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Prof. Balduccini
CS 380
Assignment 5

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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

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

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.

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

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) $Wrote(Gershwin, \text{"}The\ man\ i\ love\text{"})$

b) $\neg Wrote(Gershwin,$ Eleanor Rigby$)$

c) $Wrote(Gershwin,$ "The Man I Love"$) \vee Wrote(McCartney,$ "The Man I Love"$)$

d) $\exists s\ Wrote(Joe, s)$

e) $\exists d\ Owns(Joe, d) \wedge CopyOf(d, Revolver)$

f) $\forall s\ Sings(McCartney, s, Revolver) \rightarrow Wrote(McCartney, s)$

g) $\exists p \forall s\ Sings(p, s, Revolver) \wedge \neg Wrote(Gershwin, s)$

h) $\forall s\ Wrote(Gershwin, s) \rightarrow \exists a, p\ Sings(p, s, a)$

i) $\forall s\ Wrote(Joe, s) \rightarrow \exists' a\ \exists p\ Sings(p, s, a)$

j) $\exists a\ Sings(Billie\ Holiday, The\ Man\ I\ Love, a) \rightarrow \exists d\ Owns(Joe, d) \wedge CopyOf(d, a)$

k) $\forall a\ \exists s\ Sings(McCartney, s, a) \rightarrow\ \exists d\ Owns(Joe, d) \wedge CopyOf(d, a)$

l) $\forall a\ \forall s\ Sings(Billy\ Holiday, s, a) \rightarrow \exists d\ Owns(Joe, d) \wedge CopyOf(d, a)$