Robust Distant Supervision Relation Extraction via Deep Reinforcement Learning

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Outline

• Motivation
• Algorithm
• Experiments
• Conclusion
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Relation Extraction

Relation Type with Labeled Dataset

Plain Text Corpus (Unstructured Info) → Classifier → Entity-Relation Triple (Structured Info)

Relation Type without Labeled Dataset
Distant Supervision

“If two entities participate in a relation, any sentence that contains those two entities might express that relation.” (Mintz, 2009)
1. Nijlen is a municipality located in the Belgian province of Antwerp.
2. ......
Wrong Labeling

- **Within-Sentence-Bag Level**
  - Hoffmann et al., ACL 2011.
  - Surdean et al., ACL 2012.
  - Zeng et al., ACL 2015.
  - Li et al., ACL 2016.

- **Entity-Pair Level**
  - None
Wrong Labeling

- Place_of_Death (William O’Dwyer, New York city)

  i. Some New York city mayors – William O’Dwyer, Vincent R. Impellitteri and Abraham Beame – were born abroad.

  ii. Plenty of local officials have, too, including two New York city mayors, James J. Walker, in 1932, and William O’Dwyer, in 1950.
Wrong Labeling

- Most of entity pairs only have several sentences
- Lots of entity pairs have repetitive sentences
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Overview

DS Dataset

Negative set

Positive set

False Positive

Cleaned Dataset

Negative set

False Positive

Positive set

False Positive Indicator
Requirements

False-Positive Indicator

\[ \Downarrow \]

Sentence-Level Indicator

Without Supervised Information

General Purpose and Offline Process

\[ \Downarrow \]

Learn a Policy to Denoise the Training Data
Overview

DS Dataset

Negative set

Positive set

Cleaned Dataset

Negative set

Positive set

False Positive

Train

Action

Classifier

Reward

False Positive

Policy-Based Agent

Indicator
Deep Reinforcement Learning

- **State**
  - Sentence vector
  - The average vector of previous removed sentences

- **Action**
  - Remove & retain

- **Reward**
  - ???
Deep Reinforcement Learning

- One relation type has an agent

- Sentence-level
  - Positive: Distantly-supervised positive sentences
  - Negative: Sampled from other relations

- Split into training set and validation set
Deep Reinforcement Learning

\[ \mathcal{R}_i = \alpha(F_i - F_{i-1}) \]

Epoch i-1

Noisy dataset \( p_{t\text{ori}} \)

RL Agent → Cleaned dataset \( + N_{t\text{ori}} \)

Relation Classifier → \( F_{i-1} \)

Epoch i

Noisy dataset \( p_{t\text{ori}} \)

RL Agent → Cleaned dataset

Relation Classifier → \( F_i \)

\( \times (+\mathcal{R}_i) + \times (-\mathcal{R}_i) \)
Reward

- Accurate
- Steady
- Fast
- Obvious
Reward

**Epoch** $i$

- **Positive**
  - Positive Set
  - Train
  - Relation Classifier

- **Negative**
  - Negative Set
  - Train
  - Relation Classifier
  - Calculate

$$F_1$$
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Evaluation on a Synthetic Noise Dataset

- Dataset: SemEval-2010 Task 8
- True Positive: Cause-Effect
- False Positive: Other relation types
- True Positive + False Positive: 1331 samples
Evaluation on a Synthetic Noise Dataset

200 FPs in 1331 Samples

- (195/308)
- (197/339)
- (198/388)
- (180/279)
- (179/260)

False Positive

Removed Part

Epoch

FPs in 1331 Samples

F1 Score
Evaluation on a Synthetic Noise Dataset

0 FPs in 1331 samples
Distant Supervision

- **Dataset: Riedel et al., 2010**
  - [http://iesl.cs.umass.edu/riedel/ecml/](http://iesl.cs.umass.edu/riedel/ecml/)

- **CNN+ONE, PCNN+ONE**
  - Distant supervision for relation extraction via piecewise convolutional neural networks. (Zeng et al., 2015)

- **CNN+ATT, PCNN+ATT**
  - Neural relation extraction with selective attention over instances. (Lin et al., 2016)
Distant Supervision

CNN-based

- CNN+ONE
- CNN+ONE_RL
- CNN+ATT
- CNN+ATT_RL
Distant Supervision

PCNN-based

- PCNN+ONE
- PCNN+ONE_RL
- PCNN+ATT
- PCNN+ATT_RL
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Conclusion

- We propose a deep reinforcement learning method for robust distant supervision relation extraction.

- Our method is model-agnostic.

- Our method boost the performance of recently proposed neural relation extractors.
Thank you!

Q&A