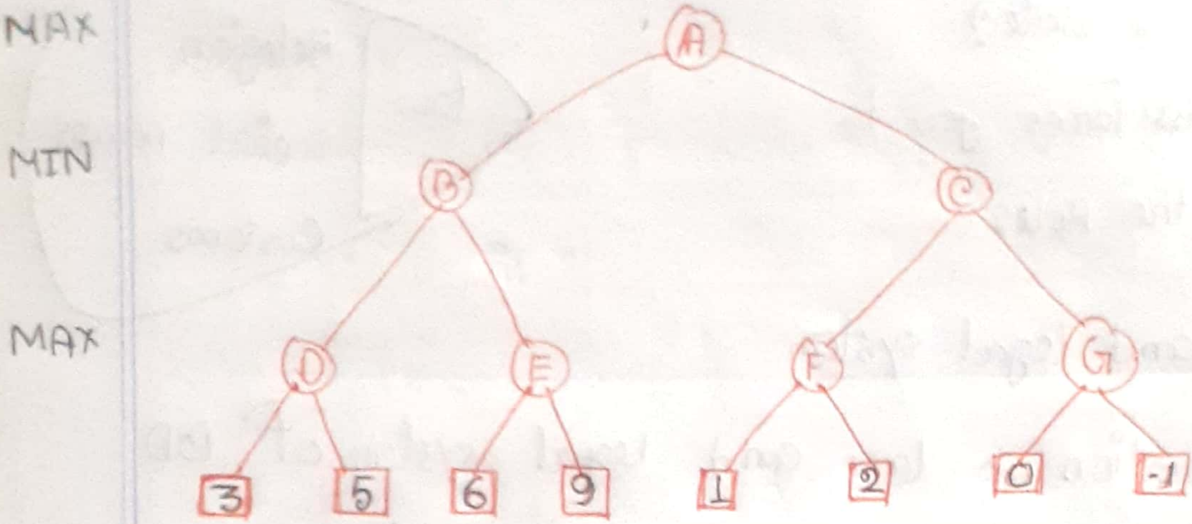
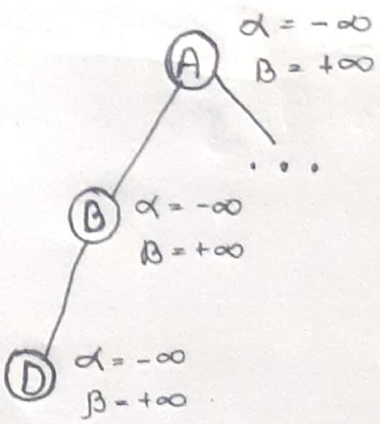
Adversarial Search . game theory.



step 1 = here max player start first from node A where $\alpha = -\infty$, $\beta = +\infty$, these value of alpha & beta passed down to node B where again $\alpha = -\infty$, $\beta = +\infty$, node B passes the same value to its child D.



step 2 = For node D,

$\alpha = MAX((3, -\infty), (5, -\infty))$

$= MAX(3, 5)$

$= 5$

$\beta = +\infty$

Step 3 = for node B, $\alpha = -\infty$,

$\beta = Min(5, \infty) = 5$.

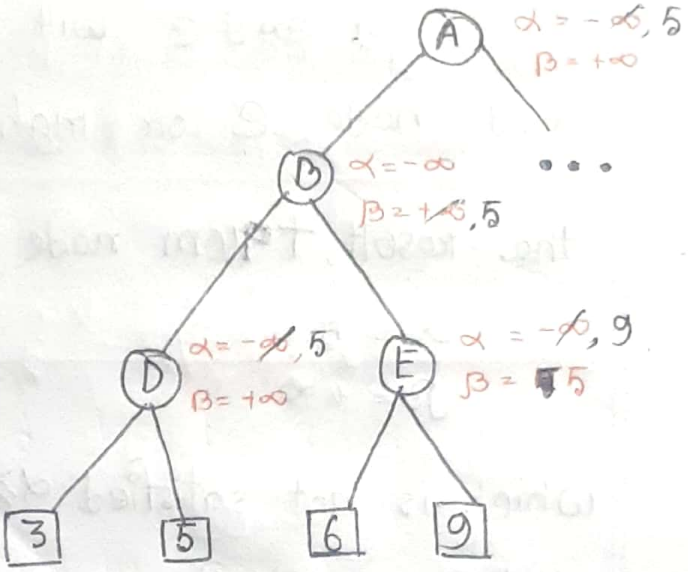
step 4: now, alpha & Beta of node B is passed to node E.

step 5 = for node E,

$\alpha = \cancel{-\infty}\ MAX((6,-\infty),(9,-\infty))$

$= MAX(6,9)$

$= 9$.



$\beta = 5$.

which is, $\alpha \geq \beta$.

~~step 6 = for~~

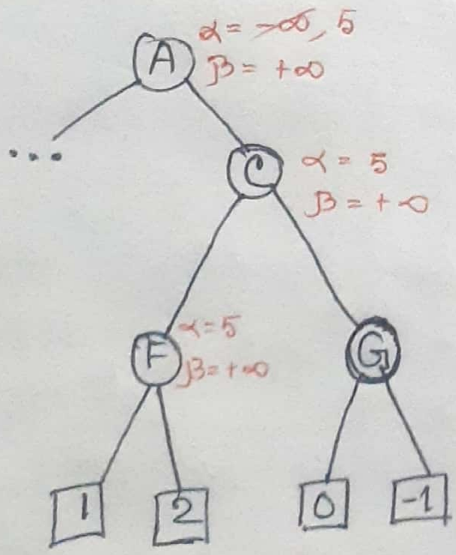
so, right successor of E will be pruned.

step-6 = ~~fo~~ Now bracktrack from Node B to A.

for node A, $\alpha = MAX(5, -\infty) = 5$.

$\beta = +\infty$

now, this α, β values of A passed to node C & F.



step-7 = for node F,

$\alpha = MAX(1,2) = 2$

$\beta = +\infty$

but, F already $\alpha = 5$ which is high from $\alpha = 2$.

it's accuare $\alpha \geq \beta$.

so, F value not change.

As same as node G.

so, F, G ~~and e~~ will be pruned.

and node C or right side of A will pruned.

the result, from node A

$\alpha = 5$,

$\beta = +\infty$.

which is not satisfied $\alpha \geq \beta$

but here $\alpha \leq \beta$.

so, here has no pruning.

return Path	= A → B → D → $\boxed{5}$

Question = What do u mean by Zero Sum Game in AI? Explain with necessary payoff matrix.

Chapter 13 : Reasoning under Uncertainty

Naive Bayes

Conditional Probability

$$P(A,B) = P(A \wedge B) = P(A|B) \cdot P(B)$$
$$= P(B|A) \cdot P(A)$$

$$P(A \vee B) = P(A) + P(B) - P(A \wedge B)$$

$$P(A) = 1 - P(B)$$

Bayes rule - $P(A|B) = \dfrac{P(B|A) \cdot P(A)}{P(B)}$

Question 04 =

Gender Dataset

Person	Height (feet)	Weight (lbs)	Foot size (inches)
Male	6	180	10
Male	6	180	10
Male	5.5	170	8
Male	6	170	10
Fe	5	130	8
Fe	5.5	150	6
Fe	5	130	6
Fe	6	150	8

determine 'Gender' of a person having height 6 feet, weight 130 lbs, foot size 8 inch

Frequency & likelihood table-

Hight	Male	Fe	P(Ma)	P(Fe)
6	3	1	3/4	1/4
5.5	1	1	1/4	1/4
5	0	2	0	2/4

weight	Ma	Fe	P(Ma)	P(Fe)
180	2	0	2/4	0
170	2	0	2/4	0
150	0	2	0	2/4
130	0	2	0	2/4

Foot size	Ma	Fe	P(Ma)	P(Fe)
10	3	0	3/4	0
8	1	2	1/4	2/4
6	0	2	0	2/4

Ma	Fe	P(Ma)	P(Fe)
4	4	4/8	4/8

Height = 6 Weight = 130 Foot size = 8

P(Male | Height, weight, footsize)

$$= \frac{P(\text{Height}=6 \mid Ma) \cdot P(\text{weight}=130 \mid Ma) \cdot P(\text{foot}=8 \mid Ma) \times P(\text{Male})}{P(\text{Height}) \cdot P(\text{weight}) \cdot P(\text{Foot size}=8)}$$

$$= \frac{3/4 \times 0 \times 1/4 \times 4/8}{4/8 \times 2/8 \times 3/8}$$

$$= \frac{0}{0} = 0$$

P(Fa | Height, weight, foot size)

$$= \frac{1/4 \times 2/4 \times 2/4 \times 4/8}{4/8 \times 2/8 \times 3/8}$$

$$= \frac{0.03125}{\cancel{0.0078125}\ 0.046875}$$

$= 0.667\%$

$\therefore$ P(Male) < P(Female)

$\Rightarrow 0 < 0.667\%$

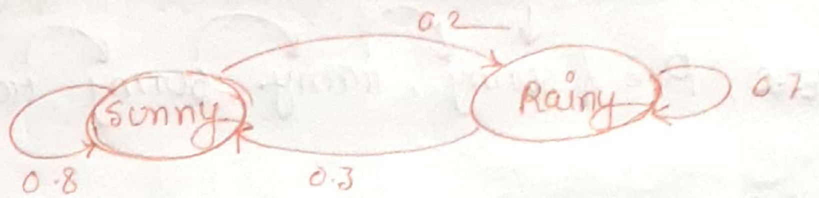
Chapter 13 = Markov Model

* Explain the stationary assumption of M. M with example.

Ans = equations & state diagram.

example 01.: state given, {sunny, Rainy}

Initial probability = {0.4, 0.6}



here, transition matrix =

$$\begin{array}{c|cc} & \text{sunny} & \text{rainy} \\ \hline \text{sunny} & 0.8 & 0.2 \\ \text{rainy} & 0.3 & 0.7 \end{array}$$

if today is sunny. What is the probability that tomorrow and day after tomorrow will be rainy and rainy.

so, $P = \{$ sunny, rainy, rainy $\}$.

sunny	rainy	rainy
↓	↓	↓
today	tomorrow	after tomorrow
↓	↓	↓
x_1	x_2	x_3

$$\therefore P(x_2, x_3 \mid x_1) = P(x_2 \mid x_1) \times P(x_3 \mid x_2)$$

$$= P(\text{rainy} \mid \text{sunny}) \times (P(\text{rainy} \mid \text{rainy}))$$

$$= 0.3 \times 0.7$$

$$= 0.14.$$

if a series is given nothing is said that today's weather is given and followed by other elements of the series . What is the probability that the series will happen .

here , P = { sunny , rainy , sunny , rainy , rainy } .

$$P(S, R, S, R, R) = P(R|R) \times P(R|S) \times P(S|R) \times P(R|S) \times P(S)$$

$$= 0.7 \times 0.3 \times 0.2 \times 0.3 \times 0.4 .$$

$$= 0.00504 .$$

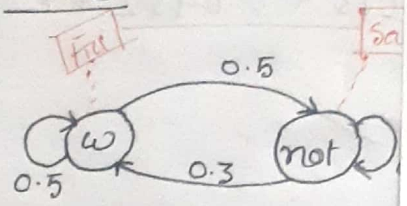
□ Markov chain

Friday	Next day	Probability
windy	w	0.5
windy	not w	0.5
not windy	w	0.3
not windy	not w	0.7

windy is 0.5

'Not windy' on 'Sunday' = ?

Solve =



p(windy) = 0.5 for

1. for next day / sat

$P(x_1 = \text{windy})$ -

$= P(x_1 = w \mid x_0 = w) \times P(x_0 = w) + P(x_1 = w \mid x_0 = \text{not}) \times P(x_0 = \text{not})$

$= 0.5 \times 0.5 + 0.3 \times \boxed{(1-0.5) = 0.5}$

$= \boxed{0.4}$

$P(x_1 = \text{not windy}) = 1 - P(x_1 = \text{windy}) = 1 - 0.4 = \boxed{0.6}$

Sat (w) Sun (not)

2. for sunday is windy -

$P(x_2 = \text{windy})$

$= P(x_2 = w \mid x_1 = w) \times P(x_1 = w) + P(x_2 = w \mid x_1 = \text{not}) \times P(x_1 = \text{not})$

$= 0.5 \times 0.4 + 0.3 \times 0.6$

$= 0.38$

$\therefore P(\text{sunday}, x_2 = \text{not windy})$

$= 1 - P(x_2 = \text{windy})$

$= 1 - 0.38$

$= 0.62$ Ans

$\frac{p}{2}$ (-2)

$$\begin{array}{c|ccc} & P & B & H \\ \hline P & 0.5 & 0.6 & 0 \\ B & 0.4 & 0 & 0.3 \\ H & 0.2 & 0 & 0 \end{array}$$

OR

$P(X_1) = [0, 1, 0]$

$$P(X_2 = \text{pizza}) = P(X_2 = P \mid X_1 = P) \cdot P(X_1 = P) + P(X_2 = P \mid X_1 = B) \cdot P(X_1 = B) + P(X_2 = P \mid X_1 = H) \cdot P(X_1 = H).$$

$$= 0.5 \times 0 + 0.4 \times 1 + 0.2 \times 0.$$

$$= 0.4.$$

$$P(X_2 = \text{Burger}) = P(X_2 = B \mid X_1 = P) \cdot P(X_1 \mid P) + P(X_2 = B \mid X_1 = B) \cdot P(X_1 = B) + P(X_2 = B \mid X_1 = H) \cdot P(X_1 = H)$$

$$= 0.$$

$$P(X_2 = \text{hotdog}) = P(X_2 = H \mid X_1 = P) \cdot P(X_1 \mid P) + P(X_2 = H \mid X_1 = B) \cdot P(X_1 = B) + P(X_2 = H \mid X_1 = H) \cdot P(X_1 = H).$$

$$= 0.3$$

$$\therefore P(X_2) = \underset{\;P \quad\; B \quad\; H.}{[0.4 \quad 0 \quad 0.3]}$$

$$P(X_3 = P) = P(X_3 = P \mid X_2 = P) \times P(X_2 = P) + P(X_3 = P \mid X_2 = B) \times P(X_2 = B) + P(X_3 = P \mid X_2 = H) \times P(X_2 = H)$$

$$= 0.5 \times 0.4 + 0.4 \times 0 + 0.2 \times 0.3$$

$$= 0.2 + 0 + 0.06$$

$$= 0.26 / \text{Pizza}$$

KRR = knowledge Representation and Reasoning.

- fuzzy logic
- logic statement
-

- $P \to Q = (\sim P \vee Q)$
- $P \leftrightarrow Q = (P = Q)$.
- $P \wedge Q$ = and
- $P \vee Q$ = or
- $0 \vee 0 = 0$, $0 \vee 1 / 1 \vee 1 / 1 \vee 0 = 1$
- $0 \wedge 0 / 0 \wedge 1 / 1 \wedge 0 = 0$, $1 \wedge 1 = 1$

- satisfiable = some true
- contradiction = no true
- valid = true

Propositional logic (PL)

Fall - 2022 / 46th /

$$\{(P \vee Q) \wedge (\sim R)\} \to (R \vee Q) = A$$

let, $\{(P \vee Q) \wedge (\sim R)\} = B$

$$= \sim (P \vee Q) \wedge (\sim R) \vee (R \vee Q) = A$$

Solve -

P	Q	R	~R	(P∨Q)	B = {(P∨Q)∧(~R)}	C = (R∨Q)	~B	A = ~B ∨ C
0	0	0	1	0	0	0	1	1
0	0	1	0	0	0	1	1	1
0	1	0	1	1	1	1	0	1
0	1	1	0	1	0	1	1	1
1	0	0	1	1	1	0	0	0
1	0	1	0	1	0	1	1	1
1	1	0	1	1	1	1	0	1
1	1	1	0	1	0	1	1	1

A is satisfiable. cz, for all that interpretation the truth value of the statement is some true.

2022 / 45th / 5@ = FOPL

David, William and Fiona are members of CSG sports club. Every member of sports club who is not a cricketer is a footballer.
Footballer likes music and everyone who does not like music is not a cricketer.
David dislikes whatever Fiona likes and likes whatever Fiona dislikes.
William likes music and rain.
Is there any member of the sports club who is a footballer but not a cricketer?

c = T
F = F

– [redacted]

D = SC(David); SC(William); SC(Fiona).

E = ~~Ax[AC(x)~~(~cricketer(x) → footballer(x))]

F = Ax [footballer(x) → like(x, Music)]
∧ Ax [~cricketer(x) → ~like(x, Music)]

D = Ax [likes(Fiona, x) → ~likes(David, x)]
∧ Ax [~likes(Fiona, x) → likes(David, x)]

W = likes(William, music);
likes(William, rain).

Is = ∃x [SC(x) ∧ footballer(x) ∧ ~(cricketer(x))]

E = Some

A = every

Examples of Predicate logic

Basic fact - Tony, Mike, and John are members of the Alpine Club

Complex - Every member of the Alpine Club who is not a skier is a mountain climber.

- Mountain climbers do not like rain, and anyone who does not like snow is not a skier.
- Mike dislikes whatever Tony likes, and likes whatever Tony dislikes.

Basic - Tony likes rain and snow.

- Is there a member of the Alpine Club who is a mountain climber but not a skier?

Solve =

- AC (Tony) ; AC (Mike) ; AC (John).
- $Ax(AC(X) \wedge \sim\{stier(x)\} \rightarrow M.climber(x))$
- $Ax(M.climber(X) \rightarrow \sim\{like(x, rain)\}) \wedge$

  $Ax(\sim(Like(x, snow) \rightarrow \sim(Skier(x)))$
- $Ax(likes(tony, x) \rightarrow \sim(likes(Mike, x)) \wedge$

  $Ax(\sim likes(tony, x) \rightarrow likes(Mike, x))$.
- $\exists x [AC\ x) \wedge M.Climber(x) \wedge \sim Skier(x)]$

Fall 2021 | 44th | ज.ⓐ = statements using Predicate logic.

(i) Jack likes ice-cream.

(ii) All red apples are delicious.

(iii) Everyone likes someone.

(iv) All black graps are not sour.

(v) students who are industrious and disciplined will succeed.

Solve: (i) likes (Jack, ice-cream).

(ii) $\forall x\ [A(x) \wedge R(x) \rightarrow \text{delicious}(x)]$

(iii) $\forall x \exists y\ [\text{likes}(x,y)]$

(iv) $\forall x\ [\text{Graps}(x) \wedge \text{black}(x) \rightarrow \sim(\text{sour}(x))]$

(v) $\forall x\ [\text{students}(x) \wedge \text{ind.}(x) \wedge \text{disci}(x) \rightarrow \text{Succeed}(x)]$

Fall 2020 | 431 . 3 (b).

given, very good = $[0.012 \quad 0.006 \quad 0.003 \quad 0.988 \quad 0.994]$
$= a$

find -

(i) extremely good ~~programmer~~ -

(ii) more or less good -

Solve = know, good = a

very good = a^2

extremely good = a^3

more or less good = $\sqrt{a} = a^{1/2}$

so, good = $\sqrt{\text{very good}, a^2}$

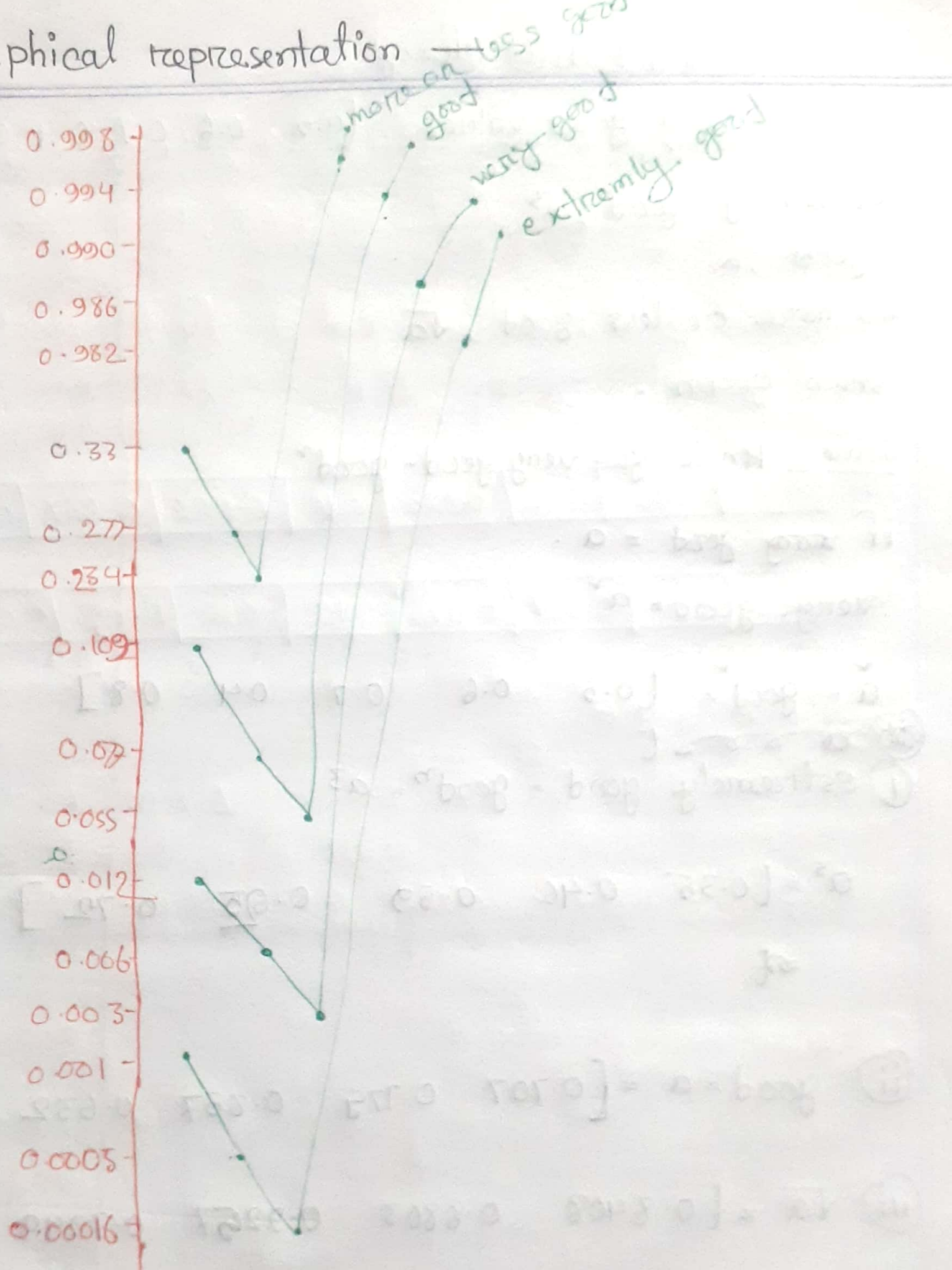
$$a = [\sqrt{0.012} \quad \sqrt{0.006} \quad \sqrt{0.003} \quad \sqrt{0.988} \quad \sqrt{0.994}]$$

$$a = [0.109 \quad 0.077 \quad 0.055 \quad 0.994 \quad 0.997]$$

(i) $a^3 = [0.001 \quad 0.0009 \quad 0.00016 \quad 0.982 \quad 0.991]$

(ii) $a^{1/2} = [0.33 \quad 0.277 \quad 0.234 \quad 0.997 \quad 0.998]$

graphical representation —



Fall 2022 / 4th / 3.(b) - fuzzy set

$$A = \left[\frac{0.1}{1} + \frac{0.3}{2} + \frac{0.6}{3} + \frac{0.9}{4} + \frac{0.8}{5} + \frac{0.5}{6} + \frac{0.4}{7} + \frac{0.5}{8}\right]$$

$$B = \left[\frac{0.3}{1} + \frac{0.8}{2} + \frac{0.5}{3} + \frac{0.3}{4} + \frac{0.6}{5} + \frac{0.9}{6} + \frac{10}{7} + \frac{0.2}{8}\right].$$

calculate (i) Not B (ii) A OR B (iii) {A AND (NOT B)}

Solve:

A =

0.1	0.15	0.2	0.225	0.16	0.083	0.057	0.0625

B =

0.3	0.4	0.167	0.075	0.12	0.15	1.43	0.025

(i) Not B = $\boxed{1-B}$

=

1-0.3	1-0.4	1-0.167	1-0.075	1-0.12	1-0.15	1-1.43	1-0.025

=

0.7	0.6	0.833	0.925	0.88	0.85	-0.43	0.975

(ii) A OR B = A max B.

=

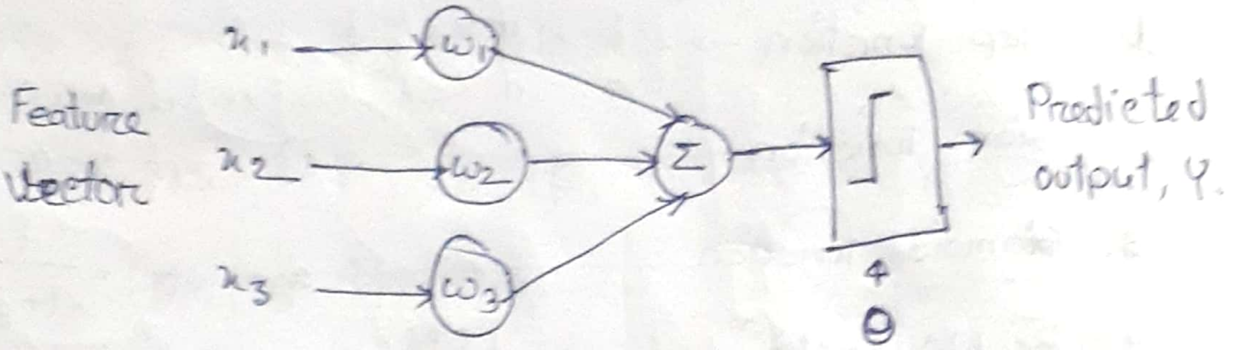
0.3	0.4	0.2	0.225	0.16	0.15	1.43	0.0625

(iii) {A AND (NOT B)} = {A min (i)}

=

0.1	0.15	0.2	0.225	0.16	0.083	-0.43	0.0625

Question 1 (b) - Fall-20 - 43th



given, $X = [1 \ 1 \ 0]$ $\quad Y_a = 1.$, $\theta = 0.3$.

$w_1 = 0.7$, $w_2 = 1.1$, $w_3 = 0.9$.

(i) Measure the predicted output using the formula -

$$Y_p = step((x_1 \times w_1 + x_2 \times w_2 + x_3 \times w_3) - \theta)$$

when step (x) is the step Activation function whose value is 1. if it is ≥ 0.5 and value is 0 if it is < 0.5

(ii) Update the weights (w_1, w_2, w_3) using the formula -

$$w_i^{(2)} = (w_i^{(1)} + \alpha \times x_i \times \varepsilon),$$

where $i = 1, 2, 3$, the learning rate, $\alpha = 0.1$ and ε is the error between the Actual output Y_a and the Predicted output Y_p.

Solve - (i)

$$Y_P = step[((x_1 w_1 + x_2 w_2 + x_3 w_3) - \theta)]$$

$$= step[(1 \times 0.7 + 1 \times 1.1 + 0 \times 0.9) - \theta]$$

$$= step[1.8 - 0.3]$$

$$= step[1.5]$$

here, 1.5 is ≥ 0.5

which Activation function value is = 1

so, step [1.5] = 1 Y_p

(ii) here, Actual output, $Y_a = 1$ = Y question

Predicted output, $Y_p = 1$

$\therefore$ ϵ, Error = $Y_a - Y_p = 1 - 1 = 0$.

now, update the weights -

$$w_1^{(2)} = (w_1^{(1)} + \alpha \times x_i \times \epsilon) = (0.7 + 0.1 \times 1 \times 0) = 0.7$$

$$w_2^{(2)} = (w_2^{(1)} + \alpha \times x_2 \times \epsilon) = (1.1 + 0.1 \times 1 \times 0) = 1.1$$

$$w_3^{(2)} = (w_3^{(1)} + \alpha \times x_3 \times \epsilon) = (0.9 + 0.1 \times 0 \times 0) = 0.9$$

here updated weights remain same.

Question - BPNN feature vector, $X = [1, 0]$

desired output, $Y = [0, 1]$
Y_{d6} Y_{d7}.

threshold value, $\theta_3 = \theta_4 = \theta_5 = 0.2$

learning rate $\alpha = 0.1$

weights, $w_{13} = 0.3$

$w_{14} = -0.5$

$w_{15} = w_{37} = 0.5$

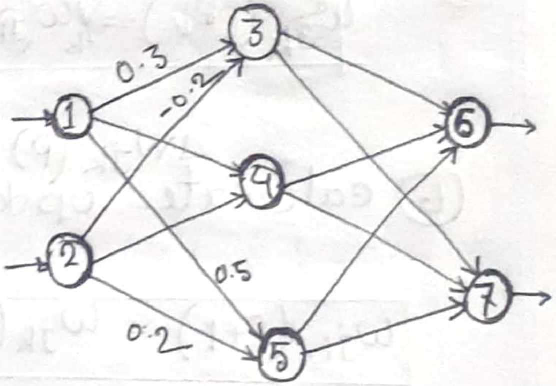
$w_{23} = w_{24} = -0.2$

$w_{25} = 0.2$

$w_{36} = w_{56} = -0.4$

$w_{46} = w_{47} = -0.3$

$w_{57} = 0.1$



(i) determine the predict output of hidden layer (3, 4, 5)
(ii) determine the predict output of output layer (6, 7)

Solve:

(i) predict output of hiden layer —

$X_1 = 1, \; X_2 = 0$

$Y_3 = \text{sigmoid}\left[1 \times 0.3 + 0 \times (-0.2) - 0.2\right]$

$= \text{sigmoid}(0.1)$

$= \dfrac{1}{1 + e^{(-0.1)}}$

$= 0.52$ ←

$Y_4 = \text{sigmoid}\left[X_1 \times \omega_{14} + X_2 \times \omega_{24} - \theta_4\right]$

$= \text{sigmoid}\left[1 \times (-0.5) + 0 \times (-0.2) - 0.2\right]$

$= \text{sigmoid}(-0.7)$

$= \dfrac{1}{1 + e^{0.7}}$

$= 0.33$ ←

$Y_5 = \text{sigmoid}\left[1 \times 0.5 + 0 \times 0.2 - 0.2\right]$

$= \text{sigmoid}\left[0.3\right]$

$= \dfrac{1}{1 + e^{-0.3}}$

$= 0.57$. ←

Scanned with CamScanner

(ii) predict output of output layer —

$$Y_6 = \text{sigmoid}\left[Y_3 \times \omega_{36} + Y_4 \times \omega_{46} + Y_5 \times \omega_{56} - \theta_6\right]$$

$$= \text{sigmoid}\left[0.52 \times (-0.4) + 0.33 \times (-0.3) + 0.57 \times (-0.4) - 0.2\right]$$

$$= \text{sigmoid}\left[-0.208 - 0.099 - 0.228 - 0.2\right]$$

$$= \text{sigmoid}\left[-0.735\right]$$

$$= \frac{1}{1 + e^{0.735}}$$

$$= \boxed{0.324}$$

$$Y_7 = \text{sigmoid}\left[0.52 \times 0.5 + 0.33 \times (-0.3) + 0.57 \times 0.1 - 0.2\right]$$

$$= \text{sigmoid}\left[0.018\right]$$

$$= \frac{1}{1 + e^{-0.018}}$$

$$= \boxed{0.5045}$$