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CSCI4511W

Problem 1:

1.

🚩		1	0
3	🚩	2	1
🚩		🚩	
🚩	3	2	🚩

🚩	🚩	1	0
3		2	1
🚩		🚩	
🚩	3	2	🚩

2.

🚩		1	0
3		2	1
🚩		🚩	
🚩	3	2	🚩

3.

🚩		1	0
3		2	1
🚩	SAFE	🚩	SAFE
🚩	3	2	🚩

problem 2 :

① $B \vee D \vee E$

② $C \longrightarrow (D \vee A) \equiv \neg C \vee D \vee A$

③ $E \vee A \longrightarrow B \equiv \neg(E \vee A) \vee B$

④ $(A \vee B) \longleftrightarrow (C \vee (D \wedge E)) \equiv \neg(A \vee B) \longrightarrow (C \vee (D \wedge E)) \wedge \neg(C \vee (D \wedge E)) \longrightarrow (A \vee B)$

$\equiv [\neg(A \vee B) \vee (C \vee (D \wedge E))] \wedge [\neg(C \vee (D \wedge E)) \vee (A \vee B)]$

$\equiv [\neg(A \vee B) \vee (C \vee \neg(\neg D \vee \neg E))] \wedge [\neg(C \vee \neg(\neg D \vee \neg E)) \vee (A \vee B)]$

CNF : (lines are ANDed together)

① $B \vee D \vee E$

② $\neg C \vee D \vee A$

③ $\neg(E \vee A) \vee B$

④ $[\neg(A \vee B) \vee (C \vee \neg(\neg D \vee \neg E))] \wedge [\neg(C \vee \neg(\neg D \vee \neg E)) \vee (A \vee B)]$

Problem 3:

KB:
$(A \vee \neg B \vee \neg C \vee D)$
$(B \vee \neg C)$
$(\neg A \vee D \vee \neg E)$
$(\neg C \vee D \vee \neg E)$
$(B \vee \neg D \vee E)$
$(C \vee \neg D \vee \neg E)$
$(B \vee C \vee D \vee E)$

1. Merge KB1 and KB2: **(A V ¬C V D)**
2. Merge 1 and KB3: **(¬C V D V ¬E)**
3. Merge 2 and KB4 are the same: **(¬C V D V ¬E)**
4. Merge 3 and KB5: **(¬C V B)**
5. Merge 4 and KB6: **(B V ¬D V ¬E)**
6. Merge 5 and KB7: **(B V C)**

1. KB ⊨ B:

Merge step 4 and 6 to get: **B**

B and **¬B = contradiction**

KB Entails **B**

2. KB ⊨ E:

Merge Step 6 and KB1 to get: **(A v D)**

Merge Step 4 and step 6 to get: **B**

Merge Step 4 and KB4 to get: **(B V D V ¬E)**

Merge Step 7 and KB3 to get: **(D V ¬E)**

Merge Step 5 and step10 to get: **(B V ¬E)**

Merge KB3 and KB5 to get: **(¬A v B)**

Merge Step 12 and KB1 to get: **(¬C V D)**

All possible options were investigated

KB Does not entail **E**

3. KB ⊨ (B ∨ E):

¬(B ∨ E) == ¬B ∧ ¬E

Merge step 4 and 6 to get **B**

B anded **¬B ∧ ¬E** == **contradiction**

KB Entails **(B ∨ E)**

Problem 4:

Relations: Dad(2), EatApple(1), Mom(2), Person(1), Unicorn(1), WhiteHorn(1)

1. Paragraph 1:

$$\exists_{x,y} \left(unicorn(x) \wedge WhiteHorn(x) \Rightarrow \text{EatApple}(x)\right) \vee \left(unicorn(y) \wedge \neg WhiteHorn(y) \Rightarrow \neg\text{EatApple}(y)\right)$$

$$\wedge \exists_p person(p) \Rightarrow EatApple(p)$$

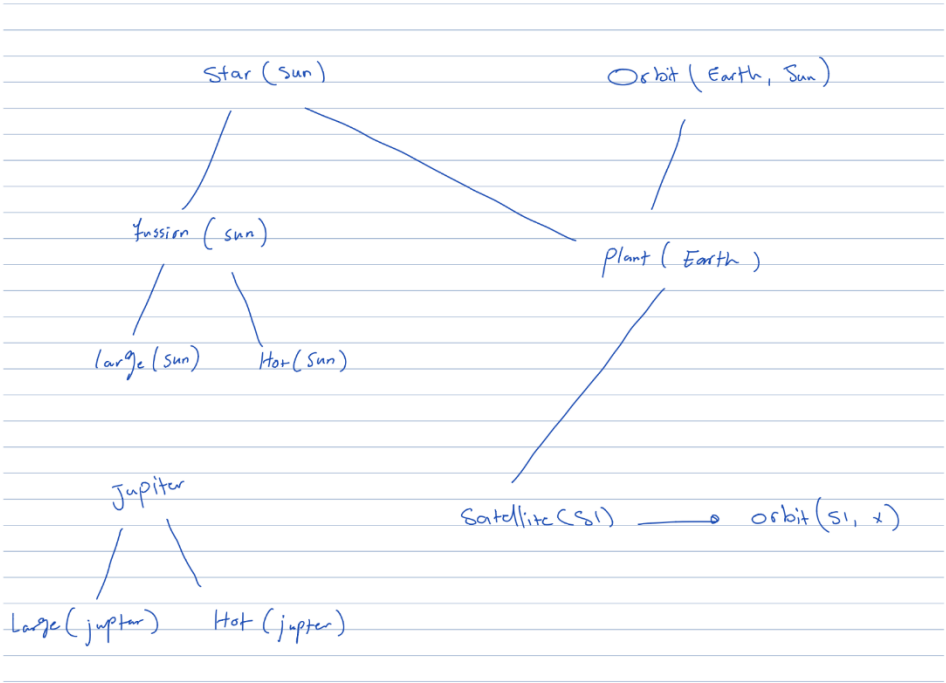
2. Paragraph 2:

$$\forall_{x,y,z} \Big(unicorn(x) \wedge unicorn(y) \wedge unicorn(z) \wedge Dad(x,z) \wedge Mom(y,z) \wedge \Big(\big(WhiteHorn(x) \wedge WhiteHorn(y)\big) \vee \big(\neg WhiteHorn(x) \wedge \neg WhiteHorn(y)\big)\Big) \Rightarrow WhiteHorn(z)\Big)$$

$$\wedge \Big(unicorn(x) \wedge unicorn(y) \wedge unicorn(z) \wedge Dad(x,z) \wedge Mom(y,z) \wedge \Big(\big(WhiteHorn(x) \wedge \neg WhiteHorn(y)\big) \vee \big(\neg WhiteHorn(x) \wedge WhiteHorn(y)\big)\Big) \Rightarrow \neg WhiteHorn(z)\Big)$$

Problem 5:

1. $Planet(Earth) \Rightarrow \exists_x\ Star(x) \wedge Orbit(Earth, x)$
2. $Planet(Earth) \Leftrightarrow \neg\ Star(Earth)$
3. $Star(Sun)\ \Leftrightarrow \neg\ Planet(Sun)$
4. $Satellite(S1) \Rightarrow \exists_y\ Planet(y) \wedge Orbit(S1, y)$
5. $Star(Sun) \Leftrightarrow Fussion(Sun)$
6. $Fussion(Sun) \Rightarrow Large(Sun) \wedge Hot(Sun)$
7. $\forall_x\ Star(x) \Rightarrow Large(x)\ \wedge\ Hot(x)$



problem 6 :

$\neg \alpha = \neg \forall x \; S(f(f(f(cat))), x, y_6)$

$= \neg S(f(f(f(cat))), x_1, y_3)$

KB 1 and KB 2 :

① $S(cat, x_2, x_2)$

② $\neg S(x_3, y_3, z_3) \vee S(f(x_3), y_3, f(z_3))$

③ (KB2 $\wedge \neg \alpha$) :

$\equiv \neg S(f(f(cat)), x, z_3) \vee S(f(f(f(cat))), x, f(z_3))$

$\vee \neg S(f(f(f(cat))), x, f(z_3))$

$\equiv \neg S(f(f(cat)), x, z_4)$

④ from KB2 and ③ :

$\equiv \neg S(f(cat), x, z_3) \vee S(f(f(cat)), x, f(z_3))$

$\vee \neg S(f(f(cat)), x, z_3)$

$= \neg S(f(cat), x, z_5)$

⑤ from KB2 and ④ :

$\equiv \neg S(cat, x, z_3) \vee S(f(cat), x, f(z_3))$

$\vee \neg S(f(cat), x, f(z_3))$

$= \neg S(cat, x, z_5)$

⑥ from KB1 and ⑤ :

$\equiv S(cat, x, x) \vee \neg S(cat, x, x) = \{\}$

KB entails α

Problem 7:

1. **True**
2. **False**