Semantically Constrained Multilayer Annotation

The Case of Coreference

Jakob Prange, Nathan Schneider, and Omri Abend
How to annotate coreference?
Did anyone else have these fears?
Did anyone else have these fears?
Did anyone else have these fears?
Did anyone else have these fears?

How did you get over them?
Did anyone else have these fears?

How did you get over them?
Representing Coreference Is Not Trivial

What to annotate as mentions?
- Syntactic criteria (e.g., all nouns)
- Semantic criteria (e.g., all events)
- Singletons?

How to annotate mention spans?
- Minimum spans (only head words)
- Maximum spans (plus args & mods)
- Hybrid?

How to annotate coreference?
- Identity, Bridging, ...
- Unordered clusters or ordered chains
- Tricky linguistic phenomena (e.g., coordination)
Representing Coreference Is Not Trivial

• Many of these decisions seem arbitrary

• Many different approaches with different guidelines
  [Poesio et al., 2016]

• Problematic for evaluation
  [Moosavi and Strube, 2016; Moosavi et al., 2019]

• Seldom integrated with other layers of meaning
Charming 4-bedroom home
Our Approach:
Build upon a **basic framework** for semantic units that can be **shared** among many higher-level meaning representations.
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Semantic Multilayering
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Coreference

UCCA
Semantic Multilayering
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Semantic Multilayering with UCCA [Abend & Rappoport, 2013]

• Identify and relate "scenes" (events) and participants → Basic semantic units

• No assumptions about grammar or lexicon → Cross-linguistically applicable
UCoref: UCCA + Coreference

Did anyone else have these fears? How did you get over them?
Did anyone else have these fears? How did you get over them?
Did anyone else have these fears? How did you get over them?
Did anyone else have these fears? How did you get over them?
UCoref: Streamlined Annotation

• UCCA units can be filtered in preprocessing
  • All scene and participant units are automatically considered mentions
Did anyone else have these fears? How did you get over them?
Did anyone else have these fears?

How did you get over them?
UCoref: Streamlined Annotation

- UCCA units can be filtered in preprocessing
- Human annotators identify remaining mentions and coreference clusters
- Semantic heads serve as minimum span versions of complex mentions
Did anyone else have these fears? How did you get over them?
Did anyone else have these fears? How did you get over them?
Did anyone else have these fears? How did you get over them?
Comprehensive Representation

✓ Flexible mention spans

✓ Event and entity coreference in one framework

✓ Anchored in predicate argument structure, which...
  ... helps humans disambiguate
  ... can be utilized in automatic resolution (as features, or in a joint or MTL setup)
Drawback: Need UCCA Annotations First

• Efficiently annotatable by non-experts

• Can use automatic parsers

• It’s worth it!
Pilot Annotation

• Small samples from 3 English coreference corpora
  • OntoNotes [Hovy et al., 2006]: Blog posts
  • GUM [Zeldes, 2017]: WikiHow articles
  • RED [O’Gorman et al., 2016]: Forum discussions

• Similar genres, different guidelines

Hypothesis:
UCoref covers (most of) what existing schemes cover, and more.
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<table>
<thead>
<tr>
<th>Anchored in syntax</th>
<th>GUM syntax</th>
<th>RED tokens</th>
<th>UCoref semantics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mention criteria</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>syntax</td>
<td>syntax</td>
<td>semantics</td>
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</tr>
<tr>
<td>Mention spans</td>
<td>max</td>
<td>max</td>
<td>min</td>
</tr>
<tr>
<td>Events</td>
<td>✓</td>
<td>(√)</td>
<td>✓</td>
</tr>
<tr>
<td>Singletons</td>
<td>✓</td>
<td>(√)</td>
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Annotation guidelines point in this direction.
Hypothesis:
UCoref covers (most of) what existing schemes cover, and more.

<table>
<thead>
<tr>
<th></th>
<th>mentions</th>
<th>UCoref mentions</th>
<th>referents</th>
<th>UCoref referents</th>
</tr>
</thead>
<tbody>
<tr>
<td>OntoNotes</td>
<td>40</td>
<td>128</td>
<td>20</td>
<td>96</td>
</tr>
<tr>
<td>GUM</td>
<td>288</td>
<td>466</td>
<td>155</td>
<td>291</td>
</tr>
</tbody>
</table>

Numbers of mentions and referents confirm: UCoref covers more than other schemes.
**Hypothesis:**
UCoref covers (most of) what existing schemes cover, and more.

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<td>291</td>
</tr>
<tr>
<td>RED</td>
<td>120 ≈ 117</td>
<td></td>
<td>82 ≈ 78</td>
<td></td>
</tr>
</tbody>
</table>

RED is very similar to UCoref in terms of coverage.
High Recall

Exact Match

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<th>Referents</th>
</tr>
</thead>
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<tr>
<td>OntoNotes</td>
<td>75%</td>
<td>25%</td>
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<tr>
<td>GUM</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>RED</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>
High Recall

Iterative greedy 1-to-1 alignment based on Dice coefficient.

Exact Match

Partial Match

DMR, August 1, 2019
High Recall

Iterative greedy 1-to-1 alignment based on Dice coefficient.

Exact Match

Partial Match

Mention spans are crucial for evaluation.
High Recall

Iterative greedy 1-to-1 alignment based on Dice coefficient.

Mention spans are crucial for evaluation.

Moosavi et al. [2019] automatically extract min spans.

DMM, August 1, 2019

Prange, Schneider, Abend
Conclusions

• Scattered coreference research needs to be unified
  • Related: Universal Coreference Initiative

• Semantic representations should be semantically anchored and modular

• UCoref is a first step in that direction
  • Main advantages: efficiency, consistency, and reusability
Approaches To Semantic Multilayering

- FrameNet [Baker et al., 1998]
- OntoNotes [Hovy et al., 2006]
- PropBank [Palmer et al., 2005]
- RED [O’Gorman et al., 2016]
- GUM [Zeldes, 2017]
- Decompositional Semantics [White et al., 2016]
- Prague [Böhmová et al., 2003]
- Multi-sentence AMR [O’Gorman et al., 2018]

ANCHORING

- Token
- Syntax
- Sentence
- Semantics

Modular

Highly modular

1 Layer
Thank you!

Questions?

Jakob Prange, Nathan Schneider, and Omri Abend

jakob@cs.georgetown.edu

https://github.com/jakpra/UCoref

Appendix
A: Did anyone else have these fears?
A: How did you get over them?
A: Did anyone else have these fears?
B: Yes, me.
A: How did you get over them?
Representing Coreference

A: Did anyone else have these fears?
A: Did anyone else have other fears?
A Quick Introduction to UCCA

• Main philosophy: Identifying "scenes" (events) and their participants

• Foundational layer is a DAG over tokens
  • Terminals (tokens) evoke pre-terminals
  • Non-terminals form larger units of meaning, such as elaborations and scenes
  • Edge labels indicate the role of a child within its parent
  • "Remote edges" and "implicit units" handle zero anaphora and constructional null-instantiation

• Additional layers are anchored in the foundational layer
A Quick Introduction to UCCA

- Agnostic about lexicon and syntax
- Semantic and usage-based guidelines for annotation

→ Efficient annotation across languages, even by non-experts
Automatic Mention Preselection...

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<tbody>
<tr>
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<td>70</td>
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<td>1436</td>
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<tr>
<td>Mention candidates</td>
<td>195</td>
<td>911</td>
<td>186</td>
</tr>
</tbody>
</table>

... simplifies manual annotation.
Semantic Multilayering: An Overview

• Much recent work on designing meaning representations and sembanking

• Can be summarized along two axes:
  • **Anchoring:** How is annotation guided and constrained by underlying structure (tokens, syntax, …)?
  • **Modularity:** To what extent are multiple kinds of information encoded in separate structures/layers?