

CPE 372/641 Natural Language Processing

Homework 2: Tarski's World

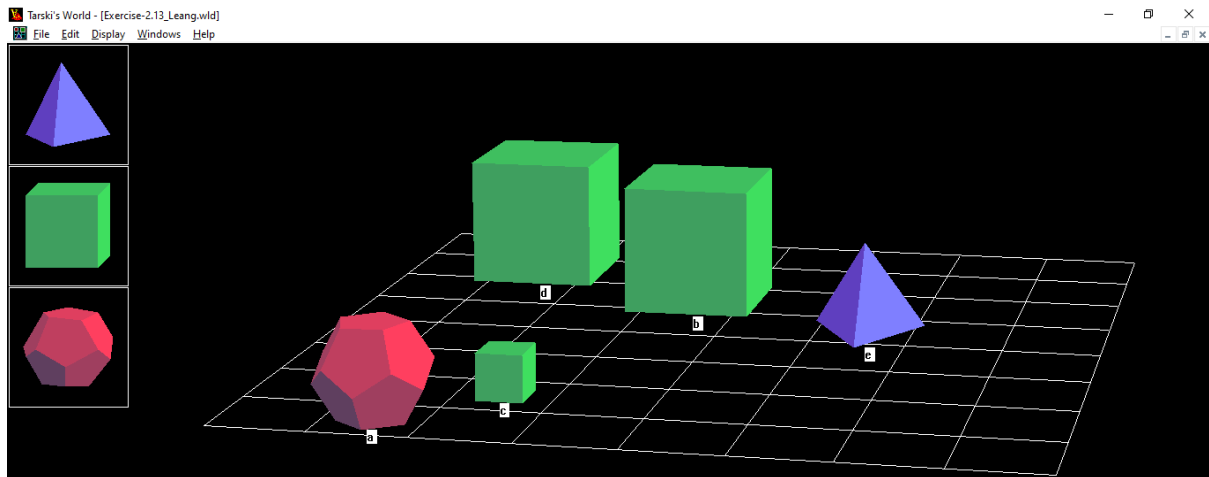
(First-order logic/ First Order Predicate Calculus)

Screen shot of translated sentences from Exercise 2.12, checked truth values against the world that you create in Exercise 2.13

Translated sentences from Exercise 2.12

1. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,d)$
2. $(\text{LeftCl}(a,d) \vee \text{RightCl}(a,d)) \rightarrow \text{Cube}(a)$
3. $\text{Between}(c,a,d) \vee \text{Between}(c,a,e)$
4. $\text{Small}(c) \rightarrow \text{RightCl}(c,a)$
5. $\text{RightCl}(c,d) \rightarrow (\text{RightCl}(b,c) \wedge \text{LeftCl}(b,e))$
6. $\text{Tet}(e) \rightarrow (\text{RightCl}(e,b) \leftrightarrow \text{FrontCl}(e,b))$
7. $\text{Dodec}(b) \rightarrow \text{SameRow}(b,d)$
8. $\text{BackCl}(c,a) \wedge \text{FrontCl}(c,e)$
9. $\text{FrontCl}(e,d) \wedge (\text{Tet}(e) \wedge \neg \text{Large}(e))$
10. $\text{Cube}(a) \vee \text{Cube}(c) \vee \text{Cube}(e)$
11. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,b)$
12. $\text{Larger}(b,a) \wedge \text{Larger}(b,e)$
13. $\text{SameSize}(a,e) \wedge \text{Larger}(a,c) \wedge \text{Larger}(e,c)$
14. $\text{SameShape}(d,b) \rightarrow \text{SameSize}(d,b)$
15. $\text{Large}(a) \leftrightarrow \text{Cube}(a)$
16. $\text{Cube}(b) \leftrightarrow \neg \text{Tet}(c)$
17. $\neg \text{Cube}(e) \rightarrow (\text{Large}(b) \vee \text{Large}(d))$
18. $(\text{Tet}(a) \vee \text{Tet}(c)) \rightarrow (\text{Cube}(b) \vee \text{Cube}(d))$
19. $\text{Large}(a) \leftrightarrow \text{Small}(d)$
20. $\text{Large}(a) \leftrightarrow \text{Large}(e)$

Checked truth values against the world that you create in Exercise 2.13

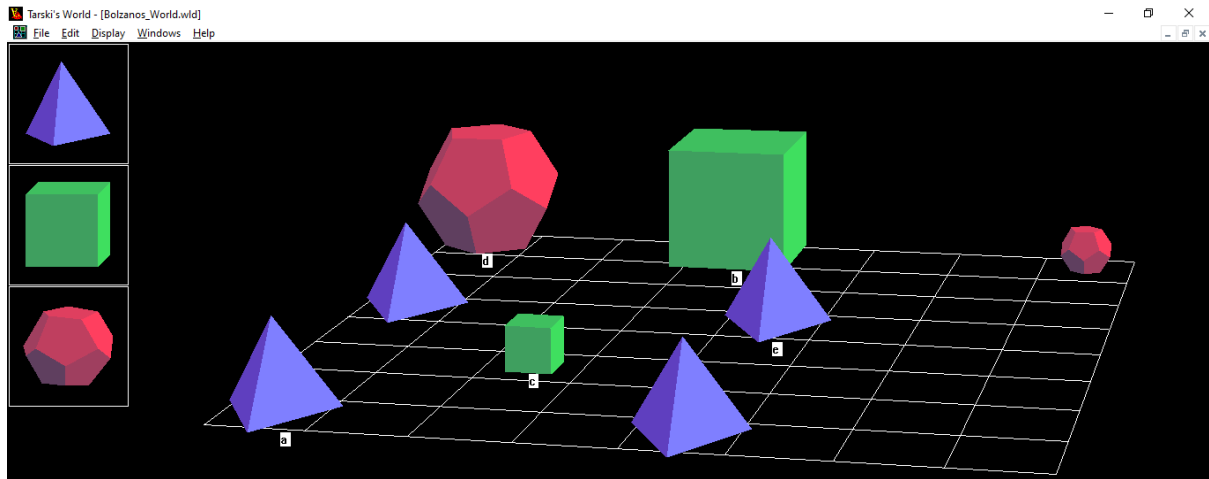


- T 1. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,d)$
- T 2. $(\text{LeftCl}(a,d) \vee \text{RightCl}(a,d)) \rightarrow \text{Cube}(a)$
- T 3. $\text{Between}(c,a,d) \vee \text{Between}(c,a,e)$
- T 4. $\text{Small}(c) \rightarrow \text{RightCl}(c,a)$
- T 5. $\text{RightCl}(c,d) \rightarrow (\text{RightCl}(b,c) \wedge \text{LeftCl}(b,e))$
- T 6. $\text{Tet}(e) \rightarrow (\text{RightCl}(e,b) \leftrightarrow \text{FrontCl}(e,b))$
- T 7. $\text{Dodec}(b) \rightarrow \text{SameRow}(b,d)$
- T 8. $\text{BackCl}(c,a) \wedge \text{FrontCl}(c,e)$
- T 9. $\text{FrontCl}(e,d) \wedge (\text{Tet}(e) \wedge \neg \text{Large}(e))$
- T 10. $\text{Cube}(a) \vee \text{Cube}(c) \vee \text{Cube}(e)$
- T 11. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,b)$
- T 12. $\text{Larger}(b,a) \wedge \text{Larger}(b,e)$
- T 13. $\text{SameSize}(a,e) \wedge \text{Larger}(a,c) \wedge \text{Larger}(e,c)$
- T 14. $\text{SameShape}(d,b) \rightarrow \text{SameSize}(d,b)$
- T 15. $\text{Large}(a) \leftrightarrow \text{Cube}(a)$
- T 16. $\text{Cube}(b) \leftrightarrow \neg \text{Tet}(c)$
- T 17. $\neg \text{Cube}(e) \rightarrow (\text{Large}(b) \vee \text{Large}(d))$
- T 18. $(\text{Tet}(a) \vee \text{Tet}(c)) \rightarrow (\text{Cube}(b) \vee \text{Cube}(d))$
- T 19. $\text{Large}(a) \leftrightarrow \text{Small}(d)$
- T 20. $\text{Large}(a) \leftrightarrow \text{Large}(e)$

Evaluating in Exercise-2.13_Leang.wld

- Screen shots of translated sentences from Exercise 2.12, checked truth values against the worlds specified in Exercise 2.14

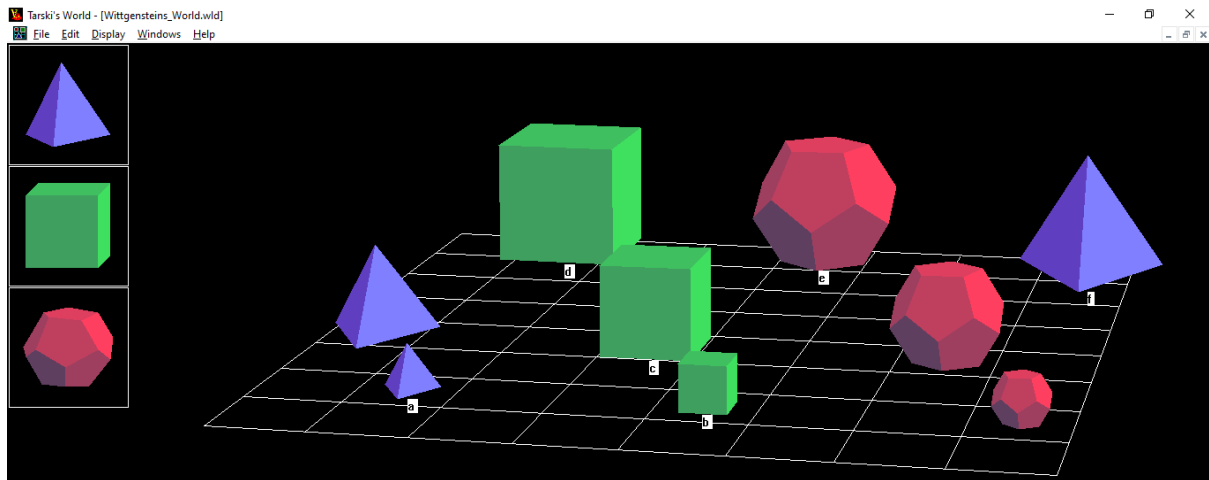
Bolzanos_World.wld



- T 1. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,d)$
- T 2. $(\text{LeftCl}(a,d) \vee \text{RightCl}(a,d)) \rightarrow \text{Cube}(a)$
- T 3. $\text{Between}(c,a,d) \vee \text{Between}(c,a,e)$
- T 4. $\text{Small}(c) \rightarrow \text{RightCl}(c,a)$
- T 5. $\text{RightCl}(c,d) \rightarrow (\text{RightCl}(b,c) \wedge \text{LeftCl}(b,e))$
- T 6. $\text{Tet}(e) \rightarrow (\text{RightCl}(e,b) \leftrightarrow \text{FrontCl}(e,b))$
- T 7. $\text{Dodec}(b) \rightarrow \text{SameRow}(b,d)$
- T 8. $\text{BackCl}(c,a) \wedge \text{FrontCl}(c,e)$
- T 9. $\text{FrontCl}(e,d) \wedge (\text{Tet}(e) \wedge \neg \text{Large}(e))$
- T 10. $\text{Cube}(a) \vee \text{Cube}(c) \vee \text{Cube}(e)$
- T 11. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,b)$
- T 12. $\text{Larger}(b,a) \wedge \text{Larger}(b,e)$
- T 13. $\text{SameSize}(a,e) \wedge \text{Larger}(a,c) \wedge \text{Larger}(e,c)$
- T 14. $\text{SameShape}(d,b) \rightarrow \text{SameSize}(d,b)$
- T 15. $\text{Large}(a) \leftrightarrow \text{Cube}(a)$
- T 16. $\text{Cube}(b) \leftrightarrow \neg \text{Tet}(c)$
- T 17. $\neg \text{Cube}(e) \rightarrow (\text{Large}(b) \vee \text{Large}(d))$
- T 18. $(\text{Tet}(a) \vee \text{Tet}(c)) \rightarrow (\text{Cube}(b) \vee \text{Cube}(d))$
- T 19. $\text{Large}(a) \leftrightarrow \text{Small}(d)$
- T 20. $\text{Large}(a) \leftrightarrow \text{Large}(e)$

Evaluating in Bolzanos_World.wld

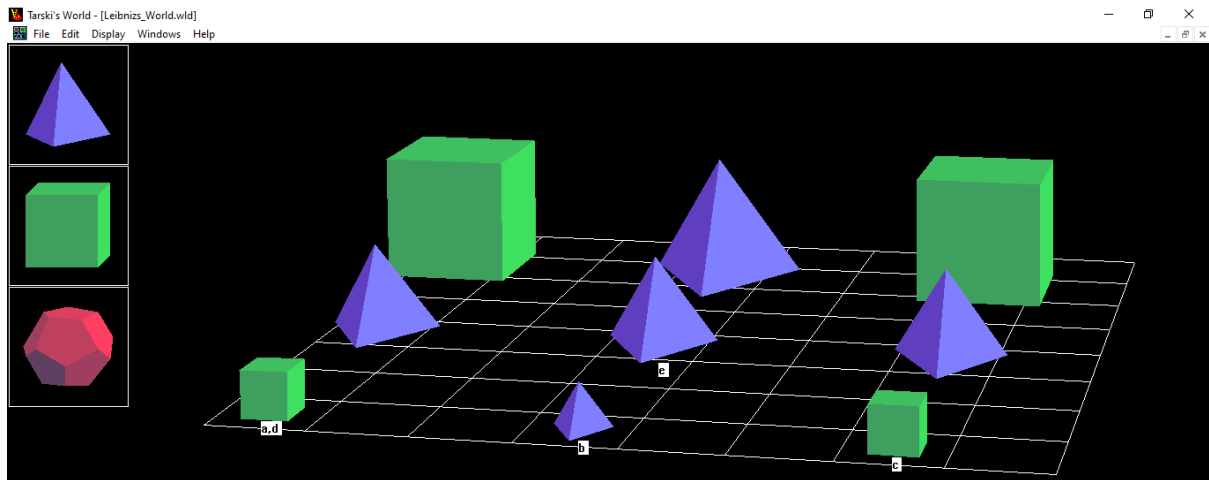
Wittgensteins_World.wld



- T 1. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,d)$
-
- T 2. $(\text{LeftCl}(a,d) \vee \text{RightCl}(a,d)) \rightarrow \text{Cube}(a)$
-
- F 3. $\text{Between}(c,a,d) \vee \text{Between}(c,a,e)$
-
- T 4. $\text{Small}(c) \rightarrow \text{RightCl}(c,a)$
-
- F 5. $\text{RightCl}(c,d) \rightarrow (\text{RightCl}(b,c) \wedge \text{LeftCl}(b,e))$
-
- T 6. $\text{Tet}(e) \rightarrow (\text{RightCl}(e,b) \leftrightarrow \text{FrontCl}(e,b))$
-
- T 7. $\text{Dodec}(b) \rightarrow \text{SameRow}(b,d)$
-
- T 8. $\text{BackCl}(c,a) \wedge \text{FrontCl}(c,e)$
-
- F 9. $\text{FrontCl}(e,d) \wedge (\text{Tet}(e) \wedge \neg \text{Large}(e))$
-
- T 10. $\text{Cube}(a) \vee \text{Cube}(c) \vee \text{Cube}(e)$
-
- F 11. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,b)$
-
- F 12. $\text{Larger}(b,a) \wedge \text{Larger}(b,e)$
-
- F 13. $\text{SameSize}(a,e) \wedge \text{Larger}(a,c) \wedge \text{Larger}(e,c)$
-
- F 14. $\text{SameShape}(d,b) \rightarrow \text{SameSize}(d,b)$
-
- T 15. $\text{Large}(a) \leftrightarrow \text{Cube}(a)$
-
- T 16. $\text{Cube}(b) \leftrightarrow \neg \text{Tet}(c)$
-
- T 17. $\neg \text{Cube}(e) \rightarrow (\text{Large}(b) \vee \text{Large}(d))$
-
- T 18. $(\text{Tet}(a) \vee \text{Tet}(c)) \rightarrow (\text{Cube}(b) \vee \text{Cube}(d))$
-
- T 19. $\text{Large}(a) \leftrightarrow \text{Small}(d)$
-
- F 20. $\text{Large}(a) \leftrightarrow \text{Large}(e)$
-

Evaluating in Wittgensteins_World.wld

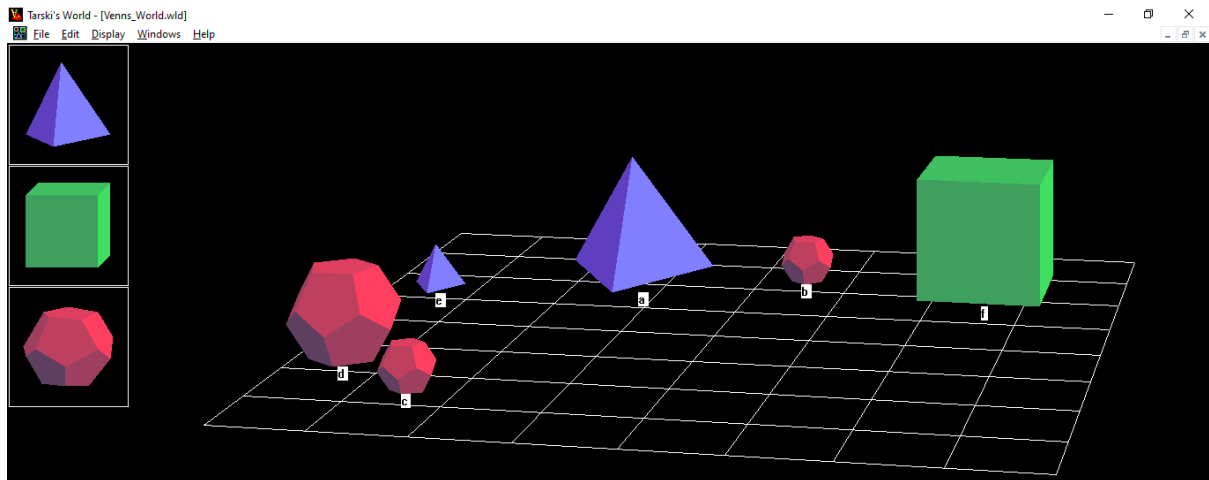
Leibnizs_World.wld



- T 1. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,d)$
- T 2. $(\text{LeftCl}(a,d) \vee \text{RightCl}(a,d)) \rightarrow \text{Cube}(a)$
- F 3. $(\text{Between}(c,a,d) \vee \text{Between}(c,a,e))$
- T 4. $\text{Small}(c) \rightarrow \text{RightCl}(c,a)$
- F 5. $\text{RightCl}(c,d) \rightarrow (\text{RightCl}(b,c) \wedge \text{LeftCl}(b,e))$
- T 6. $\text{Tet}(e) \rightarrow (\text{RightCl}(e,b) \leftrightarrow \text{FrontCl}(e,b))$
- T 7. $\text{Dodec}(b) \rightarrow \text{SameRow}(b,d)$
- F 8. $\text{BackCl}(c,a) \wedge \text{FrontCl}(c,e)$
- F 9. $\text{FrontCl}(e,d) \wedge (\text{Tet}(e) \wedge \neg \text{Large}(e))$
- T 10. $\text{Cube}(a) \vee \text{Cube}(c) \vee \text{Cube}(e)$
- T 11. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,b)$
- F 12. $\text{Larger}(b,a) \wedge \text{Larger}(b,e)$
- F 13. $\text{SameSize}(a,e) \wedge \text{Larger}(a,c) \wedge \text{Larger}(e,c)$
- T 14. $\text{SameShape}(d,b) \rightarrow \text{SameSize}(d,b)$
- F 15. $\text{Large}(a) \leftrightarrow \text{Cube}(a)$
- F 16. $\text{Cube}(b) \leftrightarrow \neg \text{Tet}(c)$
- F 17. $\neg \text{Cube}(e) \rightarrow (\text{Large}(b) \vee \text{Large}(d))$
- T 18. $(\text{Tet}(a) \vee \text{Tet}(c)) \rightarrow (\text{Cube}(b) \vee \text{Cube}(d))$
- F 19. $\text{Large}(a) \leftrightarrow \text{Small}(d)$
- T 20. $\text{Large}(a) \leftrightarrow \text{Large}(e)$

Evaluating in Leibnizs_World.wld

Venns_World.wld



- F 1. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,d)$

- F 2. $(\text{LeftCl}(a,d) \vee \text{RightCl}(a,d)) \rightarrow \text{Cube}(a)$

- F 3. $\text{Between}(c,a,d) \vee \text{Between}(c,a,e)$

- F 4. $\text{Small}(c) \rightarrow \text{RightCl}(c,a)$

- F 5. $\text{RightCl}(c,d) \rightarrow (\text{RightCl}(b,c) \wedge \text{LeftCl}(b,e))$

- F 6. $\text{Tet}(e) \rightarrow (\text{RightCl}(e,b) \leftrightarrow \text{FrontCl}(e,b))$

- F 7. $\text{Dodec}(b) \rightarrow \text{SameRow}(b,d)$

- F 8. $\text{BackCl}(c,a) \wedge \text{FrontCl}(c,e)$

- F 9. $\text{FrontCl}(e,d) \wedge \neg \text{Tet}(e) \wedge \neg \text{Large}(e)$

- F 10. $\text{Cube}(a) \vee \text{Cube}(c) \vee \text{Cube}(e)$

- F 11. $\text{Tet}(a) \rightarrow \text{FrontCl}(a,b)$

- F 12. $\text{Larger}(b,a) \wedge \text{Larger}(b,e)$

- F 13. $\text{SameSize}(a,e) \wedge \text{Larger}(a,c) \wedge \text{Larger}(e,c)$

- F 14. $\text{SameShape}(d,b) \rightarrow \text{SameSize}(d,b)$

- F 15. $\text{Large}(a) \leftrightarrow \text{Cube}(a)$

- F 16. $\text{Cube}(b) \leftrightarrow \neg \text{Tet}(c)$

- F 17. $\neg \text{Cube}(e) \rightarrow (\text{Large}(b) \vee \text{Large}(d))$

- F 18. $(\neg \text{Tet}(a) \vee \neg \text{Tet}(c)) \rightarrow (\text{Cube}(b) \vee \text{Cube}(d))$

- F 19. $\text{Large}(a) \leftrightarrow \text{Small}(d)$

- F 20. $\text{Large}(a) \leftrightarrow \text{Large}(e)$

Evaluating in Venns_World.wld

- Explain the changes you made in your translated sentences for Exercise 2.14. If you did not need to make any changes, explain why.

ทำการเปลี่ยนข้อ 7 จาก $(\text{Dodec}(b) \rightarrow \neg \text{FrontOf}(b,d)) \wedge (\text{Dodec}(b) \rightarrow \neg \text{BackOf}(b,d))$ เป็น $(\text{Dodec}(b) \rightarrow \text{SameRow}(b,d))$ ซึ่งสามารถใช้งานได้เนื่องจากประโยคเริ่มต้นหมายถึงการอยู่ในแถวเดียวกัน

ข้อ 18 จาก $(\text{Cube}(b) \vee \text{Cube}(d)) \rightarrow (\text{Tet}(a) \vee \text{Tet}(c))$ ซึ่งทำให้ผิดเมื่อตรวจสอบกับ *Leibnizs_world* และ *Venns_world* เนื่องจาก if either จะนำประโยคหลัง if either มาทำการสร้างประพจน์ก่อนที่จะกระทำการให้เหตุผลประโยคหน้า

F 18. $(\text{Cube}(b) \vee \text{Cube}(d)) \rightarrow (\text{Tet}(a) \vee \text{Tet}(c))$
Evaluating in Leibnizs_World.wld

ใน *Leibnizs_world* ในกรณีที่ถูกต้องจะได้ T แต่ผลลัพธ์ที่ได้ออกมาเป็น F

T 18. $(\text{Cube}(b) \vee \text{Cube}(d)) \rightarrow (\text{Tet}(a) \vee \text{Tet}(c))$
Evaluating in Venns_World.wld

ใน *Venns_world* ในกรณีที่ถูกต้องจะต้องได้ F แต่ผลลัพธ์ที่ได้ออกมาเป็น T

และทำการแก้เป็น $(\text{Tet}(a) \vee \text{Tet}(c)) \rightarrow (\text{Cube}(b) \vee \text{Cube}(d))$ ทำให้ผลลัพธ์นั้นถูกต้อง