Delexicalized Parsing
Daniel Zeman, Rudolf Rosa

March 31, 2022
• What if we feed the parser with tags instead of words?
  
  • Ændringer i listen i bilaget offentliggøres og meddeles på samme måde.
  • NNS IN NN IN NN VB CC VB IN DT NN
  • NNS IN NN MD VB CC VB IN DT NN
  • Förändringar i förteckningen skall offentliggöras och meddelas på samma sätt.
What if we feed the parser with tags instead of words?

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- ((NNS (IN NN (IN NN))) ((VB CC VB) (IN (DT NN))))
- ((NNS (IN NN)) ((MD (VB CC VB)) (IN (DT NN))))
- Förändringar i förteckningen skall offentliggöras och meddelas på samma sätt.
Danish – Swedish Setup

• Daniel Zeman, Philip Resnik (2008). Cross-Language Parser Adaptation between Related Languages
  • In *IJCNLP 2008 Workshop on NLP for Less Privileged Languages*, pp. 35–42, Hyderabad, India
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- CoNLL 2006 treebanks (dependencies)
  - Danish Dependency Treebank
  - Swedish Talbanken05

- Two constituency parsers:
  - “Charniak”
  - “Brown” (Charniak N-best parser + Johnson reranker)

- Other resources
  - (JRC-Acquis parallel corpus)
  - Hajič tagger for Swedish (PAROLE tagset)
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Treebank Normalization

Danish

• DET governs ADJ
• ADJ governs NOUN

Swedish

• NOUN governs both DET and ADJ

• NOUN governs NUM
• NOM governs GEN

COORD: member on previous member, commas and conjs on next member
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- NUM governs NOUN
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  Ruslands vej
  Russia’s way

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  års inkomster
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Timberbank Normalization

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- COORD: last member on conjunction, everything else on first member

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- Transform Danish to Swedish tree style
  - A few heuristics
  - Only for evaluation! Not needed in real world.
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Nonterminal labels:
- Derived from POS tags
- Then translated to the Penn set of nonterminals
- Make the parser feel it works with the Penn Treebank
  (Although it could have been configured to use other sets of labels.)
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Unlabeled F Scores

- da-da lexicalized: Charniak = 78.16, Brown = 78.24
  - (CoNLL train 94K words, test 5852 words)
- sv-sv lexicalized: Charniak = 77.81, Brown = 78.74
  - (CoNLL train 191K words, test 5656 words)
- da-sv lexicalized: Charniak = 43.28, Brown = 41.84
  - (no morphology tweaking)
- da-da delexicalized: Charniak = 79.62, Brown = 80.20 (!)
  - (hybrid sv-da Hajič-like tagset = “words”, Penn POS = “tags”)
- sv-sv delexicalized: Charniak = 76.07, Brown = 77.01
- da-sv delexicalized: Charniak = 65.50, Brown = 66.40
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How Big Swedish Treebank Yields Similar Results?

Unlabeled $F_1$-score

Delexicalized Parsing
Delexicalized Dependency Parsing

- Ryan McDonald, Slav Petrov, Keith Hall (2011). Multi-Source Transfer of Delexicalized Dependency Parsers
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  • “Danish is the worst possible source language for Swedish.”
### Multi-Source Transfer (McDonald et al., 2011)

<table>
<thead>
<tr>
<th>Source Training Language</th>
<th>da</th>
<th>de</th>
<th>el</th>
<th>en</th>
<th>es</th>
<th>it</th>
<th>nl</th>
<th>pt</th>
<th>sv</th>
</tr>
</thead>
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<tr>
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<td>79.2</td>
<td>45.2</td>
<td>44.0</td>
<td>45.9</td>
<td>45.0</td>
<td>48.6</td>
<td>46.1</td>
<td>48.1</td>
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<tr>
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<td>83.9</td>
<td>53.2</td>
<td>47.2</td>
<td>45.8</td>
<td>53.4</td>
<td>55.8</td>
<td>55.5</td>
<td>46.2</td>
</tr>
<tr>
<td>el</td>
<td>33.3</td>
<td>52.5</td>
<td>77.5</td>
<td>63.9</td>
<td>41.6</td>
<td>59.3</td>
<td>57.3</td>
<td>58.6</td>
<td>47.5</td>
</tr>
<tr>
<td>en</td>
<td>34.4</td>
<td>37.9</td>
<td>45.7</td>
<td>82.5</td>
<td>28.5</td>
<td>38.6</td>
<td>43.7</td>
<td>42.3</td>
<td>43.7</td>
</tr>
<tr>
<td>es</td>
<td>38.1</td>
<td>49.4</td>
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</tr>
<tr>
<td>it</td>
<td>44.8</td>
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</table>
Single-Source, Harmonized (DZ, summer 2015)

- Malt Parser, stack-lazy algorithm (nonprojective)
  - Same algorithm for all, no optimization
  - Same selection of training features for all treebanks

- Trained on the first **1000 sentences** only
- Tested on the whole test set
- Default score: UAS (unlabeled attachment)
- Only harmonized data used (HamleDT 3.0 = UD v1 style)
- Single source language for every target
Delexicalized Dependency Parsing with Harmonized Data
Who Helps Whom?

- Czech (62.44) $\leftrightarrow$ Croatian (63.27), Slovenian (62.87)
- Slovak (59.47) $\leftrightarrow$ Croatian (60.28), Slovenian (59.32)
- Polish (77.92) $\leftrightarrow$ Croatian (66.42), Slovenian (64.31)
- Russian (66.86) $\leftrightarrow$ Croatian (57.35), Slovak (55.01)
- Croatian (75.52) $\leftrightarrow$ Slovenian (58.96), Polish (55.42)
- Slovenian (76.17) $\leftrightarrow$ Croatian (62.92), Finnish (59.79)
- Bulgarian (78.44) $\leftrightarrow$ Croatian (74.39), Slovenian (71.52)
Who Helps Whom?

- Catalan (75.28) ⇐ Italian (71.07), French (68.30)
- Italian (76.66) ⇐ French (70.37), Catalan (68.66)
- French (69.93) ⇐ Spanish (64.28), Italian (63.33)
- Spanish (67.76) ⇐ French (67.61), Catalan (64.54)
- Portuguese (69.89) ⇐ Italian (69.48), French (66.12)
- Romanian (79.74) ⇐ Croatian (67.01), Latin (66.75)
Who Helps Whom?

• Swedish (75.73) ⇐ Danish (66.17), English (65.41)
• Danish (75.19) ⇐ Swedish (59.23), Croatian (56.89)
• English (72.68) ⇐ German (57.95), French (56.70)
• German (67.04) ⇐ Croatian (58.68), Swedish (57.48)
• Dutch (60.76) ⇐ Hungarian (41.90), Finnish (37.89)
How Big Swedish Treebank Yields Similar Results as Delex from Danish?
Multiple Source Treebanks

- So far: select one source at a time
  - How to select the best possible source?
Multiple Source Treebanks

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• Alternative 1: train on all sources concatenated
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  • Separate voting about every node’s incoming edge
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WALS features (recall the first week)

Language recognition tool

But it relies on orthography!

cs: Generál přeskupil síly ve Varšavě.
pl: Generał przegrupował siły w Warszawie.
ru: Генерал перегруппировал войска в Варшаве.
en: The general regrouped forces in Warsaw.
• Low-resource languages:
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• High(er)-resource languages (selected groups only):
  • 1 Celtic (Irish)
  • 8 Germanic
  • 10 Slavic
  • 1 Iranian
  • 2 Turkic
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### Measuring Treebank Similarity: POS Tag N-grams

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<th>en</th>
<th>de</th>
<th>it</th>
<th>cs</th>
</tr>
</thead>
<tbody>
<tr>
<td>DET ADJ NOUN</td>
<td>1.51</td>
<td><strong>1.99</strong></td>
<td>0.96</td>
<td>0.40</td>
</tr>
<tr>
<td>DET NOUN ADJ</td>
<td>0.05</td>
<td>0.26</td>
<td><strong>1.77</strong></td>
<td>0.10</td>
</tr>
<tr>
<td>#sent ADJ NOUN</td>
<td>0.13</td>
<td>0.09</td>
<td>0.02</td>
<td><strong>0.52</strong></td>
</tr>
<tr>
<td>NOUN PUNCT #sent</td>
<td>2.44</td>
<td>1.18</td>
<td>1.41</td>
<td><strong>2.73</strong></td>
</tr>
<tr>
<td>VERB PUNCT #sent</td>
<td>0.48</td>
<td><strong>1.48</strong></td>
<td>0.23</td>
<td>0.58</td>
</tr>
</tbody>
</table>
Kullback-Leibler Divergence

- $UPOS$ ... universal set of 17 coarse-grained tags (from UD)
- $UPOS' = UPOS \cup \{#sent\}$ ... added sentence boundaries
- $(t_{i-2}, t_{i-1}, t_i)$ where $t_{i-2}, t_{i-1}, t_i \in UPOS'$ ... trigram of tags at positions $i-2$ ... $i$ of the corpus
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  - \( x, y, z \in UPOS' \)
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  - In Proceedings of the 51st Annual Meeting of the Association for Computational Linguistics and the 7th International Joint Conference on Natural Language Processing, Short Papers
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Asymmetric: amount of info lost when using the source distribution to approximate the true target distribution


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  - Asymmetric: amount of info lost when using the source distribution to approximate the true target distribution
  - In *Proceedings of the 51st Annual Meeting of the Association for Computational Linguistics and the 7th International Joint Conference on Natural Language Processing, Short Papers*
How to Make the Languages More Similar?

  • In *Proceedings of COLING 2016, the 26th International Conference on Computational Linguistics: Technical Papers*, pp. 119–130, Osaka, Japan.

• Transition-based parsers rely on word order
  • en: the following question (features: s0=ADJ, b0=NOUN)
  • fr: la question suivante (features: s0=NOUN, b0=ADJ)
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  • Remove words

• How do we know?
  • Heuristics based on WALS
  • UPOS language model
    • Generate all permutations in window of 3 words
    • Discard non-projective subtrees; if nothing left, retain source sequence
    • Score them by target-language model
    • Take the best permutation