

Determining Degree of Antonymy

Step 1 for Detecting Erroneous
Coreference Links by Contradiction

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Multidocument coreference resolution

- Errors
 - **Linking** two mention chains from different documents even though they do not refer to the same entity
 - **Failing to recognize** that two mention chains refer to the same entity
- The first kind of error can be reduced by detecting contradictions

Contradictions

- a. *X supports **conservative** ideologies*
- b. *X has **liberal** leanings*

- c. *X has a **large** presence in Europe*
- d. *X has a **small-scale** presence in Europe*

- e. *In school, X showed all the signs of a **genius***
- f. *X was an **average** high school student*

Contradictions

conservative

liberal

large

small-scale

genius

average

Contradiction detection

- Detecting antonymy
- Determining that the antonymous words qualify the same fact in the two sentences
 - Techniques from:
 - paraphrase detection
 - negation handling
 - sentiment detection

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- Contrasting word pairs:
 - *fired* and *employed*,
 - *promoted* and *censured*,
 - *hard* and *fluid*,
 - *large* and *small-scale*
 - *flinch* and *advance*
 - *cogent* and *unconvincing*
 - *opportune* and *awkward*



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 - *opportune* and *awkward*
- What about these?
 - *bill* and *bill*
 - invoice (e.g. in a restaurant)
 - money; banknote
 - *bolt* and *bolt*
 - to secure in place
 - to dash away suddenly
 - *cleave* and *cleave*
 - to adhere; stick together
 - to cut apart; divide
 - *rent* and *rent*
 - to lend; lease out
 - to borrow; hire



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Observations

- There exists a **degree of antonymy** between words
 - 1: strict antonyms
 - (0,1): some degree of antonymy
 - 0: not antonymous
- Lexicons of strict antonyms occur
 - in some languages
 - limited coverage
- **Contrasting word pairs** far outnumber strict antonyms
 - Contrasting word pairs remain unrecorded
- Knowing that two words have some non-zero degree of antonymy is useful



Uses of antonymy detection

- Separating antonymous words from those that are semantically similar
 - In a distributional thesaurus (Lin, 1998)
- Detecting errors in coreference resolution
- Detecting contradictions
- Detecting paraphrases
- Opinion tracking
 - Detecting sentiment

Previous work

- No comprehensive approach
- Some ideas involve apply applying patterns
 - from X to Y

The situation changed from good to bad

** Things moved quickly from bad to worse*

Our approach: resources

- Text
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- Text
 - *BNC, Wall Street Journal*
 - Co-occurrence statistics
- Published thesaurus
 - *Macquarie Thesaurus, Roget's Thesaurus*
 - About 1000 categories
 - Words in a category
 - near synonymous, closely related
 - Ambiguous words
 - more than one category

Our approach: hypotheses

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Our approach: hypotheses

- Words in a category are semantically similar
 - No antonymous word pairs
- Antonyms such as *hot* and *cold* are far outnumbered by those created from affixes
 - *please* and *displease*; *related* and *unrelated*
- For a pair of contrasting words:
 - The degree of antonymy is to some degree correlated with their semantic distance



Our approach: Affix rules

- Manually create a list of affix rules that tend to generate antonyms
 - X *dis* X (*trust distrust*)
 - X *un* X (*classified unclassified*)
 - X *in* X (*consistent inconsistent*)
 - X *de* X (*colonize decolonize; emphasize deemphasize*)
 - X *anti* X (*clockwise anticlockwise*)
 - X *non* X (*playing nonplaying; aligned nonaligned*)
 - X *im* X (*mobile immobile; potent impotent*)
 - X *mal* X (*practice malpractice*)



Affix rules (continued)

- Manually create a list of affix rules that tend to generate antonyms
 - lX illX (legitimate illegitimate; legal illegal)
 - rX irX (regular irregular)
 - imX exX (implicit explicit)
 - inX exX (introvert extrovert)
 - Xless Xful (harmless harmful)

Affix rules (continued)

- Time
 - About 20 minutes
- Potency
 - About 2630 **seed antonym pairs**
 - Antonymy score of 1
- False positives
 - *part* and *depart*; *intone* and *tone*
 - Need way to detect false positives

Lexicon of antonyms

- Lexicon of antonyms can also be used as the seed set
 - *WordNet*
 - Certain thesauri
- Our experiments
 - 273 antonym pairs taken from the web

Bootstrapping: phase I

- Words in the same paragraphs as a seed antonym pair
 - antonymy score of 1

Bootstrapping: phase I

- Words in the same paragraphs as a seed antonym pair
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HIDING

unnoticed

unmarked

unwitnessed

⋮

cover

curtain

ensconce

REVEALING

uncloak

unclothe

uncover

⋮

blabber

spill

tell on

⋮



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$\text{Antonymy}(\textit{cover}, \textit{uncover}) = 1$

$\text{Antonymy}(\textit{ensconce}, \textit{uncover}) = 1$

$\text{Antonymy}(\textit{cover}, \textit{unclothe}) = 1$

$\text{Antonymy}(\textit{ensconce}, \textit{uncloak}) = 1$



Bootstrapping: phase II

- Let x and y be a seed antonym pair
- Let their corresponding thesaurus categories be C_x and C_y
- All the words in C_x are to some degree antonymous with the words in C_y

Example

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$\text{antonymy}(\textit{unwitnessed}, \textit{uncover}) > 0$

$\text{antonymy}(\textit{unnoticed}, \textit{blabber}) > 0$

$\text{Antonymy}(\textit{unmarked}, \textit{uncloak}) > 0$

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- Let x and y be a seed antonym pair
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 - The degree of antonymy is correlated with their **distributional distance**

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Evaluation

- Solving closest-opposite questions
 - Standard GRE and GMAT questions

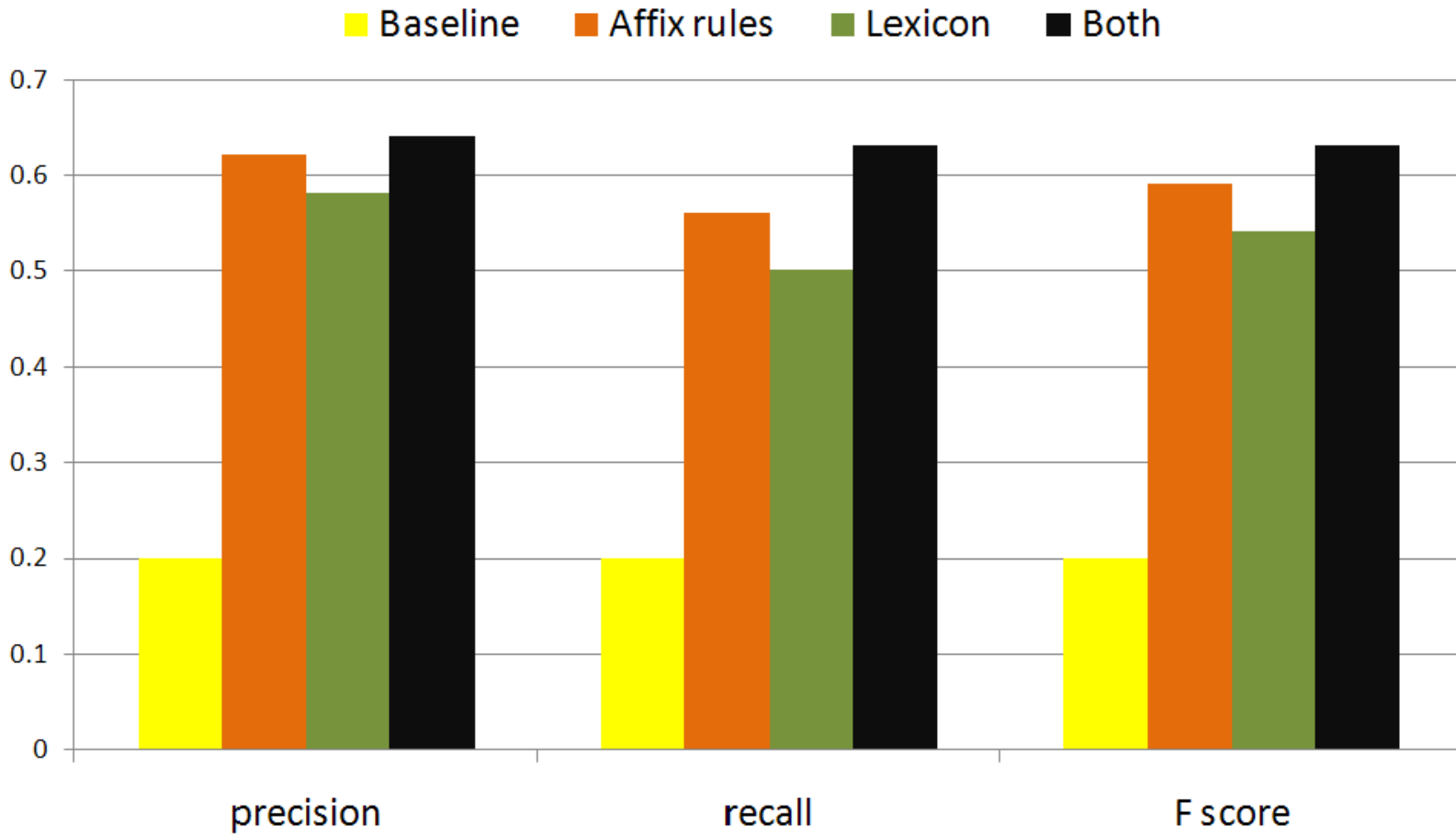
adulterate

- renounce
- forbid
- purify
- criticize
- correct

Data

- World Wide Web
 - A few hundred
 - Development set: 112 questions
- ETS
- Coaching institutions and books
 - *Antonyms 2200*: 1600 questions

Results



Other sources of information

- Distributional distance at the **granularity of paragraphs**
 - Distance between one of the target words and corresponding word of seed antonym pair
- **Number** of seed antonym **links** between a category pair
- **Adjacent categories** in a thesaurus tend to be antonymous

Crossing the language boundary

- Determining degree of antonymy **in a resource-poor language** by combining its text with an English thesaurus
 - Following the ideas of Mohammad, Gurevych, Hirst, and Zesch, 2007
- Evaluation data?

Conclusions

- Proposed a new way to determine degree of antonymy
- Encouraging preliminary results
- Small set of affix rules found to be potent
 - Effect of non-antonymous instantiations alleviated by other sources of information
- Bootstrapping from these seed antonym pairs is viable

Future work

- Improve accuracy of algorithm

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- Use antonymy detection for:
 - contradiction detection

Sirius Black managed to **evade** the clutches of the dementors.
The dementors **caught** Sirius Black.

Future work

- Improve accuracy of algorithm
- Make the approach **cross-lingual**
- Use antonymy detection for:
 - contradiction detection
 - detecting paraphrases

Sirius Black could **not evade** the
clutches of the dementors.

The dementors **caught** Sirius Black.

Future work

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 - detecting paraphrases
 - detecting sentiment

Cornelius Fudge is at best an **incompetent** minister of magic.
Fudge is one of the **finest** ministers of magic ever.

Future work

- Improve accuracy of algorithm
- Make the approach **cross-lingual**
- Use antonymy detection for:
 - contradiction detection
 - detecting paraphrases
 - detecting sentiment
- Use these in turn to:
 - help **coreference resolution**

House elf Dobby is **short** and shabby.

Dobby is an **imposing** elf of Middle Earth.

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- Use these in turn to:
 - help **coreference resolution**
 - analyze dialogic communication



Thank you

Results

- Random baseline: 1 in 5 chance = 20%
- Intelligent baseline?
- Our approach
 - Only affix rules:
 - Precision: 0.62 (63/102)
 - Recall: 0.56 (63/112)
 - F score: 0.59
 - Only lexicon of antonyms:
 - Precision: 0.58 (56/97)
 - Recall: 0.5 (56/112)
 - F score: 0.54
 - Using both:
 - Precision: 0.64 (70/110)
 - Recall: 0.63 (70/112)
 - F score: 0.63

