Machine Learning !!

Definition !!

"Study of Computer Algorithms that allows the Computer Program to automatically improve through Experience"

[Efficient - learning]

[Training]

By Tom Mitchel (founder of ML Department)
School of Computer Science at Carnegie Mellon University.

* "ML is teaching the machine about something"

How !!

1. Collect and clean the data
2. Algorithm (model) — select (Readymade) / Built.
3. Teach the model essential pattern from data (Training).
4. Expect the model to give helpful Answer.

Ex To Design a System that determine from MRI Scan, whether Tumor is present or not.

(1) Collect large No of MRI reports

Ex 10000 MRI report < 6000 has Tumor
4000 do not have Tumor } Labelled Data.

Test 30%. Train 70%.

(2) Build an efficient algorithm that detects presence or absence of Tumor in an MRI Scan.
[Expert Consultation – Radiologist].

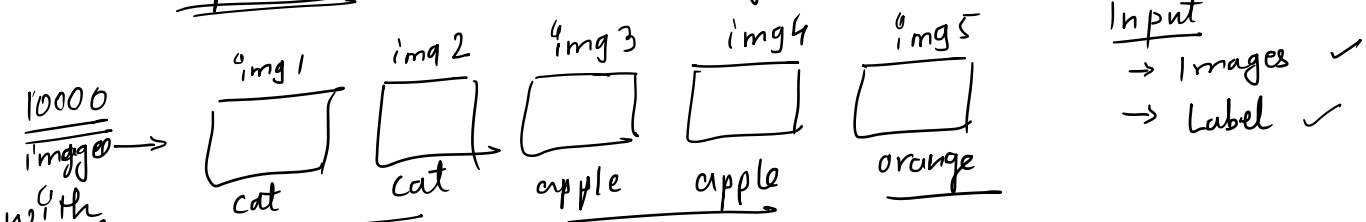
(3) To the Algorithm feed the 6000 MRI Scans and allow the model to learn (train).

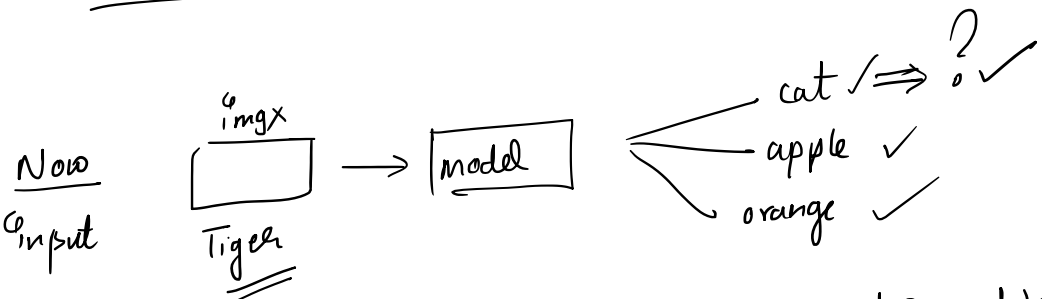
(4) Use around 3000 Images (MRI Scans) for Testing

(5) Use this model to determine presence or absence of Tumor from a New Image (MRI Scan)

Types of machine learning Algorithms.

① Supervised machine learning Algorithms.

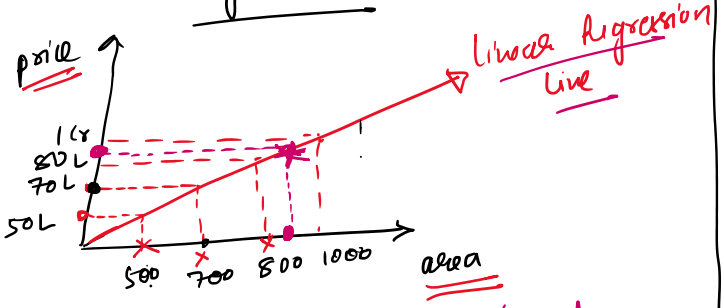


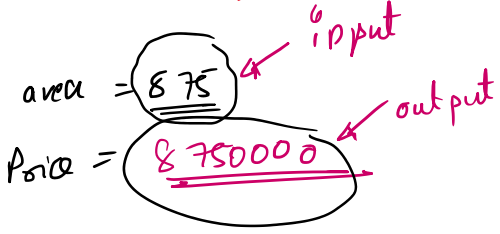


* With lot of images as input, model will be able to identify pattern and will be able to predict.

Supervised.

Regression.





Here o/p is continous value.

Here area ⇒ Independent variable
price ⇒ Dependent variable

Classification.

Here o/p is not continous value but could be Boolean or some class / category as output.

* Spam detection → Spam Hai / Spam Nahi Hai

* MRI Scan For Tumor Detection → Tumor Hai / Tumor Nahi Hai

In above cases the o/p belongs to

Here area ⇒ Independent variable

price ⇒ Dependent variable

Here the dependent and Independent Variable can have Continous value.

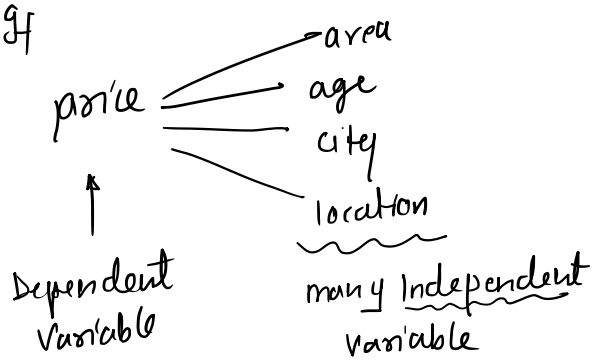
Types ⇒

if price → area.

Single Independent variable

→ Simple Regression

if

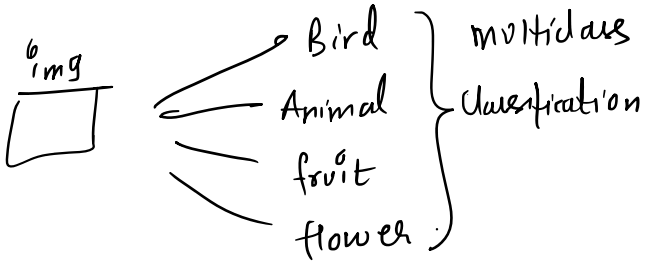


When we have more than one Independent variable ⇒ multiple Regression

In above cases the o/p belongs to one of the two dasses.

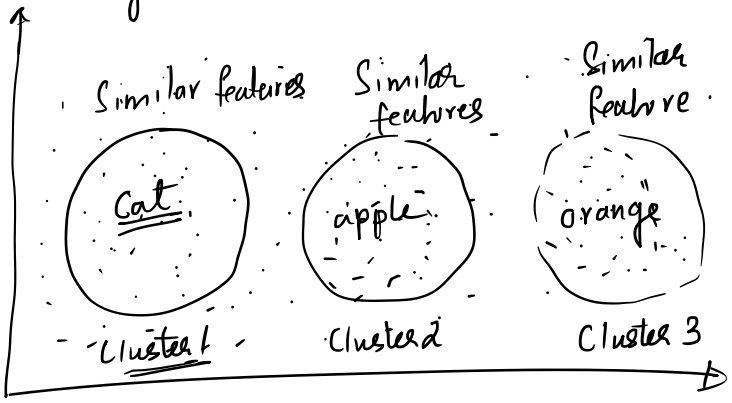
→ Binary classification.

if o/p can be one of many dasses (more than Two) then it is Called as multiclass classification.



Unsupervised Learning

Given 10000 images and no label are specified.



* Here the input is only data and no labels are associated with data.
* Not Sure about type of output
* Unsupervised Algo will work on 10000 images and will create cluster of images based on the similarities.
* It is "SELF LEARNING"

Unsupervised.

Clustering

(1) Model will identify the pattern in input data and will create cluster.

Ex Market Segmentation.

* Study the Spending / Income of population and create cluster

Association

(1) We find dependencies of one data item on another.

(2) This dependency will help to map the relation and will enhance prediction.

(3) It is like "If - Then"

Ex Used by Amazon known as

population and create clusters

(1) High Earning
(2) Medium Earning
(3) Low Earning

Ex Used by Amazon known as Market Basket Analysis.

"If a person purchases cellphone then the person has tendency to purchase screen guard & backcover"

Semi Supervised.

Text Document Classifier

Ex 1000000 articles. and need to classify them into
- News
- Literature
- Research paper
- medical Report

Label is not provided.

Manually labelling the 1000000 articles not possible.

→ we will label 10000 articles [Supervised Learning]

→ my model will be trained on these 10000 articles and will use the pattern identified to classify the remaining 990000 articles [Unsupervised]

* Uses small amount of labelled data
* and large amount of unlabelled data.
* Benefits of Both Labelled and unlabelled data.
* Overcome the challenge of finding large amount of Labelled data.

Reinforcement Learning [Experential Learning]

→ Here the agent/model learns how to behave in an Environment by performing action and experiencing the result.

Types

Episodic Learning

→ Here we have Start and End state, thus an episode is created.

→ Thus the feather action is based on feedback of result of earlier action.

Ex Fear of dog after being bitten is Episodic Learning.

Continous Task Learning

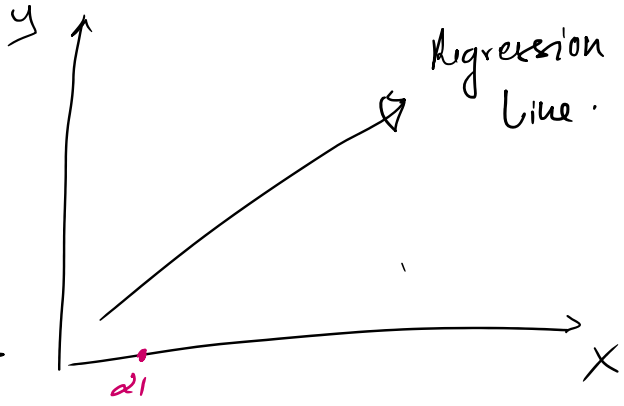
* There is no terminal state here
* Agent/model that does Automated Stock Trading goes for Continous Learning

	INDEPENDENT	DEPENDENT		
SR.NO	X	Y	x^2	xy
1	43	99	1849	4257
2	21	65	441	1365
3	25	79	625	1975
4	42	75	1764	3150
5	57	87	3249	4959
6	59	81	3481	4779
	$\Sigma x = 247$	$\Sigma y = 486$	11409	20485

↓ Actual value. $n = 6$

Now predict if $X = 55$, what is y ?

Σx^2 Σxy



→

$$y = a + bx + e$$

- y : Dependent variable
- a : Intercept
- b : decides impact of X on y.
- e : Error

[if x↑ y↑ +ve Impact]
[if x↑ y↓ -ve impact].

a = intercept
b = slope (coefficient of Independent Variable)
c = Error

Let us assume $e = 0$

$$y = a + bx \quad \text{— (1)}$$

To find a and b.

Take Σ on both side of 1

$$\Sigma y = \Sigma a + \Sigma bx$$

$$\Sigma y = a\Sigma 1 + b\Sigma x$$

$$\Sigma y = an + b\Sigma x \quad \text{— (2)}$$

multiply Eq 2 with Independent Variable X.

$$\Sigma xy = a\Sigma x + b\Sigma x^2 \quad \text{— (3)}$$

multiply Eq 2 with independent ...

$$\Sigma xy = a\Sigma x + b\Sigma x^2 \quad -(3)$$

Here $\frac{Eq\ 2}{Eq\ 3}$

$$486 = a6 + b247 \quad \checkmark$$

$$20485 = a247 + b11409 \quad \checkmark$$

$$a = 65.14$$

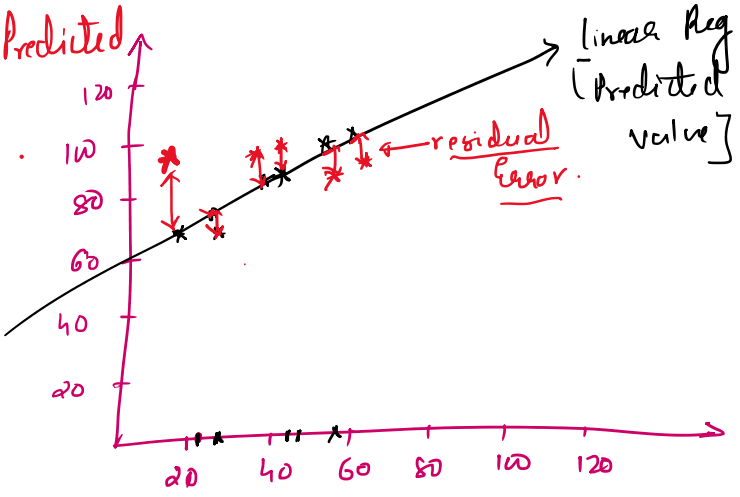
$$b = 0.385$$

$$y = 65.14 + 0.385x$$

Using this let us calculate Predicted Y for Every X

Actual − Predicted

SR.NO	INDEPENDENT X	DEPENDENT(ACTUAL) Y	PREDICTED Y	DIFFERENCE
1	43	99	81.695	-17.305
2	21	65	73.225	8.225
3	25	79	74.765	-4.235
4	42	75	81.31	6.31
5	57	87	87.085	0.085
6	59	81	87.855	6.855



Residual Error = Error between the Actual value and Predicted value.

Yaad Rakho

$$y = a + bx$$

$$a = \frac{(\Sigma y)(\Sigma x^2) - (\Sigma x)(\Sigma xy)}{n(\Sigma x^2) - (\Sigma x)^2}$$

$$b = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{\ldots}$$

Quantitative Analysis

$$b = \frac{n(\Sigma xy) - (\Sigma x)(\Sigma y)}{n(\Sigma x^2) - (\Sigma x)^2}$$

Given x & y $\quad$ $\forall^n$ $\quad$ $\boxed{y = a + bx}$

Find a, b.

If more than one Independent Variable ->

$$y = a + b_1x_1 + b_2x_2 + b_3x_3 \cdots$$

b_1: impact of x_1 on y

b_2: impact of x_2 on y

b_3: impact of x_3 on y.