Exercise Sheet 11
CS 2210 Logic for Computer Scientists (Hitzler)
Solutions due: Tuesday April 14, 2015, 11am

Exercise 56 Show, without using any of the statements in Theorem 3.4.1, that the first statement, $\neg\forall x F \equiv \exists x \neg F$, holds.

Exercise 57 Show, that $\forall x \exists y P(x, y) \not\equiv \exists u \forall v P(v, u)$.

Exercise 58 Show, using the statements from Theorem 3.4.1, that $\forall x \exists y (P(x) \wedge Q(y)) \equiv \exists y \forall x (P(x) \wedge Q(y))$.

Exercise 59 Show by using the statements from of Theorem 3.4.1, that

$$\forall x (P(x) \rightarrow (\exists y (O(x, y) \wedge C(y)) \wedge (\forall z (R(x, z) \rightarrow H(z)))))$$

and

$$\forall z \forall x \exists y ((P(x) \rightarrow (O(x, y) \wedge C(y))) \wedge ((P(x) \wedge R(x, z)) \rightarrow H(z)))$$

are equivalent.

Exercise 60 What is $(\forall x (Q(x, y, z)[y/a])[x/b] \wedge \forall x (P(x, y)[y/x][x/a]))[z/x]$?