Assignment 2

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Q1. 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.

Q1.) Example 1:

1) Every child sees some witch no which 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∀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))
4) ∈y ((witch(y) → bad(y)) → has(y → black hat))
5) ∈y (Sees(x, y) → has(y, pointed hat).

B) FOL into CNF

1) $\exists x \forall y\ (child(x), witch(y) \rightarrow Sees(x,y))$

$\rightarrow \sim\exists y,\ (witch(y) \rightarrow has(y, black\ hat)$

$\rightarrow \sim\exists y,\ (witch(y) \rightarrow has(y, pointed\ hat)$

2) $\forall y\ (witch(y) \rightarrow good(y))$

$\forall y\ (witch(y) \rightarrow bad(y))$

4) $\exists y\ [bad(y) \rightarrow has(y, black\ hats))]$

5) $\exists y\ [seen(x,y) \rightarrow has[y, pointed\ hat)]$

$\rightarrow \sim\forall y\ [seen(x,y) \rightarrow has(y, black\ hat)]$

C) $Sees(x,y)$

$witch(y) \vee Sees(x,y)$ $\{good \vee bad / y\}$

$\sim seen(x, (good) \wedge Sees(x, bad))$

$has(y,z)$ $\{y / good \vee bad\}$ $\{z / black\ cat \vee (pointed\ hat)\}$

$Seen(x, good) \vee seen(x, bad)$

$has(good, pointed\ hats \vee get(x,y)$

$Seen(x, good) \vee has(good, pointed\ hat) \vee gets(x, Candy)$

$seen(x, good) \vee gets(x, Candy)$

$gets(x, Candy)$

$gets(x, Candy)$

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 $gets(y, coal))$
3) $\forall w(boy(w) \rightarrow !gets(w, doll))$
4) for all z (child (z) and bad (z)) $\rightarrow$ gets(z, coal))
$\forall y$ child (y) $\rightarrow$! gets (y, train)
5) child (ram) $\rightarrow$ gets (ram, coal)
To Prove (child (ram) $\rightarrow$ bad (ram))

<u>CNF Clauses</u>

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)

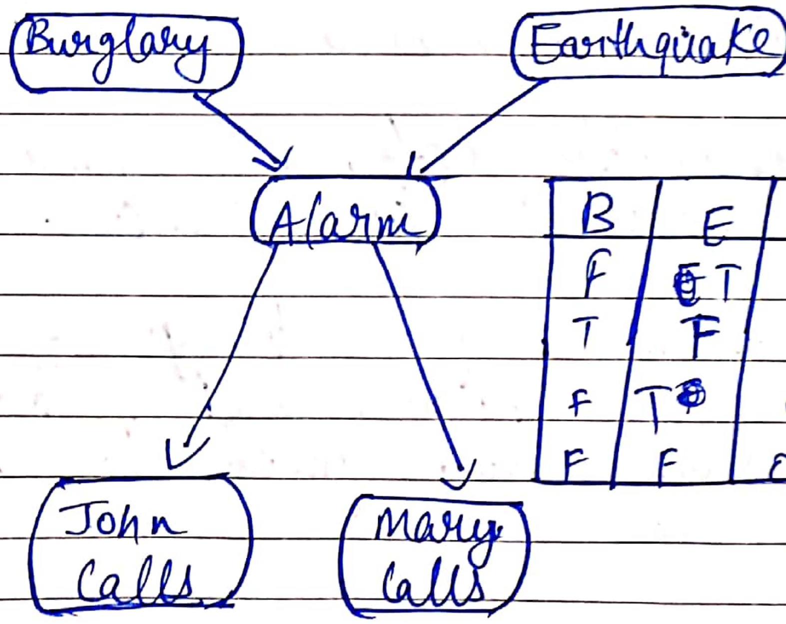
Q2. Differentiate b/w STRIPS and ADL

→

	STRIPS	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 and negative literals. For eg:- Same sentence is expressed as: ⇒ Stupid ∧ ugly
2	STRIPS stand for Standard Research Institute Problem Solver.	Stands for Action Description Language
3	Makes use of closed world assumption i.e. unmentioned literals are false	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	We can find qualified variables in goal. For eg:- $\exists x At(P1\ x) \wedge At(P_2, x)$ is the goal of having P_1 & P_2 in the same place.

5)	Goals are Conjunctions eg:- Intelligent ^ Beautiful	Goals may involve Conjunctions & disjunctions. Eg:- Intelligent ^ Beautiful ^ Rich.
6)	Effects are Conjunctions	Conditional effects are allowed. when P:E means E is an effect only if P is satisfied.
7)	Does not Support equality.	Equality predicate (x=y) is build in.
8)	Does not have support for types.	Support for types for eg:- The variable P:Person

Q4)



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(T)
T	0.09
F	0.05

A	P(M)
T	0.70
F	0.01

1) The topology of the n/w indicates that

- Burglary and earthquake affect the probability of the alarms going off

- Whether John and Mary calls depends only on alarm.

- They do not perceive any burglaries directly 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 n/w only implicitly as uncertainty associated to calling at work.

3) The probability actually summarize 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 a alarm because they are out of lunch, on vacation, temporarily 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 n/w.

11) The value of this entry is $P(x_1, \dots, x_n) =$ $\pi_{i=1,n} P(I, \text{Parents}(x_i))$, where Parents S$(x_i)$ denotes the specific values of the variables parents (x_i)

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

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

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

$= 0.000628$

12) Bayesian n/w