A structured syntax-semantics interface for English-AMR alignment

Ida Szubert       Adam Lopez       Nathan Schneider

University of Edinburgh  Natural Language Processing

Georgetown University
Abstract Meaning Representation (AMR)

Broad-coverage scheme for **scalable** human annotation of English sentences [Banarescu et al., 2013]

- Unified, readable graph representation
- “Semantics from scratch”: annotation does not use/specify syntax or align words
- **60k sentences** gold-annotated

The hunters camp in the forest
Abstract Meaning Representation (AMR)

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The hunters camp in the forest
AMR in NLP

- Most approaches to AMR parsing/generation require explicit **alignments** in the training data to learn generalizations [Flanigan et al., 2014; Wang et al., 2015; Artzi et al., 2015; Flanigan et al., 2016; Pourdamghani et al., 2016; Misra and Artzi, 2016; Damonte et al., 2017; Peng et al., 2017; …]

- 2 main alignment flavors/datasets & systems:
  - JAMR [Flanigan et al., 2014]
  - ISI [Pourdamghani et al., 2014]
Reactions to Current AMR Alignments

“Wrong alignments between the word tokens in the sentence and the concepts in the AMR graph account for a significant proportion of our AMR parsing errors” [Wang et al., 2015]

“Improvements in the quality of the alignment in training data would improve parsing results.” [Foland & Martin, 2017]

“A standard semantics and annotation guideline for AMR alignment is left for future work” [Werling et al., 2015]
This Talk: UD 💖 AMR

✓ A new, more expressive flavor of AMR alignment that captures the syntax–semantics interface
  ‣ UD parse nodes and subgraphs ↔ AMR nodes and subgraphs
  ‣ Annotation guidelines, new dataset of 200 hand-aligned sentences

✓ Quantify coverage and similarity of AMR to dependency syntax (97% of AMR aligns)

✓ Baseline algorithms for lexical (node–node) and structural (subgraph) alignment
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(String, AMR) alignments
JAMR-style [Flanigan et al., 2014]

- (Word span, AMR node), (Word span, Connected AMR subgraph) alignments
- each AMR node is in 0 or 1 alignments
ISI-style [Pourdamghani et al., 2014]

- (Word, AMR node), (Word, AMR edge) alignments
- many-to-many

Relative to JAMR: lower level,
+ Compositional relations marked by function words (but only 23% of AMR edges covered),
- Distinguishing coreference from multiword expression
Why syntax?

• To explain all (or nearly all) of the AMR in terms of the sentence, we need more than string alignment.
  ‣ Not every AMR edge is marked by a word—some reflected in word order.

• Syntax = grammatical conventions above the word level that give rise to semantic compositionality.
  ‣ Alignments to syntax give a better picture of the derivational structure of the AMR.
Universal Dependencies (UD)

- directed, rooted graphs
- semantics-oriented, surface syntax
- widespread usage
- corpora in many languages
- enhanced++ variant
  [Schuster & Manning, 2016]
Prior AMR work has modeled various kinds of syntax–semantics mappings [Wang et al., 2015; Artzi et al., 2015, Misra and Artzi, 2016, Chu and Kurohashi, 2016, Chen and Palmer, 2017].

We are the first to

▶ present a detailed linguistic annotation scheme for syntactic alignments, and

▶ release a hand-annotated dataset with dependency syntax.

AMR and dependency syntax are often assumed to be similar, but this claim has never been evaluated.
The hunters camp in the forest
The hunters camp in the forest
Structural alignments

Connected subgraphs on both sides, at least one of which is larger than 1 node

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The hunters camp in the forest
Derived Noun

Similar treatment for named entities.

The hunters camp in the forest
Subsumption Principle for hierarchical alignments: Because the ‘hunters’ node aligns to person :ARG0-of hunt, any structural alignment containing ‘hunters’ must contain that AMR subgraph.
Structural alignments

**Connected subgraphs** on both sides, at least one of which is larger than 1 node

The hunters camp in the forest
In the story, evildoer Cruella de Vil makes no attempt to conceal her greed.
200 hand-aligned sentences
UD: hand-corrected CoreNLP parses
IAA: 96% for lexical, 80% for structural

http://tiny.cc/amrud
Coverage

Perhaps from-scratch AMR annotation gives too much flexibility, and annotators incorporate inferences from beyond the sentence [Bender et al., 2015]

99.3% of AMR nodes
97.2% of AMR edges

are part of at least 1 alignment

81.5% of AMRs are fully covered

Thus, nearly all information in an AMR is evoked by lexical items and syntax.
Distribution of alignment configurations

10% complex: multiple UD edges & multiple AMR edges
90% simple
Complex configurations are frequently due to

coordination: 28% (different head rules)
	named entities: 10% (MWE with each part of name in AMR)

semantic decomposition: 6%

quantities/dates: 5%
How similar are AMR and UD?

10% complex alignments

66% of sentences have at least 1 complex alignment

Thus, most AMRs have some local structural dissimilarity.
Automatic alignment: lexical

Our rule-based algorithm: 87% (mainly string match; no syntax)
Automatic alignment: structural

Simple algorithm that infers structural alignments from lexical alignments via path search

Gold UD & lexical alignments: 76%
Gold UD, auto lexical alignments: 61%
Auto UD & lexical alignments: 55%
Conclusions

• Aligning AMRs to dependency parses (rather than strings) accounts for nearly all of the AMR nodes and edges

• AMR and UD are broadly similar, but many sources of local dissimilarity

• Lexical alignment can be largely automated, but structural alignment is harder

• We release our guidelines, data, and code
More in the paper

• Linguistic annotation guidelines

• Constraints on structural alignments

• Rule-based algorithms for lexical and structural alignment

• Syntactic error analysis of an AMR parser
Future Work

• Better alignment algorithms
  ‣ Adjust alignment scheme as AMR standard evolves [Bonial et al., 2018, ...]

• Richer alignments ⇒ better AMR parsers & generators?
  ‣ By feeding the alignments into the system, or
  ‣ Evaluating attention in neural systems
Advantages of our approach

- **Compositional** syntactic relations between lexical expressions, even if not marked by a function word (subject, object, amod, advmod, compound, ...)

- **Subgraphs** preserve contiguity of multiword expressions/morphologically complex expressions (as in JAMR, though we don’t require string contiguity)
  - Distinguish from coreference

- Lexical alignments are where to look for spelling overlap; non-lexically-aligned concepts are implicit

- A syntactic edge may attach to different parts of an AMR-complex expression (tall hunter vs. careful hunter; bad hunter is ambiguous). The lexical alignment gives us the hunt predicate, while the structural alignment gives us the person-rooted subgraph.
Complex configurations indicate structural differences

nation’s defense and security capabilities

$\Rightarrow$ nation’s defense capabilities and its security capabilities
In the story, evildoer Cruella de Vil makes no attempt to conceal her greed.
In the story, evildoer Cruella de Vil makes no attempt to conceal her greed.
Light verbs
Control
enhanced++ UD annotation
Automatic aligner

- standard label-based node alignment

<table>
<thead>
<tr>
<th>aligner</th>
<th>our</th>
<th>ISI</th>
<th>JAMR</th>
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<tr>
<td>JAMR</td>
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Table 3: Lexical alignment (precision, recall, $F_1$-score). Our *lexical* alignment algorithm does not use syntax.

* data used for experiments: our corpus, ISI corpus (Pourdamghani et al., 2014), and JAMR corpus (Flanigan et al., 2014)