Note on binding of an association property to semantic properties

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Let us consider two properties - P_i and P_j connected through association property (or link) $A_{i,j}$.

P_i----$A_{i,j}$----P_j

The properties P_i and P_j are represented by their property signatures $\mathbf{p}_i$ and $\mathbf{p}_j$. The association link $A_{i,j}$ is represented with its association matrix $\mathbf{a}_{i,j}$ and semantic significance vector $\mathbf{w}_{i,j}$.
The association matrix has the following structure:

$$\mathbf{a}_{i,j} = \begin{bmatrix} \mathbf{r}_1 & \mathbf{r}^1 \\ \mathbf{0} & \mathbf{0} \\ \mathbf{r}_2 & \mathbf{r}^2 \\ \mathbf{0} & \mathbf{0} \\ \vdots & \vdots \\ \mathbf{0} & \mathbf{0} \\ \mathbf{r}_k & \mathbf{r}^l \end{bmatrix}$$

Here $\mathbf{r}_i$, $i = 1..k$ denote regions of interest in the property signature of the property on the left of $A_{i,j}$ - P_i. Similarly, $\mathbf{r}^j$, $j = 1..l$ denote regions of interest in the property signature of the property on the left of $A_{i,j}$ - P_j. Let us assume that there is a universal law which allows us to calculate the binding force between P_i and P_j given with their signature vectors $\mathbf{p}_i$ and $\mathbf{p}_j$. Let us assume a general form for this law:

$$F^b(P_i, P_j) = f(\mathbf{p}_i, \mathbf{p}_j)$$

Obviously, the binding force between the properties depends only on the presence of specific regions of the property signatures, namely $\mathbf{r}_1, \mathbf{r}_2, \dots, \mathbf{r}_k$ and $\mathbf{r}^1, \mathbf{r}^2, \dots, \mathbf{r}^l$. Thus, it will be true:

$$f(\mathbf{p}_i, \mathbf{p}_j) = f([\mathbf{r}_1, \mathbf{0}, \mathbf{r}_2, \mathbf{0} \dots \mathbf{0}, \mathbf{r}_k], [\mathbf{r}^1, \mathbf{0}, \mathbf{r}^2, \mathbf{0}, \dots, \mathbf{0}, \mathbf{r}^l])$$

Further removal of a non-zero subregion from any of the regions $\mathbf{r}_i$, $i = 1..k$ and $\mathbf{r}^j$, $j = 1..l$ will lead to decrease of the binding force to a value lower than $f(\mathbf{p}_i, \mathbf{p}_j)$. We will assume that the positions and length of the zero regions is unique i.e. there is no other set with the same number of zeros which will lead to the same value of the binding force. Those non-zero regions $\mathbf{r}_i$, $i = 1..k$ and $\mathbf{r}^j$, $j = 1..l$ will be denoted as the ***active regions*** of the association link between the two properties.

The binding force can be calculated for any pair of active regions in the following manner:
We keep a registry of active region pairs for which we know the binding force value (which could be positive or negative). Let us denote those "registered" region pairs with hat over the symbol denoting the region. Then we have:
$(\hat{\mathbf{r}}_i, \hat{\mathbf{r}}_j) \to \hat{f}_{i,j}$ for all $(\hat{\mathbf{r}}_i, \hat{\mathbf{r}}_j) \in \mathfrak{R}$, $\hat{f}_{i,j} \in \mathfrak{F}$
Here with $\mathfrak{R}$ we denote the set of all registered region pairs and with $\mathfrak{F}$ the set of all registered binding force values. So the region registry is represented by the map $R: \mathfrak{R} \to \mathfrak{F}$. If an active region pair $(\mathbf{r}_1, \mathbf{r}_2)$ is not found in the registry we are going extrapolate its binding force by finding the set of the closest matching pairs in the registry and find the value of $f(\mathbf{r}_1, \mathbf{r}_2)$ by using some learned function. This

function can be as simple as assigning some default value determined based on certain unique characteristics of the new pair of regions.