

Assignment No. 11

Answer Key

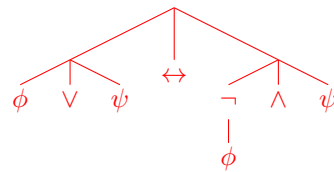
Christen N Madsen II

Due: Thursday 26 March 2015

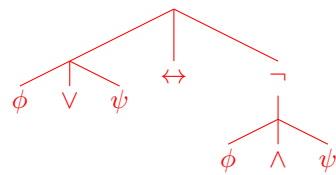
1 Scope

1. $\phi \vee \psi \leftrightarrow \neg\phi \wedge \psi$.

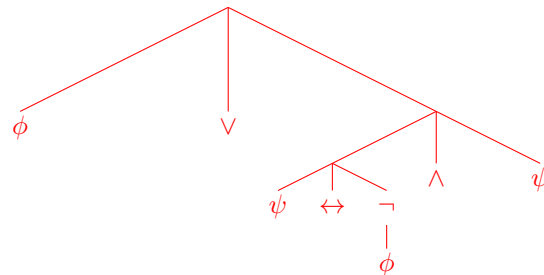
(a) $(\phi \vee \psi) \leftrightarrow ((\neg\phi) \wedge \psi)$ BICONDITIONAL



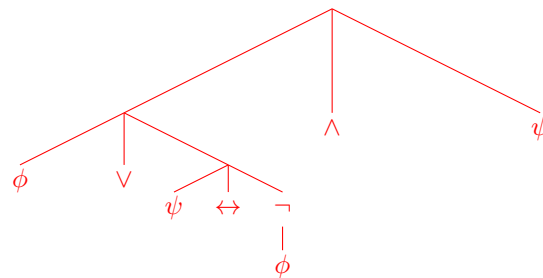
(b) $(\phi \vee \psi) \leftrightarrow \neg(\phi \wedge \psi)$ BICONDITIONAL



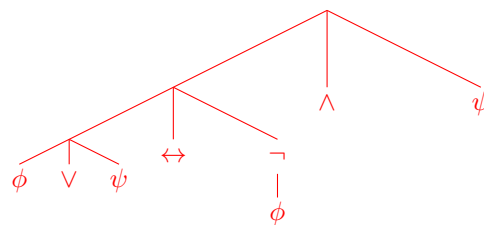
(c) $\phi \vee ((\psi \leftrightarrow (\neg\phi)) \wedge \psi)$ DISJUNCTION



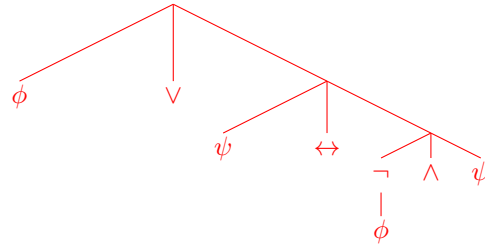
(d) $(\phi \vee (\psi \leftrightarrow (\neg\phi))) \wedge \psi$ CONJUNCTION



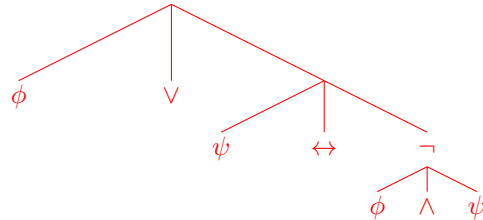
(e) $((\phi \vee \psi) \leftrightarrow (\neg\phi)) \wedge \psi$ CONJUNCTION



(f) $\phi \vee (\psi \leftrightarrow ((\neg\phi) \wedge \psi))$ DISJUNCTION

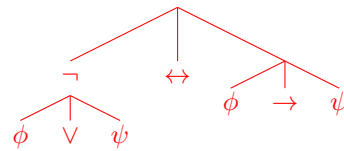


(g) $\phi \vee (\psi \leftrightarrow \neg(\phi \wedge \psi))$ DISJUNCTION

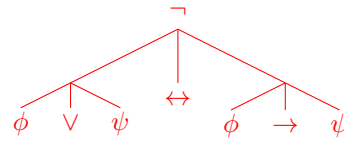


2. $\neg\phi \vee \psi \leftrightarrow \phi \rightarrow \psi$

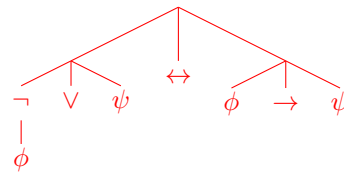
(a) $\neg(\phi \vee \psi) \leftrightarrow (\phi \rightarrow \psi)$ BICONDITIONAL



(b) $\neg((\phi \vee \psi) \leftrightarrow (\phi \rightarrow \psi))$ BICONDITIONAL



(c) $((\neg\phi) \vee \psi) \leftrightarrow (\phi \rightarrow \psi)$ BICONDITIONAL



(d) $\neg((\phi \vee \psi) \leftrightarrow \phi) \rightarrow \psi$ CONDITIONAL

(e) $\neg(((\phi \vee \psi) \leftrightarrow \phi) \rightarrow \psi)$ CONDITIONAL

(f) $((\neg\phi) \vee \psi) \leftrightarrow \phi \rightarrow \psi$ CONDITIONAL

(g) $(\neg\phi) \vee (\psi \leftrightarrow (\phi \rightarrow \psi))$ DISJUNCTION

(h) $\neg(\phi \vee (\psi \leftrightarrow (\phi \rightarrow \psi)))$ DISJUNCTION

(i) $(\neg\phi) \vee ((\psi \leftrightarrow \phi) \rightarrow \psi)$ DISJUNCTION

(j) $\neg(\phi \vee ((\psi \leftrightarrow \phi) \rightarrow \psi))$ DISJUNCTION

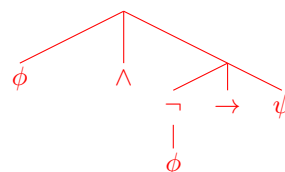
(k) $\neg(\phi \vee (\psi \leftrightarrow \phi)) \rightarrow \psi$ CONDITIONAL

(l) $\neg((\phi \vee (\psi \leftrightarrow \phi)) \rightarrow \psi)$ CONDITIONAL

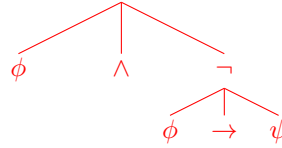
(m) $((\neg\phi) \vee (\psi \leftrightarrow \phi)) \rightarrow \psi$ CONDITIONAL

3. $\phi \wedge \neg\phi \rightarrow \psi$

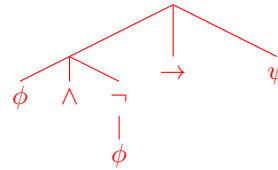
(a) $\phi \wedge ((\neg\phi) \rightarrow \psi)$ CONJUNCTION



(b) $\phi \wedge \neg(\phi \rightarrow \psi)$ CONJUNCTION

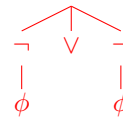


(c) $(\phi \wedge (\neg\phi)) \rightarrow \psi$ CONDITIONAL

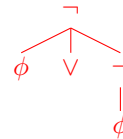


4. $\neg\phi \vee \neg\phi$

(a) $(\neg\phi) \vee \neg\phi$ DISJUNCTION



(b) $\neg(\phi \vee \neg\phi)$ DISJUNCTION



5. $\neg\phi \rightarrow \psi \rightarrow \psi \rightarrow \rho \wedge \neg\phi \rightarrow \rho$ [Optional Practice]

- (a) $\neg(\phi \rightarrow \psi) \rightarrow (\psi \rightarrow \rho) \wedge \neg(\phi \rightarrow \rho)$
- (b) $((\neg\phi) \rightarrow \psi) \rightarrow (\psi \rightarrow \rho) \wedge \neg(\phi \rightarrow \rho)$
- (c) $\neg(\phi \rightarrow \psi) \rightarrow (\psi \rightarrow \rho) \wedge ((\neg\phi) \rightarrow \rho)$
- (d) $((\neg\phi) \rightarrow \psi) \rightarrow (\psi \rightarrow \rho) \wedge ((\neg\phi) \rightarrow \rho)$
- (e) $\neg((\phi \rightarrow \psi) \rightarrow (\psi \rightarrow \rho)) \wedge \neg(\phi \rightarrow \rho)$
- (f) $(\neg((\phi \rightarrow \psi) \rightarrow (\psi \rightarrow \rho))) \wedge \neg(\phi \rightarrow \rho)$
- (g) $\neg((\phi \rightarrow \psi) \rightarrow ((\psi \rightarrow \rho))) \wedge \neg(\phi \rightarrow \rho)$
- (h) $((\neg\phi) \rightarrow \psi) \rightarrow (\psi \rightarrow \rho) \wedge \neg(\phi \rightarrow \rho)$
- (i) $((\neg\phi) \rightarrow \psi) \rightarrow ((\psi \rightarrow \rho) \wedge \neg(\phi \rightarrow \rho))$
- (j) $\neg((\phi \rightarrow \psi) \rightarrow (\psi \rightarrow \rho)) \wedge ((\neg\phi) \rightarrow \rho)$
- (k) $(\neg(\phi \rightarrow \psi) \rightarrow (\psi \rightarrow \rho)) \wedge ((\neg\phi) \rightarrow \rho)$
- (l) $\neg(\phi \rightarrow \psi) \rightarrow ((\psi \rightarrow \rho) \wedge ((\neg\phi) \rightarrow \rho))$
- (m) $((\neg\phi) \rightarrow \psi) \rightarrow (\psi \rightarrow \rho) \wedge ((\neg\phi) \rightarrow \rho)$
- (n) $((\neg\phi) \rightarrow \psi) \rightarrow ((\psi \rightarrow \rho) \wedge ((\neg\phi) \rightarrow \rho))$
- (o) $((\neg\phi) \rightarrow \psi) \rightarrow \psi \rightarrow (\rho \wedge (\neg\phi \rightarrow \rho))$
- (p) $((\neg\phi) \rightarrow \psi) \rightarrow \psi \rightarrow \rho \wedge \neg\phi \rightarrow \rho$
- (q) *et cetera*

6. $\phi \vee \neg\psi \wedge \neg\phi \rightarrow \psi$ [Optional Practice]

- (a) $(\phi \vee (\neg\psi)) \wedge \neg(\phi \rightarrow \psi)$ CONJUNCTION
- (b) $(\phi \vee (\neg\psi)) \wedge ((\neg\phi) \rightarrow \psi)$ CONJUNCTION
- (c) $(\phi \vee \neg(\psi \wedge (\neg\phi))) \rightarrow \psi$ CONDITIONAL
- (d) $(\phi \vee ((\neg\psi) \wedge (\neg\phi))) \rightarrow \psi$ CONDITIONAL
- (e) $\phi \vee (((\neg\psi) \wedge (\neg\phi)) \rightarrow \psi)$ DISJUNCTION
- (f) $\phi \vee (\neg(\psi \wedge (\neg\phi)) \rightarrow \psi)$ DISJUNCTION
- (g) $\phi \vee \neg((\psi \wedge (\neg\phi)) \rightarrow \psi)$ DISJUNCTION