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ASSIGNMENT NO. - 02

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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 & inference rule used.

Q.1. Example 1 :

1) Every child sees some witch 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 seen by any child has a pointed hat.
5) Every witch that is bad has a black cat.
6) Prove : every child gets candy

→ A) facts into fol.

1) ∃XAY (child (x) , witch (Y) → sees (x, Y))
 ∼∃Y (witch (Y) → has (Y, black cat) ∧ has (Y. pointed hat)
2) ∃Y (witch (y) → good (y) ∨ bad (y))
3) ∈x((sees (X, Y) → (witch (Y) → good (y)) → get (X, Candy)
4) ∈y ((witch (y) → bad (y)) → has (y → black hat))
5) ∈y (sees (x, y) → has (y, pointed hat)

B) FOL in CNF

1) ∃ xAy (child (x), witch (y) → sees (x, y))
 → ∼ ∃y, (witch (y) → has (Y, black hat)
 → ∼∃Y (witch (y) → has (y, pointed hat)
2) ∀y (witch (y) → good (y))
 ∀y (witch (y) → bad (y))
3) Ex [[sees (x, y) → witch (y) → good (y)] → gets (x, candy)
 → Ex [[sees (y) (x, good (y) → gets (x, candy)]

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4) $Ey[bad(y) \rightarrow has(y, black\ hats)]$
5) $Ey[seen(x, y) \rightarrow has(y, pointed\ hat)]$
→ $\sim\forall Y[seen(x, y) \rightarrow has(y, black\ hat)]$

c) sees (x, y) | witch(y) V sees(x, y) {good V bad/y}

~seen(x, (good)) ∩ sees(x, bad) | has(y, z) {y/good V bad} {z/black cat V pointed hat}

Seen(x, good) V seen(x, bad) | has(good, pointed hat V get (x, candy))

Seen(x, good) V has(good, pointed hat) V gets(x, candy) | seen(x, good) V 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 a lump of a coal.
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 gets lump of coal
7) Prove Ram is bad.

→ 1) $\forall x(boy(x)\ or\ girl(x) \rightarrow child(x))$
2) $\forall y(child(y) \rightarrow gets(y, doll)\ or\ gets(y, train)\ or\ gets(y, coal))$

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3) ∀ w(boy (w) → ! gets (w, doll)
4) for all z(child (z) and bad(z)) → gets (z, coal)) ∀ child(y)
→ ! gets (y, train)
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 (ram) or gets (ram, coal)
substituting z by ram
1) (a) ! boy (x) or child (x)
boy (ram)
8) child ram (substituting x by ram)
7) ! child (ram) or gets (ram, coal)
8) child (ram)
9) gets (ram, coal)
2) ! child (y) (or gets (y, doll or gets (y, train) or gets (y, coal)
8) child (ram)
10) gets (ram, doll) or gets (ram, train) or gets (ram, coal)
(substituting y by ram)
9) gets (ram, coal)

10) get(ram, doll) or gets (ram, train) or gets (ram, coal)
11) gets (ram, doll) ~~or gets (ram, train)~~ or gets (raam, coal)
3) ! boy (w) or ! gets (w, doll)
5) boy (ram)
12) ! get (ram, doll) (substituting w by ram)
11) gets (ram, doll) or gets (ram, train)
12) ! gets (ram, doll)
13) ! gets (ram, doll)
6) (a) get (ram, coal)
13) gets (ram, coal)
Hence, bad (ram) is proved.

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	1) Can support both positive & negative literals. For e.g. same sentence is expressed as ⇒ stupid ∧ ¬ ugly
2) STRIPS stand for Standard Research Institute Problem solver.	2) Stands for Action Description Language.
3) Makes use of closed world assumption (i.e) un mentioned literals are false	3) Makes use of open world Assumption (i.e) unmentioned literals are unknown.
4) We only can find ground literals in goals for eg. Intelligent ∧ Beautiful	4) We can find qualified variables in goal for eg. $\exists x\, At(P1\, x) \wedge At(P2, x)$ is the goal of having P_1 & P_2 in the same place in the example of blocks
5) Goals are conjunctions for eg: (Intelligent ∧ Beautiful)	5) Goals may involve conjuctions & disjunctions for eg:- (Intelligent ∧ (Beautiful ∧ Rich))

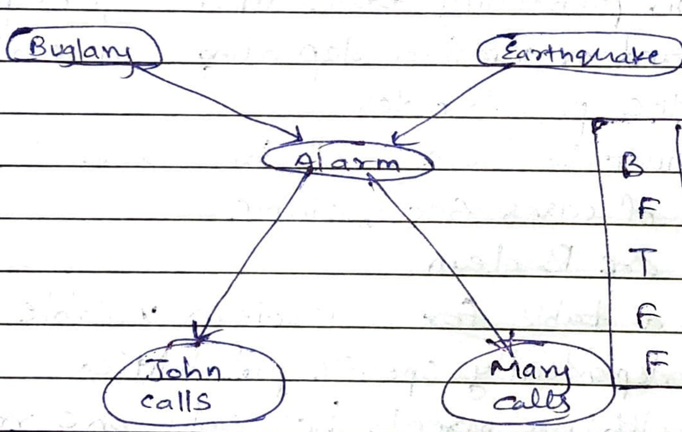
6) Effects are conjuction	6) Conditional effects are allowed when P, E means E is an effect only if P is satisfied.
7) Does not support equality	7) Equality predicate (x=y) is build in
8) Does not have support for types	8) Support for types for eg: The variable P: person.

Q.8. You have two neighbours J and M, who have promised to call you at work when they here the alarm. J always calls when he hears the alarm, but sometimes confused telephone ringing with alams & calls then too. M likes 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 burgary. Draw a Bayesian network for this domain with suitable probability table.

→

P(B)
0.001.

P(E)
0.002



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

A	P(J)
T	0.09
F	0.05

A	P(M)
T	0.70
F	0.01

① The topology of the network indicates that
- Burglary and earthquake affect the Probability of the

alarm going off.
- whether John and Mary call depends only on alarm.
- They do not perceive any burglaries directly they do not notice minor earthquake and they do not confer before calling.
2) Mary listening to aloud music & John confusing phone ringing to sound of alarm can be read from network only implicitly as uncertainly associated to calling at work.
3) The probability actually summerize potentially infinite sets of circumstances:
- The alarm might full to go off due to high humidity, power failur, dead battery, cut wires, a dead mouse stuck inside the bell, etc.
- John and mary might fail to call and report & alarm because they are out to lunch, an vacation, temporarily deaf, passing helicapter, etc.
4) The condition probability tables in n/w gives probability for values of random variables depending, on combination of values for the parent nodes.
5) Each row must be sum, to 1 because entries represent exhaution set of cases for variable.
6) All variables are Boolean.
7) In general, a table for a Boolean variable with k parents contain 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 conjuction of particular assignment to each variable
$P(x_1, \ldots, x_n)$

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11) The value of this entry is $P(x_1, \ldots, x_n) = \prod_{i=1}^{n} P(x_i \mid parents(X_i))$, where parents $s(x_i)$ denotes the specific values of the variable parents (X_i)

- $P(j \wedge m \wedge a \wedge \neg b \wedge \neg e)$

$= P(j \mid a)\, P(m \mid a)\, P(a \mid \neg b \wedge \neg e)\, P(\neg b)\, P(\neg e)$

$= 0.09 \times 0.07 \times 0.001 \times 0.999 \times 0.998$

$= 0.000628$

12) Bayesian network.