An Evaluation of Parser Robustness for Ungrammatical Sentences
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Parsing Ungrammatical Sentences

Performance of parsers degrades on sentences that have even small grammatical errors:

Robust Parser

If the parser can overlook problems such as grammar mistakes and produce a parse tree that closely resembles the correct analysis for the intended sentence, we say that the parser is robust.

Questions

- Are some parsers more robust than others against sentences that are not well-formed?
- In what ways does a parser’s performance degrade when dealing with ungrammatical sentences?

Evaluation of Parser Robustness

- Manually annotated gold standards
- Ungrammatical treebank is not available for all domains
- Creating a treebank is expensive and time-consuming

Gold standard free approach

- Compare parse tree of problematic sentence against parse tree of well-formed sentence as gold standard
- We cannot use standard metrics of comparing trees, because words of ungrammatical sentence and its grammatical counterpart do not necessarily match
- We do not want to unfairly penalize parsers when there are extra or missing words

ESL Sentence: I appreciate all about this.
Corrected ESL Sentence: I appreciate all this.

Proposed Evaluation Methodology

- Error-related dependency: dependency connected to an extra word
- Shared dependency: mutual dependency between two trees

Robustness test data

- Penn Treebank (News data)
- English-as-a-Second Language writings (ESL)
- Machine translation outputs (MT)
- Tweebo (Twitter data)
- SyntaxNet (SNN)

How do parsers perform on erroneous sentences?

- All parsers are comparably robust on ESL, while they exhibit more differences on MT
- Training conditions matter, Malt performs better when trained on Tweetbank than PTB
- Training on Tweetbank, Tweebo parser is as robust as others

Experiments


To what extent is each parser impacted by the increase in number of errors?

- Robustness degrades faster with the increase of errors for MT than ESL
- Training on Tweetbank helps some parsers to be more robust against many errors

What types of grammatical errors are more problematic for parsers?

- Replacement errors are the least problematic errors for all the parsers
- Missing errors are the most difficult errors

<table>
<thead>
<tr>
<th>Parser</th>
<th>Train on PTB §1-21</th>
<th>Train on Tweetbank train</th>
<th>Train on Tweetbank train</th>
</tr>
</thead>
<tbody>
<tr>
<td>Malt</td>
<td>93.7 (MST)</td>
<td>92.9 (Yara)</td>
<td>89.4 (SyntaxNet)</td>
</tr>
<tr>
<td>Mate</td>
<td>93.3</td>
<td>93.1</td>
<td>89.7 (Yara)</td>
</tr>
<tr>
<td>MST</td>
<td>93.4</td>
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<td>90.4 (Yara)</td>
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<td>SNN</td>
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<td>SyntaxNet</td>
<td>93.3</td>
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<td>90.4 (Yara)</td>
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<td>Turbo</td>
<td>93.3</td>
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<td>Tweebo</td>
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</tr>
</tbody>
</table>

Each bar represents the level of robustness of each parser scaled to the lowest score (empty bar) and highest score (filled bar).

Conclusion

- Introducing a robustness metric without referring to a gold standard corpus
- Presenting a set of empirical analysis on the robustness of leading parsers
- Recommending practitioners to examine the range of ungrammaticality of input:
  - If it is more similar to tweets, Malt or Turbo parser may be good choices
  - If it is more similar to MT, SyntaxNet, Malt and Turbo parser are good choices
- The results suggest some preprocessing steps may be necessary for ungrammatical sentences, such as handling redundant and missing word errors