YTEX Semantic Similarity Measures

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This document describes the semantic similarity measures implemented by YTEX. We modified some measures so that they conform to the universal definition of similarity presented by Lin [1]: measures are limited to the interval [0,1], and the similarity between a concept and itself is 1.

# Path finding measures

We focus on the *Path,* *Leacock and Chodorow* (*LCH*)*,* and *Wu-Palmer* path finding measures. These measures are based on the number of nodes (*path*(*c1, c2*),or *p)* in the shortest path separating two concepts, *c1* and *c2*. The shortest path between two concepts traverses their Least Common Subsumer (*lcs*(*c1, c2*)), i.e. their closest common parent. The depth (*depth*(*c*)) of a concept is defined as the number of nodes in the path to the root of the taxonomy; and *d* represents the maximum depth of a taxonomy.

*Path* defines the similarity between two concepts simply as the inverse of the length of the path separating them [2]:

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*LCH* is based on the ratio of path length to depth, but performs a logarithmic scaling [3]. Originally, LCH was defined as

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where *d* represents the maximum depth of the taxonomy. As proposed in [4], we scale LCH to the unit interval by dividing by log(2*d*). Dividing by a constant value has no effect on the spearman correlation with benchmarks: the relative ranks of concept pair similarities remain the same.

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*Wu & Palmer* scales the depth of the LCS by the length of the path between two concepts [4]:

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One problem with this definition is that the similarity of a concept with itself is less than 1 (if *c1* = *c2,* then). Instead, we adopt the definition of Wu & Palmer used in the Natural Language Toolkit [5]:

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Under this definition, if *c1* = *c2*, then *p*-1 = 0, and the similarity measure evaluates to 1.

# IC based measures

Information content can be estimated solely from the structure of a taxonomy (intrinsic IC), or from the distribution of concepts in a text corpus in conjunction with a taxonomy (corpus IC) [6–8].

The corpus IC (*ICcorpus(c)*) of a concept is defined as the inverse of the log of the concept’s frequency [6]. The frequency of a concept is recursively defined using a taxonomy: it is based on the number of times the concept *c* occurs within a corpus (), together with the number of times its children occur:

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We follow the intrinsic IC definition proposed by Sanchez et al [8]:

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where *leaves(c)* is the number of leaves (concepts without children) that are descendants of the concept *c*; *subsumers(c)* contains *c* and all its ancestors. The ratio of leaves to subsumers quantifies the information a concept carries– the more leaves a concept has relative to the number of ancestors, the less information it carries; this is normalized to the unit interval by *max\_leaves*, the total number of leaves in the taxonomy.

The IC based Lin measure compares the IC of a concept pair to their LCS’s IC: the greater the LCS’s IC (i.e. the more specific the LCS), the more ‘similar’ the pair of concepts.

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Sanchez & Batet redefined path finding measures in terms of information content [8]. Path finding measures are defined in terms of the path length *p* and the maximum depth *d*. Sanchez & Batet proposed redefining the maximum depth d as *icmax*, the maximum information content of any concept; and proposed redefining the minimum path length *p* between two concepts in terms of Jiang & Conrath’s semantic distance [8], [9] :

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The IC-based *LCH* measure is obtained simply by substituting *distjc* and *icmax* for *p* and *d* in equation 3 (1 is added to *distjc*to avoid taking the logarithm of 0):

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One problem with this definition is that the IC-based LCH can assume negative values. We modify this as follows:

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Both Sanchez & Batet’s and our definitions of the IC-based LCH are monotonically decreasing functions of *distjc*, and thus produce identical spearman correlations with benchmarks.

The IC-based *Path* measure (als known as the Jiang & Conrath *similarity* measure) is obtained simply by substituting *distjc* for *p* (1 is added to *distjc* to avoid dividing by 0):

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# References

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