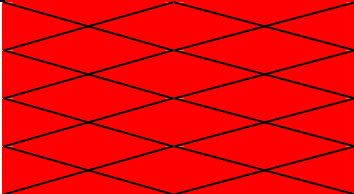
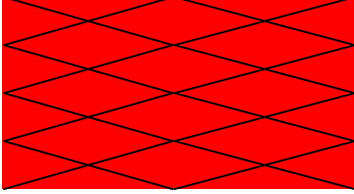


&I $\frac{\begin{array}{c} \mathcal{A} \\ B \end{array}}{\mathcal{A} \& B} \quad \frac{\begin{array}{c} \mathcal{A} \\ B \end{array}}{B \& \mathcal{A}}$	&O $\frac{\mathcal{A} \& B \quad \mathcal{A} \& B}{\mathcal{A} \quad B}$	\sim&O $\frac{\sim(\mathcal{A} \& B)}{\mathcal{A} \rightarrow \sim B}$	&D $\begin{array}{l} \text{SHOW: } \mathcal{A} \& B \\ \text{SHOW: } \mathcal{A} \\ \\ \text{SHOW: } B \\ \end{array}$
\veeI $\frac{\mathcal{A} \quad \mathcal{A}}{\mathcal{A} \vee B} \quad \frac{\mathcal{A} \quad \mathcal{A}}{B \vee \mathcal{A}}$	\veeO $\frac{\mathcal{A} \vee B \quad \mathcal{A} \vee B}{\sim \mathcal{A} \quad \sim B} \quad \frac{\mathcal{A} \vee B \quad \mathcal{A} \vee B}{B \quad \mathcal{A}}$	$\sim$$\vee$O $\frac{\sim(\mathcal{A} \vee B)}{\sim \mathcal{A} \quad \sim B}$	\veeD (ID) $\begin{array}{l} \text{SHOW: } \mathcal{A} \vee B \\ \sim(\mathcal{A} \vee B) \\ \text{SHOW: } * \\ \end{array}$
\leftrightarrowI $\frac{\mathcal{A} \rightarrow B \quad \mathcal{A} \rightarrow B}{\mathcal{A} \leftrightarrow B} \quad \frac{\mathcal{A} \rightarrow B \quad \mathcal{A} \rightarrow B}{B \rightarrow \mathcal{A} \quad B \rightarrow \mathcal{A}}$	\leftrightarrowO $\frac{\mathcal{A} \leftrightarrow B \quad \mathcal{A} \leftrightarrow B}{\mathcal{A} \rightarrow B \quad B \rightarrow \mathcal{A}}$	$\sim$$\leftrightarrow$O $\frac{\sim(\mathcal{A} \leftrightarrow B)}{\sim \mathcal{A} \leftrightarrow B}$	\leftrightarrowD $\begin{array}{l} \text{SHOW: } \mathcal{A} \leftrightarrow B \\ \text{SHOW: } \mathcal{A} \rightarrow B \\ \\ \text{SHOW: } B \rightarrow \mathcal{A} \\ \end{array}$
\rightarrowI see CD 	\rightarrowO $\frac{\mathcal{A} \rightarrow C \quad \mathcal{A} \rightarrow C}{\mathcal{A} \quad \sim C} \quad \frac{\mathcal{A} \rightarrow C \quad \mathcal{A} \rightarrow C}{C \quad \sim \mathcal{A}}$	$\sim$$\rightarrow$O $\frac{\sim(\mathcal{A} \rightarrow C)}{\mathcal{A} \& \sim C}$	CD $\begin{array}{l} \text{SHOW: } \mathcal{A} \rightarrow C \\ \mathcal{A} \\ \text{SHOW: } C \\ \end{array}$
DN $\frac{\mathcal{A}}{\sim \sim \mathcal{A}}$	DN $\frac{\sim \sim \mathcal{A}}{\mathcal{A}}$	Rep $\frac{\mathcal{A}}{\mathcal{A}}$	\simD $\begin{array}{l} \text{SHOW: } \sim \mathcal{A} \\ \mathcal{A} \\ \text{SHOW: } * \\ \end{array}$
I $\frac{\mathcal{A} \quad \sim \mathcal{A}}{}$	*O $\frac{*}{\mathcal{A}}$	DD $\frac{\text{SHOW: } \mathcal{A}}{\mathcal{A}}$	ID $\begin{array}{l} \text{SHOW: } \mathcal{A} \\ \sim \mathcal{A} \\ \text{SHOW: } * \\ \end{array}$

PREDICATE LOGIC

In the following, v is any variable; $F[v]$ is any formula in which v occurs free;
 $F[o]$ results by substituting o for every free occurrence of v , where o is any **old name**.
 $F[n]$ results by substituting n for every free occurrence of v , where n is any **new name**.
A name counts as **old** if it occurs in a line that is neither boxed nor cancelled;
otherwise it counts as **new**.

\forallI see UD 	\forallO $\frac{\forall v F[v]}{F[o] \quad \text{old}}$	$\sim$$\forall$O $\frac{\sim \forall v \Phi}{\exists v \sim \Phi}$	UD $\begin{array}{l} \text{SHOW: } \forall v F[v] \\ \text{new} \\ \text{SHOW: } F[n] \\ \end{array}$
\existsI $\frac{F[o] \quad \text{old}}{\exists v F[v]}$	\existsO $\frac{\exists v F[v]}{F[n] \quad \text{new}}$	$\sim$$\exists$O $\frac{\sim \exists v \Phi}{\forall v \sim \Phi}$	\existsD (ID) $\begin{array}{l} \text{SHOW: } \exists v F[v] \\ \sim \exists v F[v] \\ \text{SHOW: } * \\ \end{array}$