Max Shi

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

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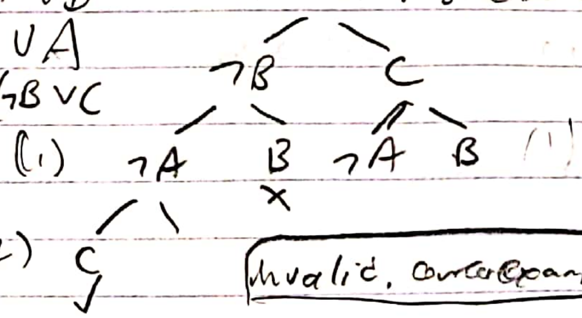
CS 135 Problem Set 2

1.a. (1) $A \to B \equiv \neg A \vee B$ $\qquad$ $\neg B \vee C$ negate conc.

(2) $\neg C \to A \equiv C \vee A$

$\therefore \neg(B \to C) \equiv \neg(\neg B \vee C)$



$\boxed{\text{Invalid, counterexample : } A = F,\ B = F,\ C = T}$

1b. (1) $U \to W \equiv \neg U \vee W$ $\qquad$ $\neg U \to \neg W$ conclusion

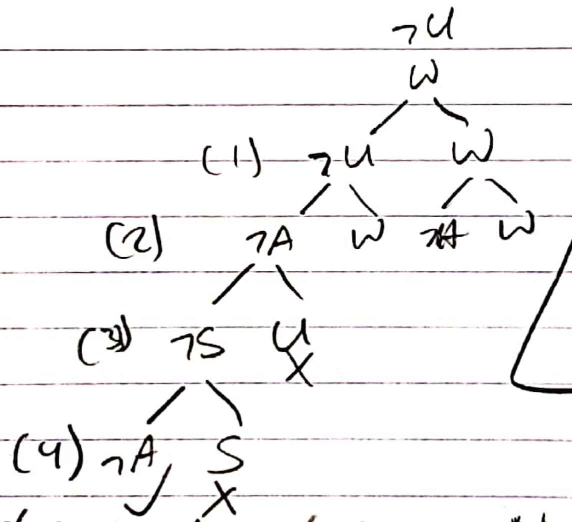
(2) $A \to W \equiv \neg A \vee W$ $\qquad$ $\neg\neg U \vee \neg W$ cond. identity

(3) $S \to U \equiv \neg S \vee U$ $\qquad$ $U \vee \neg W$ double negation

(4) $A \to S \equiv \neg A \vee S$ $\qquad$ $\neg(U \vee \neg W)$ negate conclusion

$\therefore \neg U \to \neg W$ $\qquad$ $\neg U \wedge \neg\neg W$ de Morgan's Laws

$\neg U \wedge W$ double negation



Invalid

counterexample:

$U = F$

$W = T$

$A = F$

$S = F$

1c $\longrightarrow$

2a. The domain of x is all people in the world, and the domain of d is all days spanning time.

b. $\forall d\, \exists x\ \mathrm{Loves}(x, \mathrm{Juliet}, d)$

c. $\forall d\ \neg \mathrm{Loves}(\mathrm{Iago}, \mathrm{Iago}, d)$

d. $\exists x\, \forall d\, \exists y\ (\mathrm{Loves}(x, y, d) \wedge \neg \mathrm{EQ}(x, y))$

e. $\forall x \forall d_1 \forall y \forall d_2 \forall z ((\mathrm{Loves}(x, y, d_1) \wedge \mathrm{Loves}(y, z, d_2)) \to \forall d_3 (\mathrm{Loves}(x, y, d_3) \wedge \mathrm{Future}(d_1, d_3)))$

f. $\forall x \forall y \forall d \forall z (\neg \mathrm{Loves}(y, x, d) \to \neg \mathrm{Loves}(x, z, d))$

g. $\forall x \forall y \forall z \forall d_1 \forall d_2 ((\mathrm{Loves}(x, y, d_1) \wedge \mathrm{Loves}(x, z, d_2) \wedge \mathrm{Future}(d_1, d_2)) \to (\forall d_3\ \mathrm{Future}(d_2, d_3) \wedge \neg \mathrm{Loves}(y, x, d_3)))$

1c. A: able to prevent evil
W: willing to prevent evil.
P: prevent evil
IM: impotent
M: malevolent
E: evil exists.
S: superman exists.

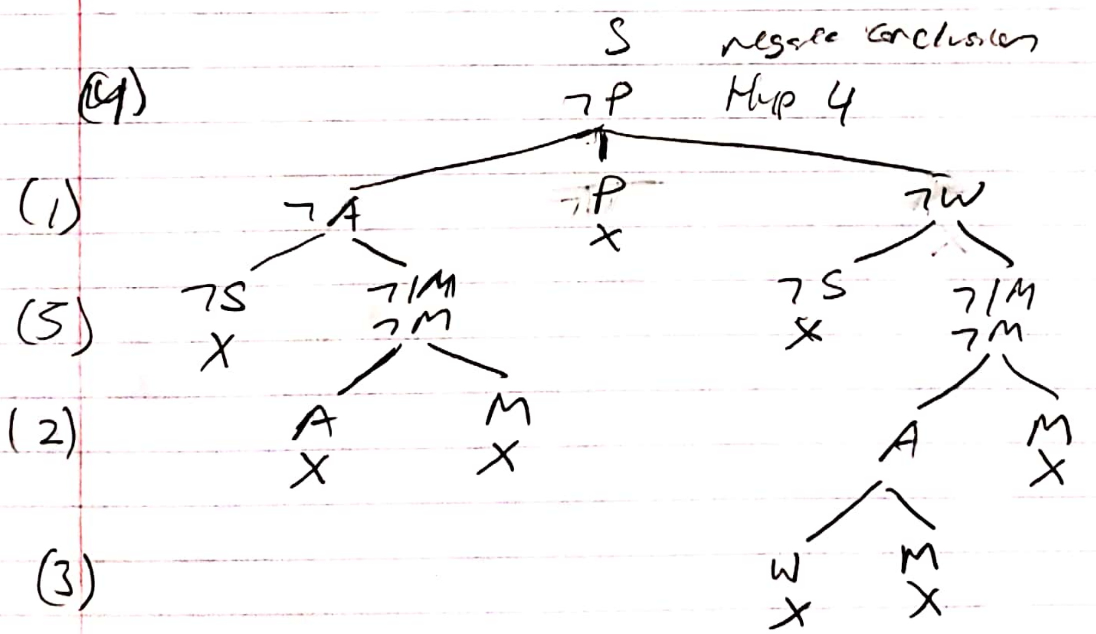
(1) $(A \wedge W) \to P$
(2) $\neg A \to IM$
(3) $\neg W \to M$
(4) $\neg P$
(5) $S \to (\neg IM \wedge \neg M)$
$\therefore \neg S$

$(A \wedge W) \to P$ Hyp 1
$\equiv \neg(A \wedge W) \vee P$ cond. identity
$\equiv \neg A \vee \neg W \vee P$ demorgan's law

$\neg A \to IM$ Hyp 2
$\equiv A \vee M$ cond identity

$\neg W \to M$ Hyp 3
$W \vee M$ cond. identity

$S \to (\neg IM \wedge \neg M)$ Hyp 5
$\neg S \vee (\neg IM \wedge \neg M)$ cond. identity



$\boxed{\checkmark \text{ Argument Valid}}$