Semantic relatedness measure using object properties in an ontology

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7th International Semantic Web Conference, October 30th 2008

Outline

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Need for efficient relatedness on graph-based KR

Semantic measure objective

Hypothesis

1. Graph-based knowledge representation (*e.g.* semantic networks, W3C SKOS):
   1. Based upon hierarchical structure
   2. With heterogeneous relations (*part-of*, etc.)
2. Extension of previous work on semantic similarity measure

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- Using all relations, must filter the set of all possible graph paths
  ⇒*set of patterns to recognize a semantically correct path, based on the combination of relation type in a path*

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- $[is\text{-}a]^+ [part\text{-}of]^+ [includes]^+$: correct pattern
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We will only consider paths which are semantically correct

Single-relation path: hierarchical path

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- Path with only one type of relation

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- Path with only one type of relation

Hierarchical single-relation path

- Information theoretic approach introduced by [Resnik95]
- Each node has a weight:
  $\Rightarrow$ the *Information Content* function: $IC(x)$ [Resnik95, Seco04]
- Converted to edge weight by [Jiang&Conrath97]:

$$W(path_{X \in \{isa, include\}}(x, y)) = |IC(x) - IC(y)|$$

Single-relation path: non-hierarchical path

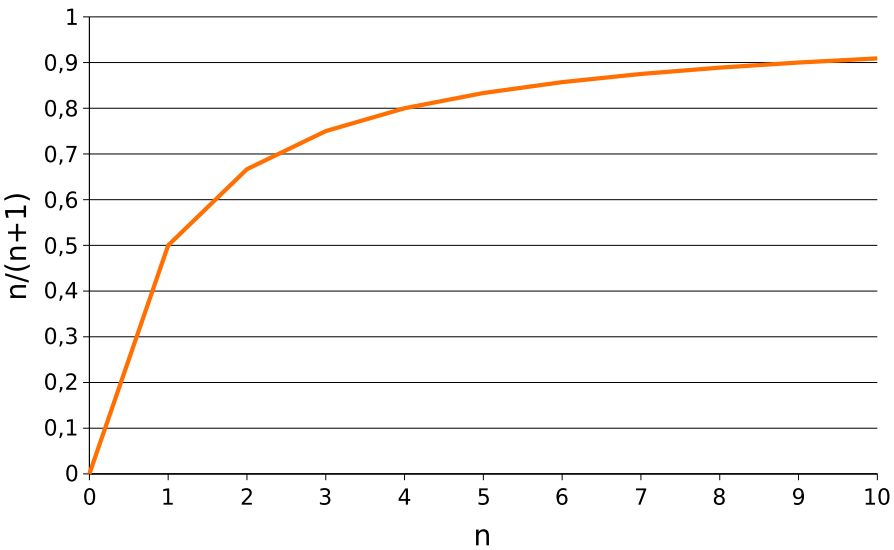
Non-hierarchical path

$$W(path_X(x,y)) = TC_X \times \left(\frac{|path_X(c_1,c_2)|}{|path_X(c_1,c_2)|+1} \right)$$

- With TC_X the weight of an infinite-length path of type X

Motivation

- TC_X: bound the value in $[0, TC_X]$
- $\frac{n}{n+1}$: approximate the IC function shape [Seco04]



Final distance

Weight of a mixed-path

- The function $T(path(x,y))$ computes the minimal set of single-relation paths

$$W(path(x,y)) = \sum_{p \in T(path(x,y))} W(p)$$

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Final distance

- Function $HSO(p)$ is *true* iff p is a valid path *w.r.t.* HSO rules.

$$dist(c_1,c_2) = \min_{\{p \in \pi(c_1,c_2) | HSO(p)=true\}} W(p)$$

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Evaluation

Protocol

- KR: WordNet 3.0, IC [Seco04], using *part-of* only
- Test: [Miller&Charles91], [Finkelstein01] for WordSimilarity-353
  - M&C: 30 couples, test *similarity* (e.g. magician-wizard)
  - WS-353: 353 couples, test *relatedness* (e.g. computer-keyboard)

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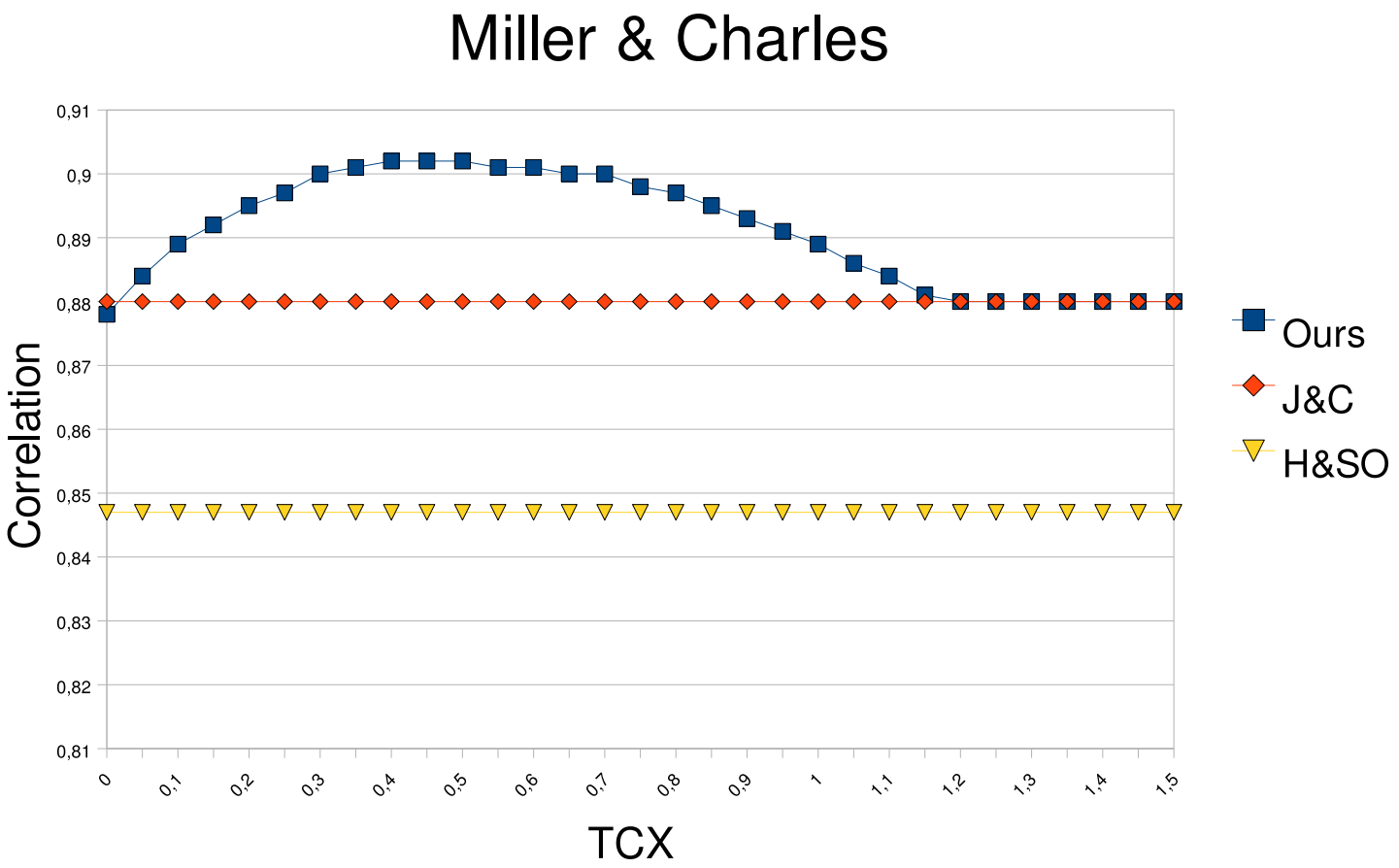
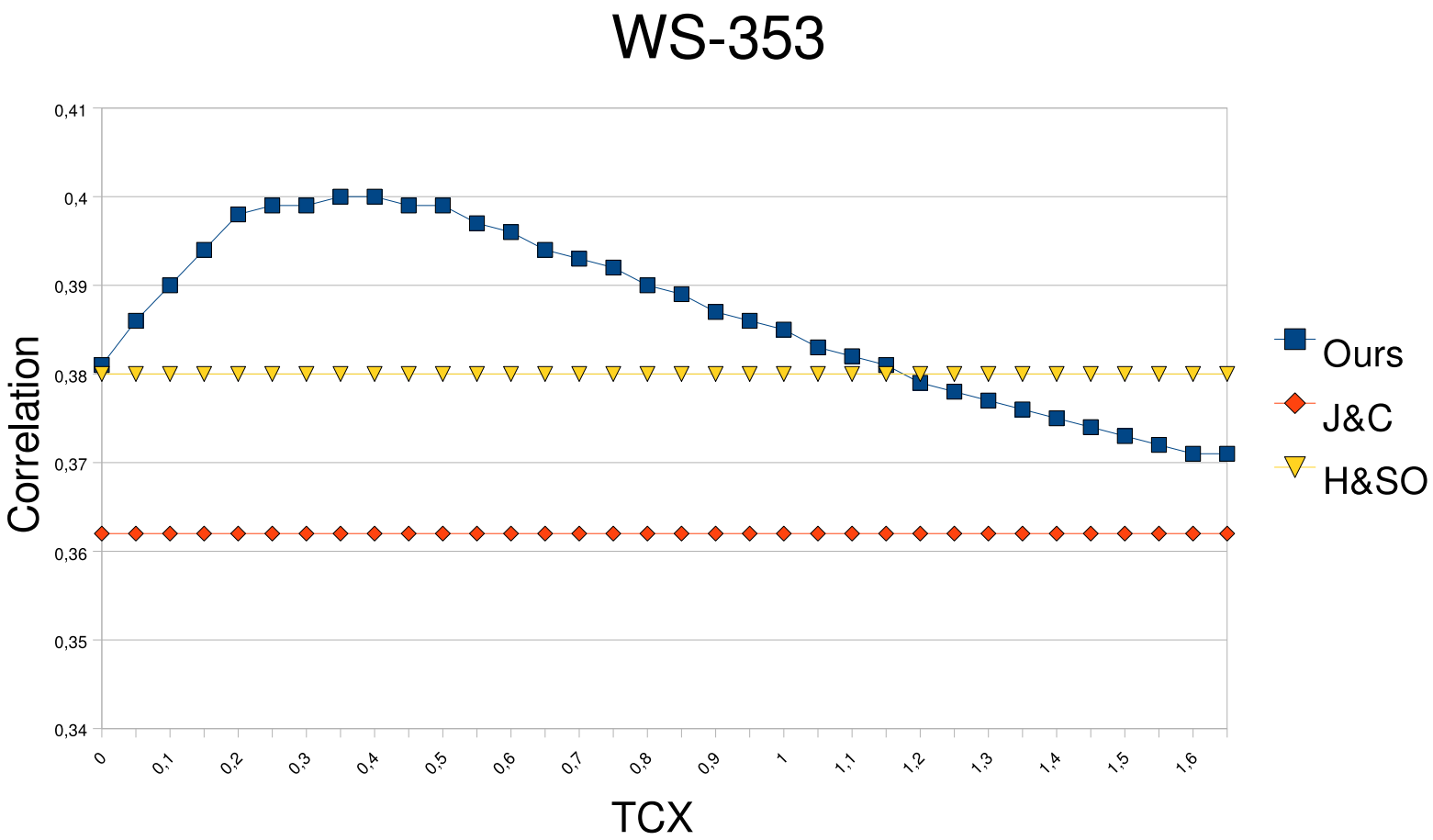
	Correlation	
Measures	M&C	WS-353
Rada	0.638	0.249
Resnik	0.804	0.375
Lin	0.836	0.377
Jiang & Conrath	0.880	0.362
Hirst & St-Onge	0.847	0.380
Our measure, $TC_{part-of} = 0.4$	0.902	0.400

TC_X study with [M&C91]



TC_X study with WS353



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  - With information theoretic approach
  - With semantic path patterns
  - *With a new formula for non-hierarchical path*
- Evaluated on classical benchmark & gives good result

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Future work

- Test with:
  - Others KR model (*e.g.* SNOMED v3.5 Fr, 105.000 concepts)
  - Integrated in a human/machine interaction system
- Extension to OWL Lite?

Thank you!

Thank you for your attention!
Have you any question?