GraphRel

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Tsu-Jui Fu, Peng-Hsuan Li, WeiYun Ma. GraphRel: Modeling Text as Relational Graphs for Joint Entity and Relation Extraction. ACL 2019.
Relation Extraction

The [United States]_{E-loc} President [Trump]_{E-per} will visit the [Apple Inc]_{E-org}.

Extracted Results:

\{United States, Country-President, Trump\}
Key Aspects

• Joint NER and RE

• Prediction of relations with overlapping entities

• Consideration of the interaction between (overlapping) relations
Pipelined (Miwa and Bansal. ACL 2016.)

- Joint, no parameter-sharing
- Overlapping
- No interaction
Sequence Labeling (Zheng et al. ACL 2017.)

- Joint
- No overlapping
- Interaction
Seq2Seq (Zeng et al. ACL 2018.)

- Joint, not all NEs
- No overlapping
- Interaction, forced linear order
GraphRel: Word pair-based; 2nd phase to enhance interaction

- Joint
- Overlapping
- Interaction
Ajablanco
, 
O.K.A.
Ajo
blanco
, 
Is
a
dish
from
Spain
Input
BI-LSTM
BI-GCN
1st-phase Prediction
entity
alias
from
1st-phase
relation-weighted graph
entity
relation
2nd-phase
entity
from
2-phase prediction

- 1^{st}-phase (usual) GCN

\[ h_u^{l+1} = \text{ReLU} \left( \sum_{v \in N(u)} \left( W^l h_v^l + b^l \right) \right) \]

- 2^{nd}-phase (relation-weighted) GCN

\[ h_u^{l+1} = \text{ReLU} \left( \sum_{v \in V} \sum_{r \in R} P_r (u, v) \times \left( W_r^l h_v^l + b_r^l \right) \right) + h_u^l, \]
Experiments

• NYT

<table>
<thead>
<tr>
<th>P</th>
<th>R</th>
<th>F1</th>
<th>NER</th>
</tr>
</thead>
<tbody>
<tr>
<td>52.5%</td>
<td>19.3%</td>
<td>28.3%</td>
<td>-</td>
</tr>
<tr>
<td>37.7%</td>
<td>36.4%</td>
<td>37.1%</td>
<td>-</td>
</tr>
<tr>
<td>42.3%</td>
<td>39.2%</td>
<td>40.7%</td>
<td>89.1%</td>
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<tr>
<td>44.7%</td>
<td>41.1%</td>
<td>42.9%</td>
<td>91.9%</td>
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</table>

• WebNLG

<table>
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<tr>
<th>Method</th>
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<th>R</th>
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<th>NER</th>
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<td>GraphRel₁p</td>
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# Case Study

<table>
<thead>
<tr>
<th>Sentence</th>
<th>GraphRel$_{1p}$</th>
<th>GraphRel$_{2p}$</th>
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</thead>
<tbody>
<tr>
<td>In <strong>Italy</strong>, the capital is <strong>Rome</strong> and <strong>A.S. Gubbio 1910</strong> is located there.</td>
<td>(Italy, captical, Rome)</td>
<td>(Italy, captical, Rome)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(A.S. Gubbio 1910, ground, Italy)</td>
</tr>
<tr>
<td>Water is an ingredient in <strong>Ajoblanco</strong>, also known as <strong>Ajo blanco</strong>, a dish that comes from Andalusia <strong>Spain</strong>.</td>
<td>(Ajoblanco, alias, Ajo blanco)</td>
<td>(Ajoblanco, alias, Ajo blanco)</td>
</tr>
<tr>
<td></td>
<td>(Ajoblanco, from, Spain)</td>
<td>(Ajoblanco, from, Spain)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Ajo blanco, from, Spain)</td>
</tr>
</tbody>
</table>