Example: Normalization

$$\texttt{WellRoundedCo} \doteq$$
$$[\textbf{AND}\ \texttt{Company}\ [\textbf{ALL}\ :\texttt{Manager}$$
$$[\textbf{AND}\ \texttt{B-SchoolGrad}$$
$$[\texttt{Exists}\ 1\ :\texttt{TechnicalDegree}]]]$$

$$\texttt{HighTechCo} \doteq$$
$$[\textbf{AND}\ \texttt{Company}\ [\textbf{FILLS}\ :\texttt{Exchange}\ \texttt{nasdaq}]$$
$$[\textbf{ALL}\ :\texttt{ManagerTechie}]]$$

$$\texttt{Techie} \doteq$$
$$[\textbf{EXISTS}\ 2\ \texttt{TechnicalDegree}]$$

$$[\textbf{AND}\ \texttt{WellRoundedCo}\ \texttt{HighTechCo}]$$

Example: Subsumption

[**AND** Company
ALL :Manager
[**AND** B-SchoolGrad
[**EXISTS** 2 TechnicalDegree]]
[**FILLS** :Exchange nasdaq]]

[**AND** LegalEntity
[**ALL** :Manager B-SchoolGrad]]

(Company $\sqsubseteq$ LegalEntity)

Structure Mapping

$$KB \models (d \sqsubseteq e)$$

IDEA: For d to be subsumed by e, the normalized d must account for each component of the normalized e in some way

Structure Mapping Procedure

Input: Two normalized concepts d and e where d is of the form $[\texttt{AND}\ d_1\ \ldots\ d_m]$ and e is of the form $[\texttt{AND}\ d_1\ \ldots\ d_m]$

Output `yes` or `no`, according to whether $KB \models (d \sqsubseteq e)$

Return `yes` iff for each component e_j, there exists a component d_i such that d_i matches e_j as follows:

1. if e_j is an atomic concept, then either d_i is identical to e_j, or there is a sentence of the form $(d_i \sqsubseteq d')$ in the KB, where recursively some coponent of d' matches e_j;
2. if e_j is of the form $[\texttt{FILLS}\ r\ c]$, then d_i must be identical to it;
3. if e_j is of the form $[\texttt{EXISTS}\ n\ r]$, then the corresponding d_i must be of the form $[\texttt{EXISTS}\ n'\ r]$, for some $n' \geq n$; if $n = 1$, then d_i may be of the form $[\texttt{FILLS}\ r\ c]$;
4. if e_j is of the form $[\texttt{ALL}\ r\ e']$, then d_i must be of the form $[\texttt{ALL}\ r\ d']$, where recursively d' is subsumed by e'.

Taxonomies and Classification

- Given some query concept q, find all c in KB such that

$$KB \models (c \rightarrow q)$$

- Given some constant c, find all atomic concepts a such that

$$KB \models (c \rightarrow a)$$

Computing Classification

Consider adding a sentence $(a \doteq d)$ to a taxonomy.

1. First calculate S, the *most specific subsumers* of d

   The atomic concepts a such that
   $KB \models (d \sqsubseteq a)$ but there is no a'
   distinct from a such that
   $KB \models (d \sqsubseteq a')$ and $KB \models (a' \sqsubseteq a)$

2. Next calculate G, the *most general subsumees* of d.

   The atomic concepts a such that
   $KB \models (a \sqsubseteq d)$ but there is no a'
   distinct from a such that
   $KB \models (a' \sqsubseteq d)$ and $KB \models (a \sqsubseteq a')$

Computing Classification (cont)

3. If there is a concept a' in $S \cap G$, then the concept is already present.

4. Otherwise, insert a.

5. Handle Constants

Computing (cont)

1. Computing most specific subsumers.

2. Computing the most general subsumees.

Example: Classification

$$\texttt{Surgeon} \doteq$$
$$[\textbf{AND}\ \texttt{Doctor}$$
$$[\textbf{FILLS}\ \texttt{:Specialty surgery}]]$$

Extensions

- [**AT-MOST** n r]
- [**ONE-OF** c_1 ... c_n]
- [**SAME-AS** r_1 r_2]
- Qualified Number Restriction

[**EXISTS** n r d]

Classification (cont)

1. Answering Questions
2. Taxonomies and Frame Hierarchies
3. Inheritance