Num

Chapter-4 Knowledge Representation Inference & Reasoning

• 8hrs
• 15-20 marks

• knowledge

=> It is an information about the domain that can be used to solve problem in that domain.

=> In other words,
"knowledge is information combined with experience, context, interpretation & reflextion"

"knowledge is human expertiese stored in a person's mind gain through experience and interaction with the person environment".

=> Research literature classify knowledge as:

1) Classification based knowledge
- Ability to classify information

2) Decision oriented knowledge ~~choosi~~
- Choosing the best option

3) Descriptive knowledge
- State of some world (heuristic)

4) Procedural knowledge
- How to do smth?

5) Reasoning knowledge
- what conclusion is valid in what situation

6) Assimilitative knowledge
- whats its impact is?

⇒ On general different types of knowledge are:

1) Meta knowledge
- It is a knowledge about knowledge & how to gain them.

2) Procedural knowledge

3) Declarative knowledge
- It is passive knowledge in the form of statement about fact

4) heuristic knowledge
(explained before)

5) Structural knowledge
(explained before).

Knowledge Representation.

⇒ It is the study of how knowledge about the world can be represented and what kinds of reasoning can be done with that knowledge.

⇒ knowledge representation is method used to encode knowledge in intelligent system.

⇒ Some issues that arise in knowledge representation from an AI perspective are:
1. How do people represent knowledge?
2. What is nature of knowledge & how do we represent it?
3. Should representation scheme deal with a particular domain or should it be for general purpose?

4. How expressive is a representation scheme or formal language?
5. Should the scheme be declarative or procedural?

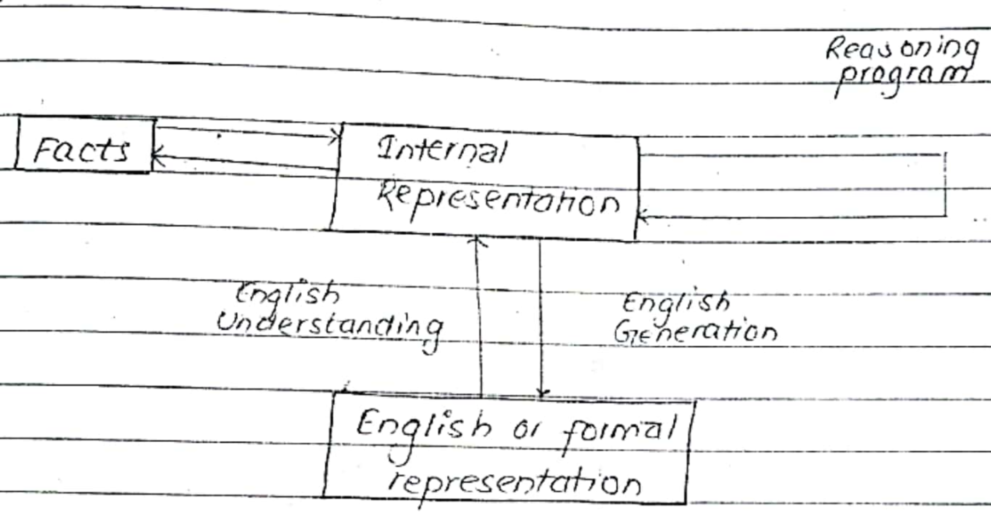


fig:- knowledge Representation System

→ Approaches to knowledge Representation
- Rule based
  - IF <condition> THEN <condition>
- Object based
  - Frames
  - Scripts
  - Semantic Networks

• Rule based Approach

⇒ Rule based system are used as a way to store and manipulate knowledge to interpret information in a useful way.

=> In this approach we use the idea of production rules sometimes called 'if then rules'.

The syntax structure is:
IF <condition> THEN <condition>

=> Logic is a method of reasoning process in which conclusion are drawn from premises (is a boolean) using rules of inference.

=> The logic is knowledge representation technique that involves:

1) Syntax
- defines well formed sentences or legal expression in the language

2) Semantics
- defines the meaning of sentences

3) Inference rules
- for manipulating sentences in the language.

=> logic can be classified as:
(i) Proposition (or statements or Calculus) logic
(ii) Predicate [or First order Predicate logic FOPL)] logic

(1) Proposition Logic
=> A proposition is a declarative sentence to which only one of truth value (i.e. true or false) can be assigned but not both.

⇒ Hence, proposition logic is also called Boolean logic.

⇒ When a proposition is true, we say that the truth value is true (T) or it is false (F).

⇒ For eg:
- The square of 5 is 25. – True
- The square of 7 is 51. – False

⇒ The sentences in proposition logic can be categorized into:

a) Atomic sentence
- It is also called simple sentence as it only consist of single proposition symbol.
- Each such symbol stands for a proposition that can be true or false.
- Ex: p, q, r, etc.

  p = sun rises in the west (F)

b) Complex sentence (Molecular or combined or Compound)
- The two or more statements connected together with some logic connectives such as ~~hand~~ AND ($\wedge$), OR ($\vee$), Implication ($\rightarrow$) etc.

- There are 5 connectives in common use.

	Name	Representation	Meaning
1.	Negation	$\neg p$ $\neg p$	not p
2.	Conjunction (true when both statement are true, otherwise false)	$p \wedge q$	p and q
3.	Disjunction (false when both statement are false, otherwise true)	$p \vee q$	p or q (or both)
4.	Exclusive Or (false when both statement are same)	$p \oplus q$	either p or q, but not both.
5.	Implication (false; when p is true & q is false)	$p \rightarrow q$	if p then q
6.	Bi-conditional or Bi-implication (true when both statement have truth value)	$p \leftrightarrow q$	p if & only if q

NOTE:
The order of precedence in propositional logic (from highest to lowest). Inverse, AND, OR, Implication & Bi-implication.

Truth Table:

			AND	OR	XOR		
p	q	¬p	p∧q	p∨q	p⊕q	p→q	p↔q
T	T	F	T	T	F	T	T
T	F	F	F	T	T	F	F
F	T	T	F	T	T	T	F
F	F	T	F	F	F	T	T

Example:

p = It is raining

q = I'm in-door.

1. It is not raining. (Negation)

2. Conjuction
   It is raining and I'm indoor.

3. Disjunction
   It is raining or I'm indoor

4. Exclusive or
   If two horses are racing, then one of the two will win race. p: two horses are racing; q = one will win.

5. Implication
   If it is raining then I'm indoor.

6. Bi-conditional or Bi-implication
   It is raining if and only if I'm indoor.

0	0	1
0	1	0
1	0	0
1	1	1

Converse
- If $p \to q$ is an implication then its converse is $q \to p$.

Inverse
- If $p \to q$ is an implication then its inverse is $\neg p \to \neg q$.

Contrapositive
- If $p \to q$ is an implication then its contrapositive is $\neg q \to \neg p$.

Q. Write converse, inverse, negation, implication, contrapositive of the following statement.

The program is readable only if it is well structured

⇒ p - The program is readable
q: It is well structured

Converse:
- If it is well structured then the program is readable.

Inverse:
- If the program is not readable then it is not well structured

Negation
- The program is not readable.

Contrapositive

- If ~~the~~ it is not well structured then the program is not readable.

Implication:

- If the program is readable then it is well structured

Q. Define logical equivalence tautology, contradiction contingent with example.

Q. Verify that $p \leftrightarrow q$ is equivalent to $(p \to q) \wedge (q \to p)$

Q. Construct the truth table of $\neg(p \wedge q) \vee (r \wedge \neg p)$

Q. There are two restuarant next to eachother. One has as a sign board as 'Good food is not cheap' and another has a sign as 'Cheap food is not good.' Are both the sign board saying the same thing?

G = Food is Good

C = Food is Cheap ~~$(p \to q)$~~

$G \to \neg C$ - - - (i)

$C \to \neg G$ - - - (ii)

Truth table

G	C	$\neg G$	$\neg C$	$G \to \neg C$	$C \to \neg G$
T	T	F	F	F	F
T	F	F	T	T	T
F	T	T	F	T	T
F	F	T	T	T	T

Since they are are logically equivalence so they are saying same thing.

Rules of Inference

⇒ The process of drawing conclusion from given premises in an argument is called inference.

⇒ To draw the conclusion from given statement we must be able to apply some well defined step.

⇒ The step of reaching the conclusion are provided by the rule of inference.

1. Modus Ponens Rule:

$$p \to q$$
$$\underline{p}$$
$$\therefore q$$

Eg:
- If Ram is hardworking, then he is intelligent
- Ram is hardworking

Ram is intelligent

2. Modus Tollens Rule:

$p \rightarrow q$
$\neg q$
$\therefore \neg p$

Example:
We will go swimming only if it is sunny.
It is not sunny
We will not go swimming

3. Hypothetical syllogism Rule:

$p \rightarrow q$
$q \rightarrow r$
$\therefore p \rightarrow r$

Example:
If Ram is an engineering student then he loves programming.
If Ram loves programming then he is an expert in java.
If Ram is an Er. then he is an expert in java.

4. Disjunctive syllogism Rule

$p \vee q$
$\neg p$
$\therefore q$

Ex:
Today is wednesday or Thursday.
Today is not wednesday
Today is Thursday.

5. Addition Rule

$$\frac{p}{\therefore p \vee q}$$

Ex:

Ram is an student of engineering

Ram is a student of Er. or BCA.

6. Simplification Rule.

$$\frac{p \wedge q}{\therefore p \text{ or } q}$$

Ex:

Ram and Shyam are the sts. of BE

Ram is sts. of BE

7. Conjuction rule:

$$\frac{\begin{matrix} p \\ q \end{matrix}}{\therefore p \wedge q}$$

Ex:

Ram is sts of BE

Shyam " " " "

Ram & shyam are sts of BE.

8. Resolution rule

$$\frac{\begin{matrix} p \vee q \\ p \vee r \end{matrix}}{\therefore q \vee r}$$

Ex: Today is Wednesday or Thursday.

Today is Wed or Friday

Today is Thursday or Friday.

Q. Hari is playing in garden. If he is playing in garden then he is not doing homework. If he is not ~~play~~ doing his hw then he'sn't learning. Leads to the conclusion 'He is not learning'.

Sol^n

p = Hari is playing in garden.
q: He is ~~not~~ doing homework
(Statement positive lekne)
r = He is learning

Hypothesis

a. p
b. $p \to \neg q$
c. $\neg q \to \neg r$

Conclusion: $\neg r$

Steps	Operations	Reason
1.	p	Given hypothesis
2.	$p \to \neg q$	" "
3.	$\neg q$	Using modus ponens on 1 & 2
4	$\neg q \to \neg r$	Given hypothesis
5	$\neg r$	Using modus ponens on 3 & 4

Q. 'If you send me an email then I will finish writing the program.' If you donot send me an email msg then I will go to sleep early. And If I go to sleep early then I will wake up feeling refreshed. Leads to the conclusion If I donot finish writing the program then I will wake up feeling refreshed.

sol:

p = Send me an email
q = I will finish writing the program
r = I will go to sleep early
s = I will wake up feeling refreshed.

Hypothesis

a. $p \longrightarrow q$
b. $\neg p \longrightarrow r$
c. $r \longrightarrow s$
d.

Conclusion:

$\neg q \longrightarrow s$

Steps	Operation	Reason
1.	$p \rightarrow q$	Given hypothesis
2.	$\neg q \rightarrow \neg p$	Using Contrapositive in ①
3.	$\neg p \rightarrow r$	Given hypothesis
4.	$\neg q \rightarrow r$	Using hypothetical syllogism rule.
5.	$r \rightarrow s$	Given hypothesis
6.	$\neg q \rightarrow s$	Using hypothetical syllogism rule.

Q. It is not sunny this afternoon & it is colder then yesterday. We will go swimming only if it is sunny. If we donot go swimming then we take hiking trip. And if we take a hiking trip then we will be home by sunset leads to the conclusion we will be home by sunset

Soln

Let,

$p \rightarrow$ It is sunny

$q \rightarrow$

Predicate logic: (FOPL)

⇒ Predicate is a parent of declarative sentences describing the properties of a object or relation among object.

⇒ For example:-

"Is a student" is a predicate of "A is a student" and "B is a student".

⇒ A predicate logic is a formal system that uses objects /variable and quantifiers ($\forall x, \exists x$) to formulate proposition.

Quantification:

⇒ A quantifier is a symbol that permits one to declare the range or scope of variables in a logical expression.

⇒ The process of binding propositional variable over a given domain is called quantification.

⇒ Two common quantifiers are the:

i) existential quantifier
("there exists or for some or at least one")

ii) Universal quantifier
("for all or for each or for any or for every or for arbitary").

i) Existential quantifier [$\exists$: for some]

- It is denoted by '$\exists$' & used for existential quantification.

- The existential quantification of $p(x)$ is denoted by $\exists x\, p(x)$ is proposition that is true for some values in universal set.

- The existential quantifier is read as:
(a) There is an 'x', such that $p(x)$
(b) There is atleast one x such that $p(x)$.
(c) For some x, $p(x)$

ii) Universal quantifier ($\forall$: for all) :-

- It is denoted by '$\forall$' and is used for universal quantification.

- The universal quantification of $p(x)$ denoted by $\forall x\, p(x)$ is proposition that is true for some values in universal set.

- The universal quantifier is read as:
  a) for all x, $p(x)$ holds.
  b) for each x, $p(x)$ holds.
  c) for each x, $p(x)$ holds.

example: $p(x)$ denotes "x is a developer".
$q(x)$ denotes "x owns macbook".

1) All developer owns macbook.
meaning: for all x, if x is developer then x owns macbook.

$$\forall x\, [p(x) \rightarrow q(x)]$$

2) Some developer owns macbook.
meaning: for some x, x is a developer and x owns macbook.

$$\exists x\, [p(x) \wedge q(x)]$$

3) All owners of macbook are developer
meaning: If x is the owner of macbook then x is a developer.

$$\forall x\, [q(x) \rightarrow p(x)]$$

pompeian = human race

4) Someone who owns a macbook is a developer.
meaning: for some x who owns a macbook and x is a developer.

$\exists x\,[q(x) \wedge p(x)]$

Q. Convert into predicate logic:

1. All men are people:
$\forall x\,[men(x) \longrightarrow people(x)]$

2. Marcus was pompeian

$\forall x$

⇒ pompeian (marcus)

3. All pompeian were roman

⇒ $\forall x\,[pompeian(x) \rightarrow roman(x)]$

4. Ram tries to assasinate hari.

⇒ Assasinate (Ram, hari) $\forall x$

5. All Roman were either loyal to Caesar or hated hi

⇒ $\forall x\,[roman(x) \rightarrow loyal(x, caesar) \vee hated(x, caesar)]$

6. Socrates is a man. All man are mortal therefore socrates is mortal.

⇒ $\forall x\,[man(x) \rightarrow mortal(x), mortal(socrates)]$

7) Some student in this class has study biology.

⇒ $\exists x\,[S(x) \wedge M(x)]$

$S(x)$: x is student in class

$M(x)$: x has std biology.

Rules of Inference for Quantified Statements:

a) Universal Instantiation

$$\frac{\forall x\, p(x)}{\therefore p(d)}$$

where, d is domain of discourse D.

For ex:

If all balls in a box are red then any randomly drawn ball is also red.

b) Universal Generalization

$$\frac{p(d)}{\therefore \forall x\, p(x)}$$

where, d = domain of discourse D.

For ex:-

If ball in a box are taken one by one in random manner and if all are red the we conclude all balls in box are red.

c) Existential Instantiation

$$\exists x\, p(x)$$
$$\therefore p(d)$$

For some d in domain of discourse.

For eg:-
If some balls in a box are red then resulting ball after experiment will also be red.

d) Existential Generalization:

$$\frac{p(d)}{\therefore \exists x\, p(x)}$$

For some d in domain of discourse.
For eg:-
If we take only one random experiment for the ball drawn and apply the result of ball to the domain.

Question Given Expression "all men are mortal". Einstein is a man. Prove that Einstein is mortal using resolution or predicate logic (FOPL)

⇒ Let $M(x)$:- "x is a man".
$N(x)$:- "x is a mortal".
Hypothesis:

$$\forall x [M(x) \rightarrow N(x)],\ M(\text{Einstein})$$

Conclusion:- N (Einstein.

steps	Operations	Reasons
1	$\forall x[M(x) \rightarrow N(x)]$	Given hypothesis
2	$M(\text{einstein}) \rightarrow N(\text{einstein})$	from (1) Universal Instantiation
3	$M(\text{einstein})$	Given hypothesis
4	$N(\text{einstein})$	from (2) & (3) modus ponens

Q. Consider the following facts & convert to appropriate logic:

1) Lucy is a professor.

⇒ $Professor(Lucy)$

2) All professor are people.

⇒ $\forall x\, [Professor(x) \longrightarrow people(x)]$

3) John is a dean

⇒ $dean(John)$

4) All Deans are Professors.

⇒ $\forall x\, [Deans(x) \rightarrow Professors]$

5) All professor consider the dean a friend or don't know him.

⇒ $\forall x (\forall y\, (Professional(x) \wedge dean(y) \rightarrow friend(y,x) \vee \neg know(x,y))$

6) Everyone is friend of someone

⇒ $\forall x\, (\exists y\, (friend(y,x))$

7) People only criticize ppl that are not there friend

⇒ $\forall x (\forall y\, (People(y) \wedge people(y) \wedge criticize(x,y) \rightarrow \neg friend(y,x))$

8) Lucy criticize John

⇒ $Criticize(Lucy, John)$.

Q. Assume the following facts.

i) Messi is a footballer
Messi plays for Barcelona
Barcelona is an A-division spanish club.
All, A-division spanish club plays laliga.

⇒ i) Footballer (Messi)
ii) Plays (Messi, Barcelona)
iii) Spanishclub (Barcelona)
iv) $\forall x$ (Spanishclub(x) $\rightarrow$ plays laliga(x))

Conclusion: plays laliga (Messi)

Let, hypothesis:
v) $\forall x \forall y$ [spanishclub(x) $\wedge$ play(y, x) $\rightarrow$ playslaliga(y)]

Steps	Operation	Reasons
1.	$\forall x$ (Spanish(x) $\rightarrow$ playslaliga(x))	Given hypothesis
2.	Spanishclub (Barcelona) $\rightarrow$ playslaliga (Barca)	using universal instantiation on (i)
3.	$\forall x \forall y$ [spanish club(x) $\wedge$ plays(y, x) $\rightarrow$ plays laliga (y)]	Given hypothesis
4.	Spanish club (Barca) $\wedge$ plays (Messi, Barca) $\rightarrow$ plays laliga (Messi)	Universal instantiation
5.	Spanishclub (Barcelona)	
6	plays (Messi, Barcelona)	Given
7.	Spanishclub (Barca) $\wedge$ plays (mess, Barca)	"
8.	plays laliga (messi)	Conjunction on 5 & 6
		modus ponens on 4 & 7

Resolution in propositional logic:

→ Resolution principle was introduced by John Alan Robinson in 1965.

→ The resolution technique can be applied in sentences in propositional logic and predicate logic.

→ Resolution technique can be used only for disjunction of literals to derive new conclusion.

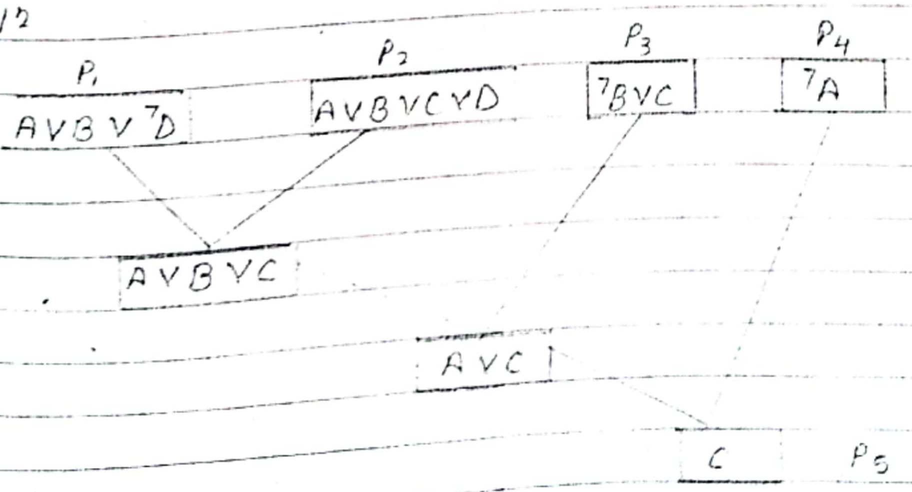
→ The resolution rule for the propositional calculus can be stated as

$(P \vee Q)$ and $(\neg P \vee R)$ gives $(Q \vee R)$

→ Resolution Refuation will terminate with the empty clause if it is logically equivalent.

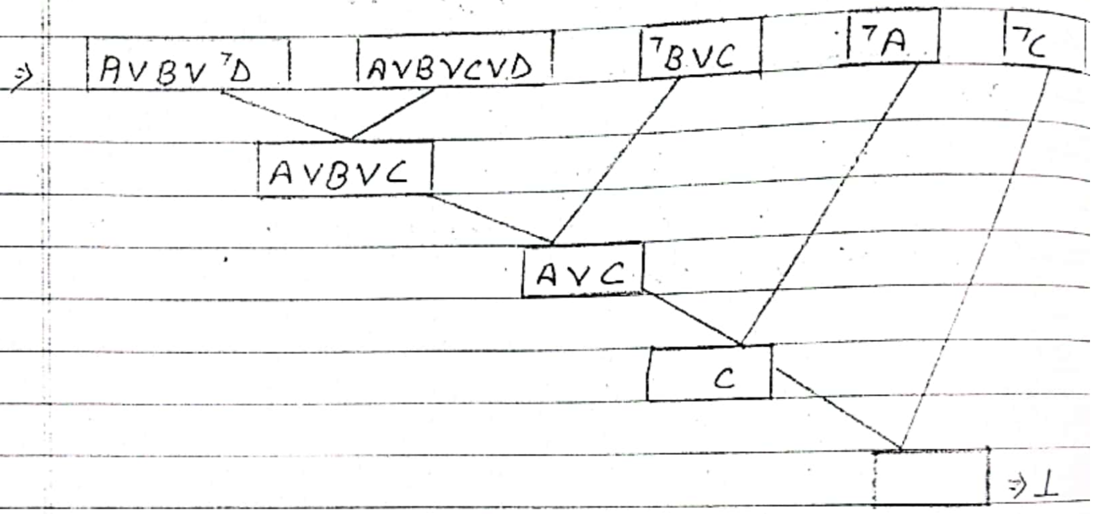
Q. Let $P_1 = A \vee B \vee \neg D$, $P_2 = A \vee B \vee C \vee D$, $P_3 = \neg B \vee C$, $P_4 = \neg A$, $P_5 = C$ then show that $\{P_1, P_2, P_3, P_4, \neg P_9\} \vdash = P_5$

Soln



Resolution Refuation

Qn: $P_1 = A \vee B \vee \neg D$, $P_2 = A \vee B \vee C \vee D$, $P_3 = \neg B \vee C$, $P_4 = \neg A$, $P_5 = C$
show that $\{P_1, P_2, P_3, P_4, P_5\} \models \perp$ (null)



Imp
Conjunctive Normal Form (CNF)
⇒ A sentence that is expressed as a conjunction of disjunction of literals is said to be conjunctive normal form.

⇒ Conversion procedure for CNF:
We illustrate the following by converting the sentence

$$\overset{\alpha}{B} \longleftrightarrow \overset{\beta}{(P \vee Q)}$$

into CNF.

The steps are:

Step 1: Eliminate $\longleftrightarrow$, replacing $\alpha \longleftrightarrow$ with
$(\alpha \longrightarrow \beta) \wedge (\beta \alpha \alpha)$

eg:- $[B \rightarrow (P \vee Q)] \wedge [(P \vee Q) \longrightarrow B]$

Step 2:

Eliminate $\rightarrow$ replacing $\alpha \rightarrow \beta$ with $\neg\alpha \vee \beta$

eg:- $(\neg B \vee P \vee Q) \wedge (\neg(P \vee Q) \vee B)$

Step 3:-
CNF requires '$\neg$' to appear only in literals, so we move '$\neg$' inwards by repeated applications of the following equivalence.

$\rightarrow$ $\neg(\neg\alpha) \equiv \alpha$ (double negation elimination)
$\rightarrow$ $\neg(\alpha \wedge \beta) \equiv (\neg\alpha \vee \neg\beta)$ (De morgan)
$\rightarrow$ $\neg(\alpha \vee \beta) \equiv (\neg\alpha \wedge \neg\beta)$ (De morgan)

Ex:-
In above eg, we require just one application of last rule.

$(\neg B \vee P \vee Q) \wedge ((\neg P \wedge \neg Q) \vee B)$

Step 4:
Now we have a sentence combining nested $\wedge$ & $\vee$ operators applied to literals

We apply a distributive law distributing $\vee$ over $\wedge$ whenever possible
i.e. $(\alpha \vee (\beta \wedge \gamma)) \equiv ((\alpha \vee \beta) \wedge (\alpha \vee \gamma))$ distribute $\vee$ over $\wedge$

For example: $(\neg B \vee P \vee Q) \wedge (\neg P \vee B) \wedge (\neg Q \vee B)$
The original sentence is now in CNF, as a conjunction of three clauses.

Example:

Given expression:

John likes all kinds of food. Apples are food. Chicken is food. Prove that John likes peanuts using the resolution.

=>

(i) $\forall x\, [Food(x) \longrightarrow likes(John, x)]$

(ii) Food (apples)

(iii) Food (Chicken)

To prove:

Likes (John, peanuts)

Using resolution (proof by contradiction)

negation of prove:

$\neg$ Likes (John, Peanuts)

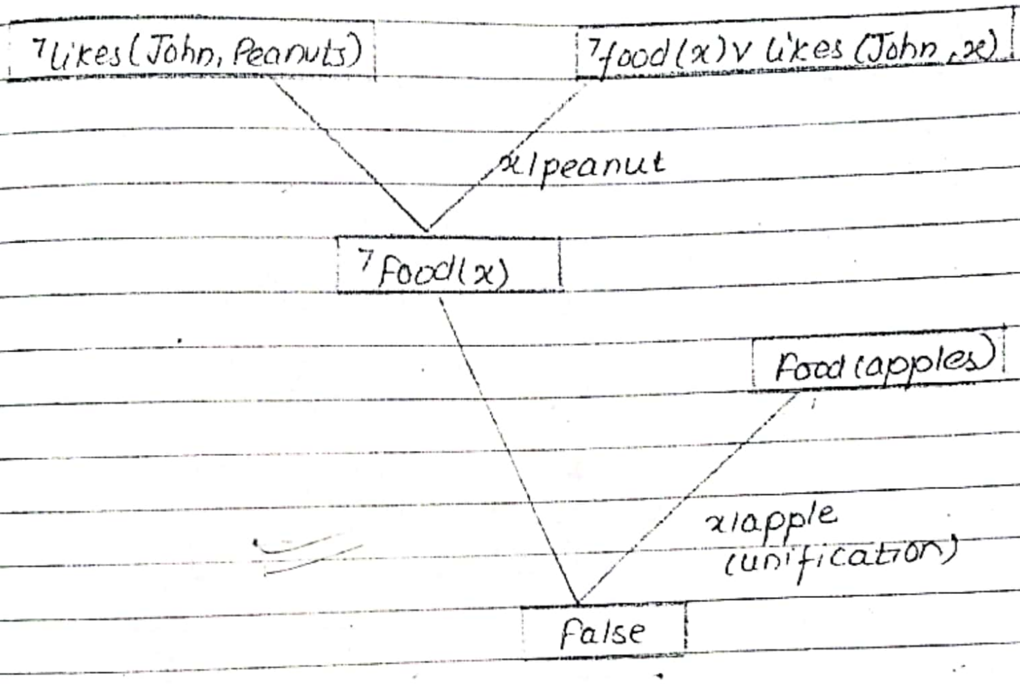
using 2nd step, from CNF conversion

$\neg food(x) \vee likes(John, x)$

Food (apples)

Food (chicken)

Now,



⇒ ¬Likes (John, Peanuts) is not possible hence Like (John, peanut) is proved.

Given expression:

Q. Akbar is a physician. All physician know surgery prove that akbar knows surgery using the principal of resolution.

Here,

FOPL:

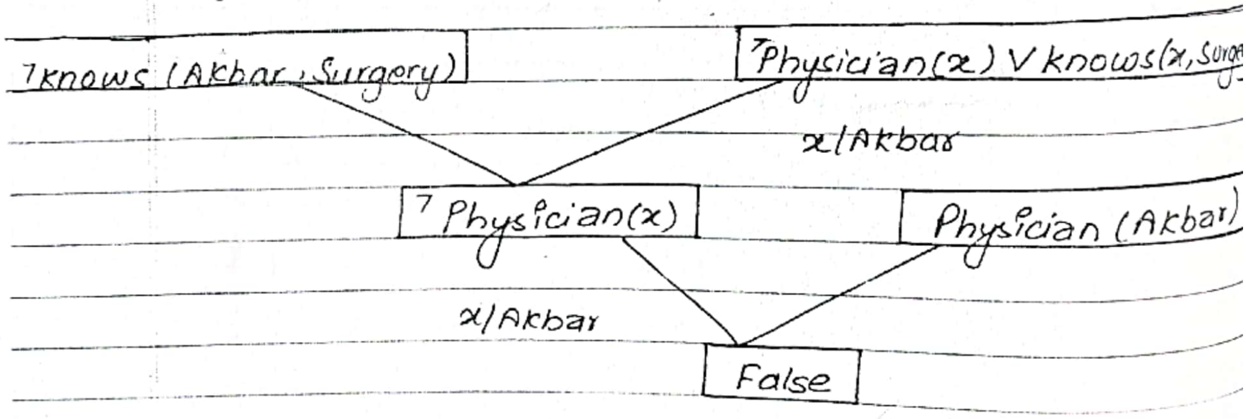
1. Physician (Akbar)
2. $\forall x$ Physician $(x) \rightarrow$ knows $(x, \text{surgery})$

or

$\neg$Physician(x) $\vee$ knows $(x, \text{surgery})$

Prove: knows (Akbar, Surgery)

Negation: $\boxed{\neg\text{knows (Akbar, Surgery)}}$



Represent the following statement using predicate logic:

1) Mary loves everyone
⇒ $\forall x$ love (Mary, x)

$\forall x$ love(My, x)

[illegible]

2) Everyone love himself
⇒ $\forall x$ love (x, x)

[illegible]

3) Every student smiles.
⇒ $\forall x$ (student (x) $\rightarrow$ smile (x))

4) Someone loves everyone
$\exists x \; \forall y \; love(x,y)$ // There is some person x and there is someone whom x loves

5) Every student who loves marry is happy.
$\Rightarrow \forall x \; ((student(x) \land loves(x, Mary) \rightarrow happy(x))$

6) Mary loves everyone except John.
$\Rightarrow \forall x \; (\neg x = John \longrightarrow love(Mary, x)$ or
$\forall x \; (x \neq John \longrightarrow love(Mary, x))$

7) Every boy who loves marry hates every boy who mary loves

$\Rightarrow \forall x \; ((boy(x) \land love(x, Mary)) \longrightarrow \forall y \; ((boy(y) \land love(Mary, y) \longrightarrow hate(x,y))$

Baye's Theorem

$\Rightarrow$ It is a simple formula that is used to calculate conditional probability.

$\Rightarrow$ For example:
Your probability of getting a parking space is connected to the time of day, where you park and what convientions are going on at that time.

$\Rightarrow$ Mathematically,

$$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$$

where, A & B are events & $P(B) \neq 0$

$P(A/B)$ is conditional probability i.e. event A occuring given that B is true.

Q. In a clinic 10% of patients are prescribed pain killers. Overall 5% of clinic patient are addicted to pain killers. Out of all people prescribe pain pills 8% are addict. If a patient is an addict what is the probability that they will be prescribe pain pills.

Here,

P(prescribed) = 10%

P(addict) = 5%

P(addict / Prescribed) = 8%

Now,

$\therefore P(\text{prescribed} / \text{Addict}) = \dfrac{P(\text{Addict} / \text{Prescribed}) \cdot P(\text{prescribed})}{P(\text{Addict})}$

$= \dfrac{0.08 \times 0.10}{0.05}$

$= 0.16$

The probability of event A given that event B has subsequently occured is

$$P(A/B) = \frac{P(A) \cdot P(B)}{[P(A) \cdot P(B/A)] + [P(\bar{A})\, P(B/\bar{A})]}$$

Q. In red country, 51% of the adults are male. One adult is randomly selected for the survey involving credit card uses.

a) Find the prior probability that the selected person is male.

b) It is ~~latter~~ later learned that the selected survey subject was smoking a cigar. Also, 9.5% of males smoke cigars whereas 1.7% of females smoke cigar.

Use this additional information to find the probability that the selected subject is male.

⇒ Prior probability
It is an initial probability value obtain before any additional information is obtained.

a) Probability of male, $P(M) = 51\%$
$= 0.51$

b) $P(M) = 0.51$
$P(\bar{M}) = 0.49$
$P(C/M) = 0.095$
$P(C/\bar{M}) = 0.017$
$\boxed{P(M/C)} = ?$

$$P(M|C) = \frac{P(M) \cdot P(C|M)}{[P(M) \cdot P(C|M)] + [P(\bar{M}) \cdot P(C|\bar{M})]}$$

$$= \frac{0.51 * 0.017}{[0.51 * 0.095] + [0.49 * 0.017]}$$

$$= 0.853.$$

$$= 85\%$$

Semantics Net :

⇒ It is an object based knowledge representation.

⇒ It is study of meaning.

⇒ Semantic Networks can:

1) Show natural relationship betn object & concept
2) Be used to represent declarative / Descriptive knowledge.
3) Sematic network is the graphical representation of the knowledge.
They are constructed using nodes linked by directional lines called arcs.

⇒ A node can represent a fact description
- physical object
- concept
- event

⇒ An arc represent relationship between nodes. Some of them are:

-is a relationship.
-has a relationship.

Advantage

1) It is easy to understand.

2) Quick inference possible.

3) Supports default reasoning infinite time.

4) Focus on bigger units of knowledge.

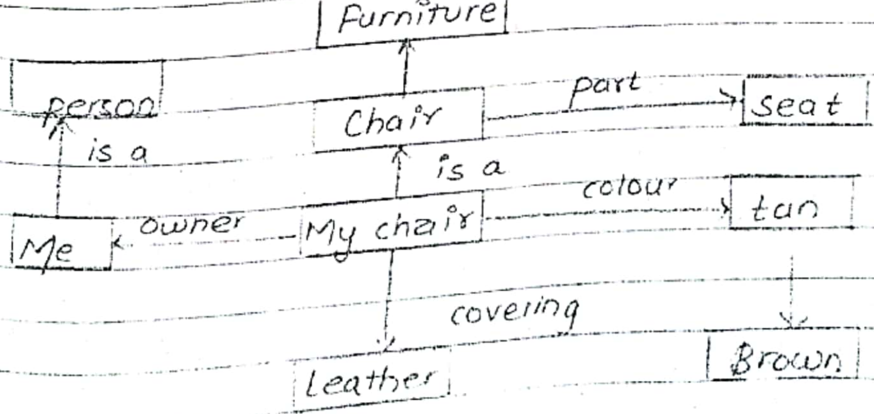
Disadvantages

1) May be incomplete.

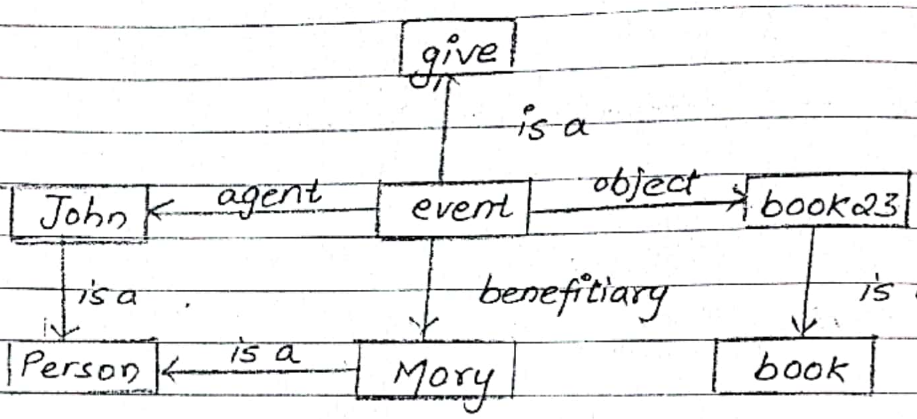
2) Lack of standard to describe object or event.

3) Doesnot represent time or sequence.

Example of semantic Network:
A. State : I own a tan leather chair.



B. Event : John gives the books to mary.



C. Complex event: Bilbo finds the magic ring in Gollum's cave.

frame:

⇒ A frame is a data structure containing typical knowledge about a concept or object.

⇒ A frame represent knowledge about real world things or entities.

⇒ Each frame has a name and slots.

- Slots are the properties of the entity that has the name and they have values or pointer to other frames.

- A particular value may be:
  i) A default value
  ii) An inherited value from a higher frame
  iii) A procedure called daemon to find a value
  iv) A specific value which might represent an exception.

Advantages

1) knowledge domain can be naturally structured (Object Oriented Approach)

2) Easy to include the idea of default values and to detect machine values

Disadvantage

1) Complex

2) Reasoninig is difficult.

3) Explanation is difficult or expressive limitation

Example of frame:

William James	
Class	Human
Location	Home
Occupation	Officer

Human	
class	mammal
Location	earth
Walks on	legs

Fig:- Two frames describing a human being.

Q Write short notes :

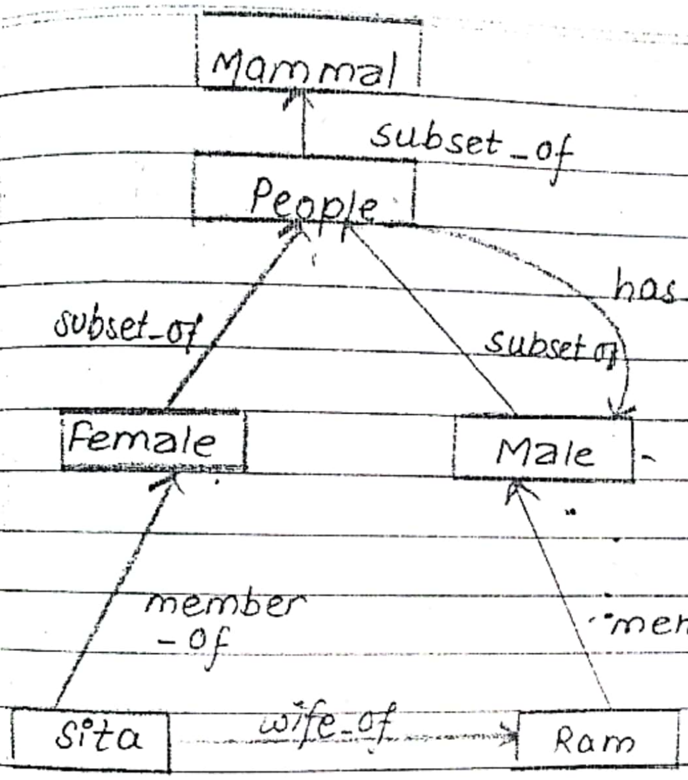
a) CNF

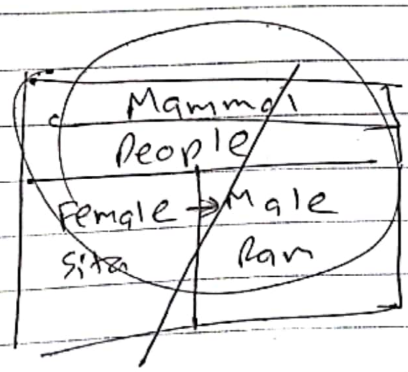
b) FOPL

c) Semantic Net & Frames

Q Diff betn Semantic Network and frame. Draw semantic Network of following clauses.

subset_of (people, mammal), subset_of (male, ppl),
subset_of (female, people),
~~su~~ has_father (people, male),
member_of (Ram, male),
member_of (sita, female),
wife_of (sita, ram)


Mammal
subset_of
People
has_a father
subset_of
subset_of
Female
Male
member
-of
member_of
Sita
wife_of
Ram


Mammal
People
Female
Male
Sita
Ram

KNN algorithm pani hooni