# Automated Reasoning: Tutorial 2

## Exercise 1

Give an interpretation that satisfies $\forall x.\forall y.\,(p(x) \rightarrow p(y))$.

## Exercise 2

Prove the following first order statements in Isabelle (Note that $P\ x$ in Isabelle is the same as the usual $P(x)$):

1. $(\forall x.\ P\ x \rightarrow Q) \rightarrow (\exists\ x.\ P\ x \rightarrow Q)$
2. $\forall x.\ \neg P\ x$, assuming that $\neg\exists x.\ P\ x$ is true
3. $\exists x.\ \neg P\ x$, assuming that $\neg\forall x.\ P\ x$ is true

## Exercise 3

Give tree representation proofs for the statements in the above exercise, annotating your steps using the Isabelle names of rules (e.g. allI, exI, etc).