Example: Normalization

Well Rounded Co ≡
[AND Company [ALL : Manager
[AND B-School Grad
[Exists 1 : Technical Degree]]]

High Tech Co ≡
[AND Company [FILLS : Exchange nasdaq]
[ALL : Manager Techie]]

Techie ≡
[EXISTS 2 Technical Degree]

[AND Well Rounded Co High Tech Co]

Example: Subsumption

[AND Company
ALL : Manager
AND B-School Grad
[EXISTS 2 Technical Degree]]

[AND Legal Entity
ALL : Manager B-School Grad]]

Techie ≡
[EXISTS 2 Technical Degree]

COMPANY ⊑ Legal Entity

Structure Mapping

KB ⊨ (d ⊆ 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 [AND d1 . . . dm] and e is of the form [AND d1 . . . dn]

Output yes or no, according to whether

KB ⊨ (d ⊆ e)

Return yes if for each component ej, there exists a component di such that di matches ej as follows:

1. if ej is an atomic concept, then either di is identical to ej, or there is a sentence of the form (di ⊑ dj) in the KB, where recursively some component of dj matches ej;
2. if ej is of the form [FILLS r c], then di must be identical to it;
3. if ej is of the form [EXISTS n r], then the corresponding di must be of the form [EXISTS n r'], for some n′ ≥ n; if n = 1, then di may be of the form [FILLS r c];
4. if ej is of the form [ALL r d'], then di must be of the form [ALL r d], where recursively d is subsumed by d'.

Taxonomies and Classification

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

KB ⊨ (c → q)

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

KB ⊨ (c → a)

Computing Classification

Consider adding a sentence (a ◄ d) to a taxonomy.

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

   The atomic concepts a such that
   KB ⊨ (d ⊆ a) but there is no a′ distinct from a such that
   KB ⊨ (a′ ⊆ a)

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

   The atomic concepts a such that
   KB ⊨ (a′ ⊆ d) and KB ⊨ (a ⊆ 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

Example: Classification

Surgeon =
   [AND Doctor
   [FILLS :Specialty surgery]]

Classiﬁcation (cont)

Computing (cont)

1. Computing most speciﬁc subsumers.
2. Computing the most general subsumees.

Extensions

• $[\text{AT-MOST} \ n \ r]$
• $[\text{ONE-OF} \ c_1 \ldots c_n]$
• $[\text{SAME-AS} \ r_1 \ r_2]$
• Qualified Number Restriction
  $[\text{EXISTS} \ n \ r \ d]$

Classification (cont)

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