Building Textual Entailment Specialized Data Sets: a Methodology for Isolating Linguistic Phenomena Relevant to Inference

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Outline

1 Introduction
   • TE as a task for automatic systems
   • Motivation

2 Methodology
   • Classification of linguistic phenomena
   • Procedure for the creation of monothematic pairs

3 Feasibility Study on RTE5-data

4 Conclusions
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4. Conclusions
TE as a task for automatic systems

- In 2005, the Recognizing Textual Entailment (RTE) Challenge has been launched
- **TASK:** developing a system that, given two text fragments (T-H), can determine whether the meaning of one text is entailed from the other
- **DATASET:** training and test sets composed of T-H pairs

T: The Mona Lisa hangs in Paris’ Louvre Museum. **ENTAILMENT √**
H: The Mona Lisa is in France.

T: Oracle fought to keep the forms from being released. **CONTRADICTION X**
H: Oracle released a confidential document.

T: An Afghan translator kidnapped in December was freed Friday. **UNKNOWN X**
H: Translator kidnapped in Iraq.
TE as a task for automatic systems

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Motivation

Different linguistic phenomena are involved in TE, and interact in a complex way:

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]

H: Doris Lessing won the Nobel Prize in Literature in 2007.
Motivation

On RTE data sets, **difficulties in the evaluation of the impact of linguistic modules addressing specific inference types:**

- Sparseness (i.e. low frequency) of the single phenomena
- Impossibility to isolate each phenomenon, and to evaluate each module independently from the others
Our Proposal:

**Methodology** for the creation of specialized TE data sets made of **monothematic T-H pairs**, i.e. pairs in which a certain phenomenon relevant to the entailment relation is highlighted and isolated
Procedure for the creation of monothematic pairs

Starting from an existing RTE pair:

1. **Identify the linguistic phenomena** which contribute to the entailment in T-H

2. **Apply an annotation procedure** to isolate each phenomenon and create the related monothematic pair

3. **Group together all the monothematic T-H pairs relative to the same phenomenon**, hence creating specialized data sets

Bentivogli et al., *Building Textual Entailment Specialized Data Sets* - LREC 2010 Malta, 17-23 May.
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Classification of linguistic phenomena

- **Fine-grained phenomena** are grouped into **macro categories**:
  - **lexical**: acronymy, demonymy, synonymy, semantic opposition, hyperonymy
  - **lexical-syntactic**: nominalization/verbalization, transparent head, paraphrase
  - **syntactic**: negation, modifier, argument realization, apposition, active/passive alternation
  - **discourse**: coreference, apposition, zero anaphora
  - **reasoning**: elliptic expression, meronymy, metonymy, reasoning on quantity, general inferences using background knowledge
Creation of monothematic pairs

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ […]

H: Doris Lessing won the Nobel Prize in Literature in 2007.

1 Identify all the phenomena which contribute to the entailment/contradiction in T-H
Creation of monothematic pairs

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H: Doris Lessing won the Nobel Prize in Literature in 2007.

ARGUMENT REALIZATION

1 entailment rule: Pattern: \( X \; Y \leftrightarrow \; Y \; \text{IN} \; X \)
   Constraint: \( \text{TYPE}(X) = \text{TEMPORAL EXPRESSION} \)

2 instantiation:
   \( 2007 \; \text{Nobel Prize in Literature} \Rightarrow \; \text{Nobel Prize in Literature in 2007} \)

3 substitution:
   \( H1: \) British writer Doris Lessing, recipient of the Nobel Prize in Literature in 2007 [...] 

4 judgment: ENTAILMENT
Creation of monothematic pairs

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]

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3 substitution:
H1: British writer Doris Lessing, recipient of the Nobel Prize in Literature in 2007 [...]

4 judgment: ENTAILMENT
Creation of monothematic pairs

T: British writer Doris Lessing, recipient of the _2007 Nobel Prize in Literature_, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ […]

H: Doris Lessing won the _Nobel Prize in Literature in 2007_.

ARGUMENT REALIZATION

1 entailment rule: Pattern: \( X \ Y \leftrightarrow Y \ IN \ X \)
   Constraint: \( \text{TYPE}(X)=\text{TEMPORAL}\_\text{EXPRESSION} \)

2 instantiation:
   \( 2007 \ \text{Nobel Prize in Literature} \Rightarrow \text{Nobel Prize in Literature in 2007} \)

3 substitution:
   H1: British writer Doris Lessing, recipient of the _Nobel Prize in Literature in 2007_ […]

4 judgment: ENTAILMENT
Creation of monothematic pairs

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘’wasn’t that terrible’’ [...]

H: Doris Lessing won the Nobel Prize in Literature in 2007.

entailment rule: Pattern: $X, Y \leftrightarrow Y$ is $X$
Constraint: apposition($X, Y$)

instantiation:
Doris Lessing, recipient of $\Rightarrow$ Doris Lessing is the recipient of

substitution:
H2: British writer Doris Lessing is the recipient of Nobel Prize in Literature in 2007 [...]
Creation of monothematicatic pairs

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...]

H: Doris Lessing won the Nobel Prize in Literature in 2007.

VERBALIZATION

1 entailment rule: Pattern: \( X \leftrightarrow Y \)
   Constraint: \( \text{TYPE}(X)=N; \text{TYPE}(Y)=V \)
   verbalization_of\( (Y,X) \)

2 instantiation:
   recipient \( \Rightarrow \) received

3 substitution:
   H3: British writer Doris Lessing received the Nobel Prize in Literature in 2007 [...]

4 judgment: ENTAILMENT
Creation of monothematic pairs

H3 ⇒ T’: British writer Doris Lessing received the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...] 

H: Doris Lessing won the Nobel Prize in Literature in 2007.

SYNONYMY

1 entailment rule: Pattern: \( X \leftrightarrow Y \)
   Constraint: synonym_of\((X,Y)\)

2 instantiation:
   received ⇒ won

3 substitution:
   H4: British writer Doris Lessing won the Nobel Prize in Literature in 2007 [...] 

4 judgment: ENTAILMENT
Creation of specialized dataset

**SYNTACTIC: ARGUMENT_REALIZATION**

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...] 
H1: British writer Doris Lessing, recipient of the Nobel Prize in Literature in 2007, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...] 

**SYNTACTIC: APPOSITION**

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...] 
H2: British writer Doris Lessing is the recipient of the 2007 Nobel Prize in Literature.

**LEXICAL-SYNTACTIC: NOMINALIZATION_VERBALIZATION**

T: British writer Doris Lessing, recipient of the 2007 Nobel Prize in Literature, has said in an interview that the terrorist attack on September 11 ‘‘wasn’t that terrible’’ [...] 
H3: British writer Doris Lessing received the 2007 Nobel Prize in Literature.

**LEXICAL: SYNONYMY**

T’: British writer Doris Lessing received the 2007 Nobel Prize in Literature. 
H4: British writer Doris Lessing won the 2007 Nobel Prize in Literature.
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Feasibility Study on RTE5-data

- 90 T-H pairs (30 entailment, 30 contradiction, 30 unknown randomly extracted examples)
- 2 annotators with skills in linguistics
- **Inter Annotator Agreement**:
  - "complete agreement": 64.4% (58 out of 90 pairs)
  - "partial" agreement (DICE coefficient): 0.78

<table>
<thead>
<tr>
<th></th>
<th>complete</th>
<th>partial (DICE)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENTAILMENT</td>
<td>60%</td>
<td>0.86</td>
</tr>
<tr>
<td>CONTRADICTION</td>
<td>57%</td>
<td>0.75</td>
</tr>
<tr>
<td>UNKNOWN</td>
<td>76%</td>
<td>0.68</td>
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</tbody>
</table>
Feasibility Study on RTE5-data

<table>
<thead>
<tr>
<th>original RTE pairs</th>
<th>phenomena/monothematic pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>E</td>
</tr>
<tr>
<td>E (30)</td>
<td>91</td>
</tr>
<tr>
<td>C (30)</td>
<td>44</td>
</tr>
<tr>
<td>U (30)</td>
<td>23</td>
</tr>
<tr>
<td>TOT (90)</td>
<td>158</td>
</tr>
</tbody>
</table>

- Different absolute frequency of macro and fine-grained phenomena (most frequent category: *reasoning*)
- Phenomena appearing only in positive/negative examples
  - only positive: e.g. *apposition*, *coreference*
  - only negative: e.g. *semantic opposition*, *negation*
Specialized Data Sets

- Higher number of monothematic positive pairs (76.7%), wrt negative (23.3%, divided into 17% contradiction, 6.3% unknown)
- The only source of negative monothematic pairs are RTE-5 contradiction pair (BUT 15% of the data set)
- How to balance the proportion of negative examples?
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Methodology for the creation of specialized TE data sets, made of monothematic T-H pairs in which a certain phenomenon underlying the entailment relation is highlighted and isolated.

- Feasibility of the task (quality, effort required)
- Annotation of previous RTE data with the linguistic phenomena
- **Resource available at Textual Entailment Resource Pool website**
  