

## Relations between Semantic Structures

D. Gueorguiev 11/4/2021

Let us consider the semantic structures  $S_i$  and  $S_j$  in specific context  $C$ .

Is-a relation:

$S_i \leftrightarrow S_j$  :  $S_i$  is-a  $S_j$

Is-not relation

$S_i \nleftrightarrow S_j$  :  $S_i$  is-not  $S_j$

Has-a relation:

$S_i \rightarrow S_j$  :  $S_i$  has-a  $S_j$

Has-not relation

$S_i \nrightarrow S_j$  :  $S_i$  has-not  $S_j$

Equivalent relation:

$S_i \Leftrightarrow S_j$  :  $S_i$  is true iff  $S_j$  is true

Not-equivalent relation:

$S_i \nLeftrightarrow S_j$  : if  $S_i$  is true then it does not follow that  $S_j$  is true **or** if  $S_j$  is true then it does not follow that  $S_i$  is true

Implication:

$S_i \Rightarrow S_j$  : if  $S_i$  is true then  $S_j$  is true

Not-Implication:

$S_i \nRightarrow S_j$  : if  $S_i$  is true then it does not follow that  $S_j$  is true

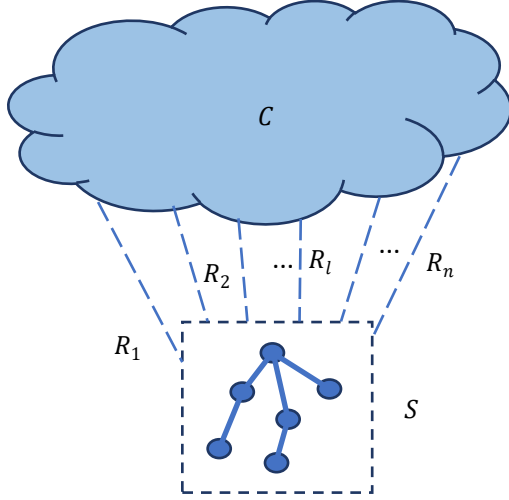
General relationship:

Let  $G$  is a semantic DAG,  $V(G)$  is the set of vertices of  $G$  and  $A(G)$  is the set of arcs of  $G$ . We say that  $S_i$  is related to  $S_j$  when  $S_i$  and  $S_j$  are subgraphs of  $G$ .

$S_i \leftrightarrow S_j$  : the structures  $S_i$  and  $S_j$  have the same semantic meaning. Two semantic structures have the same semantic meaning when the semantic distance between them is small enough. Evaluating semantic distance involves evaluating their respective semantic signatures. We need to consider all possible **semantic association chains** when we evaluate the structures in the given context. We will discuss an algorithm constructing augmented semantic structures  $S_i^+$  and  $S_j^+$  from  $S_i$  and  $S_j$  respectively.

## Constructing Augmented Semantic Structure

Let us have a semantic structure  $S$  in the context  $C$ .  $S$  is related to the context  $C$  by a set of relationships  $R_1, R_2, \dots, R_l, \dots, R_n$ .



In the future we will denote this augmented semantic structure  $S^+$  in the context  $C$  by the notation  $[C\langle R_1, R_2, \dots, R_n \rangle S]$ . Shortly:

$$S^+(C) = [C\langle R_1, R_2, \dots, R_n \rangle S]$$

The approach to construct  $R_1, R_2, \dots, R_n$  is reminiscent to the process discussed in [Semantic Parsing](#). We are attaching a set of match-seeking particles  $MA_i$  and match-repelling particles  $MR_j$  to substructures of  $S$ . Similarly, we are attaching match-seeking particles  $MA^l, l = 1, 2, \dots$  and match-repelling particles  $MR^m, m=1, 2, \dots$  to substructures of  $C$ . Each matching-seeking particle  $MA_i$  attaches to a substructure  $S_i^S$  which is a subdigraph of  $S$ . Each match-seeking particle exposes particular region of the semantic signature of the substructure it attaches to. A similarity link association is established by our match-seeking particle on  $S$  and another attached on  $C$  if the exposed regions on both sides are similar enough. More than one match-seeking particle can be attached to a specific substructure where each of the match-seeking particles exposes different region of the semantic signature of the same substructure. More on this topic in [Note on binding of Match-seeking and Match-repelling particles](#).