17th December, 2024. Tuesday Lab - 10

1) Consider the following English Statements
1. If someone suffers from allergies, then he/she sneezes
2. If someone lives with a cat and is allergic to cat, then he/she will suffer from allergies.
3. Tom is a cat
4. Mary is allergic to cats

Represent the above sentences in FOL and prove by FOL resolution "Mary sneezes"

On representation of the above premises in First order logic
1. allergies (x) → sneeze (x)
2. cat(y) ∧ allergic to cats (x) → allergies (x)
3. cat (Tom)
4. allergic to cats (Mary)

The Goal state is sneeze (Mary)

allergies (x) → sneeze (x)
• ¬ allergies (x) ∨ sneeze (x)
cat (Y) ∧ allergic to cats (X) → allergies (X)
¬(cat (Y) ∧ allergic to cats (x)) → ∨ allergies (X)
¬ cat (Y) ∨ ¬ allergic to cats (x) → ∨ allergies (X)

State Diagram to reach goals:

$\neg allergies(w) \lor sneeze(w)$ $\qquad$ $\neg cat(y) \lor \neg allergictocat(z) \lor allergies(z)$

w/z

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$\neg cat(y) \lor sneeze(z) \lor allergictocats(z)$ $\qquad$ $Cat(Tom)$

y/Tom

$allergictocats(May)$ $\qquad$ $sneeze(z) \lor \neg allergictocats(z)$

z/May

$sneeze(May)$ $\qquad$ $\neg sneeze(May)$

$\{\ \}$

$$\boxed{\begin{array}{l} \because X + \bar{X} = 1 \\ X \cdot \bar{X} = 0 \end{array}}$$

2) Consider the first order Logic (FOL) representations for the following
2 sentences
(i) Every real number has its corresponding negative
(ii) Everybody loves somebody
(iii) There is somebody whom no one loves
(iv) Seeam brought everything that Ronaldo brought
(v) Parrot is green while rabbit is not.

3) Find a most general unifier for the set
(i) $W = \{ P(a, x, f, (g(y))), P(z, f(z)) f(w)) \}$
(ii) $W = \{ g(f(a), g(x)), g(y, y)) \}$

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(i) $\forall x\ real(x) \rightarrow negative(x)$

or

$\forall real(x)\ \exists(negative(x))$

(ii) $\forall x \exists y\ loves(x, y)$

(iii) $\forall x\ \exists y \neg loves(x, y)$

(iv) $\forall x\ brought(Susan, x) \rightarrow bought(Ronald, x)$

(v) $green(parrot) \wedge \neg green(rabbit)$

or

$\forall x \forall y((Parrot(x) \rightarrow Green(x)) \wedge Rabbit(y) \rightarrow Green(y))$

II

(1) $P(a, x, f(g(y)))$ $\quad$ $P(z, f(z), f(u))$

Substitute z for a

$P(a, x, f(g(y)))$ $\quad$ $P(a, f(a), f(a))$

On substituting a by g(y) ①

$P(a, x, f(g(y)))$ $\quad$ $P(a, f(a), f(g(y)))$

On substituting x by f(a)

$P(a, f(a), f(g(y)))$ $\quad$ $P(a, f(a), f(g(y)))$

$x | f(a)$

The General Unifier z/a, $u/g(y)$

$x | f(a)$

(2) $Q(f(a), g(x))$ $\quad$ $Q(y, y)$ ② ✗

Terms isnt unifiable as y cannot accept two values

3) Convert the following sentences into FOL statements and prove the following statements using both forward & backward chaining.

John likes all kinds of foods

$\forall x \; food(x) \longrightarrow liked(John, x)$

Apples are food

food(Apples)

Chicken is food

food(Chicken)

Anything anyone eats and isn't killed by is food

$\forall x \forall y \; eats(x, y) \land \neg killedby(x) \Rightarrow food(y)$

Bill eats peanuts and is still alive

$eats(Bill, peanuts) \rightarrow alive(Bill)$

Sue eats everything Bill eats

$\forall x \; (eats(Bill, x) \rightarrow eats(Sue, x))$

* An additional required fact: $\forall x \; \neg killed(x) \longrightarrow alive(x)$

<u>The forward chaining</u>

x/Bill, y/Peanuts — Alive(Bill)

eats(Bill, Peanuts) — ¬killed(Bill)

↓

food(Peanuts)

↓ x/Peanuts — $\boxed{\text{from } 1}$

likes(John, Peanuts)

Backward Chaining:

Likes(John, Peanuts)

↓

Food(Peanuts)

x/Bill
y/Peanuts

eats(Bill, Peanuts)   ¬killed(Bill)

↓

Alive(Bill)   Proved

4) function MINIMAX-DECISION (state) returns an action
  return arg $\max_a \in$ actions(s) MIN-VALUE(RESULT(state, a))

function MAX-VALUE (state) returns a utility value
  if TERMINAL TEST (state) then return UTILITY (state)
  $v \leftarrow -\infty$
  for each a in actions (state) do
    $v \leftarrow$ MAX (v, MIN-VALUE(RESULT(s, a)))
  return v

function MIN-VALUE (state) returns a utility value
  if TERMINAL TEST (state) then return UTILITY (state)
  $v \leftarrow \infty$
  for each a in ACTIONS(state) do
    $v \leftarrow$ MIN(v, MAX-VALUE (RESULT(s, a))
  return v.

17/12/24