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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) $(\exists x)[P(x) \to (\forall y)(T(y) \to F(x,y))]$

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

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

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

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

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

Exercise 1.4

F: Flowers
P: Flowers are purple
R: Flowers are red
PA: Pansies
4. 1. $(\exists x)[F(x) \to R(x)]$ hyp
2. $(\exists x)[F(x) \to P(x)]$ hyp
3. $(\forall x)[PA(x) \to F(x)]$ hyp
4. $PA(x) \to F(x)$ 3, ui
5. $[F(a) \to R(a)]$ 1, ei
6. $[F(a) \to P(a)]$ 2, ei
7. $PA(a) \to R(a)$ 4, 5, hs
8. $PA(a) \to P(a)$ 4, 6, hs
9. $(\exists x)[PA(x) \to P(x)]$ 7, eg
10. $(\exists x)[PA(x) \to P(x)]$ 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. $(\forall x)[TH(x) \to B(x)]$ hyp
   3. $(\forall x)[B(x) \to W(x)]$ hyp
   4. $[F(a) \cap TH(a)]$ 1, ei
   5. $F(a)$, $TH(a)$ 4, sim
   6. $TH(x) \to B(x)$ 2, ui
   7. $B(x) \to W(x)$ 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.

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

37. 1. $(\forall x)(F(x) \to (\exists y)\big(C(y) \to O(x,y)\big))$ hyp

2. $(\forall x)(D(x) \to (\forall y)\big(C(y) \to \neg O(x,y)\big))$ hyp

4. $F(x) \to (\exists y)\big(C(y) \to O(x,y)\big)$ 1, ui

5. $F(x) \to \big(C(a) \to O(x,a)\big)$ 4, ei

6. $D(x) \to (\forall y)\big(C(y) \to \neg O(x,y)\big)$ 2, ui

7. $D(x) \to \big(C(y) \to \neg O(x,y)\big)$ 6, ei

8. $\big(D(x) \to \neg O(x,y)\big)$ 7, hs

9. $\big(\mathrm{O}(x,y) \to \neg D(x)\big)$ 9, cont

10. $\big(F(x) \to O(x,a)\big)$ 6, hs

11. $(F(x) \to \neg D(x))$ 9, 10, hs
12. $(\forall x)(F(x) \to \neg D(x))$ 11, ug

Problem I:

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

Problem II:

(i) $(\forall x)(\mathrm{P}(x) \to \neg I(x))$
(ii) $(\forall x)(I(x) \to V(x))$
(iii) $(\forall x)(V(x) \to \neg P(x))$

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.