Parsing of raw semantic particles and synthesis of semantic structures from the former

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The Notion of Semantic Parsing

Semantic Parsing (***SP***) is a process, distinctly different than our understanding of what *Parsing* is in the classical sense of Computer Science. The *Semantic Parsing* uses inference to construct semantic structures and is closely related to the Inference Process (***IP***) as it will be shown in this Section.

Process for transforming a sequence of raw particles into semantic structure

In the beginning we have a sequence of raw (naked) particles containing single property – $text$. We know which raw particle precedes the current one and which one succeeds it. The first part of dressing the raw particle sequence is performing *Semantic Association*.

Semantic Association

The Semantic Association (***SA***) process starts by sending *default-association* particles to attach to each raw (naked) particle on the left and on the right as follows:
$\prec N_{11}\ DA_1\ N_{12}\ DA_2\ N_{13}\ DA_3\ N_{14} \succ$
Then a set of M-particles are created attaching to the *text* property of each naked particle.
Each M-particle which binds to the same *text* property of the naked particle creates slightly different binding pattern based on the textual representation of the naked particle. Each of those M-particles will attempt to attract *similarity-association* particle (SA-particle) bound to already processed V-particles. For the case of N_{13} one of those M-particles will attract SA-particle associated with V_3 and another one of those M-particles will attract SA-particle associated with $V_{apostrophe}$.

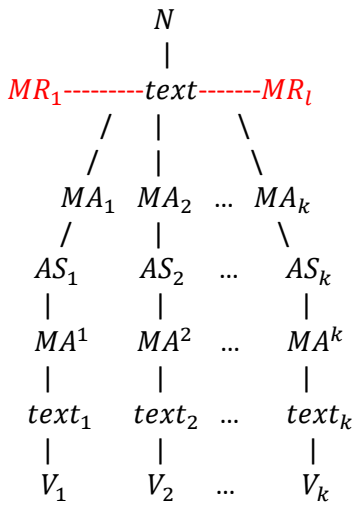
Details on the algorithm performing similarity association and dressing of raw particles are elaborated and discussed in *Supplement-9-5-29 (page1-page10)*.

Partially dressed particle
Raw particle which has been identified by name and its position in the semantic path with respect to the other partially dressed particles.

Property inference in partially dressed particles
Let us assume we have a partially dressed particle N together with other partially dressed particles N_1, N_2, … , N_k which are part of the same semantic path (sequence). We would like to infer as many properties of those as possible.

S – the set of all allowed property values for particle N
S1, S2, … , Sk are subsets of S
Existing chain C1: N has the pairs (pi,vj) where (i,j) belongs to S1
Existing chain C2: N has the pairs (pi,vj) where (i,j) belongs to S2
. . .
Existing chain Ck: N has the pairs (pi,vj) where (i,j) belongs to Sk

New chain Cnew: N has only (p0,v0) where p0 is the *name* property and v0 is the *name* value.
Goal: find out the set Snew containing the indices (I,j) of all pairs (pi,vi) which belong to N in the new chain Cnew.
One can obtain Snew by constructing Bayesian network from C1, C2, … , Ck and the sets S1, S2, … , Sk.



MA – match-seeking particle (is it really necessary?)
MR – match-repelling particle – acts as a repellent toward particular association particles. Models constraints imposed on certain V-particles in terms of similarity matching
AS – similarity particle: a special type of link particle (A-particle)
N – naked particle candidate for dressing
$text$ – the text property value of the naked particle N
V_i – V-particle (semantic particle)

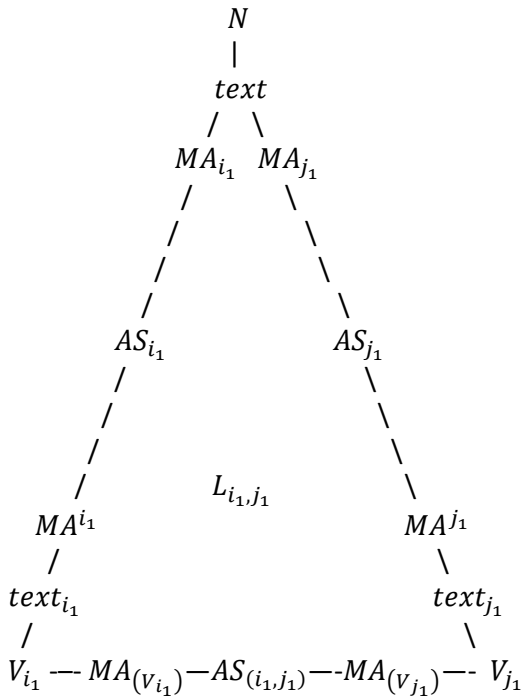
When do we terminate the particle chain established by similarity association?
Consider a set of k V-particles semantically close to each other: $V_1, V_2, \dots, V_k$
Let us assume that we have established a viable association between a pair from the set:

$\exists\, i,j \in [1,\dots,k]$ $\quad V_i$ --- MA_i --- A_i --- MA^j --- V_j

Let us assume we have a set of pairs for which association link can be established:

$(i_1,j_1),(i_2,j_2),\dots,(i_l,j_l),\ l = 1..k^2$

Let us consider the first matched tuple (i_1,j_1)



The loop N-MA_{i_1}-AS_{i_1}-MA^{j_1}-V_{i_1}-$MA_{(V_{i_1})}$-$AS_{(i_1,j_1)}$-$MA_{(V_{j_1})}$-V_{j_1}-MA^{j_1}- AS_{j_1}-MA_{j_1}- N will be denoted with L_{i_1,j_1}.

Coulomb's law for semantic particles

Let the particle V_{p_1} has "charge" with value q_1 and particle V_{p_2} has property "charge" with value q_2. Then if $sign(q_1) \neq sign(q_2)$ there will be attraction force between the two particles with magnitude F:

$F(V_{p_1}, V_{p_2}) = K \times \frac{|q_1| \cdot |q_2|}{f(r)}$ where $K > 0$ is some proportionality constant and $f(r)$ is some monotonously increasing function of the semantic distance $r(V_{p_1}, V_{p_2})$ between the two particles. If $sign(q_1) = sign(q_2)$ the force would be repelling and will be with the same magnitude F.

The binding force F^b of the association loop L_{i_1,j_1} is given with:

$$F^b(L_{i_1,j_1}) = F(MA_{i_1}, AS_{i_1}) + F(MA^{i_1}, AS_{i_1}) + F\left(MA_{(V_{i_1})}, AS_{(i_1,j_1)}\right) + F\left(MA_{(V_{j_1})}, AS_{(i_1,j_1)}\right) + F(MA_{j_1}, AS_{j_1}) + F(MA^{j_1}, AS_{j_1})$$

Here the attraction force between the match seeing particle MA and the similarity particle AS is given with the Coulomb's law for semantic particles.