Improving Data Driven Dependency Parsing Using Clausal Information

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Outline

1. Introduction
   - Data Driven Dependency Parsing

2. Why Clausal Information?
   - Definition
   - Importance
   - Identification
   - Stage1 Parse

3. Experiments
   - Baseline
   - Clausal Information
   - Results

4. Analysis
   - Dependency Accuracy Vs Distance
   - Non-projective Dependencies

5. Conclusion
Introduction

Why Clausal Information?

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Definition

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Clause Definition

Definition

Traditionally, a clause is a group of words that consist of a subject and a predicate.

Example

I went to the market yesterday, where, I found a beautiful watch.

Exact definition in experiments section
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Motivation for using Clausal Information

Most of the dependencies of words appear inside the same clause. The dependencies of the words are mostly localized to the clause boundary.

- Parsing: Finding the correct parent/child of a word in the sentence
- Use of the clause boundary information
  - Reduces the search space of the parser to find the dependent
  - Makes the parser less prone to errors?
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Does it really work?
Indian Languages

- Relatively-free word order languages
- Dependency framework is best suited
- Paninian framework proved to be helpful (Bharti et al., 93,95, etc...)

![Clausal Bias in Dependency Distance](chart1.png)

![Label Bias with Clause](chart2.png)
Dependency Distance Vs Clause

Clausal Bias in Dependency Distance

- Intra(%)
- Inter(%)

% Coverage

Dependency Distance
Dependency Label Vs Clause

Label Bias with Clause

% Coverage

Dependency Label

Intra(%) Inter(%)
Bharti et al., 93 proposed a two stage method in which
- Only Intra Clausal dependencies are resolved in Stage1
- Only Inter Clausal dependencies are resolved in Stage2

Successfully tried for Indian Languages (Bharti et al., 2008,09)

Husain et al., 2009 proposed data-driven Two-Stage Parsing

Stage1 parse of Husain et al., used as the clausal information provider

For us, a clause is a group of words having a single verb, unless the verb is a child of another verb
Stage1 Parse Details

- To do the Stage1 Parsing, Husain et al., 09
  - Adds a dummy node
  - The clauses are attached to it by dummy relations
  - The treebank is converted to this format by rules
  - Trains MSTParser on this, to get the stage1 model

- Here, we use MaltParser instead of MSTParser

- The output is post processed to get the clausal information

\* A figure needs to be included here which makes the process clear.\*
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Phani Gadde
Parsing using Clausal Features
Hindi dataset released as part of the ICON09 parsing contest.
Training: 1500, Development: 150, Testing: 150
Sentences are annotated using syntactico-semantic relations based on Paninian framework (Begum et al., 2008)
Dependency relations exist between chunks
Malt Parser is used
  - Arc-eager
  - Turkish SVM settings
Baseline Features and Accuracy

- **Data specific features**
  - Tense, Aspect, Modality for Verbs
  - Vibhakti (Post-position) for Nouns

- **General features**
  - Lexical items (Stack, Input) window size: ?
  - POS, Chunk tags (Stack, Input) window size: ?
  - **Clausal Features**

<table>
<thead>
<tr>
<th></th>
<th>Precision</th>
<th>Recall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clause Boundary</td>
<td>84.83</td>
<td>91.23</td>
</tr>
<tr>
<td>Clause Head</td>
<td>92.42</td>
<td>99.40</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>LAS</th>
<th>LA</th>
<th>L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>73.62</td>
<td>91.00</td>
<td>76.04</td>
</tr>
</tbody>
</table>
Why and How?

- As said earlier, clause boundary info. reduces the search space of the parser
- But, clausal information spans across many words
- Hard to encode as a boolean feature
- Modified the code of MSTParser to handle the following features
  - Whether two words (Stack[0] and Input[0]) are in the same clause or not (boolean)
  - The head/non-head info. of each word in a clause (H or NH)

Figure showing the feature clearly
## Results

<table>
<thead>
<tr>
<th></th>
<th>LAS</th>
<th>UAS</th>
<th>LS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>73.62</td>
<td>91.00</td>
<td>76.04</td>
</tr>
<tr>
<td>F1</td>
<td>72.66</td>
<td>91.00</td>
<td>74.74</td>
</tr>
<tr>
<td>F2</td>
<td>72.66</td>
<td>91.00</td>
<td>74.74</td>
</tr>
<tr>
<td>F3</td>
<td>74.39</td>
<td>91.87</td>
<td>76.21</td>
</tr>
</tbody>
</table>

- **F1**: Only Boundary
- **F2**: Only Head Info.
- **F3**: Both Boundary and Head info.

- Improvement in LAs: 0.87 UAS: 0.87
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Once can see that

- The accuracy improvement increases as the distance increases
- Shows that the clausal features, help distinguishing and identifying long distance dependencies
Most of the non-projectivities exist in-between the clauses (Mannem et al., 2009)

So, the head features should guide the parser to identify non-projectivities

The following table shows this clearly.

<table>
<thead>
<tr>
<th></th>
<th>F1(%)</th>
<th>F4(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precision</td>
<td>41.1</td>
<td>50</td>
</tr>
<tr>
<td>Recall</td>
<td>30.5</td>
<td>39.2</td>
</tr>
</tbody>
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Clausal features help dependency parsing, especially, when there is dependency and label bias toward the clause.
Future Work