De Morgan laws

e) \( \neg (P \land Q) \iff (\neg P \lor \neg Q) \)
    or e1>
    \( (P \lor Q) \iff \neg (\neg P \land \neg Q) \)

b) \( \neg (P \lor Q) \iff (\neg P \land \neg Q) \)
    or
    \( P \land Q \iff \neg (\neg P \lor \neg Q) \)

Double negation

\( \neg \neg P \iff P \)

Distributivity laws

\( P \land (Q \lor R) \iff (P \land Q) \lor (P \land R) \)

\( P \lor (Q \land R) \iff (P \lor Q) \land (P \lor R) \)
**Fitch rules**

\[\land\text{- Elim}\]

\[
\begin{array}{c}
P_1 \land P_n \\
\hline
P_i
\end{array}
\]

\[\land\text{- Intro}\]

\[
\begin{array}{c}
P_i \\
\hline
P_1 \land P_n
\end{array}
\]

\[\lor\text{- Elim}\]

\[
\begin{array}{c}
P_1 \lor P_n \\
\hline
P_i \\
\hline
S
\end{array}
\]

\[\lor\text{- Intro}\]

\[
\begin{array}{c}
P_i \\
\hline
P_1 \lor P_i \lor \ldots \lor P_n
\end{array}
\]

\[\neg\text{- Elim}\]

\[
\begin{array}{c}
\neg P \\
\hline
P
\end{array}
\]

\[\neg\text{- Intro}\]

\[
\begin{array}{c}
P \\
\hline
\neg P
\end{array}
\]

\[\bot\text{- Elim}\]

\[
\begin{array}{c}
\bot \\
\hline
P
\end{array}
\]

\[\bot\text{- Intro}\]

\[
\begin{array}{c}
P \\
\hline
\bot
\end{array}
\]

---

The Fitch rules are a set of logical rules used in natural deduction to construct proofs. Each rule is designed to help in the process of deriving new facts from existing ones. The diagrams illustrate the elimination and introduction rules for conjunction, disjunction, negation, and the absurdity (\(\bot\)) symbol.


**Logical Equivalences**

**Commutativity of \( \lor \) and \( \land \)**

\[ P \lor Q \iff Q \lor P \quad ; \quad P \land Q \iff Q \land P \]

**Associativity**

\[(P \land Q) \land R \iff P \land (Q \land R) \quad ; \quad P \lor (Q \lor R) \iff (P \lor Q) \lor R\]

**Distributivity**

\[P \land (Q \lor R) \iff (P \land Q) \lor (P \land R) \quad ; \quad P \lor (Q \land R) \iff (P \lor Q) \land (P \lor R)\]

**Double negation**

\[\neg \neg P \iff P\]

**Idempotence**

\[P \land P \iff P\]

**De Morgan's**

\[\neg (P \lor Q) \iff \neg P \land \neg Q \quad ; \quad \neg (P \land Q) \iff \neg P \lor \neg Q\]

**Absorption**

\[P \lor (P \land Q) \iff P \quad ; \quad P \land (P \lor Q) \iff P\]

**Conditional**

\[(P \rightarrow Q) \iff \neg P \lor Q \quad ; \quad \neg (P \rightarrow Q) \iff P \land \neg Q\]

**Identity**

\[P \land T \iff P \quad ; \quad P \lor \bot \iff P\]

**Negation**

\[P \lor \neg P \iff T \quad ; \quad P \land \neg P \iff \bot\]

**Universal bound**

\[P \lor T \iff T \quad ; \quad P \land \bot \iff \bot\]