Recognize textual entailment using Semantic Elements

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Outline

- Introduction
- RTE Framework
- Entity and relation semantic elements
- Submissions and Evaluations
- Conclusions

INTRODUCTION

- Recognizing Textual Entailment (RTE)
  - To decide whether the text can entail the hypothesis.

<pair id="964" entailment="ENTAILMENT" task="IE" >
<t>Boeing's Vice President for Expendable Launch Systems, Dan Collins, said that the rocket malfunction was caused by a shorter first stage burn than was expected.</t>
<h>Dan Collins works for Boeing.</h>

RTE Samples

<pair id="964" entailment="ENTAILMENT" task="IE" >
<t>**Boeing**'s Vice President for Expendable Launch Systems, **Dan Collins**, said that the rocket malfunction was caused by a shorter first stage burn than was expected.</t>
<h>**Dan Collins** works for **Boeing**.</h>

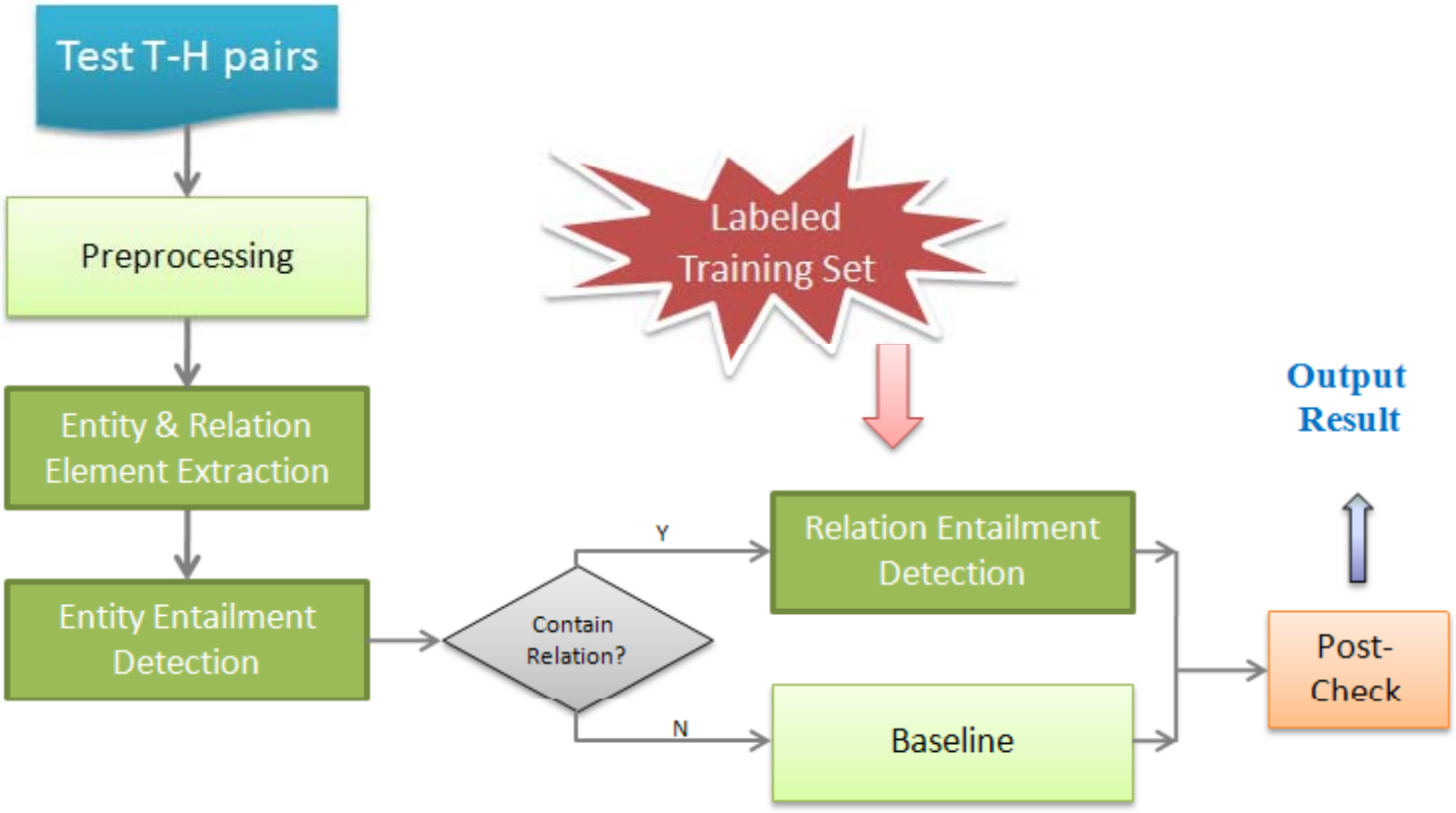
<pair id="246" entailment="UNKNOWN" task="IR" >
<t>Saimai, a 6-year-old Bengal **tiger**, has nurtured groups of piglets since she was 2 years old. The piglets wear striped vests, similar to a tiger's coat.</t>
<h>A **dog** has adopted a **tiger**.</h>

<pair id="190" entailment="UNKNOWN" task="IR" >
<t>A strong **earthquake** struck off the southern tip of Taiwan at 12:26 UTC, triggering a warning from **Japan**'s Meteorological Agency that a 3.3 foot tsunami could be heading towards Basco, in the Philippines.</t>
<h>An **earthquake** strikes **Japan**.</h>

Our Solution

- The RTE problem can be divided into
  - Entity entailment problem and
  - Relation entailment problem
- Entity Element
- Relation Element
- Treat Entity and relation entailment in a different way

RTE Framework



BaseLine: our RTE system in 2008;

Semantic Elements

- We believe the text can be divided into two types of semantics
  - One is to which objects the text referred
  - The other is the relationship between objects
    - Characteristics
    - Relation to other objects
- Define two types of Semantic Elements:
  - Entity Element
  - Relation Element

Entity Element Identification

- NER tools are not enough
- **Our solutions:**
  - Adapt the classification taxonomy of **factoid question for identifying entities**

Question Taxonomy from UIUC

Coarse-class	Fine-class
ABBR	abbreviation, expression
DESC	definition, description, manner, reason
ENTY	animal, body, color, creation, currency, disease/medicine, event, food, instrument, language, letter, other, plant, product, religion, sport, substance, symbol, technique, term, vehicle, word
HUM	description, group, individual, title
LOC	city, country, mountain, other, state
NUM	code, count, date, distance, money, order, other, percent, period, speed, temperature, size, weight

Ref: http://l2r.cs.uiuc.edu/~cogcomp/Data/QA/QC/definition.html

FACTOID QUESTION TAXONOMY

Coarse-CLASS	**Fine-CLASS**
ABBR	abbreviation, expression
DESC	definition, description, manner, reason
ENTY	**animal, body, color, creation, currency, disease/medicine, event, food, instrument, language,** letter, other, **plant, product, religion, sport, substance**, symbol, **technique,** term, **vehicle**, word
HUM	description, **group, individual,** title
LOC	**city, country, mountain, other, state**
NUM	code, count, date, distance, money, order, other, percent, period, speed, temperature, size, weight

Entity Elements Identification

For any term in H or T:

- WordNet based Extraction
  - Find a node set in WordNet for each fine-class
    - Animal – "animal", Money – "monetary unit"
  - If a word's Hypernym appears in the node set, the entity type is assigned the fine-class
  - Most Entities, and Locations
- Wiki based Extraction
  - Find the wiki-category of input term

Other processing:

- NER based Extraction
  - Stanford NER: Person, Location, Organization, MISC
- Pattern based Extraction
  - Number and Time
- Noun word appears in both T and H

Relation Elements Identification

- Dependency Tree based Relation Elements Identification:
  - Shortest path between two entities
- It is simple, but the shortest path sometimes fails to cover all the semantic information.

Properties for entity/relation entailment

- The degree of variation is different for two types of elements:
  - Entity Element:
    - Few variations.
    - Easy to detect mismatch with Knowledge based Resource
  - Relation Element:
    - A lot of variations
- Different Strategies are designed for two types of elements

ENTITY ENTAILMENT RECOGNITION

For all Entity Element in Hypothesis :

① IF the original entity word appears in Text, return TRUE

② IF min{EditDistance(Entity in H, Entity in T)} < threshold, return TRUE

③ Expand Entity in H with synonym, hypernym, hyponym, if any of them appears in the entity set of T, return TRUE

④ Do like 3), with Wikipedia redirection (if A is redirected to B in wikipedia, A is a synonym of B).

⑤ For digits, if the type (time vs. number) matches, return TRUE

If all entities in H have matches in T; we say H and T has an good entity-match.

Relation Entailment Recognition

- Most of previous studies use unsupervised methods, such as DIRT and TEASE.
- Our Solutions:
  - Investigate supervised methods to detect relation entailment (NAÏVE BAYES)

Training Set

- Data:
  - RTE 3 training set (800 pairs)
  - RTE 3 test set (800 pairs)
  - RTE 4 test set (1000 pairs)
- Label Strategy
  - False Entailment T-H pairs
    - First determine whether this false entailment is caused by relation mismatch;
    - If so, we label which two entities cause the false entailment.
  - True Entailment T-H pairs
    - we define all the relation entailments are true

Training Set

- Label sample

```
<pair id="744" entailment="UNKNOWN" task="IE" >
<t>Annan praised the courage of the people and congratulated the
Independent Election Commission of Iraq (IECI) and UN officials for
successfully running the poll.</t>
<h>Annan is a member of the IECI.</h>
```

  - We label the relation between “Annan” and “IECI” as false entailment relation.
- Data Imbalance
  - True set is much larger than False set.
  - Only use the true relation entailment from RTE4

Relation Entailment Recognition

	Feature type	Feature Description
Sentence-Level Features (two sentences)		
LLM-similarity	double	Lexical similarity [3]
Entity-similarity	double	Named Entity similarity [3]
Path-Level Features (two paths)		
Path-LLM-similarity	double	Lexical similarity in the path
Path-Relation-similarity	double	The path similarity
Verb-synonym	{0,1}	Contain synonym for verb?
Verb-antonym	{0,1}	Containing antonym for verb?
V-N-derivation	{0,1}	Containing Noun-Verb derivation relationship using WordNet?

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Submissions and Evaluations

- QUANTA1 employs the whole procedure described in the previous section.
- QUANTA2 removes the "Relation Entailment Detection" module.
  - **But the relation does not make a difference**☹

	QUANTA1	**QUANTA2**	**Best**	**Median**
Accuracy	0.67	0.6633	0.7350	0.6117
Avg. precision	0.7011	0.6755		

Evaluation Results for Two-way Task

Entity Entailment Recognition

<pair id="487" entailment="UNKNOWN" task="IR">

<t>The Zambian government has previously been criticised by some for its annual ban on fishing during December. It is unclear whether this policy, which was widely applauded by environmentalists and implemented to protect sensitive fish stocks, will be affected by the new agricultural policy.</t>

<h>The Zambian government has ordered to plant **potatoes**.</h>

<pair id="464" entailment="Unknown" task="IR">
<t>Majel also starred in other TV shows not related to Star Trek such as Earth: Final Conflict, The Lucy Show, Leave it to Beaver and Genesis II. Majel's husband Gene died in 1991 of heart failure. After his death, Majel took over the Star Trek franchise and put several of Gene's unfinished projects into production which included two television shows.</t>
<h>Majel died of **cancer**.</h>

<pair id="110" entailment="CONTRADICTION" task="QA">
<t>The pilot of an Indonesian plane that crashed at an airport on Java island, killing **21 people**, has been jailed for two years for criminal negligence. An inquiry found that Capt Marwoto Komar had approached the runway too fast and landed at too steep an angle. The Boeing 737 skidded off the runway and burst into flames on 7 March 2007. This is the first time a pilot has faced criminal charges in Indonesia, and the trial has attracted a lot of media attention.</t>
<h>Capt Marwoto Komar has been jailed for **21 years**.</h>

Relation Entailment Recognition

- Similarity is not enough, we should make use of the relation between entities.
  - High similarity, but relation is not entailment

<pair id="702" entailment="UNKNOWN" task="IE" >

<t>According to the New York Times, in an ambush occurring Jan. 19 in northern Iraq, outside of Baiji, a British man and an Iraqi security guard were killed and a Brazilian contractor was kidnapped. Both of the men who died in the attack were working for Janusian Security Risk Management of London. The Brazilian man, an engineer, was working for Norberto Odebrecht, South America's largest construction company. His identity was not revealed by the company.</t>

<h>The New York Times is **financed** by South America's largest construction company.</h>

THIS YEAR'S SOLUTION IS SIMPLE

- Shortest path can't cover all the semantic information.
  - "abuse" in T is not in the shortest path
  - Negative word

<pair id="2" entailment="ENTAILMENT"
task="IR" >

<t>Sexual abuse of children as young as six by aid workers and United Nations peacekeepers has continued unchecked despite repeated promises to stamp it out, according to a 12-month investigation.</t>

<h>UN peacekeepers abuse children.</h>

This year's solution is simple

- Feature is not powerful
  - Still based on the similarity between T and H
  - Essentially not different from baseline.
- More powerful features
  - Cross-pair with Tree Kernel
  - How to use unsupervised results, like DIRT and TEASE

Conclusions

- Recognize textual entailment with two semantic elements
  - Entity Elements
  - Relation Elements
- Treat two types of entailment in a different way
- Future work:
  - Improve the performance for relation entailment
  - More detailed analysis on entity/relation entailment

- Thanks