Lab - 8

13/10/25

First Order Logic

create a knowledge base consisting of first order logic statements and prove the given query using forward reasoning

Premises → P → Q → conclusions

$L \wedge M \Rightarrow P$

$B \wedge L \Rightarrow M$

$A \wedge P \Rightarrow L$

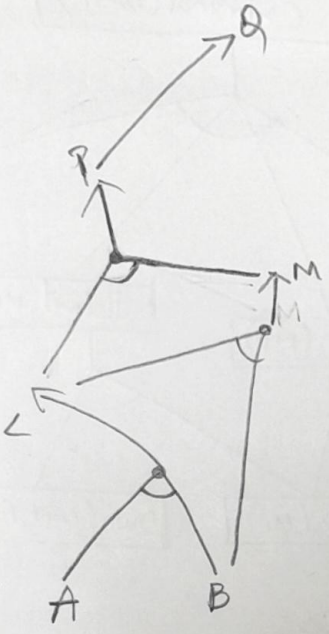
$A \wedge B \Rightarrow L$

↓

Rules

facts { A, B

Prove Q



Q = The law says that it is a crime for an American to sell weapons to hostile nations. The country Nono, an enemy of America, has some missiles, and all of its missiles were sold to it by Colonel West, who is American. An enemy of American counts as "hostile".

• Prove that "west is criminal".

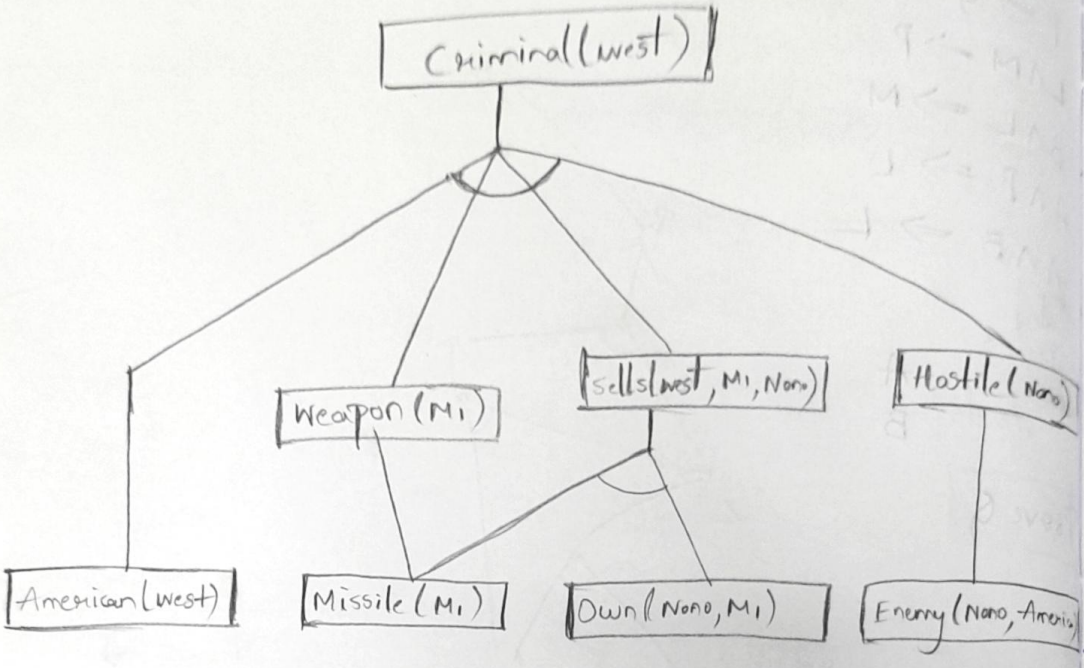
Rules

1. $\forall x, y, z$ American$(x) \wedge$ weapon$(y) \wedge$ sells$(x, y, z) \wedge$ Hostile$(z) \Rightarrow$ criminal(x)
2. $\forall x$ Missile$(x) \wedge$ owns$(Nono, x) \Rightarrow$ sells$(west, x, Nono)$
3. $\forall x$ Enemy$(x, America) \Rightarrow$ Hostile(x)

4. $\forall x \; Missile(x) \Rightarrow Weapon(x)$

Facts

5. American(west)
6. Enemy(Nono, America)
7. Owns(Nono, M1) and
8. Missile(M1)



Algorithm

function FOL-FC-ASK(KB, α) returns a substitution or false

inputs: KB, the knowledge base, a set of first-order definite clauses
α, the query, an atomic sentence

local variables: new, the new sentences inferred on each iteration

repeat until new is empty

new $\leftarrow$ { }

for each rule in KB do

$(p_1 \wedge \ldots \wedge p_n \Rightarrow q) \leftarrow$ STANDARDIZE-VARIABLES(rule)

for each θ such that SUBST(θ, p1 ∧ ... ∧ pn) = SUBST(θ, p'1 ∧ ... ∧ p'n)
for some p'1, ..., p'n in KB
q' ← SUBST(θ, q)
if q' does not unify with some sentence already in KB or new then
add q' to new
φ ← UNIFY(q', α)
if φ is not fail then return φ
add new to KB
return false

output:

Adding fact : American(west)
Adding fact : Enemy(Nono, America)
Adding fact : Missile(M1)
Adding fact : Owns(Nono, M1)
Inferred new fact : weapon(M1) from ['Missile(M1)'] => weapon(M1)
Inferred new fact : Sells(west, M1, Nono) from ['Missile(M1)', 'Owns(Nono, M1)'] => sells(west, M1, Nono)
Inferred new fact : Hostile(Nono) from ['Enemy(Nono, America)'] => Hostile(Nono)
Inferred new fact : Criminal(west) from ['American(west)', 'weapon(M1)', 'Sells(west, M1, Nono)', 'Hostile(Nono)'] => Criminal(west)
Goal Reached : west is Criminal
True

13/10/21