Machine Learning

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Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. **Machine learning** focuses on the development of computer programs that can access data and use it to learn for themselves.

Artificial intelligence (**AI**) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions.

Deep learning is an artificial intelligence (AI) function that imitates the workings of the human brain in processing data and creating patterns for use in decision making. Deep learning is a subset of machine learning in artificial intelligence that has networks capable of learning unsupervised from data that is unstructured or unlabeled. Also known as deep neural learning or deep neural network.

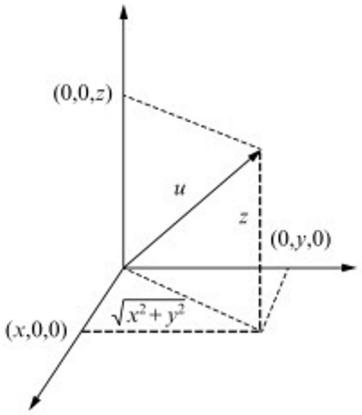
Vector :
A quantity having direction as well as magnitude, especially as determining the position of one point in space relative to another.

Euclidean Distance :

$$d(\mathbf{p}, \mathbf{q}) = \sqrt{\sum_{i=1}^{n} (q_i - p_i)^2}$$

p, q = two points in Euclidean n-space
q_i, p_i = Euclidean vectors, starting from the origin of the space (initial point)
n = n-space

Length of vector (u):



$$(\text{length}\,(u))^2 = (\sqrt{x^2 + y^2})^2 + z^2 = x^2 + y^2 + z^2$$

$$\text{length}\,(u) = \sqrt{x^2 + y^2 + z^2}$$

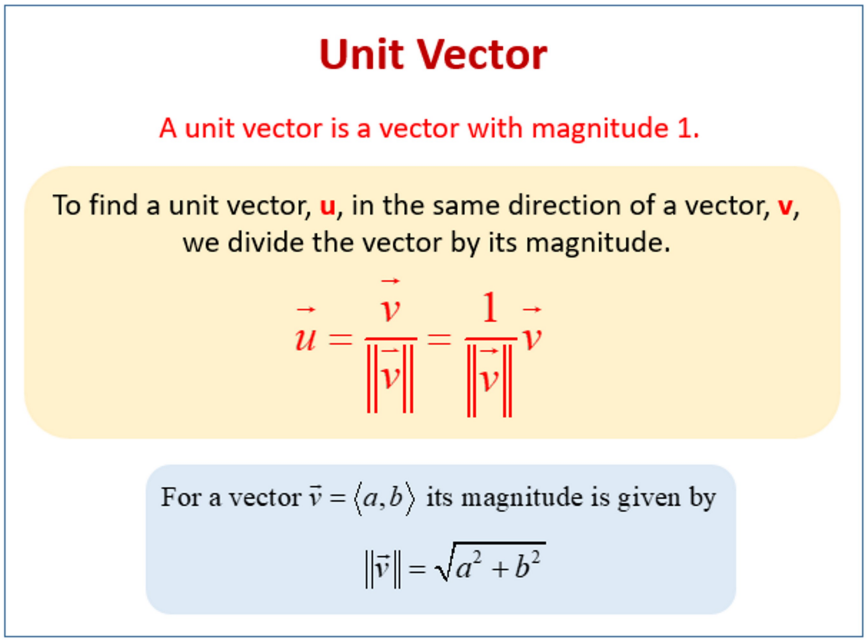
Dot Product of Vector :

$$a \cdot b = \sum_{i=1}^{n} a_i b_i$$

- a = 1st vector
- b = 2nd vector
- n = dimension of the vector space
- a_i = component of vector a
- b_i = component of vector b

= |a|.|b|.cos(Q) = aT. b

It produces scalar value.



General Equation of line (2D) :
ax + by + c = 0
y = ax/b + c/y similar to y = mx + c

General Equation of plane (3D) :
ax + by + cz + d = 0
y = ax/b + cz/b + d/b similar to y = m1x + m2z + c

General Equation of Hyperplane (4D) :
ax + by + cz + dw + e = 0
y = ax/b + cz/b + d/b + e/b similar to y = m1x + m2z + m3w + c

So, **No of dimensions = No of slopes + Intercept**
In general, we can use this equation as,

w1x1 + w2x2 + w3x3 + w4x4 + wo = 0 &
x2 = - (w1x1/w2 + w3x3/w2 + w4x4/w2 + w0/w2)

So the Equation can be :
Σ(WiXi) + w0 = 0 OR **πN(wTx + w0) = 0**

Supervised Learning :
Supervised learning is the types of machine learning in which machines are trained using well "labelled" training data, and on basis of that data, machines predict the output. The labelled data means some input data is already tagged with the correct output.

Classification :
In machine learning, classification is a supervised learning concept which basically categorizes a set of data into classes.

Regression :
In machine learning, regression is a supervised learning concept where training data present in the form of real or continuous value.

Why do we need to Standardize or Normalize the Data ?

We need to convert the input variables in similar range so that Algorithms can performs well on data.

Standardization : Convert the values into Z score, It converts the values into Standard Normal Distribution, where mean = 0 and std = 1

Normalization : $\frac{x - xmin}{xmax - xmin}$

Its value lies between 0 and 1

We can choose one between both, its all depend on experimentation. Many people prefer Standardization over Normalization.

Distances between Vectors :

1. Euclidean Distance (L2) = $\sqrt{\sum_i^n (a_i - b_i)^2}$
2. Manhattan Distance (L1) = $\sum_i^n | a_i - b_i |$
3. Minkowski Distance = $(\sum_i^n | a_i - b_i |^p)^{1-p}$

If p = 1, Minkowski = Manhattan Distance
p = 2, Minkowski = Euclidean Distance