Normal	3
Normal	2



k = 3

So, majority neighbors are pointing towards '*Normal*'

Hence, as per KNN algorithm the class of (57, 170) should be 'Normal'

Recap of KNN

Recap of KNN

- A positive integer k is specified, along with a new sample
- We select the k entries in our database which are closest to the new sample
- We find the most common classification of these entries
- This is the classification we give to the new sample

Thank you!