Assignment NO:2

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D.O.P	D.O.C.	Marks	Sign.

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.

A.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 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) ∃ X A Y (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)))

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4] Ǝ y ((witch (y) → bad (y)) → has (y → black hat)

5] Ǝ y (sees (x,y) → has (y, pointed hat)

B] Fol into CNF

1] Ǝ x ∀y (child (x), witch (y) → sees (x,y))
→ ~Ǝ y, (with (y) → has (y, black hat)
→ ~Ǝ y (witch (y) → has (y, pointed hat)

2] Ǝ y (witch (y) → good (y) V bad (y))
3] Ǝ x ((sees (x,y) → (witch (y) → good (y)] →
get (x, candy)

4] Ǝ y ((witch (y) → bad (y)] → has (y → black hat)
5] Ǝ y (sees (x,y) → has (y, pointed hat]

B> Fol into CNF

1] Ǝ x ∀y (chid (x), witch (y] → see (x,y]))
— ~Ǝ y, (witch (y) → has (y, black hat)
→ ~Ǝ y (witch (y) → has (y, pointed hat)

2] ∀y (witch (y) → good (y))
∀y (witch (y) → bad (y))

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

4) Ey[bad(y) → has (y, black hats)]

5] Ey [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}

~sees (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 a lump or coal
3) No boy gets any doll
4) Every child who is bad gets any lump or coal
5) No child gets a train
6) Ram gets 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 (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) !chid (z) or !bad (z) or gets (z, coa
5) ! chid (ram) → gets (Ram, coa)
6) bad (ram)

Resolution

4) !chid (z) or !bad (z) or get (z, coa)
6) bad (ram)
7) !chid (ram) or gets (ram, coal)
substituting z by ram

1) (a) !boy (x) or chid (x)
boy (ram)
2) chid & ram (substituting x by ram)
7) ! chid (ram) or gets (ram, coal)
8) chid (ram)
9) gets (ram, coal)

2) !chid (y) (or gets (y, doll) or gets
(y, train) or gets (y, coal)

2) child (ram)
10) gets (ram, doll) or gets (ram, train) or
gets (ram, coal)
(substituting y by ram)

9) gets (ram, coal)
10) gets (ram, doll) or gets (ram, train) or
gets (ram, coal)
11) gets (ram, doll) or gets (ram, coal)

3] !boy (w) or !gets (w, doll)

5] boy (ram)

12) !get (ram, doll) (substituting w by ram)

1) gets (ram, doll) or gets (ram, ram)
12) ! gets (ram, doll)
13) gets (ram, coal)
6] <a> get (ram, coal)
13) gets (ram, coal)
Hence, bad (ram) is proved.

Q.2] Differentiate between STRIPS and ADL

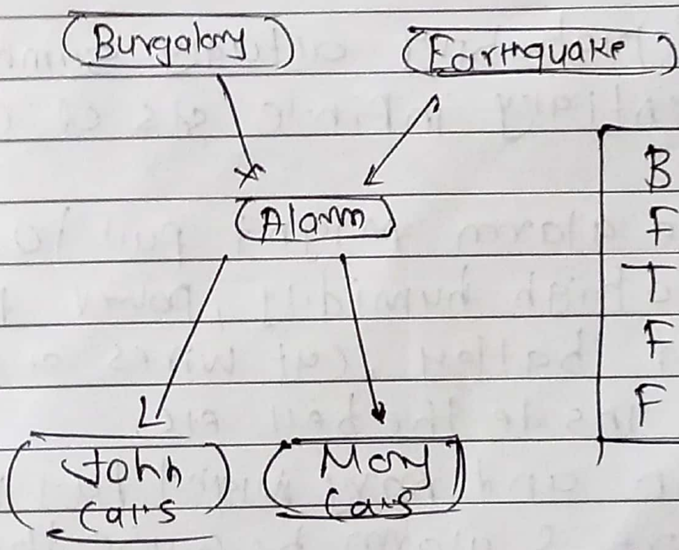
STRIPS language	ADL
1] only allow positive literals in the states for eg: A valid sentence is ~~strike~~ STRIPS is expressed as → Intelligent ∧ Beautiful	1] can support both positive & negative literals. for eg: same sentence is expressed as Stupid ∧ ¬ ugly
2] STRIPS stand for standard Research Institute problem Solver	2) stand for Action Description language

3) Makes use of closed world assumption (i.e) unmentioned 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 $\wedge$ 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 P1 & P2 in the same place in the example of blocks
5) Goals are conjunctions for eg: (Intelligent $\wedge$ Beautiful)	5) Goals may involve conjunctions & disjunctions. for eg: (Intelligent $\wedge$ (Beautiful $\wedge$ Rich))
6) Effects are conjunctions	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.4) You have two neighbours J and M, who have promised to can you at work when they hear the alarm. J always calls when he hears the alarm but sometimes confused telephone ringing with alarms & calls them 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 burglary. 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
- Burgalary and earthquake affect the probability of the alarm going off.

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- Whether john and Mary Call depends ony on alarm
- They do not percieve any burglares direcly they do not notice minor earthquakes and they do not confer before calling

2) Mary listening to loud music & john confusing phone ringing to sound of alarm can be read from network only implicity as uncertainty associated to calling at work.

3) The probability actually summarise potentially infinite sets 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 & alarm because they are out to lunch on vacation, temporary 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 nodes.

5] Each row must be sum to 1 because entries represent exhaustive set of cases for variable

6] All variables are Boolean

7] In general, a table for a Boolean variable with k parents 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 Bayesian network

10] A generic entry in joint distribution is probability of a conjunction of particular assignment to each variable $P(X_1 = x_1 \wedge \ldots \wedge X_n = x_n)$ abbreviated as $P(x_1, \ldots, x_n)$

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 (X_i) denotes the specific values of the variables parents (X_i)

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

$= P(j|a)\, P(m|a)\, P(a|\sim b \wedge \sim e)$
$P(\sim b)\, P(\sim e)$
$= 0.09 \times 0.07 \times 0.001 \times 0.999 \times 0.998$
$= 0.000628$

12] Bayesian Network.