



Cheat sheet for Knowledge Representation

Knowledge Representation (Vrije Universiteit Amsterdam)

Frequently occurring symbols

$\in, \notin, \sum, \sqsubseteq, \sqcup, \sqcap, \neg, \exists, \forall$ There is a chance that you cannot copy-paste those symbols from the provided pdf. In that case use symbols that are alike the intended ones, and define their meaning. E.g. if use E instead of \exists and mention briefly you use E as symbol for the existential quantifier.

Rules for rewriting a statement into CNF

1. $P \leftrightarrow Q \equiv (P \rightarrow Q) \wedge (Q \rightarrow P)$
2. $P \rightarrow Q \equiv \neg P \vee Q$
3. $\neg(\neg P) \equiv P$
4. $\neg(P \wedge Q) \equiv \neg P \vee \neg Q$
5. $\neg(P \vee Q) \equiv \neg P \wedge \neg Q$
6. $(P \wedge Q) \vee R \equiv (P \vee R) \wedge (Q \vee R)$

Rules for rewriting a DL concept into NNF

$$\begin{aligned}
 \neg \top &\Rightarrow \perp \\
 \neg \perp &\Rightarrow \top \\
 \neg A &\Rightarrow \neg A \\
 \neg(\neg C) &\Rightarrow C \\
 \neg(C \sqcap D) &\Rightarrow \neg C \sqcup \neg D \\
 \neg(C \sqcup D) &\Rightarrow \neg C \sqcap \neg D \\
 \neg \exists r.C &\Rightarrow \forall r. \neg C \\
 \neg \forall r.C &\Rightarrow \exists r. \neg C
 \end{aligned}$$

Tableau Rules for ABoxes and TBoxes

\Rightarrow_{\sqcap} **IF** $(a : C \sqcap D) \in S$ **THEN** $S' := S \cup \{a : C, a : D\}$
 \Rightarrow_{\sqcup} **IF** $(a : C \sqcup D) \in S$ **THEN** $S' := S \cup \{a : C\}$ **or** $S' := S \cup \{a : D\}$
 \Rightarrow_{\exists} **IF** $(a : \exists r.C) \in S$ **THEN** $S' := S \cup \{(a, b) : r, b : C\}$
 where b is a 'fresh' individual name in S
 \Rightarrow_{\forall} **IF** $(a : \forall r.C) \in S$ **and** $(a, b) : r \in S$ **THEN** $S' := S \cup \{b : C\}$
 \Rightarrow_{\times} **IF** $\{a : A, a : \neg A\} \subseteq S$ **or** $(a : \perp) \in S$ **THEN** mark the branch as CLOSED

\Rightarrow_{\equiv} **IF** $(\top \equiv C) \in S$ **and** an individual a occurs in S
THEN $S' := S \cup \{a : C\}$

Graphoid Axioms

- $\text{IPr}(\mathbf{X}, \mathbf{Z}, \mathbf{Y})$ if and only if $\text{IPr}(\mathbf{Y}, \mathbf{Z}, \mathbf{X})$. (Symmetry)
- $\text{IPr}(\mathbf{X}, \mathbf{Z}, \mathbf{Y} \cup \mathbf{W})$ only if $\text{IPr}(\mathbf{X}, \mathbf{Z}, \mathbf{Y})$ and $\text{IPr}(\mathbf{X}, \mathbf{Z}, \mathbf{W})$. (Decomposition)
- $\text{IPr}(\mathbf{X}, \mathbf{Z}, \mathbf{Y} \cup \mathbf{W})$ only if $\text{IPr}(\mathbf{X}, \mathbf{Z} \cup \mathbf{Y}, \mathbf{W})$. (Weak Union)
- $\text{IPr}(\mathbf{X}, \mathbf{Z}, \mathbf{Y})$ and $\text{IPr}(\mathbf{X}, \mathbf{Z} \cup \mathbf{Y}, \mathbf{W})$ only if $\text{IPr}(\mathbf{X}, \mathbf{Z}, \mathbf{Y} \cup \mathbf{W})$. (Contraction)