EventPlus
A Temporal Event Understanding Pipeline

Mingyu Derek Ma*, Jiao Sun*, Mu Yang, Kung-Hsiang Huang,
Nuan Wen, Shikhar Singh, Rujun Han, Nanyun Peng

Try our demo at: kairos-event.isi.edu
Code available at: github.com/pluslabnlp/eventplus
A powerful ice storm continues to maintain its grip. Yesterday New York governor George Pataki toured five counties that have been declared under a state of emergency.
Token-level Tasks
- Tokenization
- Lemmatization
- POS tagging

Sentence-level Tasks
- Syntactic parsing
- Semantic role labeling

Semantic-level Tasks
- For example, events and temporal relations
- Separate works for event extraction, temporal relation and duration extraction, not comprehensive and coherent

Tao et al., 2013; Ning, 2019; Manning et al., 2014; Khashabi et al., 2018; Peng et al., 2015; Noji and Miyao, 2016
EventPlus

- The first event pipeline system providing comprehensive event understanding capabilities
- Each component in EventPlus has comparable performance to the state-of-the-art
A powerful ice storm continues to maintain its grip. Yesterday New York governor George Pataki toured five counties that have been declared under a state of emergency.

... George Pataki (Artifact) toured (Transport) five counties (Destination) that have been ...

... ice storm continues to maintain its grip ... toured five counties that have been declared under a state of emergency.

Event definition

- Trigger word
  - Broader coverage
- Complex structure
  - Richer information
Component 1: Multi-task Learning of Event Trigger and Temporal Relation Extraction

- Event trigger extraction: raw text -> list of words
- Temporal relation extraction: list of words -> relations among them
- Intuition: event relation signals can help to distinguish event/non-event tokens
- BERT embedding + BiLSTM layer
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Component 1: Multi-task Learning of Event Trigger and Temporal Relation Extraction

<table>
<thead>
<tr>
<th>Corpus</th>
<th>Model</th>
<th>F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>TB-Dense</td>
<td>Chambers et al. (2014)</td>
<td>87.4</td>
</tr>
<tr>
<td></td>
<td>Han et al. (2020a)</td>
<td>90.3</td>
</tr>
<tr>
<td></td>
<td>Ours</td>
<td>90.8</td>
</tr>
<tr>
<td>MATRES</td>
<td>Ning et al. (2018b)</td>
<td>85.2</td>
</tr>
<tr>
<td></td>
<td>Ours</td>
<td>87.8</td>
</tr>
</tbody>
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<tbody>
<tr>
<td>TB-Dense</td>
<td>Vashishtha et al. (2019)</td>
<td>56.6</td>
</tr>
<tr>
<td></td>
<td>Meng and Rumshisky (2018)</td>
<td>57.0</td>
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<tr>
<td></td>
<td>Ours</td>
<td>64.5</td>
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<tr>
<td>MATRES</td>
<td>Ning et al. (2018b)</td>
<td>65.9</td>
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<tr>
<td></td>
<td>Ning et al. (2018a)</td>
<td>69.0</td>
</tr>
<tr>
<td></td>
<td>Ours</td>
<td>75.5</td>
</tr>
</tbody>
</table>

Performance of event trigger extraction

Performance of temporal relation extraction
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Component 2: Event Extraction on ACE Ontology

- Raw text -> semantic rich information of events
- Trained with ACE2005 corpus
- Multi-task learning of trigger detection, argument role detection and entity detection with shared BERT encoder
- Inference constraints
  - Entity-Argument constraint
  - Entity-Trigger constraint
  - Valid Trigger-Argument constraint
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Component 2: Event Extraction on ACE Ontology

<table>
<thead>
<tr>
<th></th>
<th>NER</th>
<th>Trigger ID</th>
<th>Trigger CLS</th>
<th>Arg ID</th>
<th>Arg CLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>OneIE (Lin et al., 2020) w/ predicted entities</td>
<td>90.2</td>
<td>78.2</td>
<td>74.7</td>
<td>59.2</td>
<td>56.8</td>
</tr>
<tr>
<td>Ours w/ predicted entities</td>
<td>91.3</td>
<td>75.77</td>
<td>72.45</td>
<td>57.74</td>
<td>55.65</td>
</tr>
</tbody>
</table>
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Component 3: Event Duration Detection

- Classifies event triggers into duration categories
- Model 1: Fine-tuned BERT
- Model 2: ELMo embeddings followed by attention layers to get attended representation of the event predicate (Vashishtha et al., 2019)

- Dataset 1: UDS-T (Vashishtha et al., 2019) over 11 duration categories (instant, seconds, minutes, hours, days, weeks, months, years, decades, centuries)
- Dataset 2: Typical-Duration (Pan et al., 2006) over 7 duration categories (seconds, minutes, hours, days, weeks, months, years)
- Dataset 3: ACE-Duration over 7 duration categories (seconds, minutes, hours, days, weeks, months, years)
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Component 4: Negation and Speculation Cue Detection and Scope Resolution

The United States is not considering sending troops to Mozambique.
The United States might send troops to Mozambique.

- Identifies speculation and negation events
- Step 1: cue detection
- Step 2: scope resolution
- BERT-based cue detection model and BERT-based scope resolution model (Khandelwal and Sawant, 2020)
- Train and test on SFU Review dataset with negation and speculation annotations
- 0.92 F1 score for cue detection, 0.88 F1 score for token-level scope resolution
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Interface Design

https://kairos-event.isi.edu
Extension to Biomedical Domain

Each component of EventPlus can be easily extended to other domains

Two approaches to extend event extraction to biomedical domain
• Multi-domain training (MDT) with GENIA
• Replace current component with an in-domain event extraction component: SciBERT-FT (Huang et al., 2020)
System Demo
Thanks!

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