

Exercises in Existential Quantification
PHI 154 (Eliot)

domain: people

$F(x)$: _____ x is famous

$P(x)$: _____ x is a professor

$T(x)$: _____ x has a television

$K(x, y)$: _____ x knows who _____ y is

j : Joe Biden

t : Taylor Swift

d : Doris (who cooks at Bits & Bytes)

Translate these from First-order Logic into English using the provided key. Think about them literally first, and then think whether there is a more natural way to express them in English:

1. $F(t) \wedge F(j)$
2. $T(t) \wedge F(t)$
3. $\neg P(t) \wedge K(t, j)$
4. $K(j, t) \rightarrow \neg P(t)$
5. $K(t, t) \wedge \neg K(j, j)$
6. $\neg F(d) \wedge \neg(K(j, d) \vee K(t, d))$
7. $K(j, t) \leftrightarrow T(j)$
8. $\exists x \neg F(x)$
9. $\neg \exists x F(x)$
10. $\neg \exists y \neg T(y)$
11. $\exists z (P(z) \wedge \neg F(z))$
12. $\exists z \neg (P(z) \wedge F(z))$
13. $\neg \exists z (P(z) \wedge F(z))$
14. $\exists y F(y) \wedge \exists x P(x)$
15. $\exists x K(x, j) \rightarrow K(d, j)$
16. $\exists x \neg K(d, x) \wedge K(d, t)$
17. $\exists x (P(x) \wedge \neg K(x, t))$
18. $\exists x (\neg K(x, t) \wedge P(x))$
19. $\neg \exists y (P(y) \wedge (\neg T(y) \wedge \neg K(y, t)))$
20. $\neg \exists z \neg (P(z) \vee T(z))$
21. $[\exists x \neg T(x) \rightarrow \exists y \neg K(y, j)] \wedge [\exists y \neg K(y, j) \rightarrow \exists z \neg K(z, t)]$
22. $\neg \exists x \neg T(x) \rightarrow \neg \exists y (\neg K(y, j) \wedge \neg K(y, t))$

23. $\neg\exists x\neg K(x, j) \vee [\exists x\neg K(x, j) \rightarrow \neg\exists yT(y)]$
24. $\exists y[P(y) \wedge (K(y, t) \leftrightarrow T(y))]$
25. $\exists y[(F(y) \wedge P(y)) \wedge [(T(y) \vee \neg T(y)) \rightarrow K(y, t)]]$
26. $\exists z(K(z, d) \wedge K(z, t)) \rightarrow \exists y(P(y) \wedge T(y))$

Translate from English into First-order Logic:

1. Doris isn't famous, but Taylor Swift is.
2. Taylor Swift is famous, but she is not a famous professor.
3. Taylor Swift is famous if and only if Joe Biden is.
4. Though Doris isn't famous, someone is.
5. Someone is famous and they have a TV.
6. Taylor Swift is famous only if someone has a TV.
7. Nobody is famous.
8. Somebody is not famous.
9. No one isn't famous.
10. Someone is neither famous nor a professor.
11. Someone is a non-famous professor only if someone is not famous.
12. There are no non-famous professors who own televisions.
13. Someone isn't a professor and isn't famous, but knows Taylor Swift.
14. If Taylor Swift doesn't know who she is, she doesn't have a TV or she's not famous.
15. If no one is famous and no one owns a TV, no one knows who Taylor Swift is.
16. Someone who doesn't have a TV is a famous professor.
17. If there's a professor who doesn't have a TV, there's someone who doesn't know who Taylor Swift is.
18. If Joe Biden doesn't know who Doris is, then at least some professors do.
19. There are no professors who don't know who Joe Biden is.
20. Some professors don't know who Taylor Swift is just in case some professors neither have televisions nor know who Joe Biden is.
21. If Joe Biden knows who Taylor Swift is, then there's nobody who doesn't know who Taylor Swift is.
22. There's a famous professor who knows who both Taylor Swift and Joe Biden are if and only if there's a famous professor who has a television.