

# Exercise 5.2

$$U = (\forall y)(\forall x) P(x,y) \leftrightarrow (\exists x)(\exists y) P(x,y)$$

$$\neg U = ((\forall y)(\forall x) P(x,y) \wedge \neg((\exists x)(\exists y) P(x,y))) \vee$$

$$\vee \neg \neg \quad \vee (\neg((\forall y)(\forall x) P(x,y)) \wedge (\exists x)(\exists y) P(x,y))$$

$$\neg U = ((\forall x)(\forall y) P(x,y) \wedge (\forall x)(\forall y) \neg P(x,y)) \vee$$

$$\vee ((\exists x)(\exists y) \neg P(x,y) \wedge (\exists x)(\exists y) P(x,y))$$

$$\neg U_1 = (\forall x)(\forall y) P(x,y) \wedge (\forall x)(\forall y) \neg P(x,y)$$

$$\neg U_2 = (\exists x)(\exists y) \neg P(x,y) \wedge (\exists x)(\exists y) P(x,y)$$

$$\neg U_1 = (\forall x)(\forall y) P(x,y) \wedge (\forall z)(\forall t) \neg P(z,t)$$

$$\neg U_1^P = (\forall x)(\forall y)(\forall z)(\forall t) (P(x,y) \wedge \neg P(z,t)) \quad U_1^S$$

$$\neg U_1^C = P(x,y) \wedge \neg P(z,t)$$

$$C_1 = P(x,y)$$

$$C_3 = \text{Res}^{P_2}(C_1, C_2) = \square$$

$$C_2 = P(z,t)$$

$$\neg U_1^C \vdash_{\text{Res}}^{P_2} \square \Rightarrow \vdash U_1$$

$$\neg U_2 = (\exists x)(\exists y) \neg P(x,y) \wedge (\exists z)(\exists t) P(z,t)$$

$$\neg U_2^P = (\exists x)(\exists y)(\exists z)(\exists t) (\neg P(x,y) \wedge P(z,t))$$

$$\neg U_2^S = \neg P(a,b) \wedge P(c,d) \quad [x \leftarrow a, y \leftarrow b, z \leftarrow c, t \leftarrow d]$$

$$\neg U_2^C = \neg P(a,b) \wedge P(c,d)$$

$$C_1 = \neg P(a,b)$$

$$C_3 = \text{Res}^{P_2}[\neg P(a,b), P(c,d)](C_1, C_2) = \square$$

$$C_2 = P(c,d)$$

$$\neg U_2^C \vdash_{\text{Res}}^{P_2} \square \Rightarrow \vdash U_2$$