

Assignment 5

Question 8.10

- a) $Occupation(Emily, Surgeon) \vee Occupation(Emily, Lawyer)$
- b) $\exists o (o \neq Actor) Occupation(Joe, Actor) \wedge Occupation(Joe, o)$
- c) $\forall p Occupation(p, Surgeon) \rightarrow Occupation(p, Doctor)$
- d) $\neg \exists p Occupation(p, Lawyer) \wedge Customer(Joe, p)$
- e) $\exists p Occupation(p, Lawyer) \wedge Boss(p, Emily)$
- f) $\exists p1 Occupation(p1, Lawyer) \wedge \forall p2 (p2, p1) \rightarrow occupation(p2, Doctor)$
- g) $\forall p1 Occupation(p1, Surgeon) \rightarrow \exists p2 Occupation(p2, Lawyer) \wedge Customer(p1, p2)$

Question 8.19

- a) $\exists x parent(Joan, x) \wedge female(x)$
- b) $\exists' x parent(Joan, x) \wedge female(x)$
- c) $\exists' x parent(Joan, x) \wedge female(x) \wedge (\forall y parent(Joan, y) \rightarrow x = y)$
- d) $\exists' x parent(Joan, x) \wedge parent(Kevin, x)$
- e) $\exists x parent(Joan, x) \wedge parent(Joan, y) \leftrightarrow \forall y \neg parent(Joan, y)$

Question 8.20

- a) $\forall x even(x) \leftrightarrow \exists y x = y + y$
- b) $\forall x prime(x) \leftrightarrow \exists y, z x = y * z \rightarrow (y = 1 \wedge z = x) \vee (y = x \vee z = 1)$
- c) $\forall x even(x) \rightarrow \exists y, z (x = y + z) \wedge prime(y) \wedge prime(z)$

Question 8.22

$$\forall x \text{ Key}(x) \rightarrow (\exists t \text{ Before}(\text{Now}, t) \wedge \forall t_{\text{future}} \text{ Before}(t, t_{\text{future}}) \rightarrow \text{Lost}(x, t_{\text{future}}))$$

The above statement states that for all keys, there is a certain time t that is after now, and the key will be lost for all time points that is after t .

$$\begin{aligned} \forall y, z \text{ Sock}(y) \wedge \text{Sock}(z) \wedge \text{Pair}(y, z) \\ \rightarrow \left((\exists t_1 \text{ Before}(\text{Now}, t_1) \wedge \forall t \text{ Before}(t_1, t) \rightarrow \text{Lost}(y, t)) \right. \\ \left. \vee (\exists t_2 \text{ Before}(\text{Now}, t_2) \wedge \forall t \text{ Before}(t_2, t) \rightarrow \text{Lost}(z, t)) \right) \end{aligned}$$

The above statement says that there are two socks, and that at least one of these socks will be lost at a random time from now. Either y can be lost or z can be lost, or even both.

Question 8.28

- a) $\text{Wrote}(\text{Gershwin}, \text{"The man i love"})$
- b) $\neg \text{Wrote}(\text{Gershwin}, \text{Eleanor Rigby})$
- c) $\text{Wrote}(\text{Gershwin}, \text{"The Man I Love"}) \vee \text{Wrote}(\text{McCartney}, \text{"The Man I Love"})$
- d) $\exists s \text{ Wrote}(\text{Joe}, s)$
- e) $\exists d \text{ Owns}(\text{Joe}, d) \wedge \text{CopyOf}(d, \text{Revolver})$
- f) $\forall s \text{ Sings}(\text{McCartney}, s, \text{Revolver}) \rightarrow \text{Wrote}(\text{McCartney}, s)$
- g) $\exists p \forall s \text{ Sings}(p, s, \text{Revolver}) \wedge \neg \text{Wrote}(\text{Gershwin}, s)$
- h) $\forall s \text{ Wrote}(\text{Gershwin}, s) \rightarrow \exists a, p \text{ Sings}(p, s, a)$
- i) $\forall s \text{ Wrote}(\text{Joe}, s) \rightarrow \exists' a \exists p \text{ Sings}(p, s, a)$
- j) $\exists a \text{ Sings}(\text{Billie Holiday}, \text{The Man I Love}, a) \rightarrow \exists d \text{ Owns}(\text{Joe}, d) \wedge \text{CopyOf}(d, a)$
- k) $\forall a \exists s \text{ Sings}(\text{McCartney}, s, a) \rightarrow \exists d \text{ Owns}(\text{Joe}, d) \wedge \text{CopyOf}(d, a)$
- l) $\forall a \forall s \text{ Sings}(\text{Billy Holiday}, s, a) \rightarrow \exists d \text{ Owns}(\text{Joe}, d) \wedge \text{CopyOf}(d, a)$