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
Introduction

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  relevant features for detecting TE via machine learning

- **What is done by the community?**
  RTE Challenge

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

Definition

NLP is an interdisciplinary field which seeks to enable computer to process, understand and generate natural language.
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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 semantics:**

- 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

Meaning

Logical Entailment

Semantic representation

Language

Textual Entailment
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

Features

NLP

Applications

TE
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?
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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.*

⇓ entails

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.
Recognizing Textual Entailment challenge.

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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
FBK System for RTE-7

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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.
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