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ECE 369 Homework 1
Proposition and Predicate Logic

Exercise 1.1
Problems:
3. (a) true
3. (b) false
3. (e) true
3. (f) false

8. (a) $\neg$PF $\cup$ PF
8. (c) PF $\cap$ $\neg PS$
8. (f) $\neg$PF $\cap$ $\neg FD$

13. (a) $H \rightarrow K$
13. (c) $K \rightarrow H$
13. (d) $K \leftrightarrow A$

Exercise 1.2
Problems

42.
1. $C \rightarrow \neg F$ hyp
2. $F \rightarrow \neg S$ hyp
3. $S \rightarrow \neg F$ hyp
4. $\neg F \rightarrow S$ hyp
5. C hyp
6. $\neg F$ 1, 3, mp
7. S 4, 6,mp

47.
1. $(J \cup L) \rightarrow C$ hyp
2. $\neg T$ hyp
3. $C \rightarrow T$ hyp
4. $(J \cup L) \rightarrow T$ 1, 3, hs
5. $\neg (J \cup L)$ 4, 2, mt
6. $\neg J \cap \neg L)$ 5, De Morgan's Law
7. $\neg J$ 6, sim

Exercise 1.3
Problems
2. (e) true, if y = 0;
2. (f) true,
2. (h) false, if x = 0;

11. (a) $(\exists x)[P(x) \rightarrow (\forall y)\big(T(y) \rightarrow F(x,y)\big)]$

(b) $(\forall x)[P(x) \rightarrow (\exists y)\big(T(y) \rightarrow F(x,y)\big)])$

(c) $\neg\{(\forall x)\big[P(x) \rightarrow (\exists y)\big(T(y) \rightarrow F(x,y)\big)\big]\}$

16. (a) $(\forall x)\big[B(x) \rightarrow (\forall y)\big(F(y) \rightarrow L(x,y)\big)\big]$

16. (i) $(\forall x)[F(x) \rightarrow (\exists y)\big(B(y) \rightarrow F(x,y)\big)]$

16. (l) $(\forall x)[F(x) \rightarrow (\exists y)\big(B(y) \rightarrow F(x,y)\big)]$

Exercise 1.4

F: Flowers
P: Flowers are purple
R: Flowers are red
PA: Pansies
4. 1. $(\exists x)[F(x) \rightarrow R(x)]$ hyp
2. $(\exists x)[F(x) \rightarrow P(x)]$ hyp
3. $(\forall x)[PA(x) \rightarrow F(x)]$ hyp
4. $PA(x) \rightarrow F(x)$ 3, ui
5. $[F(a) \rightarrow R(a)]$ 1, ei
6. $[F(a) \rightarrow P(a)]$ 2, ei
7. $PA(a) \rightarrow R(a)$ 4, 5, hs
8. $PA(a) \rightarrow P(a)$ 4, 6, hs
9. $(\exists x)[PA(x) \rightarrow P(x)]$ 7, eg
10. $(\exists x)[PA(x) \rightarrow P(x)]$ 8, eg
Some pansies are Purple.
Some pansies are red.

PI: Flowers are pink
TH: Flowers have thorns
B: Bad smell.
W: Weed

5. 1. $(\exists x)[F(x) \cap TH(x)]$ hyp
   2. $(\forall x)[TH(x) \rightarrow B(x)]$ hyp
   3. $(\forall x)[B(x) \rightarrow W(x)]$ hyp
   4. $[F(a) \cap TH(a)]$ 1, ei
   5. $F(a)$, $TH(a)$ 4, sim
   6. $TH(x) \rightarrow B(x)$ 2, ui
   7. $B(x) \rightarrow W(x)$ 3, ui
   8. $B(a)$ 5, 6, mp
   9. $W(a)$ 7, 8, mp
   10. $(\exists x)[W(x)]$ 9, eg

   Some flowers smell bad.

9. (a) Let Q (x, y): x talks to y

$(\forall y)(\exists x)Q(x, y)$:

Everybody is talked by someone, but someone can be different person.

$(\exists x)(\forall y)Q(x, y)$:

Someone talks to everyone. Someone should be the same person.

So $(\forall y)(\exists x)Q(x, y)$ cannot imply $(\exists x)(\forall y)Q(x, y)$.

(b) The step4 to step5 is wrong.

4. $(\forall y)Q(a, y)$ 3, ug
5. $(\forall y)(\exists x)Q(x, y)$ 4,eg

The above is the right deduction.

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1.	$(\exists x)(M(x) \rightarrow (\forall y)(R(x,y))$	hyp
2.	$(\forall x)(\forall y)(R(x,y) \rightarrow T(x,y))$	hyp
3.	$(\exists x)M(x)$	hyp
4.	$(M(a) \rightarrow (\forall y)(R(a,y))$	1, ei
5.	$(M(a) \rightarrow (R(a,y))$	4, ui
6.	$R(x,y) \rightarrow T(x,y)$	2, ui
7.	$M(a,y) \rightarrow T(a,y)$	5, 6, hs
8.	$(\exists x)(M(x) \rightarrow (T(x,y))$	6, 7, eg
9.	$(\exists x)(M(x) \rightarrow (\forall y)(T(x,y))$	8, ug

37.

1.	$(\forall x)(F(x) \rightarrow (\exists y)\big(C(y) \rightarrow O(x,y)\big))$	hyp
2.	$(\forall x)(D(x) \rightarrow (\forall y)\big(C(y) \rightarrow \neg O(x,y)\big))$	hyp
4.	$F(x) \rightarrow (\exists y)\big(C(y) \rightarrow O(x,y)\big)$	1, ui
5.	$F(x) \rightarrow \big(C(a) \rightarrow O(x,a)\big)$	4, ei
6.	$D(x) \rightarrow (\forall y)\big(C(y) \rightarrow \neg O(x,y)\big)$	2, ui
7.	$D(x) \rightarrow \big(C(y) \rightarrow \neg O(x,y)\big)$	6, ei
8.	$\big(D(x) \rightarrow \neg O(x,y)\big)$	7, hs
9.	$\big(O(x,y) \rightarrow \neg D(x)\big)$	9, cont
10.	$\big(F(x) \rightarrow O(x,a)\big)$	6, hs
11.	$(F(x) \rightarrow \neg D(x))$	9, 10, hs
12.	$(\forall x)(F(x) \rightarrow \neg D(x))$	11, ug

Problem I:

Wrong

$A \cup (B \cap C) = (A \cup B) \cap (A \cup C) \neq ((A \cup B) \cap C)$

Problem II:

(i) $(\forall x)(P(x) \rightarrow \neg I(x))$

(ii) $(\forall x)(I(x) \rightarrow V(x))$

(iii) $(\forall x)(V(x) \rightarrow \neg P(x))$

No.

Because not only ignorant people can be vain, suppose good person also can be vain. Then Professor can be good person. So professor can be vain.