

Issac Zheng  
Jackey Yang

I pledge my honor that I have abided by the Stevens Honor System

CS135

Problem Set 1

1/25

1) a)  $\neg(\neg p \wedge (p \vee q)) \vee (r \wedge q)$   
 $\uparrow$   
 $((\neg p \wedge (p \vee q)) \rightarrow (r \wedge q)) \neq (p \vee q)$

p	q	r	$((\neg p \wedge (p \vee q)) \rightarrow (r \wedge q))$	$(p \vee q)$
T	T	T	T	T
T	T	F	T	T
T	F	T	T	T
T	F	F	T	T
F	T	T	T	T
F	T	F	F	T
F	F	T	T	F
F	F	F	T	F

not equivalent  
these  
combinations

b)  $(\neg p \vee q) \wedge (\neg q \vee p)$   
 $\uparrow$   
 $((p \rightarrow q) \wedge (q \rightarrow p))$   $(p \vee (\neg p \vee q)) \vee \neg q$

p	q	$((p \rightarrow q) \wedge (q \rightarrow p))$	$(p \vee (\neg p \vee q)) \vee \neg q$
T	T	T	T
T	F	F	T
F	T	F	T
F	F	T	T

not equivalent

c)  $\neg p \wedge (q \vee \neg(r \vee t))$   
 $\uparrow$   
 $\neg(p \vee \neg(q \vee \neg(r \vee t)))$   $(\neg p \vee \neg q) \vee (r \vee t)$

p	q	r	t	$\neg(p \vee \neg(q \vee \neg(r \vee t)))$	$(\neg p \vee \neg q) \vee (r \vee t)$
T	T	T	T	F	F
T	T	T	F	F	T
T	T	F	T	F	T
T	T	F	F	F	T
T	F	T	T	F	T
T	F	T	F	F	T
T	F	F	T	F	T
T	F	F	F	F	T
F	T	T	T	T	T
F	T	T	F	T	T
F	T	F	T	T	T
F	T	F	F	T	T
F	F	T	T	F	T
F	F	T	F	F	T
F	F	F	T	F	T
F	F	F	F	T	T

not equivalent

not equivalent

$$\neg(p \vee \neg(q \vee \neg(r \vee t))) \equiv \neg(p \vee \neg(q \vee \neg(r \wedge \neg t))) \equiv \neg(p \vee (\neg q \wedge \neg(\neg r \wedge \neg t)))$$

$$\equiv \neg(p \vee (\neg q \wedge (\neg r \vee \neg \neg t))) \equiv (\neg p \wedge \neg(\neg q \wedge (\neg r \vee \neg t))) \equiv (\neg p \wedge (q \vee \neg(\neg r \vee \neg t)))$$

$$\equiv \neg p \wedge (q \vee \neg(r \vee t))$$

CS135

## Problem Set 1

1/26

- 2) a)  $P$  only if  $Q \equiv P \rightarrow Q \equiv (\neg P \vee Q)$  a: iff:  $P \quad Q \quad P \rightarrow Q$   
 b)  $P$  unless  $Q \equiv \neg Q \rightarrow P \equiv (Q \vee P)$   $T \quad T \quad T$   
 c)  $P$  is sufficient for  $Q \equiv P \rightarrow Q \equiv (\neg P \vee Q)$   $T \quad F \quad T$   
 d)  $P$  is necessary for  $Q \equiv Q \rightarrow P \equiv (\neg Q \vee P)$   $F \quad T \quad T$   
 e)  $P$  whenever  $Q \equiv Q \rightarrow P \equiv (\neg Q \vee P)$   $F \quad F \quad F$

$$(P \rightarrow Q) \wedge (Q \rightarrow P)$$

- 3) a) let  $P$  = the hero is large  
 let  $Q$  = the hero is green  
 let  $R$  = the hero has layers like an onion  
 $\bullet ((P \wedge Q) \wedge R)$

$$P \quad Q \quad P \text{ unless } Q$$

$$T \quad T \quad F$$

$$T \quad F \quad T$$

$$F \quad T \quad T$$

$$F \quad F \quad F$$

- b) let  $P$  = the muth man lives on Diny Lane  
 let  $Q$  = lives in Duloc  
 let  $R$  = has all fairies

$$\bullet P \rightarrow (Q \wedge R)$$

$$P \leftrightarrow Q$$

$$(P \rightarrow Q) \wedge (Q \rightarrow P)$$

$$(\neg P \vee Q) \wedge (\neg Q \vee P)$$

- c) let  $P$  = the hero accepts the quest  
 let  $Q$  = he will fight a dragon  
 let  $R$  = he will get his swamp back  
 $\bullet P \rightarrow (Q \wedge R)$

- d) let  $P$  = a princess will turn green  
 let  $Q$  = she is cursed  
 let  $R$  = sun goes down

$$\bullet (P \vee (Q \wedge R)) \wedge (\neg (Q \wedge R) \vee P) \equiv P \leftrightarrow (Q \wedge R)$$

- 4)  $P \quad Q \quad R \quad ((P \rightarrow Q) \wedge (Q \rightarrow R)) \rightarrow (P \rightarrow R) \quad \bullet \neg((\neg P \vee Q) \wedge (\neg Q \vee R)) \vee (\neg P \vee R)$   
 $T \quad T \quad T \quad T \quad \hookrightarrow (\neg(\neg P \vee Q) \vee \neg(\neg Q \vee R)) \vee (\neg P \vee R)$   
 $T \quad T \quad F \quad T \quad \hookrightarrow ((\neg \neg P \wedge \neg Q) \vee (\neg \neg Q \wedge \neg R)) \vee (\neg P \vee R)$   
 $T \quad F \quad T \quad T \quad \hookrightarrow (P \wedge \neg Q) \vee (Q \wedge \neg R) \vee (\neg P \vee R)$   
 $T \quad F \quad F \quad T \quad \rightarrow \text{tautology}$   
 $F \quad T \quad T \quad T$   
 $F \quad T \quad F \quad T$   
 $F \quad F \quad T \quad T$   
 $F \quad F \quad F \quad T$

5)  $D \rightarrow \neg W$

$D \rightarrow W \equiv \neg W \rightarrow \neg D$  contrapositive

$P \rightarrow D$

$\neg P \rightarrow D \rightarrow \neg W \rightarrow \neg D \equiv P \rightarrow \neg D$

6) a) let  $p$  = someone is sane,  $q$  = someone can do logic,  
 $r$  = someone is fit to serve on a jury,  $s$  = someone is your son.

$p \rightarrow q$ ,  $\neg q \rightarrow \neg p$  goal:  $\neg s \rightarrow \neg r$

$\neg p \rightarrow \neg r$

$q \rightarrow \neg s$ ,  $s \rightarrow \neg q$

$\rightarrow s \rightarrow \neg q \rightarrow \neg p \rightarrow \neg r$

$\Rightarrow s \rightarrow \neg r$

b) let  $a$  = someone is on train  $b$  = someone is from Sarasus

$c$  = someone is a knucklehead  $d$  = someone wears a mask

$e$  = someone is angry  $f$  = I avoid someone

$g$  = someone is a werewolf  $h$  = someone hawks at the moon

$i$  = someone tweets  $j$  = someone asks if i'm happy

$k$  = someone is from Jersey City  $l$  =

1)  $a \rightarrow b$

5)  $\neg f \rightarrow \neg e \rightarrow j \rightarrow a \rightarrow b \rightarrow i \rightarrow g \rightarrow h$

2)  $d \rightarrow \neg c$ ,  $c \rightarrow \neg d$

$j \rightarrow c \rightarrow \neg d \rightarrow \neg k$

3)  $e \rightarrow f$ ,  $\neg f \rightarrow \neg e$

$\rightarrow \neg f \rightarrow \neg k$

4)  $\neg h \rightarrow \neg g$ ,  $g \rightarrow h$

$\Rightarrow k \rightarrow f$

5)  $\neg i \rightarrow \neg b$ ,  $b \rightarrow i$

$\Rightarrow$  I avoid people from Jersey City

6)  $i \rightarrow a$

7)  $k \rightarrow d$ ,  $\neg d \rightarrow \neg k$

8)  $i \rightarrow g$

9)  $\neg j \rightarrow \neg e$ ,  $\neg e \rightarrow j$

10)  $h \rightarrow c$

goal:  $\rightarrow f$