

# 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).