

Don't 'have a clue'?

Unsupervised co-learning of downward-entailing operators

Cristian Danescu-Niculescu-Mizil
Lillian Lee


Department of Computer Science, Cornell University

ACL 2010

Why my poster?

Tackles a complex semantic phenomenon.

Uses only raw text + **one** “seed word”.

The only solution that works for Klingon 

Monotonicity

“I know I’ll buy a Mac” \implies “I know I’ll buy a computer”

Monotonicity

“I know I’ll buy a Mac” \implies “I know I’ll buy a computer”

“I doubt I’ll buy a Mac” $\not\Rightarrow$ “I doubt I’ll buy a computer”

Monotonicity

“I know I’ll buy a Mac” \implies “I know I’ll buy a computer”

“I doubt I’ll buy a Mac” \longleftarrow “I doubt I’ll buy a computer”

Monotonicity

Upward monotone:

“I know I’ll buy a Mac” \implies “I know I’ll buy a computer”
<subset> <set>

Downward monotone:

“I doubt I’ll buy a Mac” \longleftarrow “I doubt I’ll buy a computer”
<subset> <set>

Monotonicity

Upward monotone:

“I know I’ll buy a Mac” \Rightarrow “I know I’ll buy a computer”
<subset> <set>

Downward monotone:

“I **doubt** I’ll buy a Mac” \Leftarrow “I **doubt** I’ll buy a computer”
<subset> <set>

Downward-entailing operators

Downward-entailing operators invert the default monotonicity, allowing one to “reason from sets to subsets”.

Downward-entailing operators

Downward-entailing operators invert the default monotonicity, allowing one to “reason from sets to subsets”.

Examples:

<set>

<superset>

“I **doubt** I’ll buy a computer” \implies “I **doubt** I’ll buy a Mac”

“He came **without** cash or cards” \implies “He came **without** cash”

“She is **too lazy to** run” \implies “She is **too lazy to** run a 10k”

Downward-entailing operators

Task:

Automatically discover DE operators.

Challenges:

No monotonicity-annotated corpora.

Not deducible from any public lexical database.

[Nairn et al., 2006]

Downward-entailing operators

Why?

Linguistic importance:

DE operators play “an extremely important role in natural language”

[van der Wouden, 1997; van Benthem, 1986; Hoeksema, 1986; Dowty, 1994; Sánchez Valencia, 1991]

Textual Entailment:

TE systems that approach monotonicity rely on relatively small **hand-annotated** lists of English DE operators.

[Nairn et al.; 2006, MacCartney and Manning, 2008; Bar-Haim et al., 2008.]

Natural Language Generation:

DM inferences induce greater cognitive load than UM inferences.

[Geurts and van der Slik, 2005]

Prevalence:

At least 6% of newswire sentences contain a non-trivial DE operator

[Danescu-Niculescu-Mizil et al., 2009]

How to find DE ops.?

Before:

[Danescu-Niculescu-Mizil et al., 2009]

Sprinkle some linguistic magic powder over the raw text:
“NPIs” are noisy clues for DE operators.

Examples:

anymore, have a clue, budge, give a damn, ...

How to find DE ops.?

Before:

[Danescu-Niculescu-Mizil et al., 2009]

Sprinkle some linguistic magic powder over the raw text:
“NPIs” are noisy clues for DE operators.

Examples:

“They do not listen anymore.” vs. “*They do listen anymore.”

“I doubt they have a clue.” vs. “*They have a clue.”

How to find DE ops.?

Before:

[Danescu-Niculescu-Mizil et al., 2009]

Sprinkle some linguistic magic powder over the raw text:
“NPIs” are noisy clues for DE operators.

Examples:

“They do not listen anymore.” vs. “*They do listen anymore.”

“I doubt they have a clue.” vs. “*They have a clue.”

Where’s the green?

“It is wise to try compensating for any excess.”

How to find DE ops.?

Before [Danescu-Niculescu-Mizil et al., 2009]:

Input:

English Text +
English NPIs: have a clue give a damn anymore a red cent budge ...

Output:
DE ops.



How to find DE ops.?

Before [Danescu-Niculescu-Mizil et al., 2009]:

Input:

English Text +
English NPIs:
have a clue
give a damn
anymore
a red cent
budge
...

Romanian Text +
Romanian NPIs:

Output:
DE ops.



How to find DE ops.?

Before [Danescu-Niculescu-Mizil et al., 2009]:

Input:

English Text +
English NPIs:
have a clue
give a damn
anymore
a red cent
budge
...

Romanian Text +
Romanian NPIs:
?
?
?
?
?
...

Output:
DE ops.



How to find DE ops.?

Before [Danescu-Niculescu-Mizil et al., 2009]:

Input:

English Text +
English NPIs:
have a clue
give a damn
anymore
a red cent
budge
...

Romanian Text +
Romanian NPIs:
?
?
?
?
?
...

...

Text +
NPIs:
?
?
?
?
?
?
...

Output:
DE ops.

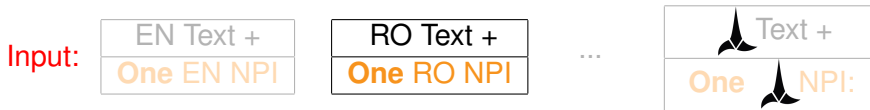


...



How to find DE ops.?

This work: a co-learning approach.



Come to poster #4!

Results:

First time DE operators are learned for a language other than English!

How to chose the seed word?

Spoiler: seed word for Klingon is **vay'**

Does it really work for Klingon?

Connections to linguistic typology.