Assignment No :- 2

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Sem :- VII

Sub :- IS Lab

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Q.1 Solve the following with forward chaining or backward chaining or resolution (any one) use predicate logic as language of knowledge representation clearly specify the facts and inference rule used.

Q.1 Example I.

1) Every child sees some with No witch has both a black cat & a pointed hat.
2) Every witch is good or bad
3) Every child who sees any good witch gets candy.
4) Every witch that is bad has a black cat.
5) Every witch that is seen by any child has a pointed hat.
6) Prove : Every child gets candy.

→

A) Facts into FOL

1) $\exists x \forall y$ (child (x), witch (y) → sees (x, y))
$\sim \exists y$ (witch (y) → has $(y$, black cat$)$ ∧ has $(y$, pointed hat$)$)

2) $\exists y$ (witch (y) → good (y) ∨ bad (y))

3) $\forall x$ ((see (x, y) → (witch (y) → good (y))) →

4) $\forall y$ ((witch (y) → bad (y)) → has $(y$ → black$)$ hat)

5) $\forall y$ (see (x, y) → has $(y$, pointed hat$)$)

B) FOL into CNF

1) $\exists x \forall y$ (child (x), witch (y) → sees (x, y))
→ $\sim \exists y$ (witch (y) → has $(y$, black hat$)$
→ $\sim \exists y$ (witch (y) → has $(y$, pointed hat$)$

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2) ∀y (witch (y) → good (y))

∀y (witch (y) → bad (y))

3) ∃x [(sees (x,y) → witch(y) → good (y) → gets (x, candy)]

⇒ ∃x [(sees (x, good (y)) → gets (x, candy)]

4) ∃y [bad (y) → has (y, black hats)]

5) ∃y [seen (x,y) → has (y, pointed hat)]

⇒ ~∀y (seen (x,y) → has (y, black hat)]

c) sees (x,y)

witch(y) ∨ sees (x,y)

{good ∨ bad/y}

~ seen(x, (good) ∧ sees (x, bad))

has (y, z)

{y/good ∨ bad}

{z/black cat ∨ pointed hat}

seen (x, good) ∨ seen (x, bad)

has (good, pointed hats ∨ get (x, candy))

seen (x, good) ∨ has (good, pointed hat) ∨ gets (x, candy)

seen (x, good) ∨ gets (x, candy)

gets (x, candy)

gets (x, candy).

2) Example 2:

1) Every boy or girl is a child

2) Every child gets a doll or a train or lump of a coal

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3) No boy gets any doll
4) Every child who is bad gets any lump of coal.
5) No child gets a train
6) Ram get lump of coal
7) Prove Ram is bad.

→ 1) ∀ x (boy(x) or girl(x) → child (x))
2) ∀y (child (y) → gets (y, doll) or gets (y, train) or gets (y, coal))
3) ∀ w (boy (w) → ! gets (w, doll))
4) For all z (child (z) and bad (z)) → gets (z, coal)] ∀ y child (y) → ! gets
5) Child (ram) → gets (ram, coal)
To Prove (child (ram) → bad (ram))

CNF clauses
1) ! boy (x) or child (x)
! girl (x) or child (x)
2) ! child (y) or gets (y, doll) or gets (y, train) or gets (y, coal)
3) ! boy (w) or ! gets (w, doll)
4) ! child (z) or ! bad (z) or gets (z, coal)
5) ! child (ram) → gets (ram, coal)
6) bad (ram)

Resolution

4) ! child (z) or ! bad (z) or get (z, coal)

6) bad (ram)

7) ! child or gets (ram, coal)

substituting z by ram

2) (a) ! boy (x) or chid (x)

boy (ram)

8) child ram

7) ! child (ram)

8) child (ram)

9) gets (ram, coal)

2) ! child (y) or gets (y, doll)

8) child (ram)

10) gets (ram, doll)

9) gets (ram, coal)

10) gets (ram, doll)

11) gets (ram, doll) or gets (ram, coal)

3) ! boy (w)

5) boy (ram)

12) ! get (ram, doll)

11) get (ram, doll) or gets (ram, train)

12) ! gets (ram, doll)

13) gets (ram, coal)

6) (a) get (ram, coal)

gets (ram, coal)

Hence, bad (ram) is Proved

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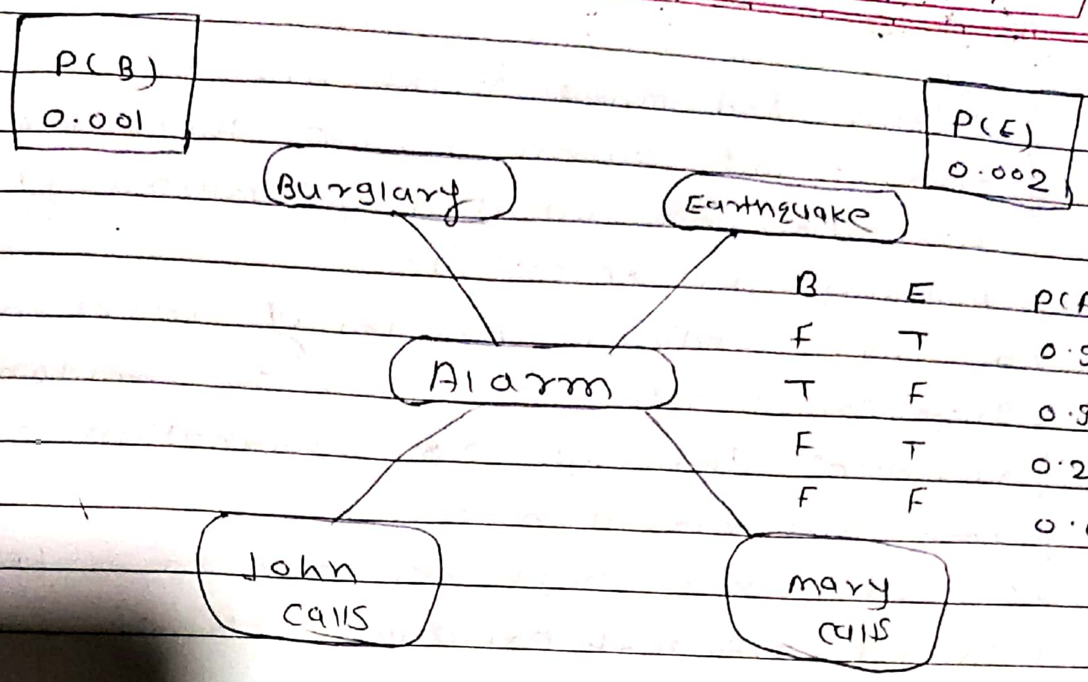
Q.2 Differentiate between STRIPS and ADL

	STRIPS language	ADL
1)	Only allow positive literals in the states. For eg: A valid sentence is STRIPS is expressed as ⇒ Intelligent ∧ Beautiful	Can support both positive & negative literals. For eg :- same sentance is expressed as ⇒ stupid ∧ ¬ugly
2)	STRIPS stand for Standard Research Institute Problem Solver.	Stand for Action Description Language.
3)	Makes use of closed world assumption un mentioned literals are false	Makes use of open world Assumption unmentioned literals are unknown
4	We only can find ground literals in goals for e.g. Intelligent ∧ Beautiful	We can find qualfied variables in goal for eg :- $\exists x\, At(P_1, x) \wedge At(P_2, x)$ is the goal of having P_1 & P_2 in the same place in e.g of blocks.

5	Goals are conjunctions for e.g. (Intelligent ∧ beautiful)	Goals may involve conjunctions & disjunctions for e.g. (Intelligent ∧ (Beautiful ∧ Rich))
6	Effects are conjunctions	conditional effects are allowed i.e. when P:E means E is an effect only if P is satisfied

Q.4 You have two neighbors J and M, who have promised to call you at work when they hear the alarm. J always calls when he hears the alarm, but sometimes confused telephone ringing with alarms & calls then too. M likes loud music loud music and sometimes misses the alarm together. Given the evidence of who has or has not called, we would like to estimate the probability of burglary. Draw a Bayesian network for this domain with suitable probability table.

1] The topology of the network indicates that burglary and earthquake affect the probability of the alarms going off.



B	E	P(A)
F	T	0.95
T	F	0.94
F	T	0.29
F	F	0.001

A	P(T)
T	0.09
F	0.05

A	P(M)
T	0.70
F	0.01

- wheather John and mary call depends only on alarm
- They do not perceive any burglaries directly they do not notice minor earthquakes and they do not confer before calling
- mary listening to loud music & John confusing Phone ringing to sound of alarm can be read from network only implicitly of uncertainty associated to calling at work.
- The Probability actually summarize Potentially infinite set of circumstances.
- The alarm might fail to go off due to high humidity, Power failure, dead battery, cut wires, a dead mouse stuck inside the bell etc.

• John and mary might fail to call and report and alarm because they are out to lunch on vacation, temporarity deaf passing helicopter etc.

4. The condition probability tables in n/w gives probability for values of random variables depending on combination of values for the parent node.

5. Each row must be sum to 1 because entires represent exhastive set of cases for variable.

6. All variables are boolean

7. In general, a table for a Boolean variable with k parent contains 2^k independently specific probabilities

8. A variable with no parents has only one row, representing prior probabilities of each possible value of the variable.

9. Every entry in full joint probability distribution can be calculated from information in Bayessian Network.

10. A generic entry in joint distribution is probability of a conjunction of particular assigments to each variable $P(x_1 = x_1 \wedge \ldots \wedge \ldots x_n = x_n)$ abbreviated as $P(x_1, \ldots, x_n)$

11. The value of this entry is P(x1 ... xn) = $\prod_{i=1}^{n}$ P(xi | Parents (xi)).

• P(j ∧ m ∧ a ∧ ~b ∧ ~e)
= P(j | a) P(m | a) P(a | ~b ∧ ~e) P(~b) P(~e)
= 0.0.9 × 0.07 × 0.001 × 0.999 × 0.998
= 0.000628

12. Bayesian Network