

$E(s, c)$: student s is enrolled in class c .
 $D(c, d)$: class c is in department d .

 There is a student who took at least one class in each dept.
 $\forall d, \exists c$ st. $D(c, d)$ every dept has a class in all dept
 $\exists c$ st. $\forall d, D(c, d)$

 $\exists s$ st. $\forall d, \exists c$ st. $D(c, d) \wedge E(s, c)$
negation
 $\neg (\exists s$ st. $\forall d, \exists c$ st. $D(c, d) \wedge E(s, c)$)
 $\forall s, \neg (\forall d, \exists c$ st. $D(c, d) \wedge E(s, c)$)
 $\forall s, \exists d$ st. $\forall c, \neg (D(c, d) \wedge E(s, c))$
 $\forall s, \exists d$ st. $\forall c, \neg D(c, d) \vee \neg E(s, c)$

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There is a smallest positive integer.
 Domain: \mathbb{Z}^+
 $\exists m \in \mathbb{Z}^+$ st. $\forall n \in \mathbb{Z}^+, m \leq n$

 Every non-empty subset of \mathbb{Z}^+ has a smallest value.
 $\forall S$: non-empty subset of $\mathbb{Z}^+, \exists m \in S$ st.
 $\forall n \in S, m \leq n$
 $P(x)$: x is not empty
 $\forall S \subseteq \mathbb{Z}^+ (P(S) \wedge (\exists m \in S$ st. $\forall n \in S, m \leq n))$
 $Q(m, S)$
 $R(S)$
 \subseteq subset

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Universal Instantiation
 true for all implies true for an indiv.
 D : all rolling chairs in this room
 $P(c)$: c has 5 wheels
 $\forall c \in D, P(c)$ } premises
 this chair $\in D$ }
 $\therefore P(\text{this chair})$ } \leftarrow concl.

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Universal Modus Ponens
 $\forall x, P(x) \rightarrow Q(x)$ } major premise
 $P(a)$ for a particular a } minor premise
 $\therefore Q(a)$

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