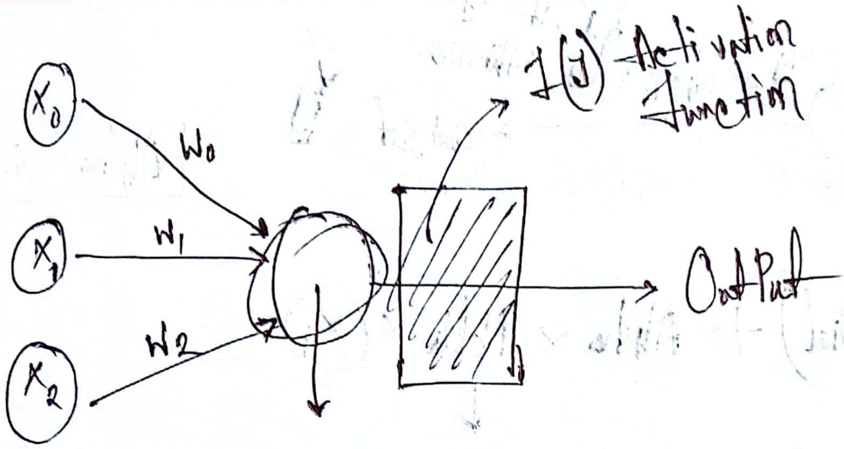
"Final Term"

Neural Network

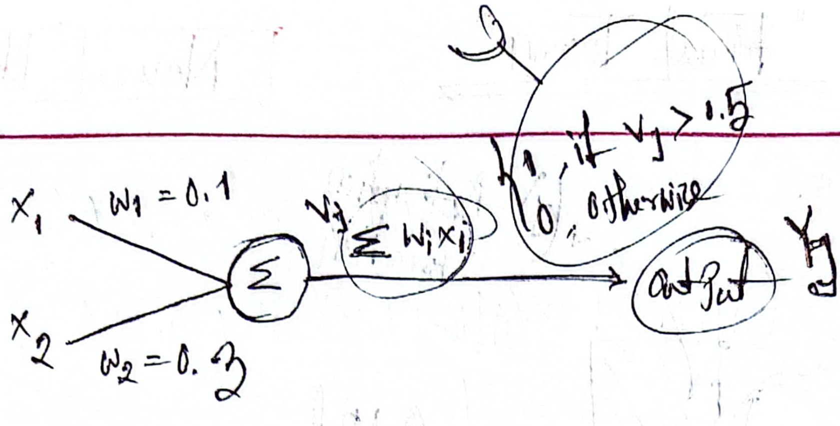


[Single Neural Networks]

Learn Weight, $W_i(\text{Final}) = W_i(\text{initial}) + \text{Alpha} \times \text{Delta} \times x_i$

$$\text{Delta} = Z - Y$$

Sigmoid function, $Z = \dfrac{1}{1+e^{-V}}$



$\boxed{\text{Alpha} = 0.2}$

$$w_i(\text{final}) = w_i(\text{initial}) + \text{Alpha} \times \text{Delta} \times x_i$$

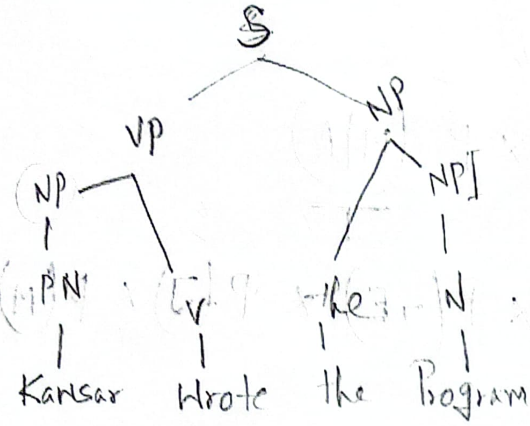
$\downarrow$

$\boxed{Z - Y}$

x_1	x_2	Desired Output Z	Initial w_1	Initial w_2	Y	Delta	Final w_1	Final w_2
0	0	0	0.1	0.3	0	0	0.1	0.3
0	1	1	0.1	0.3	0	1	0.1	0.5
1	0	1	0.1	0.5	0	1	0.3	0.5
1	1	1	0.3	0.5	1	0	0.3	.5

$\cancel{1 \times 0.1 + 0 \times} \boxed{0.5}$

$\cancel{0 \times 0.2\ 0.5 = 0}$



$$\frac{2}{10} \times \frac{1}{10}$$

$$= \frac{2}{100} = \frac{1}{50}$$

$$P(A \cap B) = P(A|B)\, P(B)$$

$$P(A \cap B) = P(B|A)\, P(A)$$

$$P(M|S)$$

$$\Rightarrow P(A|B)\, P(B) = P(B|A)\, P(A)$$

$$1 - \frac{1}{10}$$

$$= \frac{9}{10}$$

6(b)

$$P(S|M) = 0.5$$

$$P(M) = \frac{1}{50{,}000}$$

$$P(S) = \frac{1}{20}$$

8(b)

$$\cancel{P(S|M)} = 0.2$$

$$P(M) = \frac{1}{10}$$

$$P(S|S) = \cancel{\frac{1}{30}} \quad P(\neg\ |S$$

$$(S|\neg M)$$

$$\Rightarrow \frac{1}{30} \times \frac{1}{10} = P(M|S) \times \frac{2}{10}$$

$$\Rightarrow \frac{1}{300} \times \frac{10}{2}$$

$$\Rightarrow \frac{1}{60} = P(M|S)$$

(iii) $P(A \land \neg B \land \neg E \land J \land M)$

$= P(A \land \neg B \land \neg E) \times P(J|A) \times P(M|A)$

$= P(A|\neg B \land \neg E) \times P(\neg B) \times P(\neg E) \times P(J) \times P(M)$

(iii) $P(A \land B \land \neg E \land J \land M)$

$= P(A|B \land \neg E) \times P(B) \times P(\neg E) \times P(J) \times P(M)$

Segment - 4

Propositional & First Order logic

* Knowledge Base Agent : (KBA)

AI system based on →
- Knowledge
- Decision Making
- Reasoning
- Action

* Knowledge base agents are Composed of Two main Part -

(i) Knowledge Base

(ii) Inference system (Update new Knowledge from Bevious Knowle

* Operation Performed by KBA :

(i) Tell : This operation tells the knowledge ~~bae~~ ~~it~~ base what it Perceive from the environment.

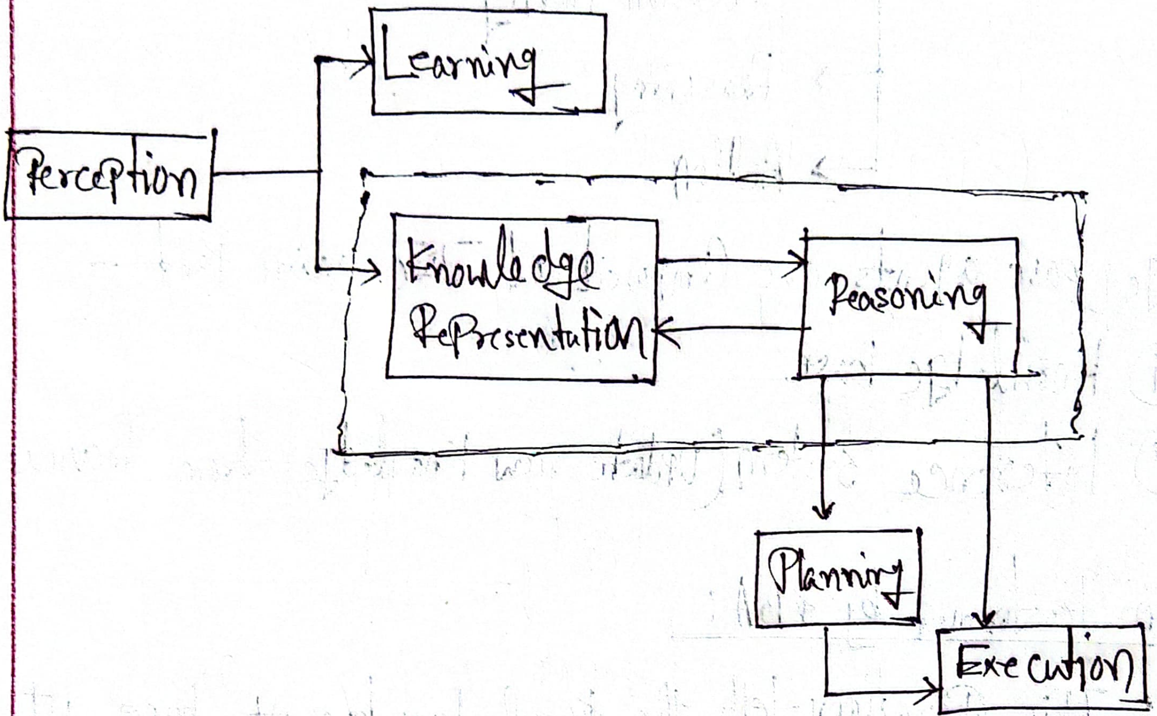
(ii) Ask : This operation ask the Knowledge base what action it should Perform.

(iii) Perform : It Perform the select action.

~~Kno~~

Knowledge Representation:

AI Knowledge Cycle:



Approches of Knowledg Representation:

Four Approches

- Simple Relational Knowledge
- Inheritable "
- Inferential "
- Procedural "

Techniques of KR:

(i) Logical Representation
(ii) Semantic Network
(iii) Frame Rep.
(iv) Production Rules.

Logical Representation: [If Condition then Action]

e.g.: If (at the bus stop AND bus arrives)
Then (get into the bus)

Logic
↓
Propositional Logic   Predicate Logic

Propositional Logic:

It's a declarative statement. Those statement either true/false.
It represent as logical or mathematical form.

e.g: (i) It is Sunday — true/false (ii) 3+3 = 7 — true/false

* **Tautology :** Eternal truth / চিরন্তন সত্য Statement.

  e.g : Sun rises in the east (True)

* **Contradiction :** If eternal truth represent as False.

  e.g : Sun rises in the West. (False)

Any kinds of Question, Commands, Opinion not Propositional logic

Type

- Atomic (It is raining) Simple statement
- Compound (It's raining and street is wet)

* **Operator :** *

(i) Negation ($\neg$) / NOT

(ii) ConJunction / AND ($\wedge$)

(iii) DisJunction / OR ($\vee$)

(iv) Implication ($\rightarrow$) [If $\underset{P}{\text{it is raining}}$ then $\underset{Q}{\text{street is wet}}$] > $P \rightarrow Q$

(v) Biconditional ($\leftrightarrow$)

e.g : [$\underset{P}{\text{I will go to school}}$ iff $\underset{Q}{\text{it's not raining}}$]. / $P \leftrightarrow Q$

Logical Equivalence : $[A \to B = \neg A \vee B]$

A	B	$\neg A$	$A \to B$	$\neg A \vee B$
T	T	F	T	T
T	F	F	F	F
F	T	T	T	T
F	F	T	T	T

Properties of Operators :

(i) $P \vee Q = Q \vee P$
$P \wedge Q = Q \wedge P$ } Commutativity

Associativity

(ii) $P \vee (Q \vee R) = (P \vee Q) \vee R$
$P \wedge (Q \wedge R) = (P \wedge Q) \wedge R$

(iii) Identity Element

$P \wedge \text{true} = P$

$P \vee \text{true} = \text{True}$

(iv) Distributive

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

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

(v) De morgan's Law

$\neg (A \wedge B) = \neg A \vee \neg B$

$\neg (A \vee B) = \neg A \wedge \neg B$

(vi) Double Negation Elimination

$\neg(\neg A) = A$

* Satisfiable : If any value of given statement is True | T.

* Contradictory : If all value of given statemen is False | F.

* Valid / Tautology : If all value is True | T.

Aut-22

* 2b) $(P \lor Q) \land (P \lor \neg Q)$

P	Q	¬Q	P∨Q	P∨¬Q	(P∨Q)∧(P∨¬Q)
0	0	1	0	1	0
0	1	0	1	0	0
1	0	1	1	1	1
1	1	0	1	1	1

Ans : $\boxed{\text{Satisfiable}}$

* Example : $(P \land Q) \rightarrow (R \lor \neg Q)$

$\boxed{A \rightarrow B = \neg A \lor B}$

P	Q	R	¬Q	P∧Q	R∨¬Q	¬(P∧Q)	¬(P∧Q)∨(R∨¬Q)
0	0	0	1	0	1	1	1
0	0	1	1	0	1	1	1
0	1	0	0	0	0	1	1
0	1	1	0	0	1	1	1
1	0	0	1	0	1	1	1
1	0	1	1	0	1	1	1
1	1	0	0	1	0	0	0
1	1	1	0	1	1	0	1

$\boxed{\text{Satisfiable}}$

Ans

FAHIM REZA | C211046

Rules of Inference :

(i) Implication ⇒ $P \to Q$

(ii) Converse ⇒ $Q \to P$

(iii) ContraPositive ⇒ $\neg Q \to \neg P$

(iv) Inverse ⇒ $\neg P \to \neg Q$

P	Q	$\neg P$	$\neg Q$	$P \to Q$	$Q \to P$	$\neg Q \to \neg P$	$\neg P \to \neg Q$
0	0	1	1	1	1	1	1
0	1	1	0	1	0	1	0
1	0	0	1	0	1	0	1
1	1	0	0	1	1	1	1

Implication = ContarPositive
Converse = Inverse

Types of Inference Rules :

(i) Modus ~~Pon~~ Ponens : If $P \to Q$, P is true, then Q also true

P	Q	$P \to Q$
0	0	1
0	1	1
1	0	0
1	1	1

(ii) Modes Tollens:

If, $P \to Q$ and $\neg Q \Rightarrow$ True

$\neg P \Rightarrow$ True

P	Q	¬P	¬Q	P→Q
0	0	1	1	1
0	1	1	0	1
1	0	0	1	0
1	1	0	0	1

(iii) Hypothetical Syllogism:

If $P \to Q$ and $Q \to R$ = True

Then, $P \to R$ = True

(iv) Disjunctive Syllogism:

If, $P \vee Q$ and $\neg P$ = True

Then, Q = True

* Statement:

(i) Today is $\underbrace{\text{sunday}}_{P}$ or $\underbrace{\text{Monday}}_{Q}$ ($P \vee Q$)

(ii) Today is not Sunday; ($\neg P$)

(iii) Today is Monday (Q)

(v) **Addition:** [If P is True Then, $P \vee Q$ is True]

P	Q	$P \vee Q$
0	0	0
0	1	1
1	0	1
1	1	1

(vi) **Simplification:** [$P \wedge Q$ $\Rightarrow$ True then P = True
or, $P \wedge Q$ $\Rightarrow$ True then Q = True]

(vii) **Resolution:** [$P \vee Q$ and $\neg P \wedge R$ $\Rightarrow$ True
Then, $Q \vee R$ $\Rightarrow$ True]

"First-Order Logic / Predicate Logic"

e.g: → Some human are Intelligent.
→ All birds can fly.

First-Order Logic
- Syntax
- Semantics

Atomic Sentence : (Basic Sentence)

e.g: (i) Karan and Arjun are brothers.

⇒ Brothers (Karan, Arjun)

(ii) Chinky is a Cat.

⇒ Cat (Chinky).

Complex Sentence : [Combination of two/more atomic Sentences]

Quantifiers

- Universal
- Existential

(i) Universal Quan. : For all, For each, For every

Symbol ⇒ $\forall$

e.g: ~~All~~ boys like cricket.

⇒ $\forall_x : boys(x) \rightarrow like(x, Cricket)$ / $\forall_x \; like(x, Cricket)$

* (ii) Existential Quan: There exist, For Some, For at least

Symbol $\Rightarrow \exists$

e.g: Some boys like cricket.
x

$\Rightarrow \exists_x : boys(x) \wedge like(x, Cricket) \,/\, \exists_x\, like(x, Cricket)$

* Properties of Quantifier:

(i) $\forall_x . \forall_y = \forall_y . \forall_x$

(ii) $\exists_x . \exists_y = \exists_y . \exists_x$

(iii) $\forall_x . \exists_y \neq \exists_y . \forall_x$

Quantifier Duality:

e.g: (i) All boys like Cricket

$\Rightarrow \forall_x\, like(x, Cricket)$ is ~~equal~~ equivalent to, ~~$\neg \exists_x$ like~~

$\neg \exists_x \neg like(x, Cricket)$ *

(ii) Some boys like Cricket.

$\Rightarrow \exists_x : like(x, Cricket) = \neg \forall_x \neg like(x, Cricket)$

Example: (L-40)

Given knowledge,

(i) If you have a current password, then you can log on to the network.

(ii) You have a current password.

⇒ Infer: You can log on to the network.

Soln:

P = You have a current pass.

Q = You can log on to the network

(i) $P \rightarrow Q$ (ii) P

From, (i) $P \rightarrow Q = \neg P \vee Q$

$= \neg T \vee Q$

$= F \vee Q$

$= Q$

= You can log on the network.

※ Predicate Logic Example: (41)

Question:

(i) Every student is sincere.

(ii) All who are sincere and hard worker will succeed in life.

(iii) Meena is hard worker.

(iv) Meena is student.

⇒ Will Meena succeed in life?

Soln:

(i) $\forall_x\ student(x) \rightarrow Sincere(x)$

(ii) $\forall_x\ (sincere(x) \land Hardworker(x)) \rightarrow Succeed(x)$

(iii) $Hardworker(Meena)$.

(iv) $Student(Meena)$

From (i), $\forall_x\ Student(x) \rightarrow Sincere(x)$

$\Rightarrow Student(Meena) \rightarrow Sincere(Meena)$

$\Rightarrow \neg Student(Meena) \lor Sincere(Meena)$

$\Rightarrow \neg T \lor sincere(Meena)$

$\Rightarrow F \lor Sincere(Meena)$

$\Rightarrow Sincere(Meena)$

From (ii),

$Sincere(Meena) \land HardWorker(Meena) \rightarrow Succeed(Meena)$

$\Rightarrow T \land T \rightarrow Succeed(Meena)$.

$\Rightarrow T \rightarrow Succeed(Meena)$

$\Rightarrow \neg T \lor Succeed(Meena)$

$\Rightarrow F \lor Succeed(Meena)$

$\Rightarrow Succeed(Meena)$

So, Meena will succeed in life..

Aut (22)

(2c) Soln :

(i) ~~$\forall_x$ like(sun)~~ $\forall_x\, like(x, Sun)$

or, $\forall_x\, Gardener(x) \rightarrow like(x, Sun)$

~~(ii)~~ ~~$\exists_x$ fool~~

(ii) $\exists_x\, People(x) \land \forall_t\, time(t) \rightarrow Fool(x, t)$

or,

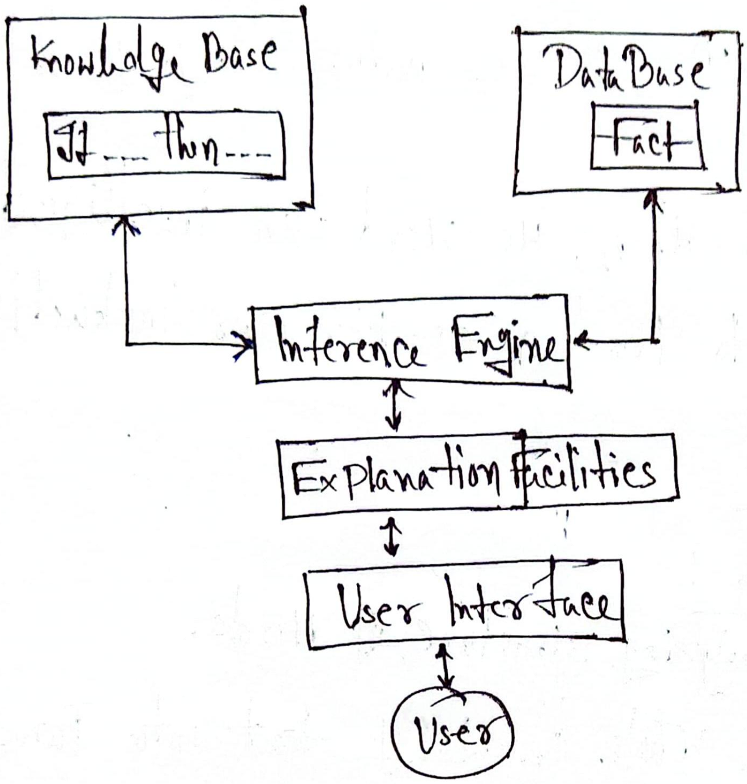
$\exists_x \forall_t\, Fool(x, t)$

(iii) ~~$\forall_p$ Poisonous~~ ~~&~~ $\forall_m\, Poisonous(m, Purple)$

or, $\forall_m\, (mashroom(m) \land Purple(p)) \rightarrow Poisonous(m)$

(iv) ~~$(\exists_x\, tall(x))$~~ $\boxed{\neg Tall(Clinton)}$

Rule Base Expert System : (12)



Inference Engine → Reasoning → 2 Approch

- → Forward Chaining *
- → Backward Chaining *

Reasoning :

Reasoning refers to the Process of giving Soln from available information.

It involves using existing knowledge to make decisions, solve problems.

Segment - 5
"Natural Language Processing"

52

NLP:
It is a method of Communicating with intelligent system. It use natural language like English.

NLP is required when, we want an intelligent System (Robot) to Perform as Per our instruction.

※ Steps in NLP:

1. **Lexical Analysis:**
   → Identify & analyzing structure of words.
   → Divides the whole chunk of text into Paragraphs - sentences and words.

2. **Syntactic Analysis:** [CFG and Parsing]
   → Grammatical analysis of the ~~sent~~ Sentence.

3. **Semantic Analysis:**
   → Check the sentence ~~weather~~ Whether meaningful or not.

4. **Discuse Integration:**
   → Check the meaning and Previous sentence.

5. **Pragmatic Analysis:**
   → What was said is re-interpreted on what ~~it~~ actually meant.

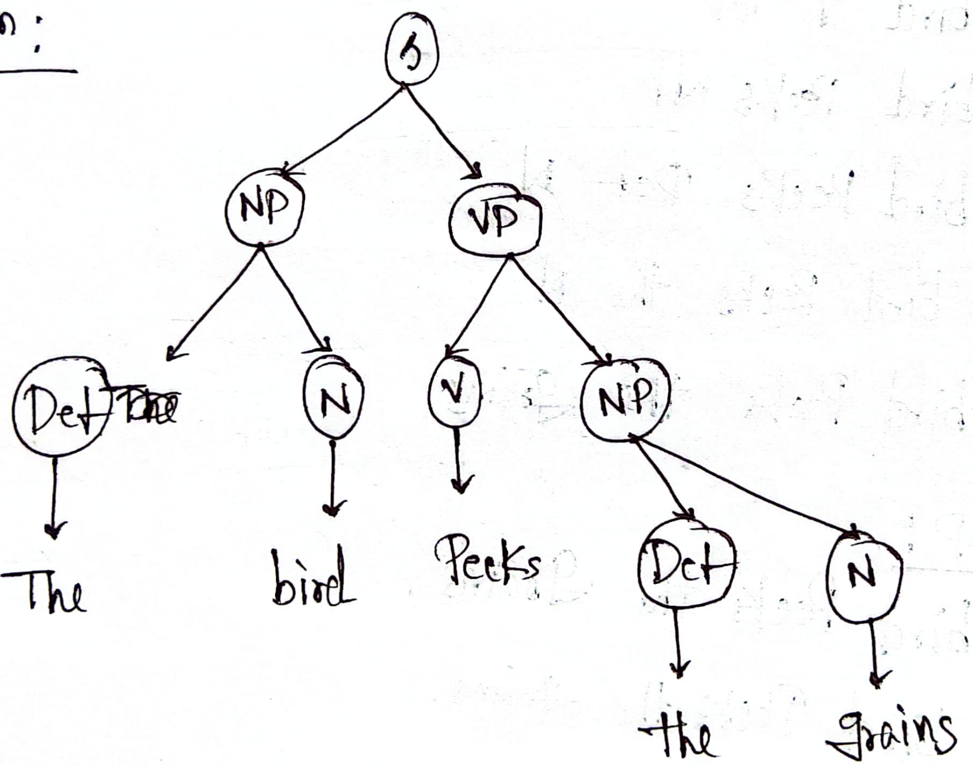
Syntactic Analysis :

CFG : e.g : "The bird Packs the grains."

S → NP VP
NP → Det N | Det Adj N
VP → V NP

Det → a | the
Adj → beautiful | Perching
N → bird | birds | grain | grains
V → Peck | Pecks | Pecking

Soln :



Parsing :

→ Top Down Approch
→ Bottom up "
> 2 Types

e.g: [~~for~~ Previous Parse Tree]

* **Top Down:**

S → NP VP

→ Det N VP

→ The N VP

→ The bird VP

→ The bird V NP

→ The bird Pecks NP

→ The bird Pecks Det N

→ The bird Pecks the N

→ The bird Pecks the grains.

* **Bottom Up:**

→ The bird Pecks the grains.

→ Det bird Pecks the grains.

→ Det N Pecks the grains

→ NP Pecks the grains

→ NP V ~~the grains~~ Det grains

→ NP V ~~Det~~ Det N

→ NP V NP

→ NP VP

→ S

Artificial Neural Network. (ANN)

※ Human Neuron ↔ Artificial Neuron

(i) Dendrite ↔ Input

(ii) Soma ↔ Node (Σ)

(iii) Axon ↔ Output

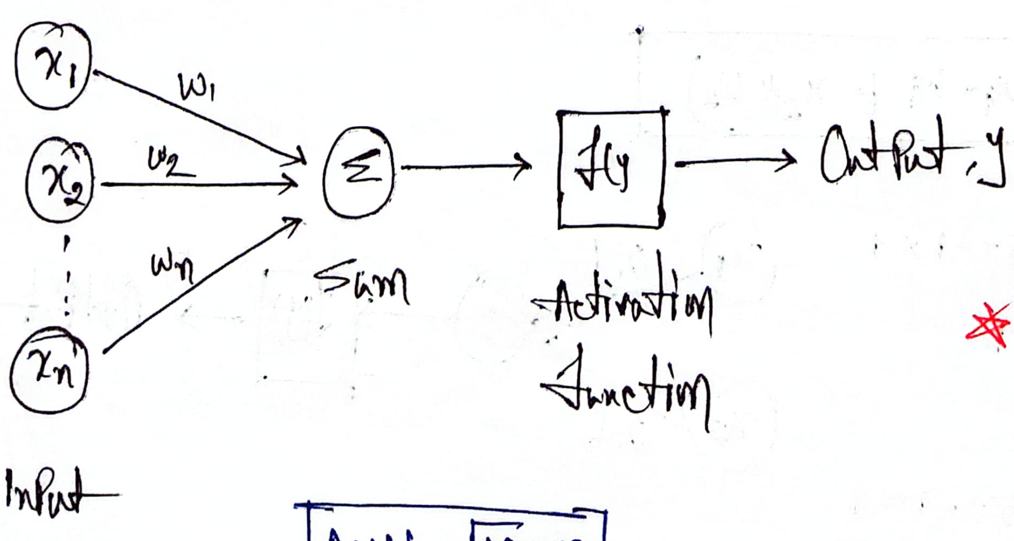
(iv) Synapse ↔ Weighting factor (w_i)

Compare between Artificial and biological network.

※ Perceptron:

A Perceptron is a neural Network that does certain computation to detect features or recognize pattern in the input data.

 # Consists of 4 Parts: (i) Input, (ii) Weight and bias (iii) Net Sum (iv) Activation function.

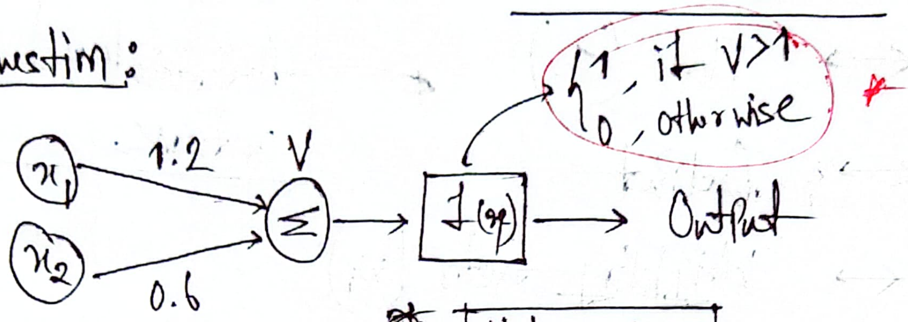


ANN figure

$$W_i(\text{final}) = W_i(\text{initial}) + (\text{Alpha} \times \text{Delta} \times x_i)$$

$$\text{Delta} = [\text{Desire Output} - \text{Output}]$$
$$= [Z - Y]$$

Question:



$\boxed{\text{Alpha} = 0.5}$

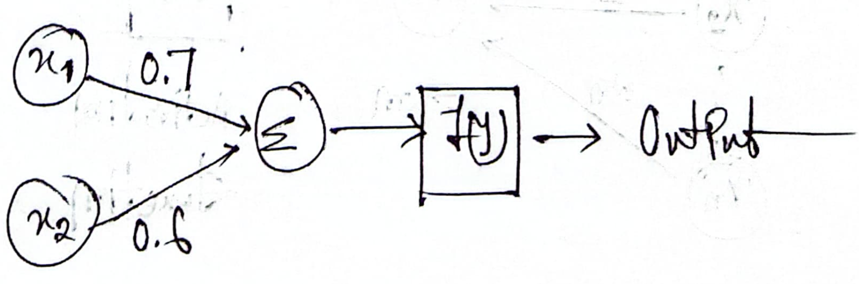
Soln:

x_1	x_2	Σ	Initial W_1	Initial W_2	Y	Delta	Final W_1	Final W_2
0	0	0	1.2	0.6	0	0	1.2	0.6
0	1	0	1.2	0.6	0	0	1.2	0.6
1	0	0	1.2	0.6	1	-1	.7	.6
1	1	1	.7	.6	1	0	.7	.6

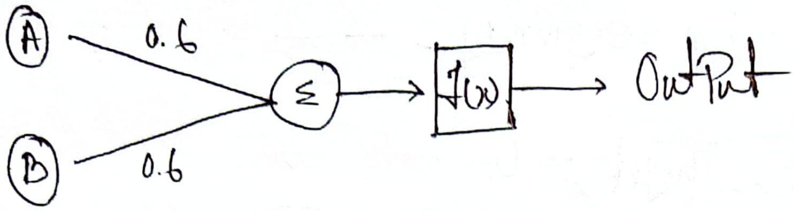
$$V \Rightarrow \boxed{\sum x_i W_i = (x_1 * W_1 + x_2 * W_2)}$$

$w_1 = 1.2 + .5 \times -1 \times 1$
$= 1.2 - .5$
$= .7$

$w_2 = 0.6 + .5 \times -1 \times 0$
$= .6$



Question : OR Gate Perception : L61



Alpha = 0.5
Treshold = 1

Soln :

(i) A = 0, B = 0, Target = 0

$\Sigma w_i x_i = 0.6 \times 0 + 0.6 \times 0$
$= 0$

$\Sigma w_i x_i <$ Treshold

so OutPut = 0, Continue ...

	A	B	A∨B
(i)	0	0	0.
(ii)	0	1	1
(iii)	1	0	1
(iv)	1	1	1

(ii) A = 0, B = 1, Target = 1

$\Sigma w_i x_i = 0.6 \times 0 + 0.6 \times 1 = 0.6$

$\Sigma w_i x_i < 1$ So, OutPut = 0

Target ≠ OutPut

so, $W_1 = W_1 + 0.5 \cdot (1 - 0) \cdot 0$
$= 0.6 + 0 = 0.6$

$W_2 = 0.6 + 0.5 (1 - 0) \cdot 1$
$= 1.1$

Now, $W_1 = 0.6$ and $W_2 = 1.1$

Again Calculating from beginning –

(i) $A = 0$, $B = 0$, Target $= 0$

$\sum W_i x_i = 0.6 \times 0 + 1.1 \times 0 = 0$

$\sum W_i x_i < 1$ so, Output $= 0$

(ii) $A = 0$, $B = 1$, Target $= 1$

$\sum W_i x_i = 0.6 \times 0 + 1.1 * 1 = 1.1$

$\sum W_i x_i > 1$, Output $= 1$

(iii) $A = 1$, $B = 0$, Target $= 1$

$\sum W_i x_i = 0.6 * 1 + 1.1 * 0 = 0.6$

$\sum W_i x_i < 1$, Output $= 0$

Target $\neq$ Output,

So,

$W_1 = 0.6 + 0.5(1-0) \cdot 1$

$= 1.1$

$W_2 = \cancel{0}. 1.1 + 0.5(1-0) \cdot 0$

$= 1.1$

Now, $w_1 = 1.1$ and, $w_2 = 1.1$

Again, Calculating from beggining,

(i) $A = 0, B = 0$, Target $= 0$

$\sum w_i x_i = 0$, Output $= 0$

(ii) $A = 0, B = 1$, Target $= 1$

$\sum w_i x_i = 1.1 \times 0 + 1.1 \times 1$

$= 1.1$

$\sum w_i x_i > 1$, Output $= 1$

(iii) $A = 1, B = 0$, Target $= 1$

$\sum w_i x_i = 1.1 \times 1 + 1.1 * 0$

$= 1.1$

$\sum w_i x_i > 1$, Output $= 1$

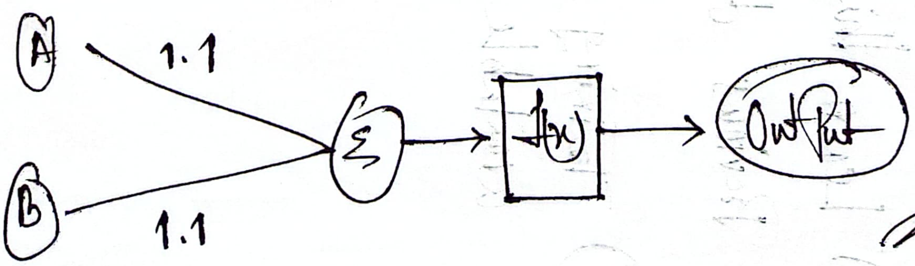
(iv) $A = 1, B = 1$, Target $= 1$

$\sum w_i x_i = 1 \times 1.1 + 1.1 \times 1$

$= 1.1 + 1.1 = 2.2$

$\sum w_i x_i > 1$, Output $= 1$

So, All four steps ~~are~~ have no Problem for,
$w_1 = 1.1$ and $w_2 = 1.1$.



Question: Supervised Vs Unsupervised Vs Reinforcement ## L56

Learning
Segment 7

Supervised	Unsupervised	Reinforcement
(i) Learning with teacher.	(i) Learning with no teacher.	(i) Learning with teacher. (Yes/No)
(ii) Data is well Labeled.	(ii) Data is nither classified nor Labeled.	(ii) Data is not labeled.
(iii) Learn things from Previous data.	(iii) Learn thing by grouping Unsorted information according to similarities, Patterns and difference.	(iii) Learn thing by taking action (step by step).
(iv) Training data is available.	(iv) Training data is not available.	(iv) No training data available.
		OutPut Value $\neq$ Target (No)
		OutPut = Target (Yes)

~~Segment 8~~
~~Knowledge Acquisition~~

* Learning : Learning is ~~a~~ Constructing or modifying based on Predifined facts, rules and experienced.

Achived by —

(i) Taking Advice.

(ii) From Observation.

(iii) From Examples.

(iv) By direct Instruction.

(v) By deduction.

(vi) Using relevant infoⁿ.

(vii) By Correcting mistakes, etc.

Following tasks are associated with NLP :

(i) Traslation, (ii) Summarization, (iii) Speech recognition, (iv) Sentiment Analysis.

* Baye's Theorem :

⇒ Describe the Prob^y of an event based on Prior knowledge of Condition that might be related to the event.

In Prob^y theory it relates the Conditional Prob^y and marginal Prob^y of two random events.

$\Rightarrow \quad P(H|E) = \dfrac{P(H \cap E)}{P(E)}$

[Prob^y of "H" when "E" is true]

~~Quest~~ Calculating P(B|A) with Knowledge of P(A|B)

$\Rightarrow \quad P(A \cap B) = P(A|B) \cdot P(B)$ —— (i)

$P(A \cap B) = P(B|A) \cdot P(A)$ —— (ii)

(i) & (ii) $\Rightarrow \quad P(A|B) \cdot P(B) = P(B|A) \cdot P(A)$

So, $\boxed{P(A|B) = \dfrac{P(B|A) \cdot P(A)}{P(B)}}$ ##

Baye's Theorem Formula

Question: What is the Prob^y that a Person has disease dengue & with neck Pain?

dengue → D, neck Pain → N

Given, 80% of time dengue causes neckpain

$\hookrightarrow P(N|D) = 0.8$

$P(D) = \dfrac{1}{30000}, \quad P(N) = 0.02$

~~Soln~~: As per Baye's theorem,

$$P(D|N) = \frac{P(N|D) \cdot P(D)}{P(N)} = \frac{0.8 * 1/30000}{0.02} \quad \text{(Ans)}$$

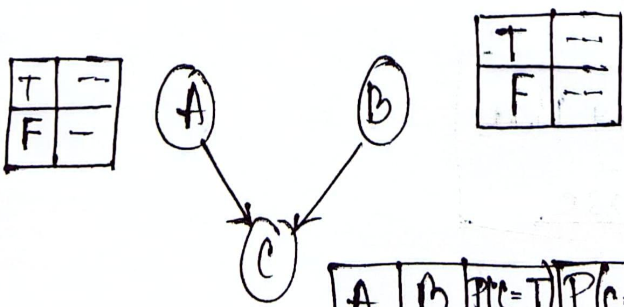
※ Application of Baye's Theorm: Weather Forecasting

↳ Probality of Tommorow weather depending on Previous weather.

※ Bayesian Belief Network:

⇒ It defines Prob^y independencies and dependencies among the variables. ~~in~~

⇒ It is a Prob^y graphical model which represents a set of variables and their dependencies using a directed acyclic graph.

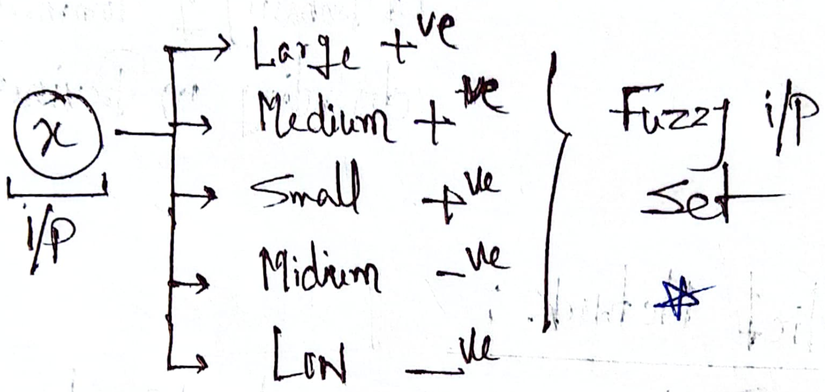


A	B	P(C=T)	P(C=F)
T	T	—	—
T	F	—	—
F	T	—	—
F	F	—	—

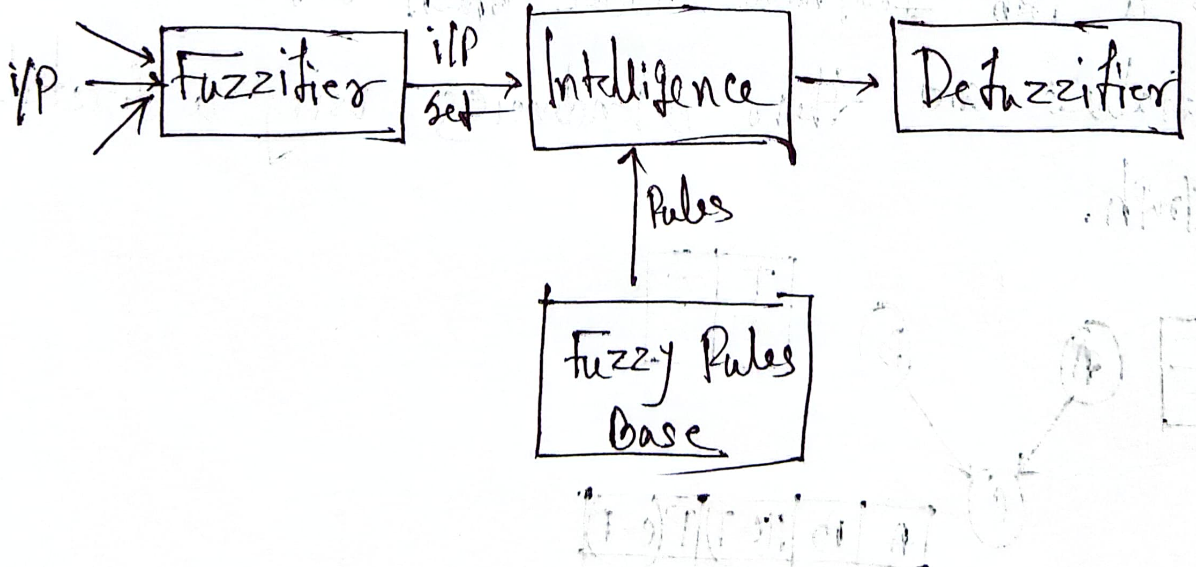
Fuzzy Logic :

- ⇒ Multivalued logic that allows Intermediate logic values to be defined between Conventional equan.
- ⇒ Mathematical rules to represent Uncertainity.
- ⇒ DeVides input into a set of multiple degrees.

e.g.



Architecture :



Inductive learning : [use Supervised Learning]

⇒ You need to be learned Correct Concept Untill that you have to search different topic ~~#~~ and when get the target Concept stop. Then ~~for~~ your decision is ~~this~~ right. that is Inductive learning.

1. e.g : Human use Inductive learning to arrive at a general Conclusion from a limited set of facts by the Process of generalization.

Case 1 : Monkey of Dhaka zoo eat Banana.
Case 2 : Monkey of CTG zoo eat Banana.

Conclation : In general all money eat Banana *

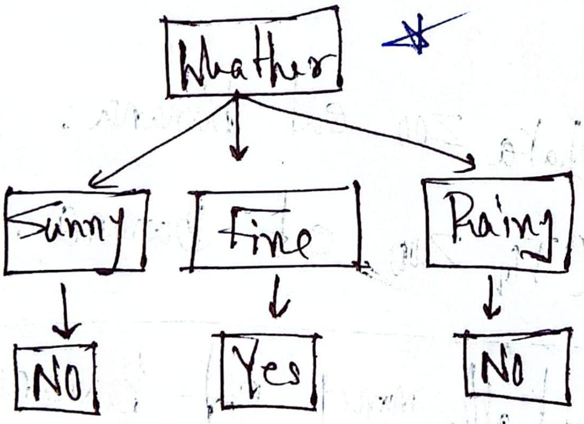
2. e.g : To learn a Correct Concept we watche many viedios on this Particular Topic and find out a Conclution.

※ Dicision Tree Learning :

⇒ It's a function that takes i/p as a Vector of attributes values and return a dicision as a single Output Value.

It's falls into category of supervised learning.

A dicision tree reach it's dicision by Performing a sequence of test.



ID3

↓

Decision Tree Algorithm.

※ Expert System:

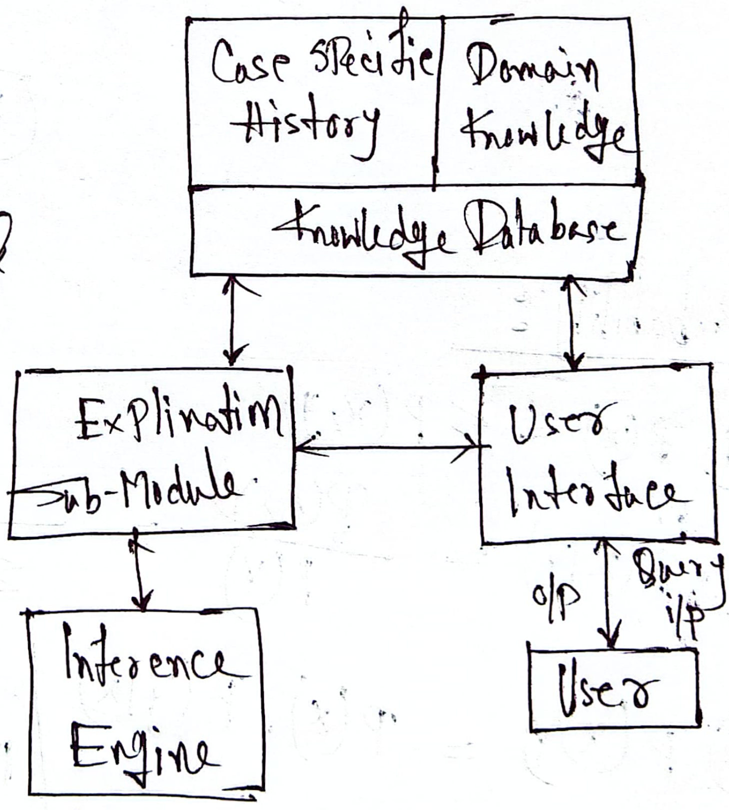
⇒ Expert system in AI is Computer Application with the level of human intelligence & expertise.

ES draws upon knowledge of human experts Captured in a Knowledge base to solve Problems that require human expertise.

※ Characteristics:

(i) High Performance
(ii) Reliable
(iii) Highly Responsive &
(iv) Understandable

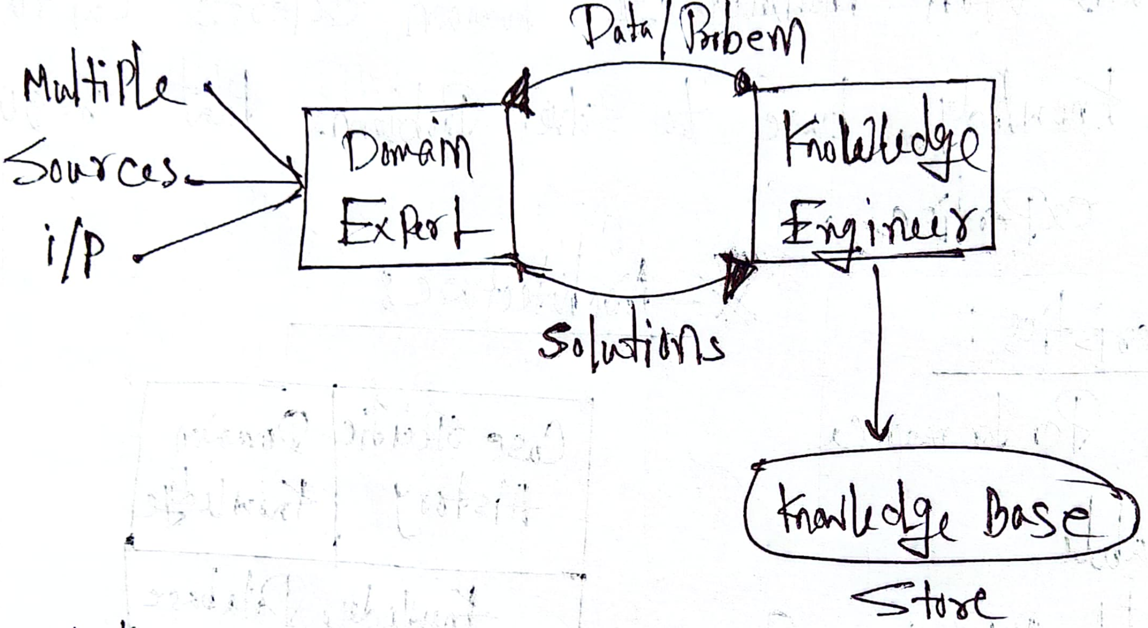
※ Architecture:



Brain of Expert System.

Knowledge Acquistion :

⇒ Is the Process of extracting, structuring and Organizing knowledge from One or many Sources.



Probability :

(i) $P(x) = \sum P(x,y)$

(ii) $P(x|Y) = \dfrac{P(x,Y)}{P(Y)} = \dfrac{P(x,Y)}{\sum P(X,Y)}$

(iii) $P(x,Y) = P(x) \cdot P(Y|x) \;\Big|\; P(Y)\, P(x|Y)$

Dempster Shafer Theory:

⇒ Also known as DS Theory

⇒ Introduced by P. Dempster and his student Glenn Shafer. It's used for reasoning and decision making in situation involving uncertainty.

⇒ The theory Provides a framework for Combining evidence from different source in a Principled manner. In traditional Prob theory, the sum of ~~all Possible out~~ Probabilities for all Possible outcomes is always equal to 1. However in many real word situation, we may not have Complete information on may face Conflict evidence. D-S theory is designed to handle such situation by allowing for the representation of ~~on~~ uncertainty in a more flexible way.

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B_A	$m_{1,i}$	$m_{2,i}$	$m_{3,i}$	$m_{H,i}$	$\bar{m}_{H,i}$	$\tilde{m}_{H,i}$
0.1	0.14	0.175	0	0.685	0.65	0.035
0	0.065	0.49	0.098	0.35	0.35	0

$\Rightarrow m_{1,1} = \omega_1 \beta_{1,1}$

$\Rightarrow \beta_H = 1 - (\beta_{1,i} + \beta_{2,i} + \beta_{3,i})$

$\Rightarrow \bar{m}_{H,i} = 1 - \omega_i$

$\Rightarrow \tilde{m}_{H,i} = \beta_{H,i} * \omega_i$

$\Rightarrow m_{H,i} = (\bar{m}_{H,i} + \tilde{m}_{H,i})$

5C

$$f(z) = \frac{1}{1+e^{-z}}$$ [Sigmoid Function]

$P = 9.8$

$Q = 7.7$

$$f(P) = \frac{1}{1+e^{-9.8}} = 0.99$$

$$f(Q) = \frac{1}{1+e^{-7.7}} = 0.99$$

$Z = 0.99 * 0.6 + 0.99 * .45 = 1.04$ Ans

6b

Stiff neck = S

Maningitis = M

Given,

$P(M|S) = .4$

$P(M) = 1/50000$

$P(S) = 1/25$

So, $$P(S|M) = \frac{P(M|S) * P(S)}{P(M)}$$

$= 0.0002$ Ans

6C

(i) $P(F, E, A, Y, S) = P(F) \cdot P(E) \cdot P(A|F, E) \cdot P(Y|A) \cdot P(S|A)$

(ii) $P(A \land \neg F \land \neg E \land Y \land S)$

$= P(A | \neg F \land \neg E) * P(\neg F) * P(\neg E) * P(Y|A) * P(S|A)$

$= 0.001 * 0.99 * 0.99 * .9 * .8$

$= .00071$ Ans

Question: What is the Prob of John Call?

Soln: $P(J|a) \cdot P(a) + P(J|\neg a) \cdot P(\neg a)$

$= P(J|a) \{ P(a|e, b) * P(e) * P(b) + P(a|\neg e, b) * P(\neg e) * P(b)$
$+ P(a|e, \neg b) * P(e) * P(\neg b) + P(a|\neg e, \neg b) * P(\neg e) * P(\neg b)$

2b

1. $\forall_x$ Child$(x) \rightarrow$ love (x, Santa)

2. $\forall_x$: Child$(x) \wedge$ love $(x, \text{Santa}) \rightarrow$ love $(x, \text{reindeer})$

3. Reindeer (Rudolph) $\wedge$ Red Nose (Rudolph).

4. $\cancel{\forall}$ ~~(x)~~ $\forall_x$: ~~Weird~~ Red nose $(x) \rightarrow$ ~~Wired (x, red nose)~~ Weird$(x) \vee$ Clown (x)

5. ~~¬Raindeer (Clown)~~

$\neg$ Clown (Raindeer)

6. $\forall_x$: Weired $(x) \rightarrow \neg$ Love $(x, \text{scrooge})$

7. $\neg$ child (scrooge)

Child $(x) \rightarrow$ Love (x, Santa)

$\Rightarrow$ Child (scrooge) $\rightarrow$ Love (scrooge, Santa)

$\Rightarrow$ Child (scrooge) $\wedge$ Love (scrooge, Santa) $\rightarrow$ Love (scrooge, Raindeer)

$\Rightarrow$

Question:

$R_1 : \neg P_{1,1}$

$R_2 : B_{1,1} \leftrightarrow (P_{2,1} \lor P_{1,2})$

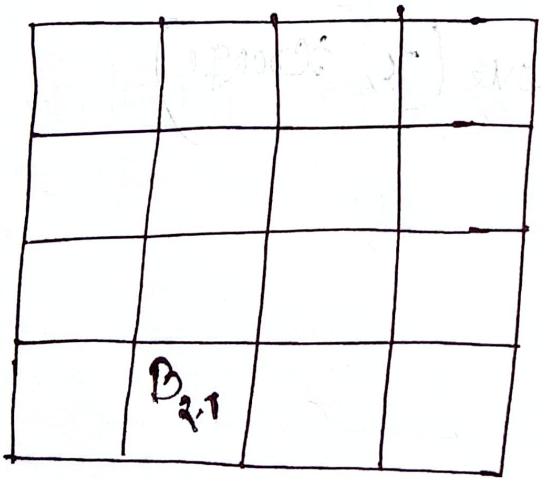
$R_3 : B_{2,1} \leftrightarrow (P_{1,1} \lor P_{2,2} \lor P_{3,1})$

$R_4 : \neg B_{1,1}$

$R_5 : B_{2,1}$

Show that $\nvDash \neg P_{1,2}$ is true

Soln:



(iii) $P(A \land B \land \neg E \land J \land M)$

$= P(A|B, \neg E) * P(B) * P(\neg E) * P(J|A) * P(J/M)$

5(b)

$S \rightarrow NP\ VP$

$\rightarrow PN\ V\ NP$

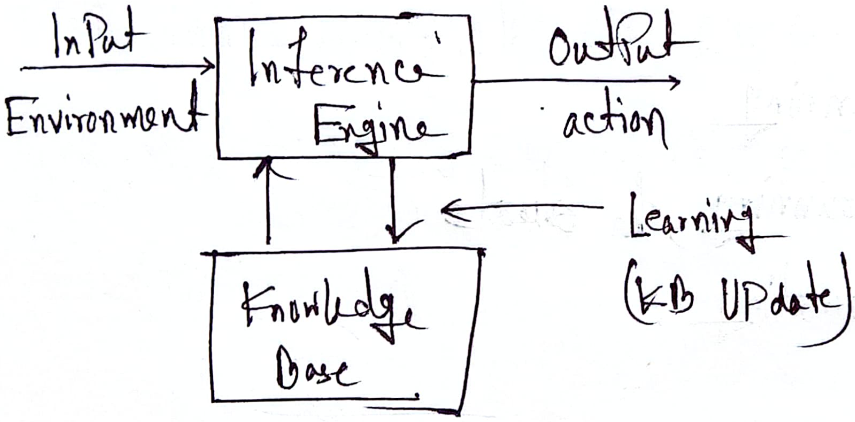
$\rightarrow$ Kawsar Wrote the NP1

$\rightarrow$ ________ ADJs N

ε Program

Kawsar Wrote the Program

$\Rightarrow$ PN V NP N



Modus Ponens:

$A \rightarrow B$

A

B

Inference System:

⇒ Is generate new facts so that an agent can update the KB.

2 Types:

(i) Forward Chaining:

A

$A \rightarrow B$

B

e.g: He is running

If he is running, he sweats

He is sweating.

(ii) Backward Chaining:

B

$A \rightarrow B$

A

eg: He is sweating

If he is running he sweats.

He is running.

FAHIM REZA | C211046
fahim.bdctg51@gmail.com

⇒ AI Learned new iteam by back Propagation.

⇒ Back Propagation is that Change the weights by Computing the error of the Output Units.

$$P(a|b) = \frac{P(a,b)}{P(b)}$$

(i) $P(W) = ?$

$P(W = sun) = (0.3 + 0.1 + 0.1 + 0.15) =$

$P(W = rain) = (0.05 + 0.05 + 0.05 + 0.2) =$

(ii) $P(W | winter) = ?$

$$P(W = Sun | winter) = \frac{P(W = Sun, Winter)}{P(Winter)} = \frac{(.1 + 0.15)}{(.1 + .05 + .15 + .2)}$$

$P(W = rain | Winter) = ---$

(iii) $P(W | winter, hot) = ?$

$$P(W = Sun | Winter, hot) = \frac{P(W = Sun, Winter, hot)}{P(Winter)}$$

W	P
Sun	0.1/0.15
rain	0.05/0.15

$0.1/0.15 =$

$0.05/0.15 =$