Textual Entailment

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Introduction

Textual Entailment (TE):

- What is it?
  a notion from classical logic is applied to natural language using NLP technologies
- Which techniques can be applied?
  relevant features for detecting TE via machine learning
- What is done by the community?
  RTE Challenge

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Fondazione Bruno Kessler, Human Language Technology group
RTE-7 Challenge participation

Natural Language Processing Nowadays

Definition

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Modern NLP consists of multiple subareas which can be defined by the tasks they aim to solve.

- Machine Translation
- Information Retrieval
- Question Answering
- Word Sense Disambiguation
- ...
- **Recognizing Textual Entailment**

Textual Entailment

Intuition: Recognizing Textual Entailment is a generic task that captures major semantic inference between pieces of text.

Definition

Given two text fragments, *Text (T)* and *Hypothesis (H)*:
T entails H iff the meaning of H can be inferred from the meaning of T by human reading.

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Notes:

- why "human reading"?
- what is a "text fragment"?

Example:
T: If you help the needy, God will reward you.
H: Giving money to a poor man has good consequences.

TE: How-To

2 opposite approaches:

Using formal sematics:

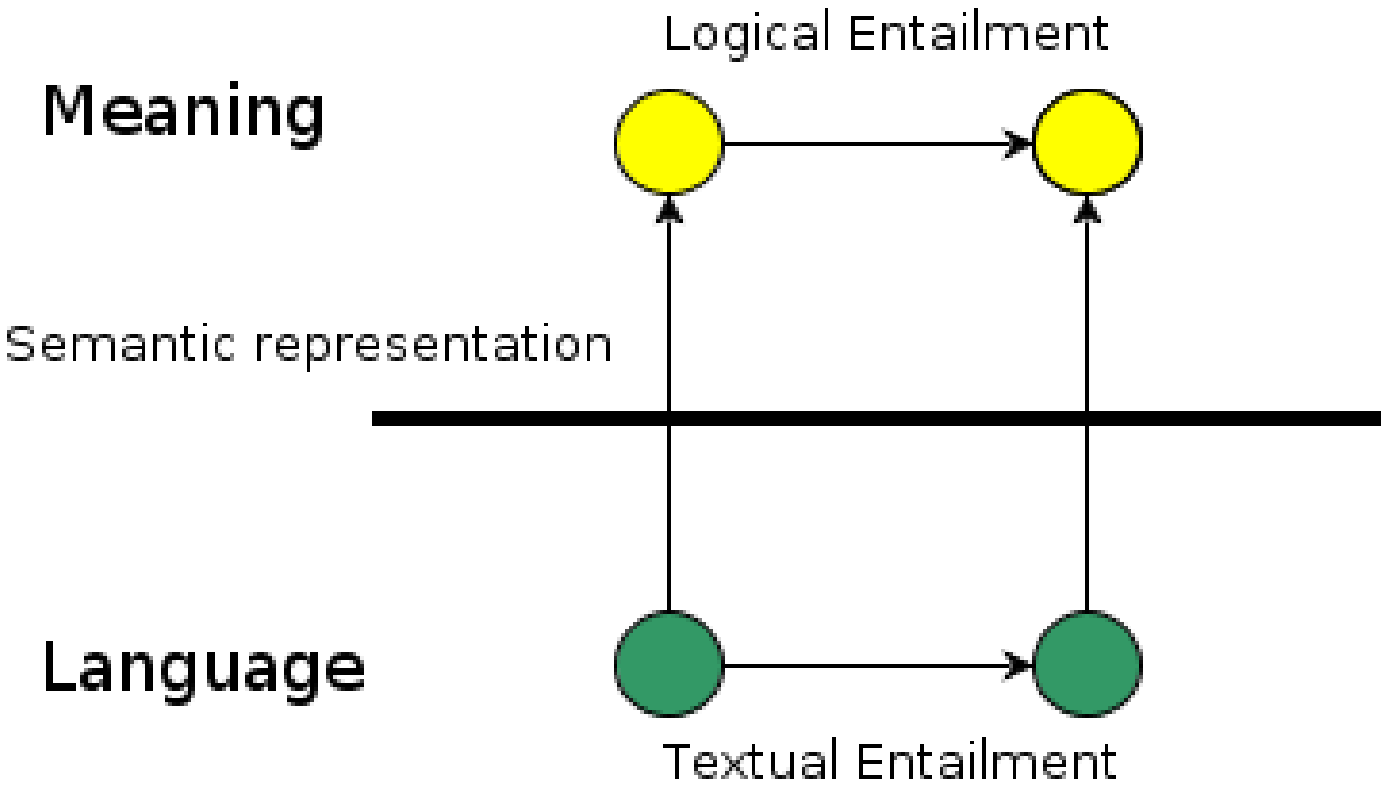
- translation of natural language fragments into some logical systems
- classical approach which brings together logic, language and psychology
- successful for narrow domains, but not working on comprehensive data!
- few training data

Using surface structure:

- counterintuitive, but proved to be fruitful.

Why? A wide range of entailments follow general patterns that arise from surface (lexical and syntactic) considerations.

TE: How-To cont'd



Surface approach

Main feature is **lexical similarity**.

- naive word overlap
- n-grams (= sequences of neighboring words) overlap

Ex: A student Computational Logic workshop took place in Vienna. ⇒ Workshop took place in Vienna.

- normalized forms

working = work, brought = bring

- paraphrasing (different lexical forms with similar meaning)

Ex: A student workshop was organised in the capital of Austria. ⇒ A student workshop took place in Vienna.

Surface Approach - cont'd

The entailment holds iff the word overlap reaches a certain threshold.
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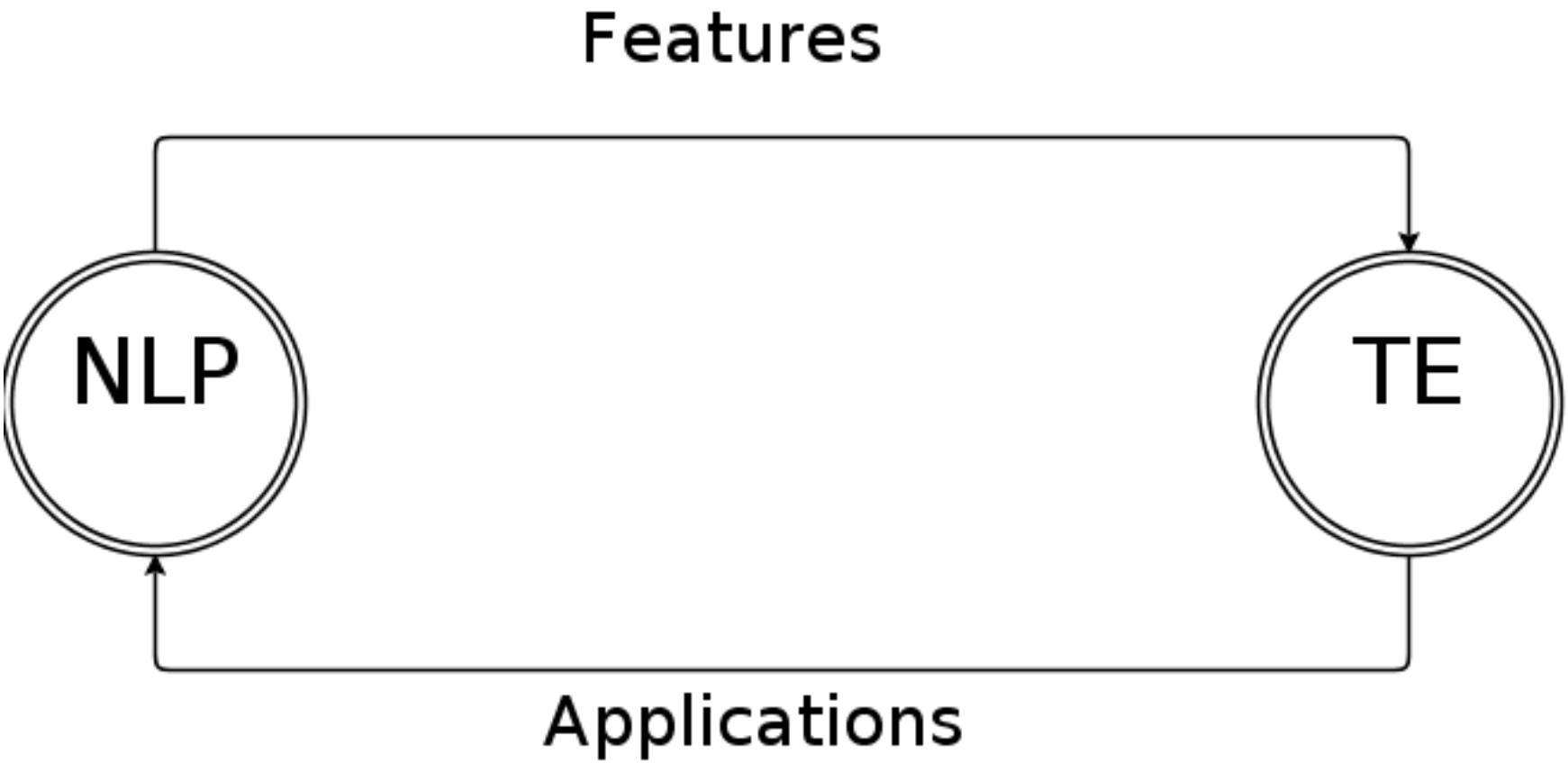
Statistics on F-measure (2010 data):

- best performance - 48.01%
- average performance - 33.77%
- **up to 40% using only lexical matching**

But this seems to be a limit for lexical matching.

NLP vs. Textual Entailment



NLP contribution to TE

Using extra features from other areas of NLP improve lexical match results:

- Semantic Roles
- Named Entity Recognition
- lexical knowledge bases (VerbOcean, WordNet)
- coreference
- syntactic parsing

etc.

Applications

Textual entailment recognition is used in several NLP tasks:

- *Question Answering*
- Information Extraction
- Information Retrieval
- Text Summarization

and many more.

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What is it? How TE is used?

Example:

T: *The technological triumph known as GPS was incubated in the mind of Ivan Getting.*

$$\Downarrow \textit{entails} \tag{1}$$

H: *X invented the GPS*

Textual Entailment in the Community

Recognizing Textual Entailment challenge.
Main Task: given a corpus of T (real data) and a set of H, determine such pairs T-H in which one fragment entails the other.

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- compares the performance of TE systems
- launched in 2004 by FBK
- supported by Microsoft Research

Mehdad, Negri, de Souza, Petrova. FBK Participation in the RTE-7 Main Task. Text Analysis Conference, 2011

FBK System for RTE-7

Multifeature system with lexical similarity being the key feature.
An algorithm to compute n-gram match scores for every level of *n*:

- start from 5-grams
- eliminate a string when matched
- repeat for (n-1) level

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Extra NLP features: Semantic Roles, Named Entities, Wordnet, Syntactic Dependencies

Conclusion

- TE is an example of how logical notion can be projected to natural language.
- Area of active research.
- Straightforward surface techniques outperform semantic representation approaches...
- ...but clever way of computing lexical similarity should be found to achieve high performance.

Bibliography

- Mehdad, Negri, de Souza, Petrova. FBK Participation in the RTE-7 Main Task. Text Analysis Conference, 2011
- Jia, Huang, Ma, Wan, Xiao. RKUTM Participation at TAC 2010 RTE and Summarization Track. Text Analysis Conference, 2010
- Majumdar, Bhattacharyya. Lexical Based Text Entailment System for Main Task of RTE6. Text Analysis Conference, 2010