Multigraph Clustering for *Unsupervised* Coreference Resolution

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### Relations

- **9 negative relations**: indicate that mentions are not coreferent.
- **14 positive relations**: clues for coreference between mentions.

Some example relations:

- N_Number: two mentions do not agree in number
- P_HeadMatch: heads of mentions match, anaphor definite or proper name
- P_AnaPron: anaphor is a pronoun, none of the mentions is first/second person pronoun
- P_Subject: anaphor is third person pronoun, both mentions are subjects, sentence distance \( \leq 1 \)

### Graph Construction

- each mention is a node
- relation \( r \) holds for pair \((m, n)\): add edge from \( m \) to \( n \) with label \( r \)
- if \( r \) is a negative relation, edge gets weight \( w(m, n, r) = -\infty \), otherwise \( w(m, n, r) = 1 \)

### Clustering

- employ 1-nearest-neighbor clustering
- for every mention \( m \): choose as antecedent mention \( n \) such that sum of edge weights maximal and positive

### Input Text

Politicians met in Paris, the French capital, to discuss recent developments. They met for the first time in Paris. The developments are alarming.

### Mention Extraction


### Results

Official CoNLL scores on CoNLL’12 shared task English data:

<table>
<thead>
<tr>
<th></th>
<th>dev</th>
<th>test</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>best</strong></td>
<td>63.35</td>
<td>63.37</td>
</tr>
<tr>
<td><strong>median</strong></td>
<td>58.9</td>
<td>58.68</td>
</tr>
<tr>
<td><strong>this work</strong></td>
<td>62.05</td>
<td>61.10</td>
</tr>
</tbody>
</table>

- would have ranked fourth on English data in CoNLL’12 shared task (only 0.2 difference to second ranked system)
- difference to best mainly due to MUC metric

### Error Analysis

#### Precision Errors

- lots of mention detection errors for nominals/names
- of 8000 clustering decisions when anaphor is pronoun, \( 1/3 \) wrong: performance good for I/he/she, mediocre for they, bad for you/it (many expletive cases)
- many difficult cases which require world knowledge or more complex features:
  
  Mr. Clinton praised Al Gore’s campaign manager, Bill Daley, for the way he handled the election.

#### Recall Errors

- count missing links between entities: many due to pairs of nominals
- often missing world knowledge:
  
  Barnett says Kostunica should cooperate with the Hague Tribunal. This particular UN Institution has in its power to give instant legitimacy to Kostunica.

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Competitive Performance with a Simple, Fast and *Unsupervised* Model