Event Coreference Resolution using Convolutional Neural Networks

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Outline

Introduction
   Task Definition
   What is an Event?

Learning to Identify Events
   Identifying an Event
   Event Extraction
   Related Work

Coreference Resolution
   Recent Work
   Our CNN Architecture
   Conclusion
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What is Coreference Resolution?

Parag broke his arm when he fell down the stairs. It was Nirbhay who pushed him.

- Two or more expressions in a text are coreferent if they refer to the same entity.
What is Coreference Resolution?

Parag_ broke his arm when he_ fell down the stairs. It was Nirbhay who pushed him_.

- Two or more expressions in a text are **coreferent** if they refer to the same entity.

- The task of identifying coreferent expressions is called **Entity Coreference Resolution**
What is an Event?

An event is any occurrence or happening, typically associated with a trigger word or phrase called an event trigger.

In Baghdad, a cameraman died when an American tank fired on the Palestine Hotel.
What is an Event?

- An event is any occurrence or happening, typically associated with a trigger word or phrase called an **event trigger**.

  *In Baghdad, a cameraman died when an American tank fired on the Palestine Hotel.*

- **What does the event Die consist of?**
  - Trigger Word(s) - "died"
  - Victim - "cameraman"
  - Instrument - "American Tank"
  - Place - "Baghdad"
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Identifying an Event

- Upper side: Event mentions **Die** and **Attack**
- Lower size: A subset of dependency parse tags

Source: Chen et. al. in "Event Extraction via Dynamic Multi-Pooling Convolutional Neural Networks"
Inherent Ambiguity in Events

- Multiple events in a sentences, overlap in arguments
Inherent Ambiguity in Events

- Multiple events in a sentences, overlap in arguments
- Same trigger words, different event types

**E1:** Donald Trump beats Clinton.
**E2:** Muhammad Ali beats his opponent.
Inherent Ambiguity in Events

- Multiple events in a sentence, overlap in arguments
- Same trigger words, different event types
  - **E1:** *Donald Trump beats Clinton.*
  - **E2:** *Muhammad Ali beats his opponent.*
- Trigger words are not discriminatory enough!
Event Extraction
A Machine Learning Approach

- The aim is learn how to differentiate between true and false event triggers.
- What discriminatory information can be used to automatically identify true event triggers?
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A Machine Learning Approach

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- What discriminatory information can be used to automatically identify true event triggers?
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  - Semantic information, estimated using word vectors.

- Learning features automatically using deep learning.
Related Work
Event Extraction using CNNs

- Recently Chen et. al. proposed a convolutional neural network approach for event extraction.
- Incorporated multiple event sentences by using a dynamic multi-pooling framework.
Chen’s CNN Architecture

![Diagram of Chen's CNN Architecture]

Figure 2: The architecture for the stage of argument classification in the event extraction. It illustrates the processing of one instance with the predict trigger \textit{fired} and the candidate argument \textit{cameraman}.

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Coreference Resolution

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- Best performance (a coreference metric related to F-score) until 2015 was around 60 for the ACE 2005 dataset.
Coreference Resolution

- Classifying event pairs as coreferent or not - simple binary classification?
- Best performance (a coreference metric related to F-score) until 2015 was around 60 for the ACE 2005 dataset.
- We aim to empirically analyse the performance of a CNN approach for feature extraction.
Our CNN Architecture

- Features of the two events taken by the CNN are:
  - Word vectors of event trigger context window
  - Position feature embeddings of event triggers

- A single convolutional layer with multiple convolution filter sizes, followed by a dynamic max-pooling layer

- Three FC (fully connected) layers followed by softmax over the three predicted classes:
  - 1 - First event is true or false
  - 2 - Second event is true or false
  - 3 - The two events are coreferent or not
Conclusion

- Our joint CNN architecture is the first such approach for Coreference Resolution and Event Extraction.

- We hope to test whether sequence learning methods (RNNs) can provide better features for coreference resolution.
Thank You