學號:B06902136

系級:資工四

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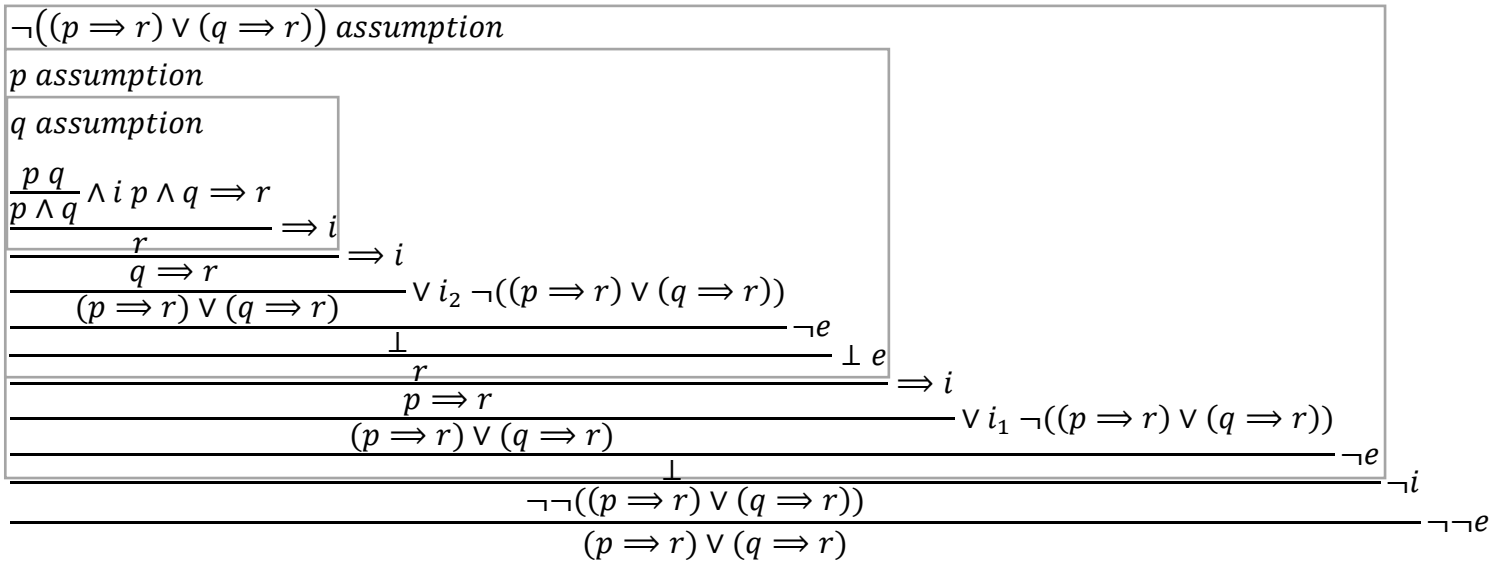
(1) $p \Longrightarrow q, r \Longrightarrow s \vdash p \wedge r \Longrightarrow q \wedge s$

$$\dfrac{\dfrac{\boxed{\begin{array}{l}p \wedge r \ assumption\\ \dfrac{\dfrac{p \wedge r}{p} \wedge e_1 \quad p \Longrightarrow q}{q} \Longrightarrow e \quad \dfrac{\dfrac{p \wedge r}{r} \wedge e_2 \quad r \Longrightarrow s}{s} \Longrightarrow e}{q \wedge s} \wedge i\end{array}}}{p \wedge r \Longrightarrow q \wedge s} \Longrightarrow i$$

(2) $(p \wedge q) \vee (p \wedge r) \vdash p \wedge (q \vee r)$

$$\dfrac{(p \wedge q) \vee (p \wedge r) \quad \boxed{\begin{array}{l}p \wedge q \ assumption\\ \dfrac{\dfrac{p \wedge q}{p} \wedge e_1 \quad \dfrac{\dfrac{p \wedge q}{q} \wedge e_2}{q \vee r} \vee i_1}{p \wedge (q \vee r)} \wedge i\end{array}} \quad \boxed{\begin{array}{l}p \wedge r \ assumption\\ \dfrac{\dfrac{p \wedge r}{p} \wedge e_1 \quad \dfrac{\dfrac{p \wedge r}{r} \wedge e_2}{q \vee r} \vee i_2}{p \wedge (q \vee r)} \wedge i\end{array}}}{p \wedge (q \vee r)} \vee e$$

(3) $p \wedge q \Longrightarrow r \vdash (p \Longrightarrow r) \vee (q \Longrightarrow r)$



(4) $p \Longrightarrow q \vdash \neg p \vee q$

$$\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{\dfrac{}{\neg(\neg p \vee q)\ assumption}\quad \dfrac{\dfrac{}{p\ assumption}\quad \dfrac{p \quad p \Longrightarrow q}{q} \Longrightarrow e}{\neg p \vee q} \vee i_2}{\bot} \neg e}{\neg p} \neg i}{\neg p \vee q} \vee i_1}{\bot} \neg e}{\neg\neg(\neg p \vee q)} \neg i}{\neg p \vee q} \neg\neg e$$

(5) $\vdash (p \Longrightarrow q) \vee (q \Longrightarrow r)$

$$\dfrac{\dfrac{}{q \vee \neg q}\ LEM \quad \dfrac{\dfrac{\dfrac{}{q\ assumption}\quad \dfrac{\dfrac{}{p\ assumption}\quad \dfrac{q}{p \Longrightarrow q} \Longrightarrow i}{(p \Longrightarrow q) \vee (q \Longrightarrow r)} \vee i_1}{}\quad \dfrac{\dfrac{\dfrac{}{\neg q\ assumption}\quad \dfrac{\dfrac{}{q\ assumption}\quad \dfrac{q \quad \neg q}{\bot} \neg e}{r} \bot e}{(q \Longrightarrow r)} \Longrightarrow i}{(p \Longrightarrow q) \vee (q \Longrightarrow r)} \vee i_2}{(p \Longrightarrow q) \vee (q \Longrightarrow r)} \vee e$$