BME-TUW at SR’20
Lexical grammar induction for surface realization

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Third Workshop on Multilingual Surface Realisation, 12/12/2020
Summary

Rule-based system for word order restoration + DL reinsertion

Improves the grammar-based approach in Kovács et al. (2019)

Still inferior to DL systems, but opens up new possibilities

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Interpreted Regular Tree Grammars

...
Interpreted Regular Tree Grammars (IRTGs, Koller and Kuhlmann, 2011) encode the correspondence between operations over a string algebra and an s-graph algebra (Courcelle and Engelfriet, 2012; Koller, 2015).

\[
\text{VERB} \rightarrow \text{nsubj (VERB, NOUN)}
\]

\[
\text{[string]} \ast (\text{?2, ?1})
\]

\[
\text{[ud]} \text{f_depl (merge (merge (\text{?1, } (r < r \text{oot} > : n \text{subj d1 < depl1>}) ), r_depl1 (\text{?2}))}
\]

Read: constructing the subgraph \text{VERB} \rightarrow \text{nsubj} \rightarrow \text{NOUN} corresponds to concatenation in the order \text{NOUN VERB}.
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\[
\text{VERB} \rightarrow \_nsubj(\text{VERB}, \text{NOUN}) \\
[\text{string}] *(?2, ?1) \\
[\text{ud}] f_{\text{dep1}}(\text{merge}(\text{merge}(?1,"(r<\text{root}> :nsubj d1<\text{dep1}>)"),\text{r}_{\text{dep1}}(?2)))
\]

Read: constructing the subgraph \( \text{VERB} \xrightarrow{\text{nsubj}} \text{NOUN} \) corresponds to concatenation in the order \( \text{NOUN} \xrightarrow{} \text{VERB} \).
Generating subgraphs

For a head word with N dependents, we enumerate \( \sim 3 \) N subgraphs.
Generating subgraphs

\[ \text{He/PRON} \xleftrightarrow{\text{nsubj}} \ \text{enjoy/VERB} \xrightarrow{\text{obj}} \ \text{it/PRON}. \]
Generating subgraphs

\[ \text{He/PRON} \xleftrightarrow{nsubj} \text{enjoy/VERB} \xrightarrow{obj} \text{it/PRON}. \]

For a head word with \( N \) dependents, we enumerate \( \sim 3^N \) subgraphs.
## Model statistics

| Lang | $N_{patt}$ | $D_{max}$ | $|V|$  | $D_{words}$ | $N_{tok}$ |
|------|------------|-----------|-------|------------|-----------|
| ar   | 8.6M       | 4.8       | 14K   | 36.9       | 224K      |
| en   | 29.8M      | 5.0       | 25K   | 17.6       | 352K      |
| es   | 50.2M      | 5.5       | 48K   | 29.0       | 827K      |
| fr   | 37.1M      | 5.7       | 34K   | 24.6       | 429K      |
| hi   | 17.2M      | 5.5       | 15K   | 21.1       | 281K      |
| id   | 7.0M       | 5.2       | 19K   | 21.8       | 98K       |
| ja   | 14.5M      | 5.6       | 24K   | 22.5       | 160K      |
| ko   | 8.6M       | 3.9       | 119K  | 12.9       | 353K      |
| pt   | 27.2M      | 5.2       | 32K   | 25.7       | 462K      |
| ru   | 41.6M      | 4.7       | 51K   | 18.0       | 946K      |
| zh   | 14.8M      | 6.8       | 20K   | 24.7       | 99K       |
Generating subgraphs

For each UD graph, we generate a separate IRTG. For each subgraph, we add the most frequent rule. Identical rule weights favor shorter derivations with more specific rules.
For each UD graph, we generate a separate IRTG.
Generating subgraphs

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- For each UD graph, we generate a separate IRTG
- For each subgraph, we add the most frequent rule
- Identical rule weights → grammars favor shorter derivations with more specific rules
Generating subgraphs
Generating subgraphs

I really enjoyed reading it.

Diagram:

- **ROOT**
  - **ADVMOD**
    - **really**
  - **NSUBJ**
    - **enjoyed**
  - **XCOMP**
    - **I**
  - **OBJ**
    - **reading**
    - **it**

- **NSUBJ**
  - **ADVMOD**
    - **really**
    - **enjoyed**
Hierarchical SR

Cut UD graphs along edges between clauses: acl, advcl, ccomp, xcomp, conj.
Hierarchical SR

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Hierarchical SR

Cut UD graphs along edges between clauses: acl, advcl, ccomp, xcomp, conj.

```
I/PRON really/ADV enjoyed/VERB reading/VERB it/PRON
```

```
really/ADV enjoyed/VERB
```

```
I/PRON
```
Hierarchical SR

Cut UD graphs along edges between clauses: acl, advcl, ccomp, xcomp, conj.

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Hierarchical SR

Cut UD graphs along edges between clauses: acl, advcl, ccomp, xcomp, conj.

```
really/ADV  enjoyed/VERB  I/PRON  reading/VERB  it/PRON

I  really  enjoyed  reading  it  enjoyed  reading
```
Hierarchical SR

In a sample of 500 English sentences, we run 1794 iterations of the core method, and observe recursion depths up to 6.
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Perhaps had we not gone into this restaurant believing Zahav was going to be golden as its name suggests (and as the many golden reviews seem to attest), we would have enjoyed a decent little expensive experience.
In a sample of 500 English sentences, we run 1794 iterations of the core method, and observe recursion depths up to 6.

*Perhaps had we not gone into this restaurant believing Zahav was going to be golden as its name suggests (and as the many golden reviews seem to attest), we would have enjoyed a decent little expensive experience.*
| Team         | Meaning Ave. | Meaning Ave. z | Readability Ave. | Readability Ave. z |
|--------------|--------------|----------------|------------------|--------------------|
| HUMAN        | 92.7         | 0.534          | 75.7             | 0.417              |
| IMS          | 92.3         | 0.475          | 73.9             | 0.374              |
| ADAPT        | 90.7         | 0.476          | 72.5             | 0.320              |
| Concordia    | 87.0         | 0.332          | 70.2             | 0.270              |
| BME 2020     | 79.3         | 0.086          | 58.2             | -0.152             |
| BME 2019     | 77.4         | 0.024          | 56.7             | -0.208             |
## Evaluation

| Data          | Meaning |                  | Readability |                  |
|---------------|---------|------------------|-------------|------------------|
|               | BME 2020 | BME 2019 | BME 2020 | BME 2019 |
|               | Ave. | Ave. z | Ave. | Ave. z | Ave. | Ave. z | Ave. | Ave. z |
| en_ewt        | 79.3 | 0.086 | 77.4 | 0.024 | 58.2 | -0.152 | 56.7 | -0.208 |
| en_wiki       | 81.8 | -0.050 | 82.4 | -0.074 | 60.8 | -0.299 | 64.4 | **-0.181** |
| ru_syn        | 81.2 | -0.166 | 81.3 | -0.177 | 69.7 | -0.166 | 67.3 | -0.230 |
| ru_wiki       | 78.2 | **-0.079** | 68.2 | -0.493 | 63.2 | **0.050** | 37.7 | -0.781 |
| es_ancora     | 70.2 | -0.276 | 70.6 | -0.271 | 66.4 | -0.401 | 67.1 | -0.378 |
| es_wiki       | 69.8 | **-0.170** | 55.5 | -0.726 | 77.2 | **0.015** | 62.2 | -0.628 |
Plans

- Use ‘unlimited’ silver standard UD data
Plans

- Use ‘unlimited’ silver standard UD data
- Learn rule weights
Plans

- Use ‘unlimited’ silver standard UD data
- Learn rule weights
- Qualitative analysis of performance gap
All components of our system are free and open source:

| Component               | URL                                           | License  |
|-------------------------|-----------------------------------------------|----------|
| Word order restoration  | github.com/adaamko/surface_realization       | MIT      |
| Reinflection            | github.com/juditacs/deep-morphology          | MIT      |
| IRTG generation         | github.com/recski/tuw-nlp                     | MIT      |
| IRTG parsing            | github.com/coli-saar/alto                     | Apache 2.0 |
Thank you!

Courcelle, Bruno and Joost Engelfriet (2012). *Graph structure and monadic second-order logic*. Cambridge University Press.

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