

# First Order Logic, Description Logics, Reasoning

Semantic Web

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January 10, 2008

## 1 Solution 1: First Order Logic

Express the following statements in First Order Logic:

- Each Employee works for a Company:  
 $\forall E.\exists C.(Employee(E) \rightarrow worksFor(E, C) \wedge Company(C))$
- A Company has at least one Employee:  
 $\forall C.(Company(C) \rightarrow \exists E.(worksFor(E, C)))$
- A Manager is a (special) Employee:  
 $\forall X.(Manager(X) \rightarrow Employee(X))$
- A Manager must not work for more than two Companies:  
 $\forall M.\forall X.\forall Y.\forall Z.(Manager(M) \wedge worksFor(M, X) \wedge worksFor(M, Y) \wedge worksFor(M, Z) \rightarrow (X = Y) \vee (X = Z) \vee (Y = Z))$
- A Company cannot be an Employee at the same time  
 $\forall X.(Company(X) \rightarrow \neg Employee(X))$
- For each Employee that works for a Company we can automatically deduce that the Company employs the Employee:  $\forall E.\forall C.(worksFor(E, C) \rightarrow employs(C, E))$

## 2 Solution 2: Description Logic

Given are again the statements from Exercise 1. Express those statements in Description Logics.

1. Each Employee works for a Company:  
 $Employee \sqsubseteq \exists worksFor.Company$
2. A Company has at least one Employee:  
 $Company \sqsubseteq \exists worksFor^-.Employee$
3. A Manager is a (special) Employee:  
 $Manager \sqsubseteq Employee$
4. A Manager must not work for more than two Companies:  
 $Manager \sqsubseteq \leq 2 worksFor.Company$

5. A Company cannot be an Employee at the same time:  
 $\perp \equiv \textit{Company} \sqcap \textit{Employee}$
6. For each Employee that works for a Company we can automatically deduce that the Company employs the Employee:  
 $\textit{worksFor}^- \equiv \textit{employs}$