Last Moment Tuitions

LMT

(An online tutor who teaches you as a friend)

www.lastmomenttuitions.com

Notes

Scanned by CamScanner

Last moment tuitions

ek online friend hai jo apko dost ki tarah padhata hai
jaise exam time dost padhate hai
aur exam me kaise PASS hona hai uska jugaad
apko yeh jaroor milenga

Note : pehle website or youtube pe videos dekhlo
fir apko notes bahut ache se samjhenge

www.Lastmomenttuitions.com

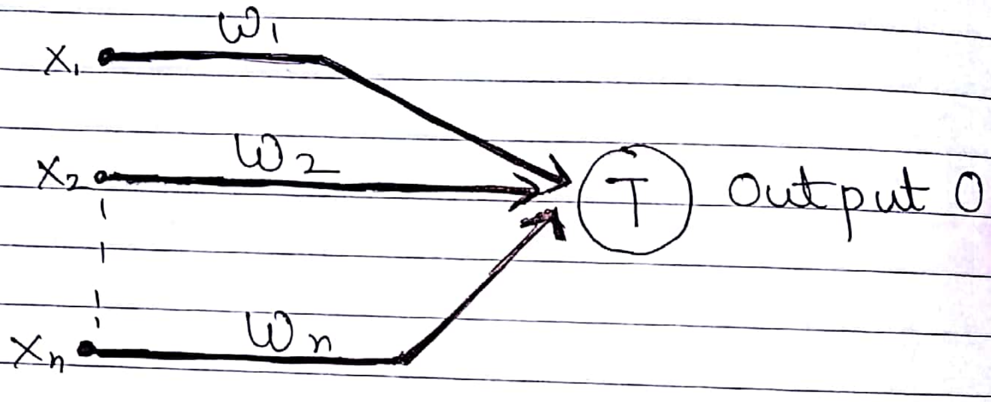
Scanned by CamScanner

Soft Computing

MP Neuron

1) This Neuron is known as McCulloch Pitts Neuron

2) The Model of this Neuron is as follow :-



$X \rightarrow$ input

$w \rightarrow$ Weights

$O \rightarrow$ Output

3) Their are 'n' inputs having values '0' and '1'.

4) The weights may be excitatory $(w = +1)$ or inhibitatory $(w = -1)$

5) There is a Threshold for each neuron, if net input is greater than threshold, then neuron fires

Agar input threshold se jyada hain toh output ayega.

6)

$$O^{k+1} = \begin{cases} 1 & \text{if } \sum_{i=1}^{n} w_i x_i \geq T \\ 0 & \text{if } \sum_{i=1}^{n} w_i x_i < T \end{cases}$$

7) This Neuron can perform basic logic operations such as AND, OR, NOT, etc (provided threshold should be appropriately selected)

Scanned by CamScanner

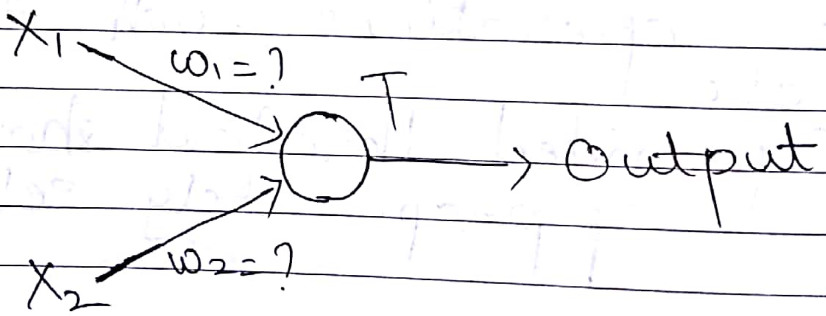
Q) Design two input AND logic using M.P Neuron Model.

→ 1) The truth table for AND is given by

X_1	X_2	O
0	0	0
0	1	0
1	0	0
1	1	1

// Here X_1, X_2 are 2 input and O is output

2) The diagram will be as follow



$x_1 \omega_1 + x_2 \omega_2 = 0$

3) Drawing the four cases

a) $x_1 = 0 \quad x_2 = 0 \Rightarrow y = 0$ (inhibitatory)

$0 < T$

b) $x_1 = 1, \quad x_2 = 0 \Rightarrow y = 0$ (inhibitatory)

$\therefore \omega_1 < T$

c) $x_1 = 0 \quad x_2 = 1 \Rightarrow y = 0$ (inhibitatory)

$w_2 < T$

d) $x_1 = 1 \quad x_2 = 1 \Rightarrow y = 1$ (Firing)

$\therefore \quad x_1 w_1 + x_2 w_2 \geq T$

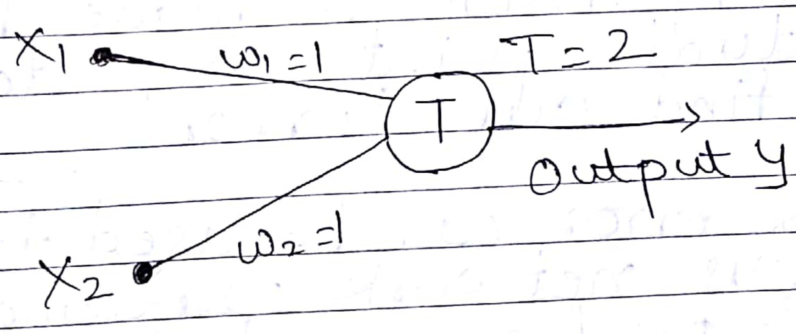
$\therefore \quad w_1 + w_2 \geq T$

// w_1 and w_2 can take value only +1 or −1.

$\therefore$ Assuming $w_1 = 1$ and $w_2 = 1$

We get, $T = 2$ //

Hence,



[Agar Output is 0 or −1 then $x_1 w_1 + x_2 w_2 < T$

Or Agar Output is 1 or +1 then $x_1 w_1 + x_2 w_2 \geq T$]

Scanned by CamScanner

Learning Method

1) Learning is relative permanent change in behaviour brought about by experience.

2) Learning in network is response to specific input.

3) Learning in network are of three types :-

a) Supervised Learning

i) Each input has a corresponding output associated with it, which is the target.

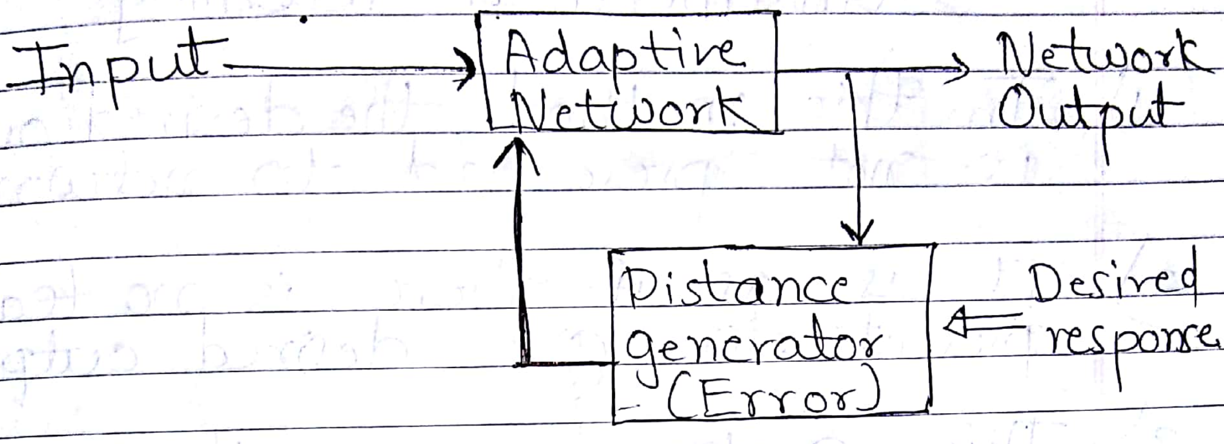
ii) A comparison is made between the actual point and desired output to find out 'error'.

iii) These error can be used to adjust various network parameters like performance of Network.

iv) This training is done until the network is able to produce the desired response.

v) Weights are adjusted to improve Network performance.

Scanned by CamScanner



Here, p[d, O] is distance function
where
d → desired output
O → Network output

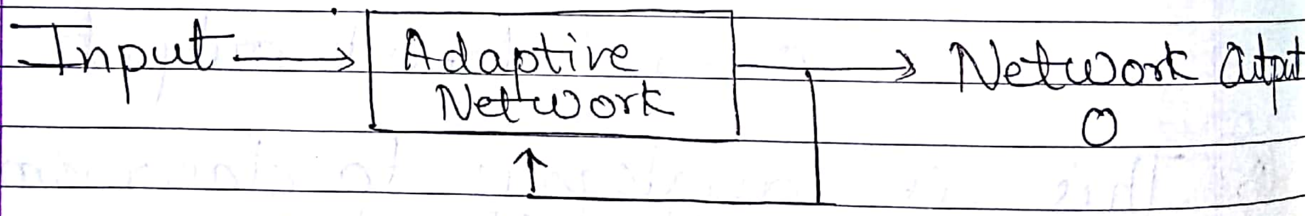
vi) This is analogous to classroom learning with Teacher.

Unsupervised learning

1) In this method, the desired output is not presented to network.

2) It is as if there is no teacher is present to give desired output.

3) This system learns on its own by discovering features present in input pattern.



4) Here No information is avaliable so as to correct the Network.

Reinforced learning

- Here, a teacher is avaliable, but it does present that whether computed output is correct or incorrect.
- It does not present the desired output.
- A reward is given for correct answer and penalty is given for wrong answer.
- It is used when knowledge required for supervised learning is not avaliable.
- However, it is better method than supervised and unsupervised learning.
- Here system knows output is correct or not, but does not know correct output.

Scanned by CamScanner

Linear Seprability

1) A classification problem, where if input pattern is member of class then desired output is 'Yes' or 'No'

2) A 'Yes' represent output signal '1' and 'No' represent output signal '-1'
[Bipolar Signal]

3) Net input is compared with

$$net = b + \sum_{i=1}^{n} x_i w_i$$

4) The boundary between region where net>0 and region where net<0

net = 0 — (Line of Seprability)

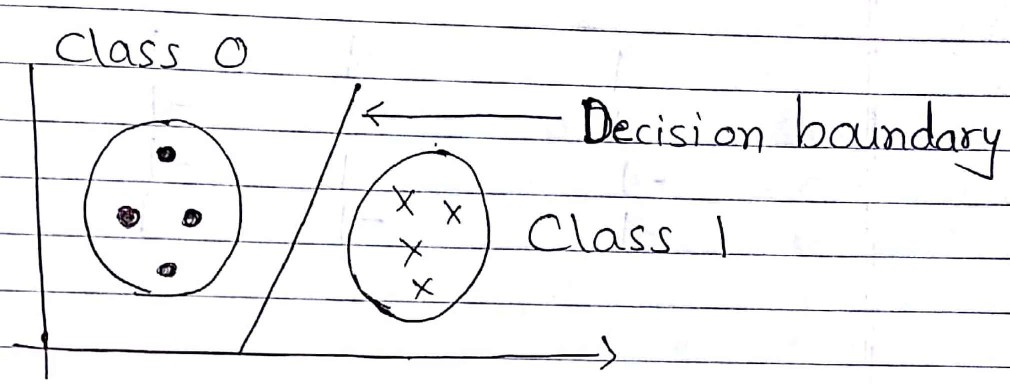
$\therefore\ b + \sum_{i=1}^{n} x_i w_i = 0$ // b → bias

This is also called decision boundary.

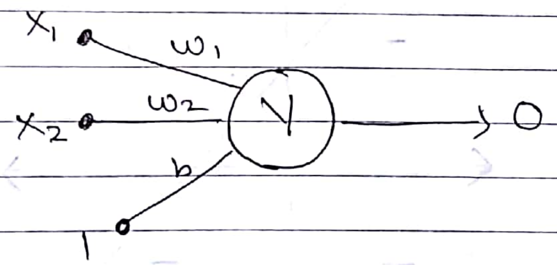
5) Depending on the no of inputs, the equation can be line or hyperplane

Scanned by CamScanner

6) If there exist weights such that all training input '+1' lie on one side and '-1' lie on other side of boundary, then problem is "linearly Seprable".



7) Network can be shown as



Considering two inputs and 2 weights and one bias,

$$net = x_1 w_1 + x_2 w_2 + b$$

Here, net = 0 —— Decision boundary

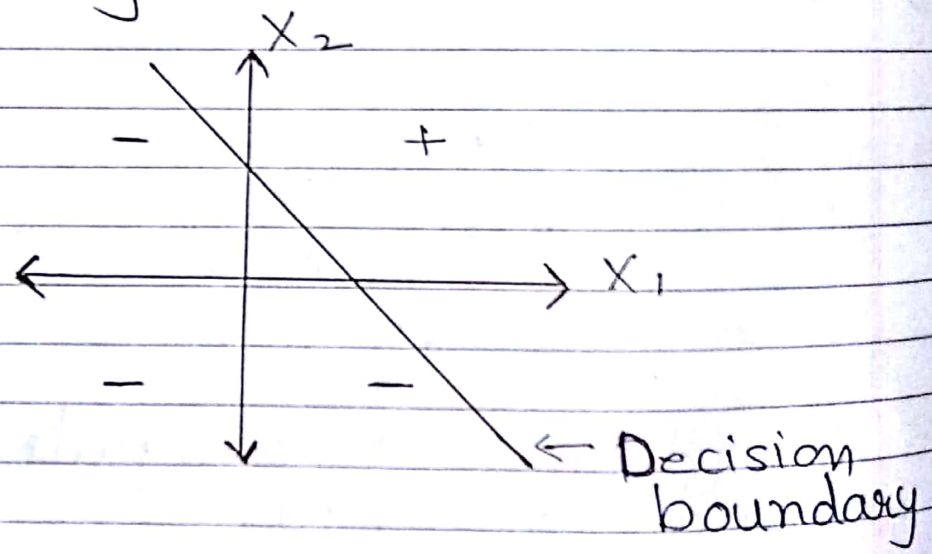
$$\therefore \quad b + w_1 x_1 + w_2 x_2 = 0$$

$$\therefore \quad \boxed{x_2 = \frac{-w_1}{w_2} x_1 - \frac{b}{w_2}}$$

8) Considering AND function for linear seprability

X_1	X_2	y (Output)
1	1	1
1	-1	-1
-1	1	-1
-1	-1	-1

9) Graphically it can drawn as

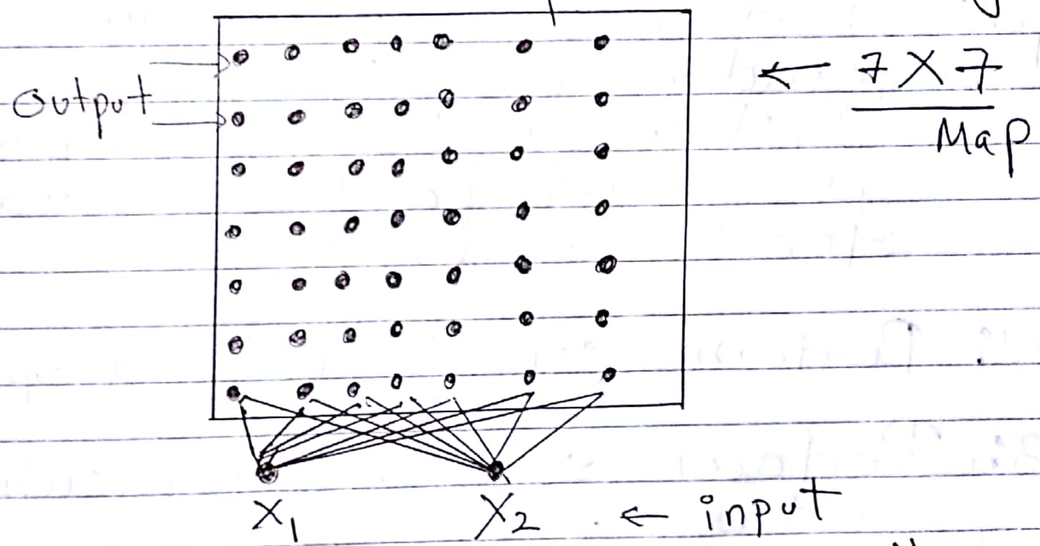


If the problem couldnot be solved by single line decision boundary then the problem is linearly non-seprable.

* Kohonen's Self Organizing Network

1) It is also known as Kohonen's feature maps, used for Data Clustering

2) Network of this type impose a neighbourhood constraint on output ~~such~~ unit, such that certain property is reflected in output units weight.



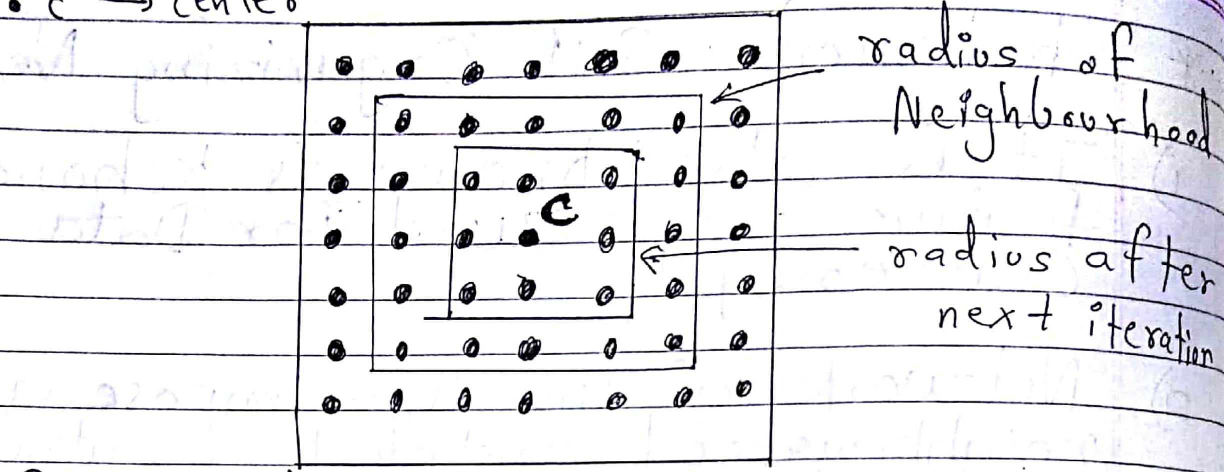
3) The learning process is similar to that of competitive learning network.

4) Here, we update not only winning units' weight but also weight of neighbourhood around winning unit.

5) The neighbourhood size decreases with each iteration.

Scanned by CamScanner

• c → center



Algorithm

Step 1: Initialize the weights at some Random values.
Initialize the learning rate 'α'.
It should be slow decreasing function of time.

Step 2: Perform steps 3-9 till stopping condⁿ.

Step 3: Perform steps 4-6 for each input vector x.

Step 4: Compute the square of Euclidean distance

$$D(j) = \sum_{i=1}^{n} \sum_{j=1}^{m} (x_i - w_{ij})^2$$

// Distance to make neighbourhood less as per the iterations.

Step 5: Find winning unit index J, ~~so D(j)~~ so D(j) is minimum.

Step 6: For all unit 'j', calculate new weights

$$w_{ij} = w_{ij}(old) + \alpha[x_i - w_{ij}(old)]$$

// This are the neighbours.

Step 7: Update learning rate using formula

$$\alpha(t+1) = 0.5(t)$$

Step 8: Reduce Radius of neighbourhood

Step 9: Test for stopping condition

Refer Video

Scanned by CamScanner

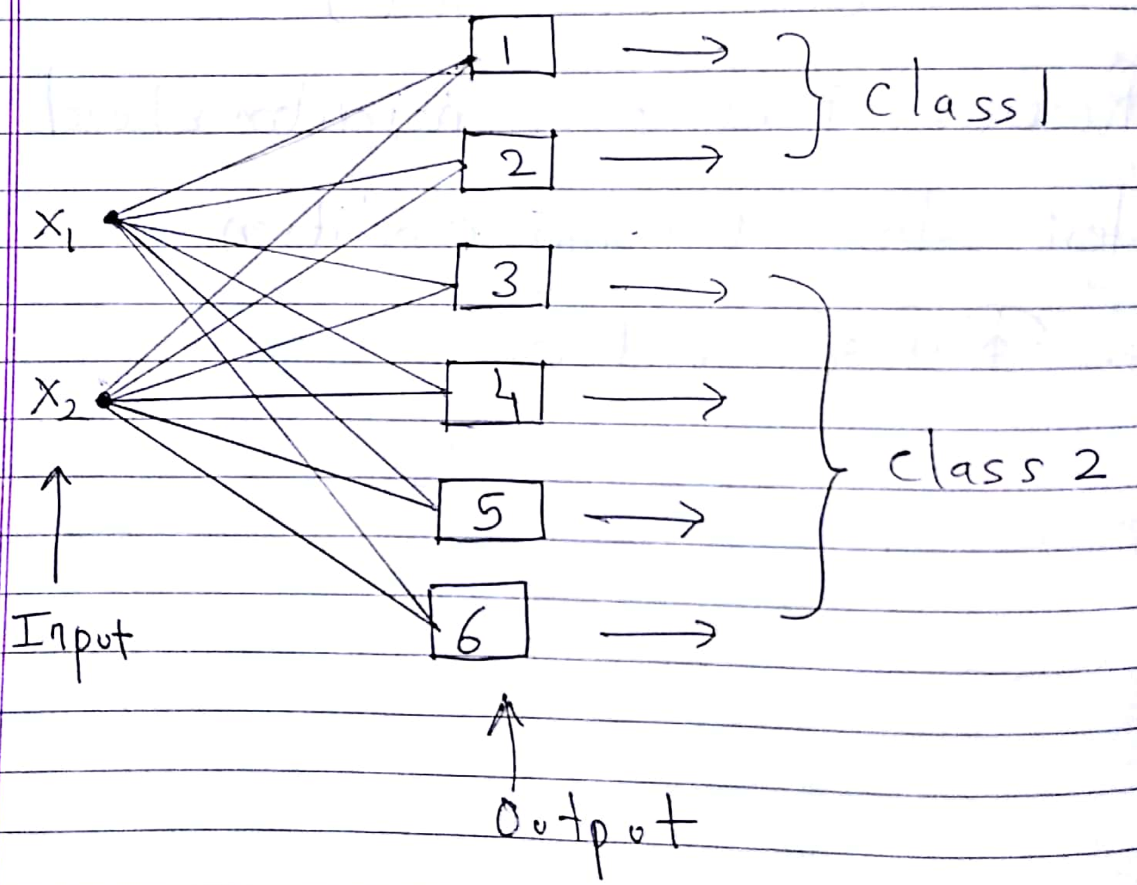
Date: / /

Linear Vector Quantization

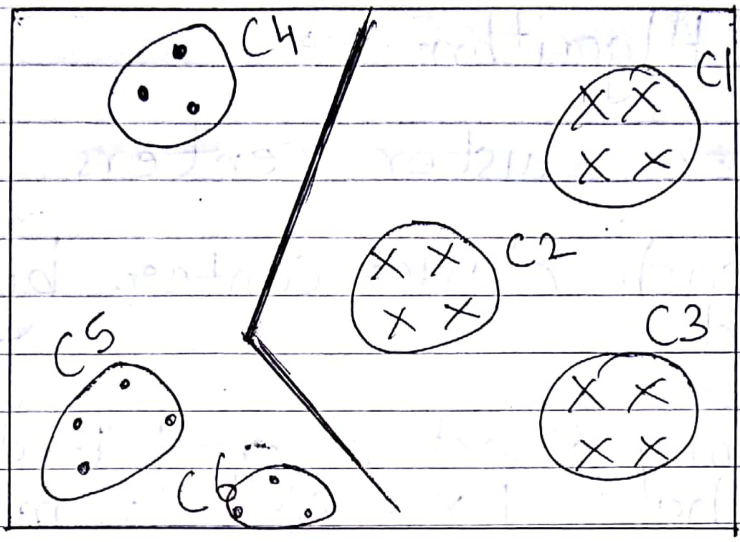
* LVQ is an adaptive classification method. It is based training data with desired class information.

* LVQ employs unsupervised data clustering technique.

* LVQ network architecture closely resembles competitive learning ~~technique~~ network.



Scanned by CamScanner



Here input space is divided into 6 Cluster and 2 dimensions.

* Steps involved in LVQ

Step 1: Locate several cluster centers without using class information.

Step 2: Use class information and fine tune Cluster to avoid the misclassification

LVQ Algorithm :-

1) Initialize cluster centers
2) Label each cluster center by voting method.
3) Randomly select X and find k such that $|X - W_K|$ is minimum.
4) If X and W_K belong to same class, then update W_K as

$$\Delta W_K = \eta(X - W_K)$$

Or

$$\Delta W_K = -\eta(X - W_K)$$

Where, $X \rightarrow$ input vector

$W \rightarrow$ weigh vector

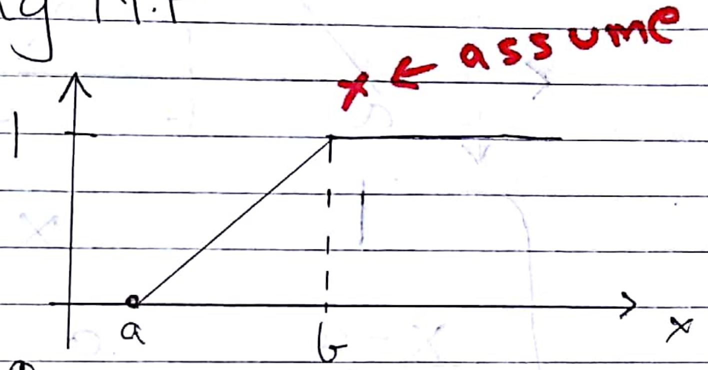
$\eta \rightarrow$ learning rate

Scanned by CamScanner

Fuzzy Set Theory

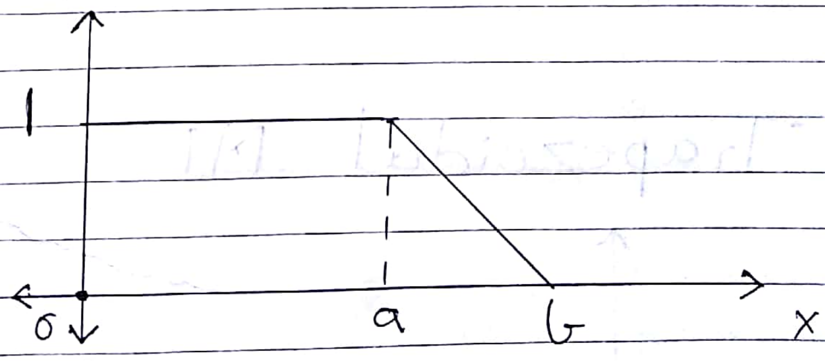
Different Membership function (M.F)

1) Increasing M.F



$$T = \begin{cases} 0 & x < a \\ (x-a)/(b-a) & a < x < b \\ 1 & x > b \end{cases}$$

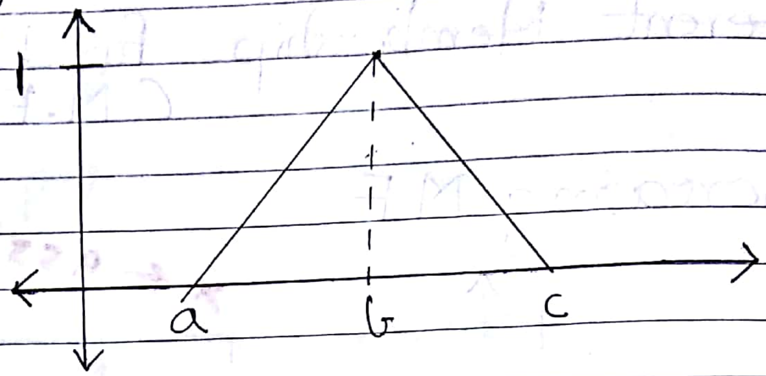
2) Decreasing M.F



$$\begin{cases} 1 & x < a \\ \dfrac{b-x}{b-a} & a < x < b \\ 0 & x > b \end{cases}$$

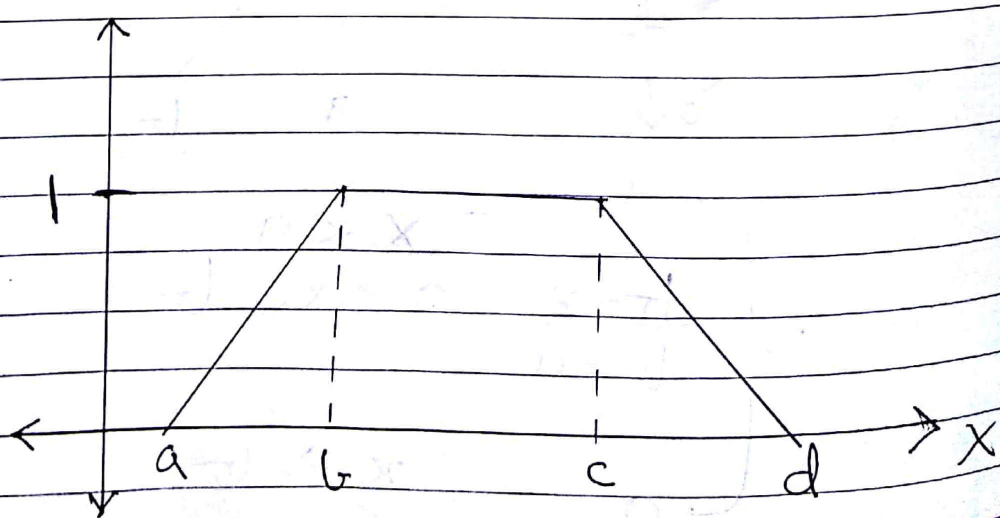
Scanned by CamScanner

3) Triangular M.F

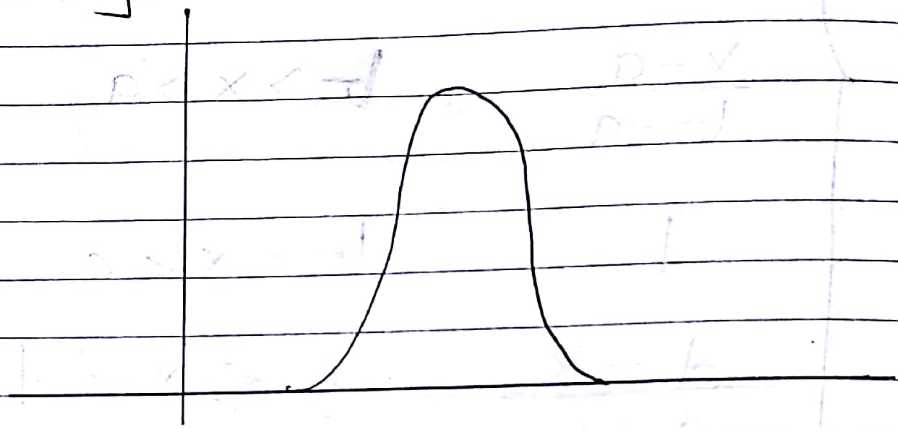


$$T = \begin{cases} 1 & x < a \\ \dfrac{x-a}{b-a} & a \leq x < b \\ 1 & x = b \\ \dfrac{c-x}{c-b} & b < x < c \\ 0 & x > c \end{cases}$$

4) Trapezoidal M.F



6) Cauchy M.F



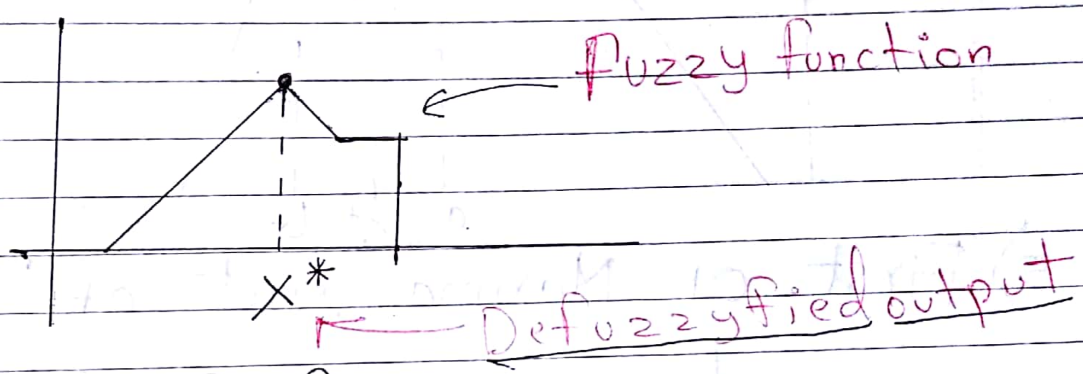
$$C = \frac{1}{1 + \left| \frac{x-c}{a} \right|^{2b}}$$

Scanned by CamScanner

Defuzzication :-

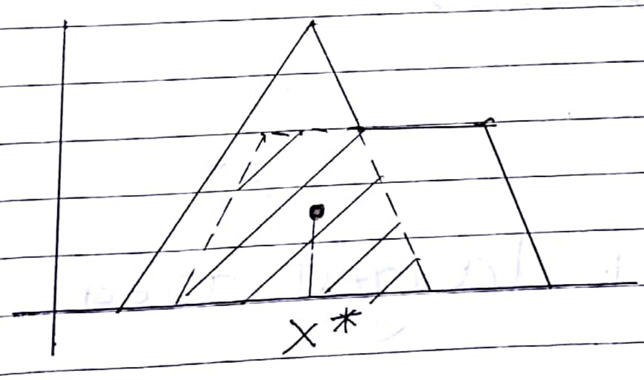
There are total 7 Defuzzyfication Methods

1) Max Membership Method

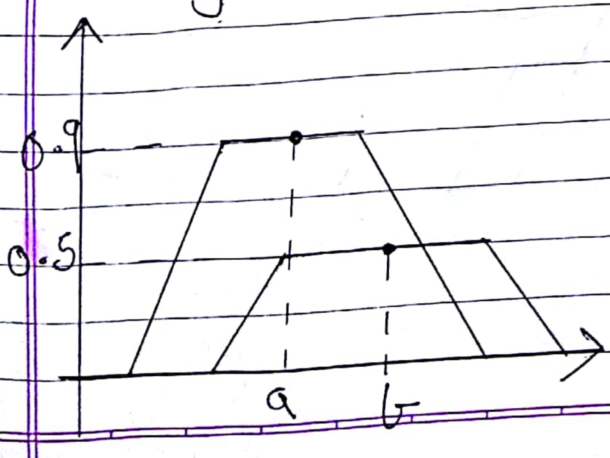


2) Center of Area

[Area ka Center]



3) Weighted Average Method

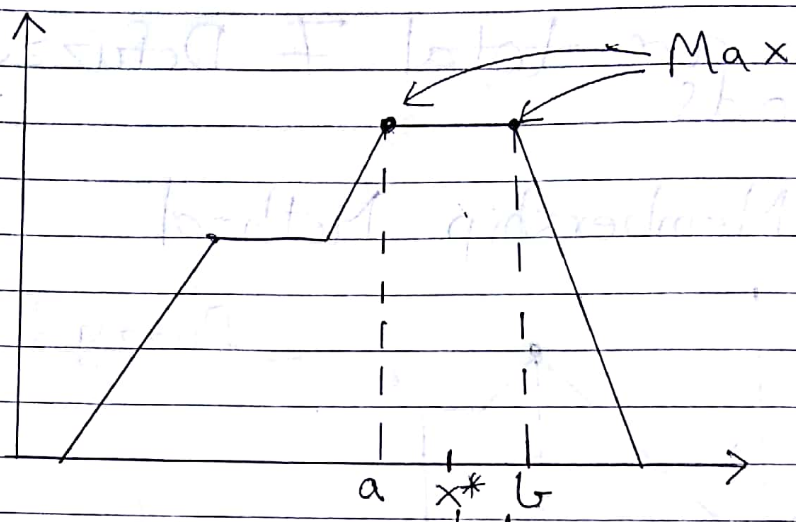


$$x^* = \frac{a \times 0.9 + b \times 0.5}{0.5 + 0.9}$$

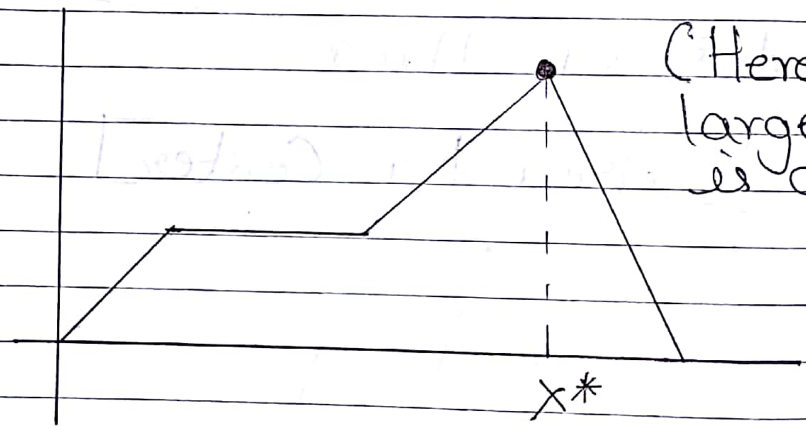
This is only valid for Symmetric function

Scanned by CamScanner

4) Mean – Max Membership

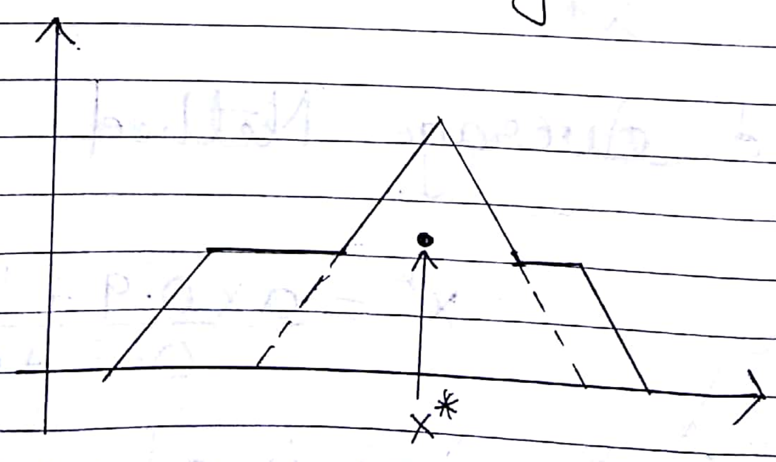


5) First of Maxima | Last of Maxima



(Here max of largest area is determined)

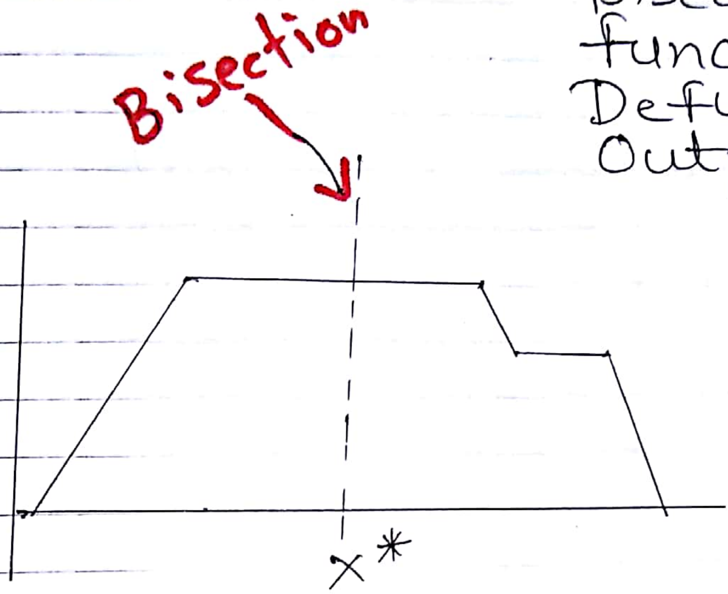
6) Center of largest area



Scanned by CamScanner

7) Bisector Method

Bisection of function is the Defuzzyfied Output (x*)



Scanned by CamScanner

Q) Optimization technique

1) Optimization techniques are classified as
   i) Derivative based optimization
   ii) Derivative free optimization

2) Derivative based optimization exploit the derivative value of objective function

3) The first order derivative is called as gradient and second is known as hessian matrix.

4) These methods cannot be applied to functions which are discontinuous or discrete.

5) Examples of Derivative based Optimization
   i) Descent Method
   ii) Steepest Descent Method
   iii) Newton's Method
   ~~iv)~~

6) Another problem is that this method converge at locally optimal point.

Scanned by CamScanner

7) Steepest Descent Method

$$\boxed{\theta_{next} = \theta_{new} + \eta d}$$

$\eta \rightarrow$ step size

$d \rightarrow$ direction

$\theta_{next} \rightarrow$ Next point

$\theta_{now} \rightarrow$ current point

In steepest descent Method, negative gradient (g_i) is been selected, which is given as follow

$$d_i = -g_i.$$

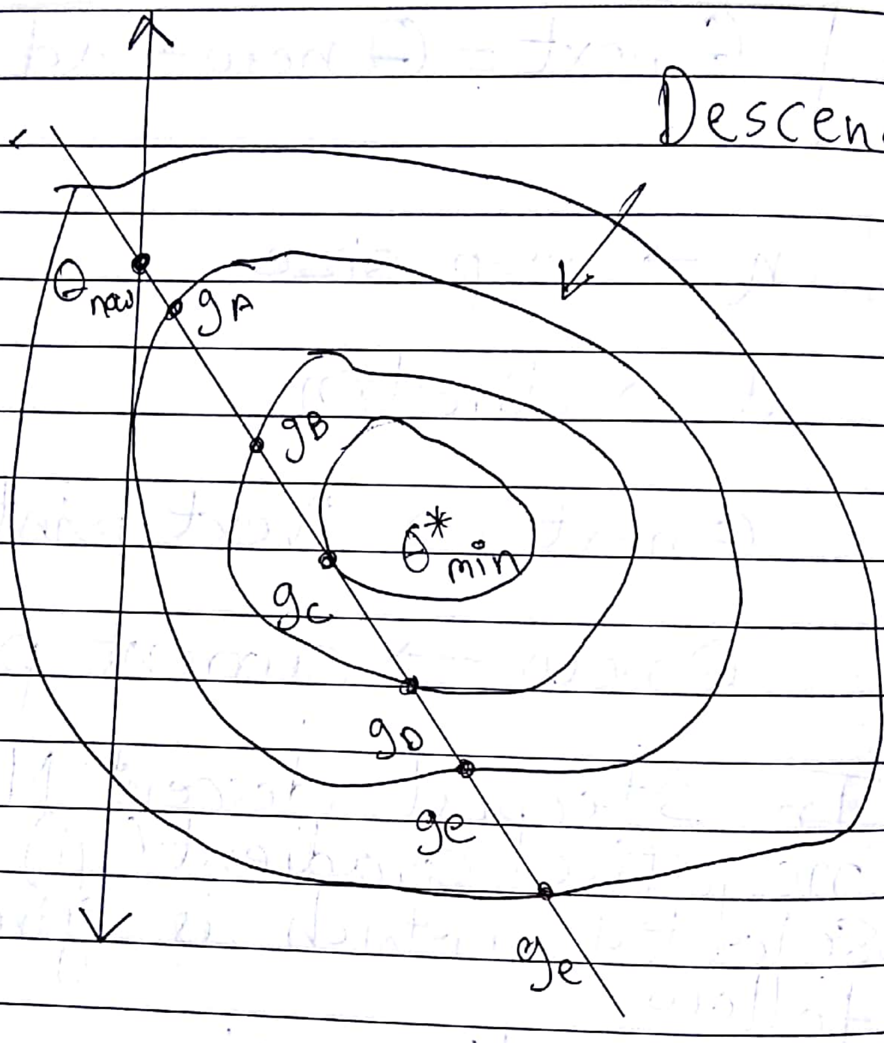
$$\therefore \theta_{i+1} = \theta_i - \eta g_i$$

$$\therefore \phi'(\eta) = \frac{d}{d\eta}(\theta_i - \eta g_i) = 0$$

Testing θ_{i+1} for optimality, if optimal then stop, else start again with new iteration

Scanned by CamScanner

Descending



* Newton's Method :-

Here descent direction by second derivate of Activation/Function
Obj. E

$\theta = \theta_{now} + \eta d$

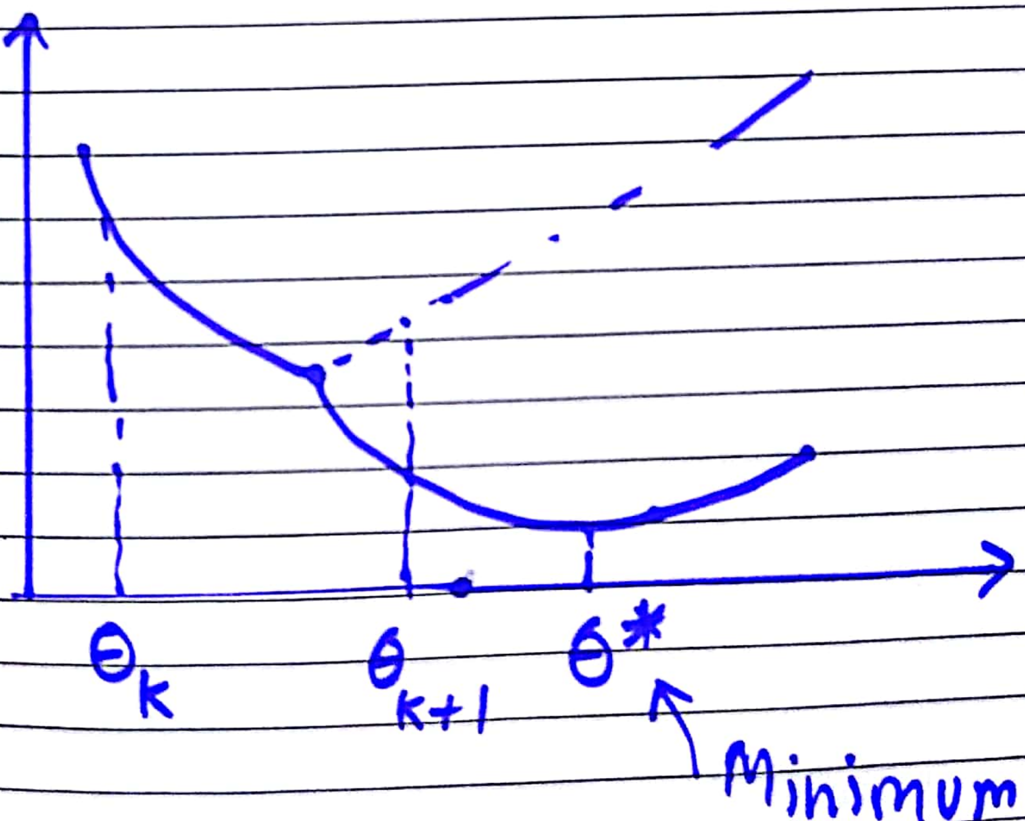
$\therefore E(\theta) = E(\theta_{now} + \eta d)$

$$\boxed{\hat{\Theta} = \Theta_{now} - H^{-1} g}$$

$-H^{-1} g \longrightarrow$ Newton's step

When minimum point $\hat{\Theta}$ of approximated quadratic function is chosen as next point, Θ_{now}, we call it Newton's Method

when $\eta = 1$ and $G = H^{-1}$



Design a controller to determine the wash time of a domestic wachine machine. Assume the inpub is dirt & grease on cloths. Use three descriptors for input variables and five descriptor for output variable. Derive the set of rules for controller action and defuzzification. The design should be supported by figure where ever Possible. Show that if the clothes are solid to a larger degree the wash time will be more and vice versa.

Scanned by CamScanner

Steps to Solve

Step 1) Identify input and output variables and decide descriptor for the same

step 2) Define membership functions for each of input and output variables

step 3) Form a rule base

step 4) Rule Evaluation

Step 5) Defuzzification

Scanned by CamScanner

Step 1) Identify input & output variable and decide descriptor

- Here inputs are 'dirt' and 'grease'. Assume they %
- Output is 'washtime' measured in minutes

Descriptor for INPUT Variable

DIRT

SD - small dirt
MD - medium dirt
LD - large dirt

{SD, MD, LD}

Grease {NG, MG, LG}

NG - NO Grease
MG - Medium Grease
LG - Large Grease

Descriptor for Output Variable

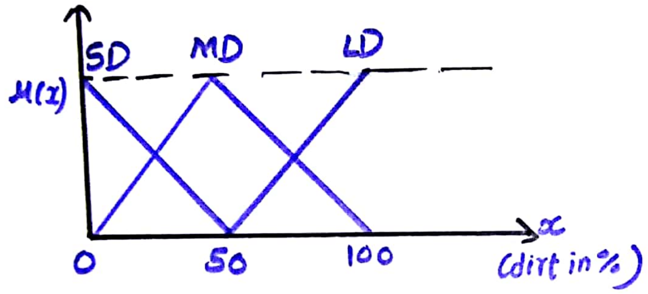
Wash time {VS, S, M, L, VL}

VS - {Very short}
S - Short
M - Medium
L - Large
VL - Very Large

Scanned by CamScanner

Step 2) Define membership function for each of the input and Output variable. We use triangular MFs

(1) Membership function for dirt:

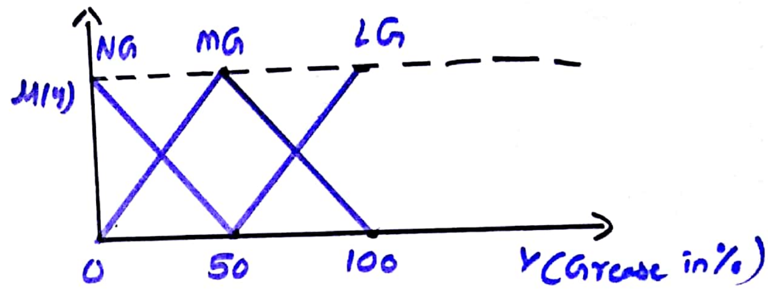


$$\mu_{SD}(x) = \frac{50-x}{50}, \quad 0 \le x \le 50$$

$$\mu_{MD}(x) = \begin{cases} \frac{x}{50}, & 0 \le x \le 50 \\ \frac{100-x}{50}, & 50 \le x \le 100 \end{cases}$$

$$\mu_{LD}(x) = \frac{x-50}{50}, \quad 50 \le x \le 100$$

(2) Membership function for grease:



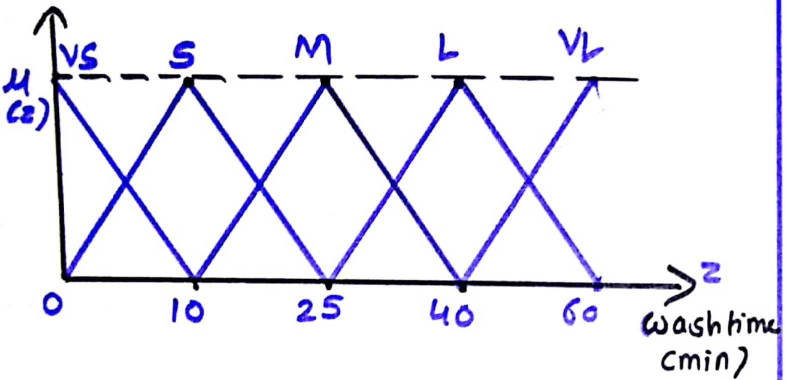
$$\mu_{NG}(y) = \frac{50-y}{50}, \quad 0 \le y \le 50$$

$$\mu_{MG}(y) = \begin{cases} \frac{y}{50}, & 0 \le y \le 50 \\ \frac{100-y}{50}, & 50 \le y \le 100 \end{cases}$$

$$\mu_{LG}(y) = \frac{y-50}{50}, \quad 50 \le y \le 100$$

Scanned by CamScanner

3) Membership function for wash time



$$\mu_{VS}(z) = \frac{10-z}{10}, \quad 0 \le z \le 10$$

$$\mu_{S}(z) = \begin{cases} \frac{z}{10}, & 0 \le z \le 10 \\ \frac{25-z}{15}, & 10 \le z \le 25 \end{cases}$$

$$\mu_{M}(z) = \begin{cases} \frac{z-10}{15} & 10 \quad z \quad 25 \\ \frac{40-z}{15} & 25 \le z \le 40 \end{cases}$$

$$\mu_{L}(z) = \begin{cases} \frac{z-25}{15} & 25 \le z \le 40 \\ \frac{60-z}{20} & 40 \le z \le 60 \end{cases}$$

$$\mu_{VL}(z) = \frac{z-40}{20}, \quad 40 \le z \le 60$$

Step 3 : Form a Rule base

x \ y	NG	MG	LG
SD	VS	M	L
MD	S	M	L
LD	M	L	VL

Scanned by CamScanner

Step 4) Rule Evaluation

Assume Dirt = 60%, Grease = 70%

Dirt = 60% maps two MFs of dirt V

$\mu_{MD}(x) = \frac{100-x}{50}$ | $\mu_{LD}(x) = \frac{x-50}{50}$

simly Grease = 70% maps 2 MFs

$\mu_{MG}(y) = \frac{100-y}{50}$ | $\mu_{LG}(y) = \frac{y-50}{50}$

Evaluate $\mu_{MD}(x)$ and $\mu_{LD}(x)$ for $x = 60$, we get

$$\mu_{MD}(x) = \frac{100-60}{50} = \frac{4}{5}$$

$$\mu_{LD}(x) = \frac{60-50}{50} = \frac{1}{5}$$

Evaluate $\mu_{MG}(y)$ & $\mu_{LG}(y)$ for $y = 70$, we get

$$\mu_{MG}(70) = \frac{100-70}{50} = \frac{3}{5}$$

$$\mu_{LG}(70) = \frac{70-50}{50} = \frac{2}{5}$$

The above four equation leads to 4 rules we need evaluate

1) dirt is Medium and Grease is Medium
2) dirt is Medium and Grease is Large
3) dirt is Large and Grease is Medium
4) dirt is large and Grease is Large

Scanned by CamScanner

since the antecedent Part of each of the above rule is connected by and operator we use min operator to evaluate strength of each rule

Strength of rule 1 DMGM

$S1 = \min(\mu_{MD}(60), \mu_{MG}(70))$

$= \min(4/5, 3/5)$

$= 3/5$

Strength of rule 2 DMGL

$S2 = \min(\mu_{MD}(60), \mu_{GL}(70))$

$= \min(4/5, 2/5)$

$= 2/5$

Strength of rule 3 DLGM

$S_3 = \min(\mu_{LD}(60), \mu_{MG}(70))$

$= \min(1/5, 3/5) = 1/5$

Strength of rule 4 DLGL

$S_4 = \min(\mu_{LD}(60), \mu_{LG}(70))$

$= \min(1/5, 2/5)$

$= 1/5$

D \ G		$\mu_{MG}(70)$	$\mu_{LG}(70)$
	X	X	X
$\mu_{MD}(60)$	X	3/5	2/5
$\mu_{LD}(60)$	X	1/5	1/5

Max MF

X	X	X
X	M	L
X	L	VL

Step 5) Defuzzification

Since we use "Mean of max" defuzzification technique

maximum strength

$= \max(S_1, S_2, S_3, S_4)$

$= \max(3/5, 2/5, 1/5, 1/5)$

$= 3/5$

- This correspond to rule 1
- rule 1 - Dirt is medium and Grease is medium has maximum strength (3/5)

To find out the final defuzzified value, we now take average (mean) of $\mu_m(z)$

$\mu_m(z) = \frac{z-10}{15}$ and $\mu_m(z) = \frac{40-z}{15}$

$3/5 = \frac{z-10}{15}$ $\quad$ $3/5 = \frac{40-z}{15}$

$\therefore z = 19$ $\quad$ $z = 31$

$\therefore z^* = \frac{19+31}{2} = 25\text{min}$

Scanned by CamScanner

Thank you so much 😄
videos and notes dekhne ko

if you have any doubt
you can contact us at

website: www.lastmomenttuitions.com
email: lastmomenttuitions@gmail.com
whatsapp: 9762903078
facebook: www.facebook.com/lastmomenttuition
Instagram: www.instagram.com/last_moment_tuitions

Scanned by CamScanner

Strongly suggest to see

Sandeep maheshwari

videos

To change your life

Scanned by CamScanner