Closed Domain Question Answering Using Fuzzy Semantics

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Acknowledgments

thanks for supervising the project!

Ann Copestake  (Cambridge Computer Lab)

thanks for helping with the fuzzy logic!

Ulrich Bodenhofer  (Johannes Kepler University Linz)

thanks for reading related manuscripts!

Ted Briscoe  (Cambridge Computer Lab)

Daniel Osherson  (Princeton Psychology Dept)

thanks for participating in the experiment!

MPhil students, NLIP Group, RMRS-list, personal friends
Motivation

*a small city near San Francisco*  
(example due to Zadeh)

What does small’(x) mean in terms of population? What does near’(x,y) mean in terms of distance?

How do we deal with the vagueness in *small* and *near*?
## Motivation

### Natural Language Database Demo Interface

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Fuzzy Logic

In classical logic: A is a set on domain X iff \( \exists \) characteristic function \( \chi_A : X \to \{0,1\} \) such that \( \chi_A(x) = 1 \) iff \( x \in A \).
In fuzzy logic: $A$ is a fuzzy set on domain $X$ iff $\exists$ characteristic function $\mu_A: X \rightarrow [0,1]$ such that $\mu_A(x)$ is a degree of membership.
Let $A, B, C$ be fuzzy sets on $X$. Then $C = A \cap B$ with $\mu_C(x) = \mu_A(x) \land \mu_B(x)$ iff

$\land : [0,1] \times [0,1] \to [0,1]$ with

1. $a \land b = b \land a$
2. $a \land (b \land c) = (a \land b) \land c$
3. $a \leq b \Rightarrow (a \land c) \leq (b \land c)$
4. $a \land 1 = a$

For example: numeric product!
Ordering-based semantics

What exactly is it that a fuzzy set represents in a theory of natural language semantics?

A first approach: The meaning of a vague expression **is a fuzzy set**.

Alternatively: meaning is the **ordering imposed** on the domain **by a fuzzy set**.
Ordering-based semantics

Problem: no universal intuitions about sets.

The decision boundary for a tiny city is sometimes placed higher than for a small one, for different subjects (Bergmair 2006).

very only shifts decision boundaries when subjects can directly contrast them. (Cliff 1988, Smith et al. 1988, O’ Muircheartaigh et al. 1993, Wright et al. 1995)
Conclusions

We’ve introduced fuzzy semantics as a new approach to semantics which provides a more adequate model of vague language.

We’ve implemented the model in the form of an NLID, and provided empirical evidence in support of our model.
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