(D)MRS Comparison

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DELPH-IN summit

Acknowledgments and current situation

Work done at Nanyang Technological University with Francis Bond, with financial support by the Erasmus Mundus MULTI program via the Laboratoire Parole et Langage at Aix-Marseille University.

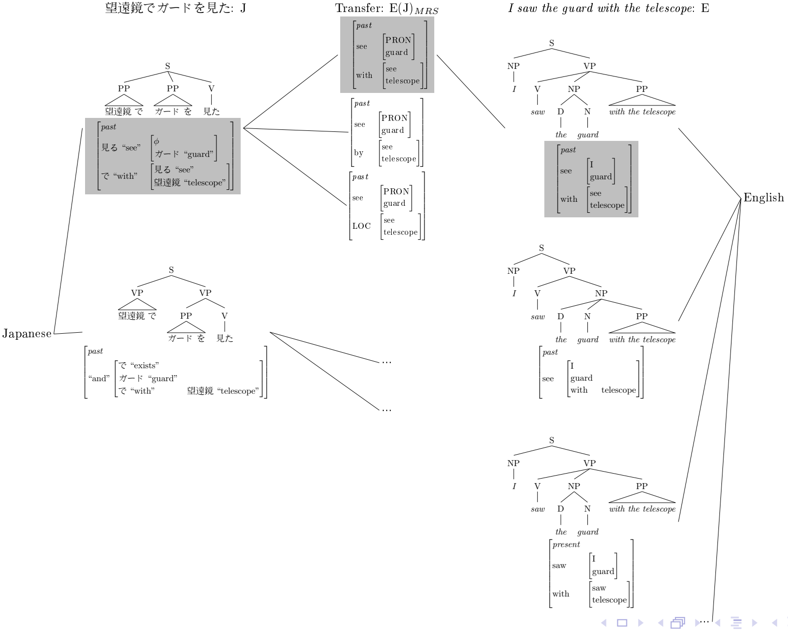
Currently working at the Laboratoire d'Informatique Fondamentale in Aix-Marseille University on a speech-to-speech translation project: graph-based syntactic dependency parsing and semantic role labelling.

Motivation

General need to compare arbitrarily dissimilar (D)MRSs:

- treebanking,
- cross-lingual parse disambiguation (Frermann and Bond 2012),
- extraction of transfer rules (Haugereid and Bond 2012),
- paraphrase detection
- ...

Example: Cross-lingual Disambiguation



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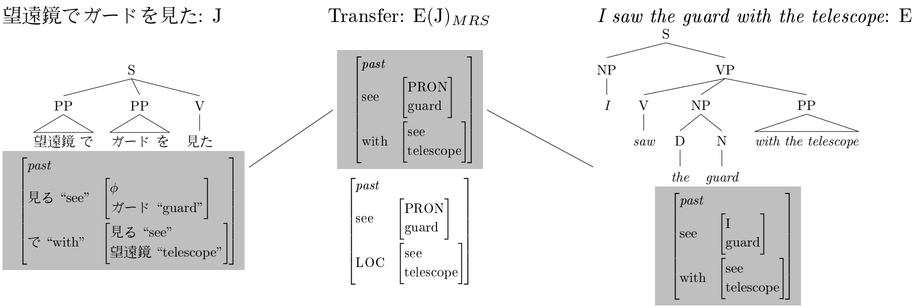


Comparing MRSs from bitexts

- Tanaka Corpus: Japanese-English parallel corpus (147,190 Sentence pairs)

- English side parsed with the ERG,
- Japanese side parsed with Jacy,
- Japanese MRSs partially transferred to English MRSs with Jaen.

Transfer system

- Transfer rules are rewriting rules that operate on subparts of MRS structures
- Many rules are simple predicate changing rules:
  - same category: "_hon_n_rel" ⇒ "_book_n_1_rel"
  - different categories: adjective ⇒ intransitive verb
- Other rules are more complex, and may transfer one-to-many Japanese relations into one-to-many English relations:
  - noun + noun ⇒ noun: "[minor] [test]" ⇒ "quiz"
  - noun + adj ⇒ adj: "[much] [snow]" ⇒ "snowy"
- The Jaen transfer system is made of
  - 1,415 hand-written transfer rules for function words, pronouns, time expressions, spatial expressions, proper nouns, and the most common open class items
  - 190,356 rules automatically extracted from parallel corpora

MRS comparison: Bags of predicates

- Consider an MRS as a bag of predicates.
- The best aligning MRSes are the ones that share the highest proportion of predicates.

- Cross-lingual disambiguation: ignored grammatical predicates
- Results: slight improvement over the baseline (monolingually trained stochastic models) for both an intrinsic and an extrinsic evaluation tasks.
- Pros:
  - Elementary predicate matching solves part of the lexical ambiguity,
  - Simple and computationally cheap.
- Cons:
  - Very dependent on the lexical coverage of the translation rules,
  - Discards all structural (predicate-argument) information: The cat chases the mouse $\equiv$ The mouse chases the cat.

MRS comparison: Bags of elementary dependencies

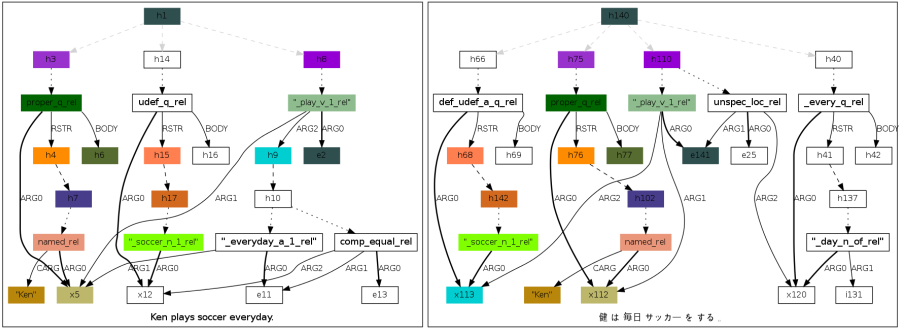
- Consider an MRS as a bag of elementary dependencies.
- The best aligning MRSes are the ones that share the highest proportion of elementary dependencies.

- Did not work so well for cross-lingual disambiguation.
- Pros:
  - Elementary dependency matching captures individual predicate-argument relations,
  - Simple and computationally cheap.
- Cons:
  - Still dependent on the lexical coverage of the translation rules,
  - Very local view of structural information

MRS comparison: Inexact graph matching

- MRSs can be viewed as (directed acyclic) graphs
- MRS comparison can be seen as *inexact graph matching*
- MRSs exhibit properties such as DAGness, relatively small size, finite number of possible labels. . . that help to limit the algorithmic complexity in practice.

Inexact MRS matching



Ken plays soccer everyday.

健 は 毎日 サッカー を する 。

MRS comparison: Graph edit distance

Differences between MRSs can be formulated in terms of graph edit operations, with associated costs:

- insertion/deletion of predicates,
- insertion/deletion of (argument) links,
- substitution of predicates, cost according to a SEM-I- or WordNet-based distance.

MRS edit distance

Pros:

- accounts for structural differences,
- captures transfer rules as sequences of graph edit operations $\rightsquigarrow$ could be used to acquires transfer rules

Cons:

- finding the most appropriate edit costs is not trivial,
- in practice, computing the graph edit distance between MRSs exhaustively and exactly is too expensive

Practical challenges: Computation

Inexact graph edit distance is NP-hard

- A naive encoding of MRSs generates graphs that are unnecessarily and prohibitively large;
  - help: DMRS provides a concise encoding
- A concise encoding helps but does not suffice for long sentences ($>$ 30 words).
- Approximate solutions:
  - approximate the graph by a tree and use an inexact tree matching algorithm,
  - approximate the graph by a collection of small subgraphs and use inexact graph matching on these,
  - use approximate binary/integer (linear) programming...

Practical challenges: Grammars

MRSs output by Jacy+Jaen are quite different from MRSs output by the ERG.

- Cross-lingual and cross-grammar differences
- Grammars use different (versions of the same) design principles and (naming) conventions
  - help: grammar documentation, SEM-I, sanity checks
- Some rules in Jaen lose part of the structure
  - ex: silent deletion of an argument link (dangling QEQ), merged labels (self QEQ),
  - help: more error flagging by the transfer engines ? well-formedness checks on the partially transferred MRSs

Conclusion

(D)MRS comparison is feasible:

- exactly for short sentences and very similar MRSs (code and first results on parse disambiguation soon),
- inexactly otherwise (lots of work for anyone interested).

Strongly linked to hot topics:

- SEM-I,
- WordNet - ERG links,
- MRS sanity checks: well-formedness etc.

SEM-I: quiz

- "_about_a_1_rel" : ARG0 e, ARG1 i, ARG2 h.
- "_about_a_1_rel" : ARG0 e, ARG1 h.

- "_acceptable_a_for_rel" : ARG0 e, ARG1 p, ARG2 i.
- "_acceptable_a_for_rel" : ARG0 e, ARG1 e.
- "_acceptable_a_for_rel" : ARG0 e, ARG1 h.

How many different predicates?

Important for (D)MRS comparison, transfer, conversion from DMRS to MRS.