Lesson4:
Descriptive Modelling of Similarity of Text
Unit1:
Similarity Measures

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Introduction to Web Science Part 2

Emerging Web Properties

WeST People and Knowledge Networks

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Completing this unit you should …

- Know the properties of a similarity measure
- Be able to relate similarity and distance measures
- Know of two applications for modelling similarity

Similarity measures (definition & properties)

Given a Collection of text documents $D \subseteq W^*$ for a finite set of words $W = \{w_1, \ldots, w_N\}$

$s : D \times D \longrightarrow \mathbb{R}^+$ is called a similarity measure iff

- Equal self-similarity $s(D_i, D_i) = s(D_j, D_j)$
- Symmetry $s(D_i, D_j) = s(D_j, D_i)$
- Maximality $s(D_i, D_i) \geq s(D_i, D_j)$

Normalized similarity measures

Given a similarity measure $s : D \times D \longrightarrow \mathbb{R}^+$

We can deduce $\tilde{s} : D \times D \longrightarrow [0, 1]$ by setting

$$\tilde{s}(D_i, D_j) = \frac{s(D_i, D_j)}{s(D_i, D_i)}$$

Quiz:

- Why is this well defined?
- Do all the properties hold?

Connection to distance measures

Given a normalized similarity measure

$$\tilde{s} : D \times D \longrightarrow [0, 1]$$

We can deduce a distance function by setting

$$d(D_i, D_j) = -log(\tilde{s}(D_i, D_j))$$

Or the other way around:

$$\Leftrightarrow \tilde{s}(D_i, D_j) = e^{-d(D_i, D_j)}$$

1st application: Ranking and querying

Given a query $q \in W^*$ (or $q \in D$?)

We can always assume that s can be extended to W^*

One can look at $s(q, D_i) \forall D_i \in D$

In particular at $r_1 = \underset{D_i \in D}{\operatorname{argmax}}\{s(q, D_i)\}$

We can iterate the process and create a ranking of a query based retrieval system

$$r_1 = \underset{D_i \in D}{\operatorname{argmax}} \{s(q, D_i)\}$$

$$r_2 = \underset{D_i \in D \setminus \{r_1\}}{\operatorname{argmax}} \{s(q, D_i)\}$$

$$r_3 = \underset{D_i \in D \setminus \{r_1, r_2\}}{\operatorname{argmax}} \{s(q, D_i)\}$$

And so on for as many result documents as we want to retrieve

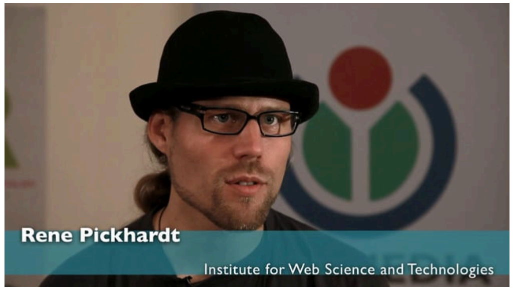
2nd application: Recommender Systems

- Given a Document D_j
- Compute $s(D_i, D_j) \forall D_i \in D$
- And like before $r_1 = \underset{D_i \in D \setminus \{D_j\}}{\operatorname{argmax}} \{s(D_i, D_j)\}$
- And iterate again for more results

Discussion

- Often natural similarity measures or natural distance measures occur
- Minimality becomes Maximality and vice versa
- You should get used to the fact that we and other people mix the terms (similarity and distance).
- Once the concept is understood you will do the same
- The omitted triangle inequality has better semantics for distance measures but won't translates to similarities

Thank you for your attention!



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