Cheat sheet for Knowledge Representation

Knowledge Representation (Vrije Universiteit Amsterdam)

Frequently occurring symbols

∈, ∉, ∑,⊑, ⊔, ⊓, ¬, ∃, ∀ 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 ∃ and mention briefly you use E as symbol for the existential quantifier.

Rules for rewriting a statement into CNF

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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. $(P \wedge Q) \vee R \equiv (P \vee R) \wedge (Q \vee R)$

$$J(l) := \sum_{l \in \omega, \omega \in \varphi} 2^{-|\omega|}$$

Rules for rewriting a DL concept into NNF

MOMs

$$[f^*(x) + f^*(x')]^*2^k + f^*(x) * f^*(x')$$

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

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** $(a : \bot) \in S$ **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

- I_{Pr} (**X**, **Z**, **Y**) if and only if I_{Pr} (**Y**, **Z**, **X**). (Symmetry)
- I_{Pr}(**X**, **Z**, **Y** ∪ **W**) only if I_{Pr}(**X**, **Z**, **Y**) and I_{Pr}(**X**, **Z**, **W**). (Decomposition)
- I_{Pr}(**X**, **Z**, **Y** ∪ **W**) only if I_{Pr}(**X**, **Z** ∪ **Y**, **W**). (Weak Union)
- I_{Pr}(**X**, **Z**, **Y**) and I_{Pr}(**X**, **Z** ∪ **Y**, **W**) only if I_{Pr}(**X**, **Z**, **Y** ∪ **W**). (Contraction)

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- It was earlier stated that you need to know the semantics of DL statements.