Modeling attractive and repulsive forces between semantic structures

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Initial Notes

The attractive / repulsive force between semantic structures (**SARF**) acts on different (larger) scales compared to the attractive / repulsive force between properties (**PARF**).

Discovery of mutual attraction happens through regional exploration. Let us have a new semantic structure S constructed from recently parsed data. The chances are that all semantic structures which are attracted to S are in the vicinity of S.

Let us consider a newly formed semantic structure A^{new}. The closest already formed semantic structure will be denoted with B. On an aggregation level l_1 the nearby semantic structure B can be represented as a graph of n_{l_1} substructures all of which belong to the set $\{B\}_{l_1}$. With $2^{\{B\}_{l_1}}$ we denote the power set of $\{B\}_{l_1}$. We want to compute the attractive force between A^{new} and B.

Case 1). There are already formed instances of *substructures* from B which are close to some of the already formed instances of A.

Let us assume that there are other structures involving previous instances of A - A^{old_1}, A^{old_2}, …, A^{old_k}. For brevity we will denote the set $\{A^{old_1}, A^{old_2}, \dots, A^{old_k}\}$ with $\mathcal{A}^{old}$. Let us assume that in the neighborhoods of the elements of $\mathcal{A}^{old}$ there are instances of elements in $2^{\{B\}_{l_1}}$.

Let us denote with $\left\{\{B\}_{l_1}\right\}_i$ the instances of the elements from $2^{\{B\}_{l_1}}$ which are in the neighborhood of A^{old_i}. Let us denote with $n_i(l_1)$ the number of those instances $n_i = \left|\left\{\{B\}_{l_1}\right\}_i\right|$. We will denote each element of $\left\{\{B\}_{l_1}\right\}_i$ by $B_j^{old_i}$ where $j = 1..n_i(l_1)$.
Obviously, we know masses, energy signatures and the semantic distances between A^{old_i} and the elements of $\left\{\{B\}_{l_1}\right\}_i$.
We would like to estimate the attractive force between A^{new} and B by using the information stored in the pairs A^{old_i} and $B_j^{old_i}$ for $i = 1..k$ and $j = 1..n_i(l_1)$. Let us assume that we know the attractive / repulsive force for each of those pairs $f_{i,j} = f^{\mathrm{SARF}}\left(A^{old_i}, B_j^{old_i}\right)$ for the current moment in time t. Let us denote the masses of those two sets of structures with $\mathfrak{m}_{A_i}$ and $\mathfrak{m}_{B_{i,j}}$ accordingly for $i = 1..k$ and $j = 0..n_i(l_1)$. Let us denote with $d_{i,j} = \mathrm{sdist}\left(A^{old_i}, B_j^{old_i}\right)$ the semantic distance between the pair A^{old_i} and $B_j^{old_i}$ for the current moment in time t.

Case 2) There are already formed instances of *substructures* from A which are close to some of the already formed instances of B.

Case 3) There are already formed instances of *substructures* from A which are close to some of the already formed instances of *substructures* of B.

Case 4) There are neither previously formed instances nor instances of substructures for both A and B.

In this case we will look for similarity and assess the degree of similarity.

Estimation of the attractive force between two structures

Let us have two structures S_1 and S_2 which are in bound positions. We will denote with $\vec{r}_1$ the position of the centroid of S_1 in general. Similarly, with $\vec{r}_2$ we denote the position of the centroid of S_2 in general. The centroid of the compound structure $S_1 \cup S_2$ is given with $\vec{r}_c$. We denote with $\vec{x}_{1,b} = \vec{r}_{1,b} - \vec{r}_c$ and $\vec{x}_{2,b} = \vec{r}_{2,b} - \vec{r}_c$ the semantic distances from the bound positions of S_1 and S_2 to the centroid of the compound structure $S_1 \cup S_2$. Let us denote with $E\left(\vec{r}_{1,b}\right)$ and $E\left(\vec{r}_{2,b}\right)$ the semantic energies of S_1 and S_2 in bound state. With $\mathfrak{m}_1$ and $\mathfrak{m}_2$ we denote the semantic masses of S_1 and S_2.

Let us denote by S_i' the set of structures which are already assigned force particles such that $S_i' \subset S_1$. With S_i'' we denote the set of structures which are already assigned force particles such that $S_i'' \supset S_1$