Lecture-14 Main Points

- Motivation for First Order Logic (FOL)
  - Examples of reasoning not expressible in propositional logic.
- Quantifiers. Writing examples in FOL syntax.
- Informal semantics. Universe of discourse.
- Free and bound variable occurrences. Scope of a quantifier. Precedence conventions.
- Proof rules for quantifiers.

$\exists\mathbf{i}\ \dfrac{\Gamma \vdash \phi[t/x]}{\Gamma \vdash \exists x.\phi}$

$\exists\mathbf{e}\ \dfrac{\Gamma \vdash \exists x.\phi \qquad \Gamma', \phi[y/x] \vdash \psi}{\Gamma, \Gamma' \vdash \psi} \quad y \notin FV(\Gamma', \psi, \exists x.\phi)$

$\forall\mathbf{i}\ \dfrac{\Gamma \vdash \phi[y/x]}{\Gamma \vdash \forall x.\phi} \quad y \notin FV(\Gamma, \forall x.\phi)$

$\forall\mathbf{e}\ \dfrac{\Gamma \vdash \forall x.\phi}{\Gamma \vdash \phi[t/x]}$