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CSE 3521
Homework 05

Problem 1

a. Every student takes both MATH and CHEMISTRY.

$$
\begin{aligned}
&\text{P: Student(x)}\\
&\text{Q: Takes(x, MATH)}\\
&\text{R: Takes(x, CHEMISTRY)}\\
&\forall x, \text{Student(x)} \Rightarrow (\text{Takes(x, MATH)} \wedge \text{Takes(x, CHEMISTRY)})\\
\equiv &\forall x, P \Rightarrow (Q \wedge R)\\
\equiv &\forall x, \neg P \vee (Q \wedge R)\\
\equiv &\neg\neg (\forall x, \neg P \vee (Q \wedge R))\\
\equiv &\neg (\exists x, P \wedge \neg (Q \wedge R))\\
\equiv &\neg (\exists x, P \wedge (\neg Q \vee \neg R))\\
\equiv &\neg\exists x, P \wedge (\neg Q \vee \neg R)\\
\equiv &\neg\exists x, \text{Student(x)} \wedge (\neg\text{Takes(x, MATH)} \vee \neg\text{Takes(x, CHEMISTRY)})
\end{aligned}
$$

b. No person enjoys a non-intelligent robot.

$$
\begin{aligned}
&\text{P: Person(x)}\\
&\text{Q: Robot(y)}\\
&\text{R: Intelligent(y)}\\
&\text{S: Enjoys(x, y)}\\
&\neg\exists x, y, (\text{Person(x)} \wedge \text{Robot(y)} \wedge \neg\text{Intelligent(y)}) \wedge \text{Enjoys(x, y)}\\
\equiv &\neg\exists x, y, (P \wedge Q \wedge \neg R) \wedge S\\
\equiv &\forall x, y, \neg ((P \wedge Q \wedge \neg R) \wedge S)\\
\equiv &\forall x, y, (\neg (P \wedge Q \wedge \neg R) \vee \neg S)\\
\equiv &\forall x, y, (P \wedge Q \wedge \neg R) \Rightarrow \neg S\\
\equiv &\forall x, y, (\text{Person(x)} \wedge \text{Robot(y)} \wedge \neg\text{Intelligent(y)}) \Rightarrow \neg\text{Enjoys(x, y)}
\end{aligned}
$$

Problem 2

1. Ostrich (True)

- ~~ANIMAL is a bird~~
  - ~~ANIMAL has feathers (F1)~~ OR (ANIMAL flies AND ~~ANIMAL lays eggs (F2)~~)
- ~~ANIMAL does not fly (F3)~~
- ~~ANIMAL has long legs (F6)~~
- ~~ANIMAL has long neck (F7)~~
- ~~ANIMAL is black and white (F4)~~

2. Penguin (True)
   - ~~ANIMAL is a bird~~
     - ~~ANIMAL has feathers (F1)~~ OR (ANIMAL flies AND ~~ANIMAL lays eggs (F2)~~)
   - ~~ANIMAL does not fly (F3)~~
   - ~~ANIMAL swims (F5)~~
3. Albatross (False)
   - ~~ANIMAL is a bird~~
     - ~~ANIMAL has feathers (F1)~~ OR (ANIMAL flies AND ~~ANIMAL lays eggs (F2)~~)
   - ANIMAL flies well

(R3 AND R4) before R13, R14, R15 for satisfying query (R3 OR R4).

The result is NOT peculiar because Splashy have the characteristics form both Ostrich and Penguin. Since we started from our goal state to inital state, however, both path can lead us to the initial state.

Problem 3

1. R1: Like(x1, LA) $\rightarrow$ Goodlooking(x1)
2. R2: Goodlooking(x2) $\wedge$ In(x2, LA) $\rightarrow$ Like(x2, LA)
3. R3: In(x4, LA) $\rightarrow$ Love(x4, LA)
4. R4: Appear(x5, ET) $\wedge$ Female(x5) $\wedge$ Love(x5, LA) $\rightarrow$ Actress(x5)
5. R5: Appear(x6, ET) $\rightarrow$ Love(x6, LA)
6. R6: Love(x7, LA) $\rightarrow$ Greedy(x7)

7. F1: Female(Jane)
8. F2: Like(Jane, LA)
    - Goodlooking(Jane) {R1}
9. F3: Appear(Jane, ET)
    - Love(Jane, LA) {R5}
        - Actress(Jane) {F3, F1, R5}
        - Greedy(Jane) {R6}

Problem 4

0. $\neg$Acotr(Jerry)
1. $\neg$RockStar(Jerry) $\vee$ $\neg$Millionaire(Jerry) $\vee$ Actor(Jerry)[kb $-$ 1]
2. $\neg$Actor(Jerry), RockStar(Jerry) $\vee$ $\neg$Millionaire(Jerry) $\vee$ Actor(Jerry)
    1. RockStar(Jerry) $\vee$ $\neg$Millionaire(Jerry) $\vee$ Actor(Jerry)[resolution: 0, 1]
3. Millionaire(Jerry) $\vee$ $\neg$Drives(Jerry, Ferrari)[kb $-$ 2]
4. RockStar(Jerry) $\vee$ $\neg$Millionaire(Jerry), Millionaire(Jerry) $\vee$ $\neg$Drives(Jerry, Ferrari)
    1. RockStar(Jerry) $\vee$ $\neg$Drives(Jerry, Ferrari)[resolution: 2.1, 3]
5. Likes(Jerry, Snakes) $\vee$ $\neg$RockStar(Jerry)[kb $-$ 3]
6. RockStar(Jerry) $\vee$ $\neg$Drives(Jerry, Ferrari), Likes(Jerry, Snakes) $\vee$ $\neg$RockStar(Jerry)
    1. $\neg$Drives(Jerry, Ferrari) $\vee$ Likes(Jerry, Snakes)[resolution: 4.1, 5]
7. Drives(Jerry, Ferrari), $\neg$Drives(Jerry, Ferrari) $\vee$ Likes(Jerry, Snakes)
    1. Likes(Jerry, Snakes)
8. $\neg$Likes(Jerry, Snakes), Likes(Jerry, Snakes)

We have prove Actor(Jerry) by contradition.