Modeling attractive and repulsive forces between semantic structures

D. Gueorguiev 6/6/2022

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 S_1^{new}. The closest semantic structure will be denoted with S_0. On an aggregation level l_1 the nearby semantic structure S_0 can be represented as a graph of n_{l_1} substructures all of which belong to the set $\{S_0\}_{l_1}$. With $2^{\{S_0\}_{l_1}}$ we denote the power set of $\{S_0\}_{l_1}$. We want to compute the attractive force between S_1^{new} and S_0. Let us assume that in a neighborhood of S_1^{new} there are other structures involving previous instances of S_1 - $S_1^{old_1}$, $S_1^{old_2}$, ..., $S_1^{old_k}$. For brevity we will denote $\left\{S_1^{old_1}, S_1^{old_2}, \dots, S_1^{old_k}\right\}$ with $\mathcal{S}^{old}$. Let us assume that in the neighborhoods of the elements of $\mathcal{S}^{old}$ there are instances of elements in $2^{\{S_0\}_{l_1}}$ and possibly another instance of S_0 itself. Let us denote with $\left\{\{S_0\}_{l_1}\right\}_i$ the instances of the elements from $2^{\{S_0\}_{l_1}}$ which are in the neighborhood of $S_1^{old_i}$.
Obviously, the semantic distances between $S_1^{old_i}$ and the elements of $\left\{\{S_0\}_{l_1}\right\}_i$ are given as well as the masses and energy signatures of the latter.
We would like to estimate the attractive force between S_1^{new} and S_0 by using the information stored in the pairs $S_1^{old_i}$ and $\left\{\{S_0\}_{l_1}\right\}_i$ for $i = 1..k$.

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.