Learning Relational Structure for Temporal Relation Extraction

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Motivation

- The TempEval task addresses the problem of extracting temporal relations from text, e.g., “bought” event happened BEFORE ’2002’ in “He bought the house before 2002.”
- “Married” event OVERLAPS with “September” in “She got married in September.”
- Most of the approaches applied to the TempEval task independently learn relations for each task
  - Can lead to inconsistencies in the final prediction
  - e.g., A < T and T < B is inconsistent with A > B
- New approaches find consistent set of joint predictions
  - By selecting from the individual predictions during inference
  - By learning a joint model across tasks
- These approaches require the constraints to be provided by the expert
- We present an approach that uses structure learning in SRL models to learn these constraints while using expert advice when available

Relational Gradient Boosting

Initial Model

Data

GRADIENTS

Induce

Final Model =

Our Approach

Input Documents

Stanford NLP Toolkit

Raw facts

RDN-Boost

Relational Facts

Compute

Richer Features

Background Knowledge

Input

Predictions

Gradients

Induce

Initial Model

Richer Features

If DP goes up the tree and then goes down then it is a strong signal that the event and timex are not related

veenDepPath("be", "2002")

Richer Features

Coref

Word object

wordText(W1, John)

wordType(W1, NN)

phraseType(P5, NP)

headWord(P5, W10)

depType(W1, W2, "nnn")

NERWord(W1, W8)

Raw Facts

Raw Facts

wordText(W1, John)

wordType(W1, NN)

phraseType(P5, NP)

headWord(P5, W10)

depType(W1, W2, "nnn")

NERWord(W1, W8)

Background Knowledge

RDN-Boost

Relational Facts

Compute

Richer Features

Expert

(Not required)

Background Knowledge

- Previous SRL approaches designed rules for TempEval task
  - Can use these rules as the initial model for RDN-Boost.
  - E.g., a sample rule used by previous approaches was
    \( relE2T(e1, t, "BEFORE") \land relE2T(e2, t, "AFTER") \rightarrow relE2E(e1, e2, "BEFORE") \).
  - \( i.e., \) if \( e1 < t \) and \( e2 > t \) then \( e1 < e2 \)
  - \( relE2E \) represents relations between events and times
  - \( relE2T \) represents relations between events.

Results

Initial Results (Testset accuracy)

- Without expert advice: 0.56
- With expert advice: 0.60
- State-of-the-art: 0.65

Future Work

- Use the other TempEval tasks such as relation between events and document creation time to perform joint inference across tasks
- Use the cross-task MLN rules as the initial model
- Incorporate more features based on previous work on relation extraction such as the words between the event and timex
- Use the annotations from other tasks to increase the training data for relation extraction tasks
- e.g., if the annotations have marked event \( A \prec T \) and event \( B \succ T \), we can add annotations to mark event \( A \prec B \)