Submission 2.1

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1 Translate into English

1. For all x and y, if x is a person and y is a time, and x is down and out at time y, then there does not exist a person z that knows x at time y.
   If x is down and out at y, then nobody knows him at that time.

2 Translate into quantificational logic

1. W_x: x is well
   E_x: x ends well
   $\forall_x(E_x \implies W_x)$

2. S_x: x is seen
   T_x: x is temporal
   E_x: x is eternal
   $\forall_x((S_x \implies T_x) \wedge (\neg S_x \implies E_x))$

3. B_x: x is an object in B
   A_x: x is an object in A
   $\forall_x(A_x \implies B_x)$

4. A_x: x is an object in A
   B_x: x is an object in B
   $\forall_x((A_x \implies \neg B_x) \wedge (B_x \implies \neg A_x))$

5. A_x: x is an object in A
   B_x: x is an object in B
   $\exists_x(A_x \wedge B_x)$

6. Y_x: x loves themself
   A_x: x loves anybody else
   $\forall_x(\neg Y_x \implies \neg A_x)$

7. A_x: x is the best band ever!
   N_x: x is N' Sync
   $\forall_x(N_x \iff A_x)$

3 Section 2.8.3

11. L_{xy}:x loves y
    $\exists_x \forall_y (L_{xy})$

12. F_{xy}:x is for y
    $\forall_y \exists_x (F_{xy})$

13. L_{xy}:x loves y
    S_x: x is Scrooge
    $\exists_x \forall_y (S_x) \land \neg (L_{sy})$

14. S_x: x is shallow
    K_x: x knows himself
    $\forall_x (S_x \iff K_x)$

15. M_x: x has a mother
    $\forall_x (M_x)$

19. P_x: x is a pig
    $\exists_x \exists_y ((x \neq y) \land P_x \land P_y)$

20. P_x: x is a pig
    $\exists_x \exists_y ((x \neq y) \land P_x \land P_y \land \neg \exists_z ((x \neq z) \land (y \neq z)))$

21. P_x: x is a pig
    $(\exists_x \exists_y) \implies ((x \neq y) \land P_x \land P_y \land \neg \exists_z ((x \neq z) \land (y \neq z)))$

4 Section 2.8.4

1.

a C_{xy}: x is caused by y

$$\frac{\forall_y \exists_x (C_{xy})}{\exists_y \forall_x (C_{xy})}$$

2.

a H_{xy}: x hates y
f: Fred
a: Al

$$\frac{\begin{array}{l}\forall_x (H_{xa} \implies H_{fx}) \\ \forall_x H_{ax}\end{array}}{H_{af} \land H_{fa}}$$

3.

a L_x: x is large and hostile
I_x: x is impervious to pesticides

i: An insect in this house

$$\begin{array}{l} \forall_i(L_i) \\ \exists_i(I_i) \\ \hline \exists_i(L_i \wedge I_i) \end{array}$$

4.

a S_x: x can succeed at the university

B_x: x is bright

M_x: x is mature

s: student

$$\begin{array}{l} \exists_s \neg S_s \\ (B_s \wedge M_x) \implies (S_s) \\ \hline \exists_x(\neg B_x \vee \neg M_x) \end{array}$$

5.

a P_x: x is a pig

$$\begin{array}{l} \exists_x \exists_y \exists_z((x \neq y) \wedge (x \neq z) \wedge (z \neq y) \wedge P_x \wedge P_y \wedge P_z) \\ \hline \exists_x \exists_y((x \neq y) \wedge P_x \wedge P_y) \end{array}$$

6.

a L_{xy}: x likes y

p: Popeye

o: Olive Oyl

$$\begin{array}{l} \forall x(L_{xo} \implies L_{px}) \\ \forall x(L_{ox}) \\ \hline L_{po} \wedge L_{op} \end{array}$$

7.

a S_x: x is sound

C_x: x has a true conclusion

a: this argument

$$\begin{array}{l} \neg C_a \\ \neg \exists_x(S_x \wedge \neg C_x) \\ \hline \neg S_a \end{array}$$

8.

a O_x: x weighs over 200 pounds

j: Jones' killer

s: Smith

$$\begin{array}{l} O_j \\ \neg O_s \\ \hline O_s \neq O_j \end{array}$$

9.

a L_{xy}: x likes y

m: mandy

a: andy

$$\begin{array}{l} \forall_x(L_{xm}) \\ \forall_x(L_{mx} \iff (x = a)) \\ \hline m = a \end{array}$$

10.

a A_{xy}: x if afraid of y
h: Mr. Hyde
j: Dr. Jekyll

$$\begin{array}{l} \forall_x (A_{xh}) \\ \underline{\forall_x (A_{hx} \iff (x = j))} \\ j = h \end{array}$$

5 Section 2.8.5

1.

a This argument is invalid.

b Assume the premises are true. Consider a case in which x is not in F or H, but is in G. This does not contradict any of the premises, because none of the premises have a true antecedent. However, this contradicts the conclusion because its antecedent is true but its consequent is false. Therefore, the argument is valid.

2.

a This argument is valid.

3.

a This argument is invalid.

b Assume the premises are true. Consider a case in which x is a part of G but not a part of F. This does not contradict the premise because that premise's antecedent is false. This does contradict the conclusion because its antecedent is true but its consequent is false. Therefore, the argument is invalid.

4.

a This argument is invalid.

b Assume the premises are true. Consider a case in which x is a part of F and H, but not G. Because x is not a part of both F and G, the first premise is still true. Because the antecedent of the second premise is false, it is also still true. However, because the antecedent of the conclusion is true, but its consequent is false, the conclusion is false. Therefore, the argument is invalid.