FIRST-ODER LOGIC - HOMEWORK

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Question 1:

- Jack owns a dog. (1)
- Every dog owner is an animal lover. (2)
- No animal lover kills an animal. (3)
- Either Jack or Curiosity killed the cat, who is named Tuna (4)

-> Did Curiosity kill the cat?

SOLUTION:

Step 1: Conversion to FOL

1. ∃x.(Dog(x) ∧ Owns(Jack, x))
2. ∀x(∃y(Dog(y) ∧ Owns(x, y)) → AnimalLover(x))
3. ∀x(AnimalLover(x) → ∀y(Animal(y) → ¬Kills(x, y)))
4. Kills(Jack, Tuna) ∨ Kills(Curiosity, Tuna)

Need to prove: Kills(Curiosity, Tuna)

Step 2: Introduce new predicates in the KB

1. ∃x.(Dog(x) ∧ Owns(Jack, x))
2. ∀x(∃y(Dog(y) ∧ Owns(x, y)) → AnimalLover(x))
3. ∀x(AnimalLover(x) → (∀y(Animal(y) → ¬Kills(x, y)))
4. Kills(Jack, Tuna) ∨ Kills(Curiosity, Tuna)

*5. Cat(Tuna)

*6. ∀x(Cat(x) → Animal(x))

Step 3: Conversion into CNF

a. Dog(D) ∨ Owns(Jack, D)

b. ¬Dog(y) ∨ ¬Owns(x, y) ∨ AnimalLover(x)

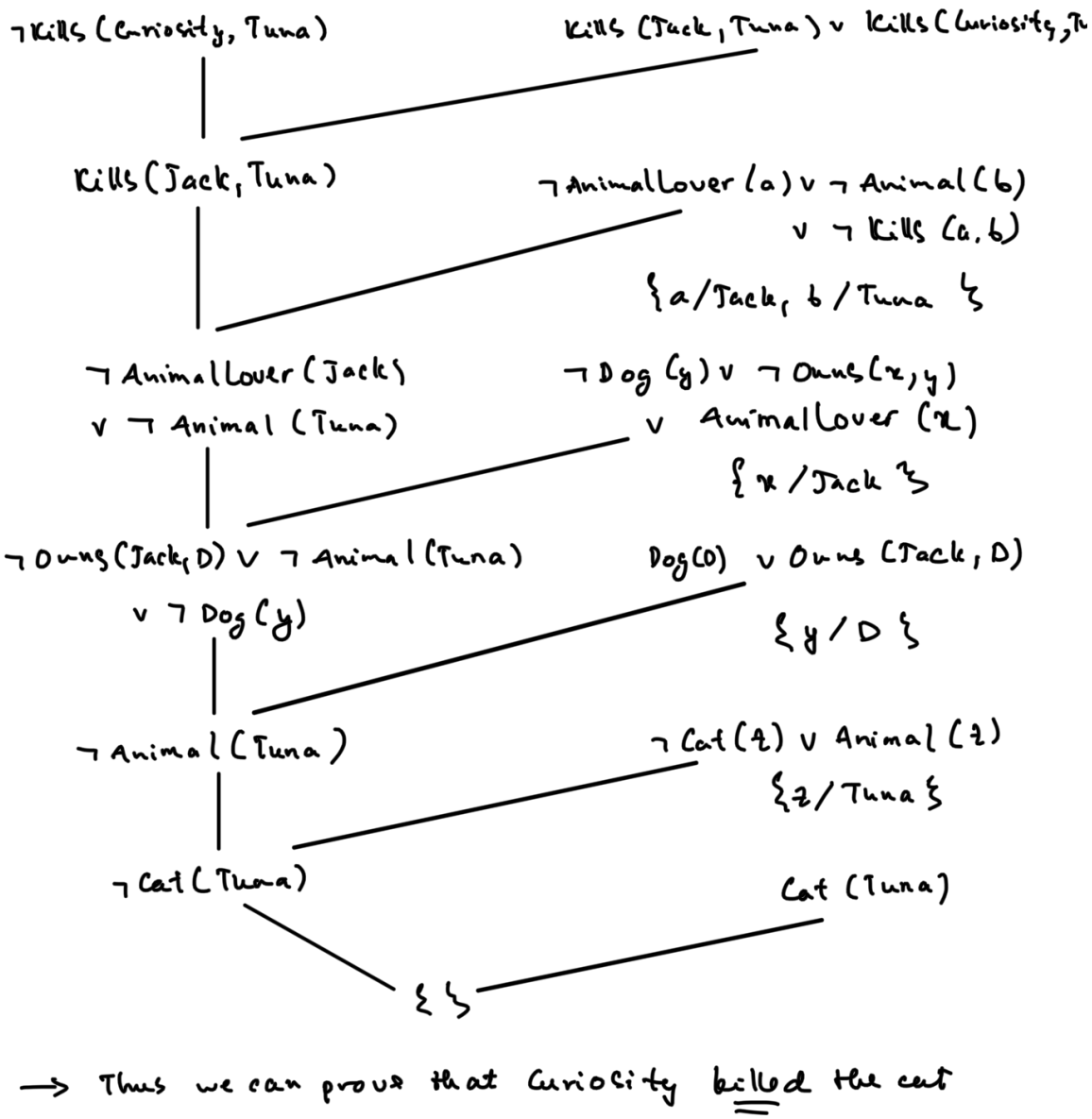
c. ¬AnimalLover(a) ∨ ¬Animal(b) ∨ ¬Kills(a, b)

d. Kills(Jack, Tuna) ∨ Kills(Curiosity, Tuna)

e. Cat(Tuna)

f. ¬Cat(z) ∨ Animal(z)

Negated goal: (¬Kills(Curiosity, Tuna))



Question 2:

- 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 an American
- Is West a criminal?

SOLUTION:

Step 1: Conversion to FOL and introduce new predicates

1. It is a crime for an American to sell weapons to hostile nations: ∀x∀y∀z(American(x) ∧ Hostile(y) ∧ Sells(x, y, z) ∧ Weapon(z) → Criminal(x))

2. The country Nono, an enemy of America, has some missile. All

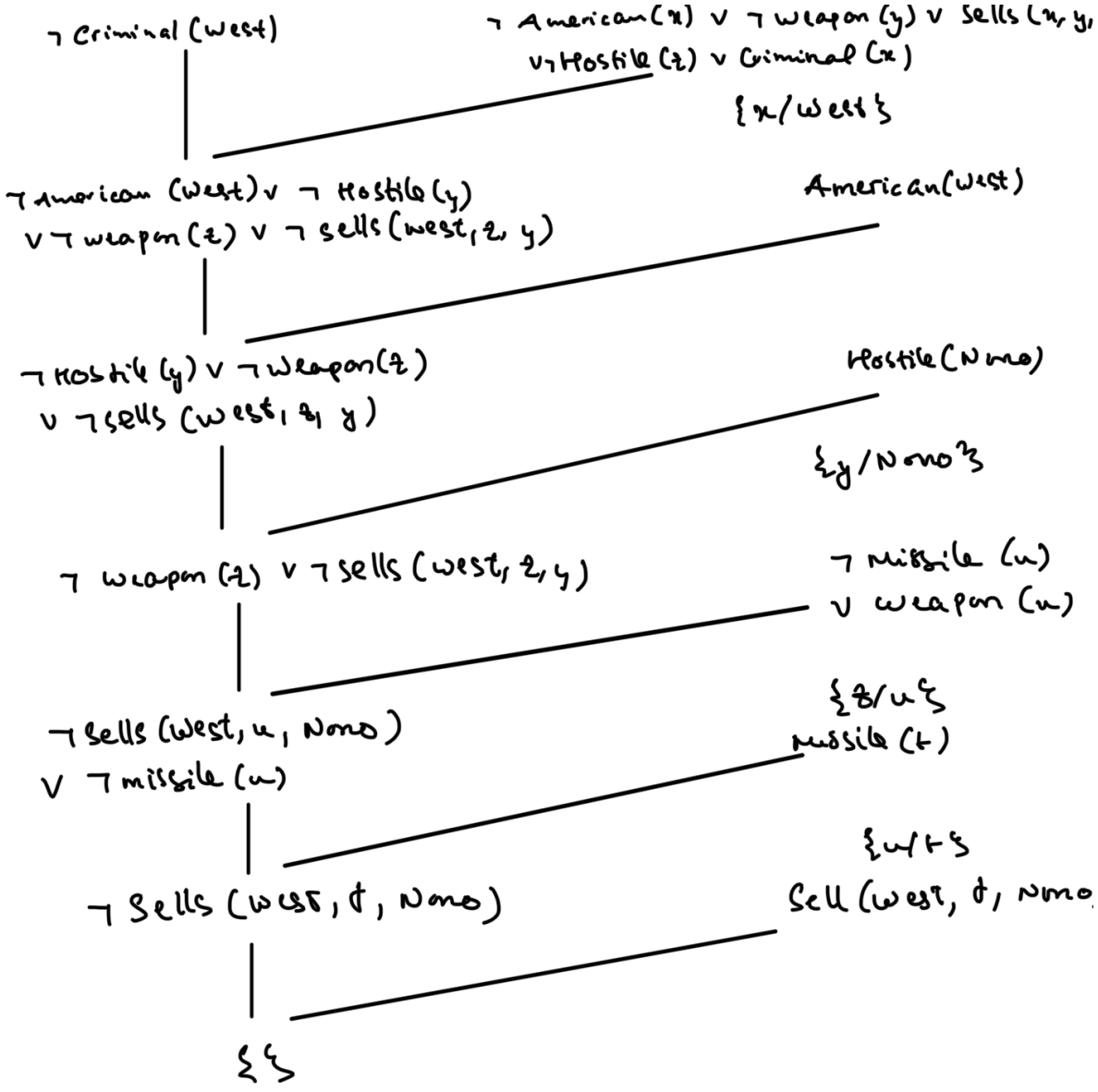
of its missisles were sold to it by Colonel West:
∃t(Hostile(Nono) ∧ American(West) ∧ Missile(t) ∧ Sell(West, t, Nono))

3. Missiles are considered as weapons:
∀u(Missile(u) → Weapon(u))
Need to prove: Criminal(West)

Step 2: Conversion into CNF:

1. ¬American(x) ∨ ¬Hostile(y) ∨ Sells(x, y, z) ∨ ¬Weapon(z) ∨ Criminal(x)
2. Hostile(Nono) ∧ American(West) ∧ Missile(t) ∧ Sell(West, t, Nono)
3. ¬Missile(u) ∨ Weapon(u)

Negated goal: ¬Criminal(West)



$\Rightarrow$ thus West is a criminal $\square$