

**HW 9****Due:** 29 September 2009**Prof. Caldwell****COSC 2300**

Prove the following sequents. The course web-pages has a link to a page containing all the proof rules we've seen so far.

In these problems, the predicate symbols are selected from the set  $\{S, R, P, Q\}$  where  $S$  is a nullary predicate symbol (a constant),  $R$  and  $P$  are unary predicate symbols and  $Q$  is a binary predicate symbol.

Remember the rule of thumb, wait to apply the  $(\exists R)$  and  $(\forall L)$  rules until later in the proof when possible.

1.  $\vdash (\exists x.P(x)) \Rightarrow \neg \forall x.\neg P(x)$
2.  $\vdash (\forall x.P(x)) \Rightarrow \neg \exists x.\neg P(x)$
3.  $\vdash (S \Rightarrow \forall x.P(x)) \Rightarrow \forall x.S \Rightarrow P(x)$
4.  $(\forall x.P(x)) \Rightarrow S \vdash \exists x.(P(x) \Rightarrow S)$
5.  $\vdash (\exists x.P(x) \Rightarrow R(x)) \Rightarrow ((\forall x.P(x)) \Rightarrow \exists x.R(x))$