Argumentation Mining

MARIE-FRANCINE MOENS

JOINT WORK WITH RAQUEL MOCHALES AND PARISA KORDJAMSHIDI

LANGUAGE INTELLIGENCE AND INFORMATION RETRIEVAL

DEPARTMENT OF COMPUTER SCIENCE

KU LEUVEN, BELGIUM

http://liir.cs.kuleuven.be

http://people.cs.kuleuven.be/~sien.moens/

Outline

- PhD thesis of Raquel Mochales

- Focus on two problems:
  - Learning models that recognize argumentation structures
  - Learning representations that help detecting relationships between argumentation components

- Conclusions

KATHOLIEKE UNIVERSITEIT LEUVEN

Arenberg Doctoral School of Science, Engineering & Technology
Faculty of Engineering
Department of Computer Science

Automatic Detection and Classification of Argumentation in a Legal Case

Raquel MOCHALES

Dissertation presented in partial
fulfillment of the requirements for
the degree of Doctor
in Engineering
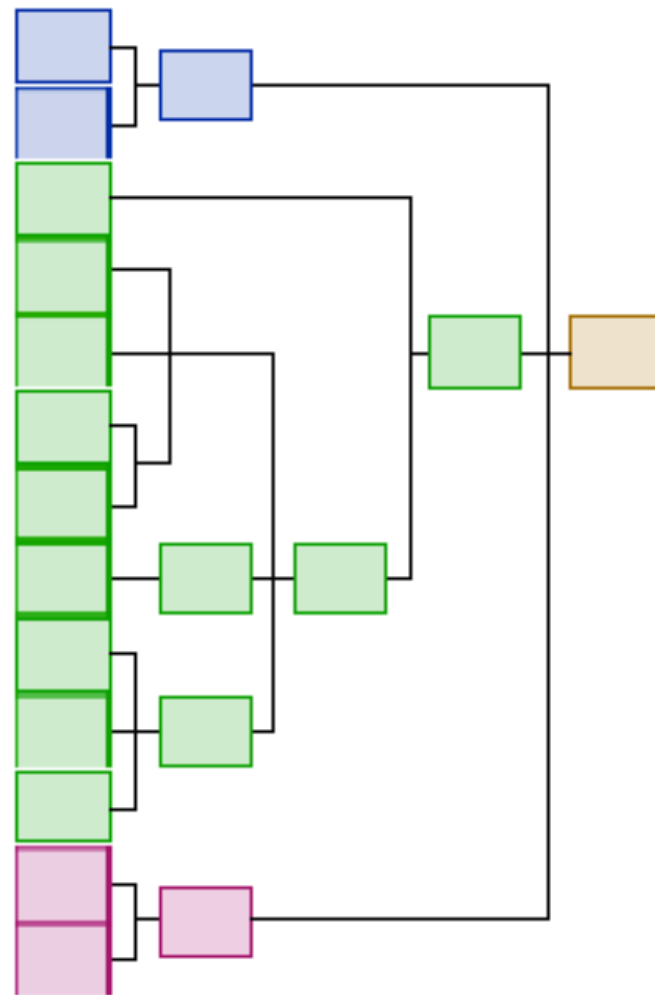
July 2011

Argumentation mining of legal cases

Legal field:

◦ Precedent reasoning

◦ Search for cases that use a similar type of reasoning, e.g., acceptance of rejection of a claim based on precedent cases

Argumentation mining:

◦ Needs detection of the argumentation structure and classification of its components

◦ Components or segments are connected with argumentative relationships

◦ Adds an additional dimension to argumentative zoning (i.e., classifying text fragments as being argumentative or not)

[Moens, Boiy, Mochales & Reed ICAIL 2007]

Figure 1.1: Reasoning structure of the legal case in Appendix A. Each block is a sentence of the legal case. There are 3 arguments (blue, green and red) that justify the final decision (brown). The contents of each argument and the final decision can be seen in detail in Figures 1.2, 1.3, 1.4 and 1.5

Argumentation structure of a case of the European Court of Human Rights

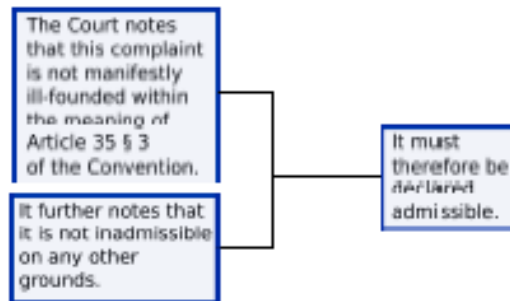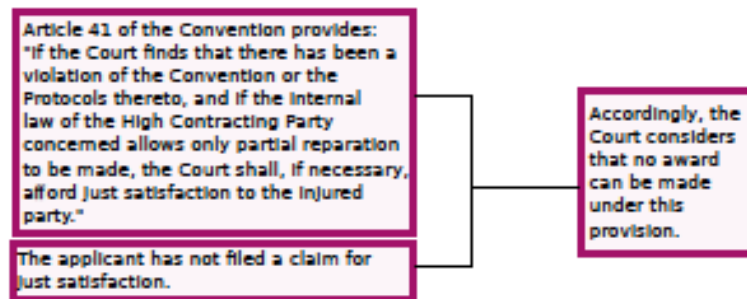[PhD thesis Raquel Mochales Palau 2011]

Figure 1.2: Closer view 1st Argument

Figure 1.3: Closer view 2nd Argument

Figure 1.4: Closer view Final Decision

[PhD thesis Raquel Mochales Palau 2011]

… as provided in Article 6 § 1 of the Convention, which reads as follows: In the determination of his civil rights and obligations......., everyone is entitled to afair... hearing within reasonable time... by(a)... tribunal"

The Court reiterates that the reasonableness of the length of proceedings must be assessed in the light of ...., particularly the complexity of the case, the conduct of the applicant and of the relevant authorities...

The Court considers that the present proceedings ...were not particularly complex.

As regards the conduct of the applicant ... applicants cannot be blamed for making full use of the remedies available to them ...

However, an applicant's behaviour ... whether or not the reasonable time referred to in Article 6 § 1 ...

In the present case, the Court acknowledges that the applicant had filed numerous requests, ...

On the other hand, the Court notes that there are substantial delays attributable to the authorities.

In particular, in the first set of proceedings, there is a period of inactivity of more than two years ...

In the second set of proceedings, there is a period of inactivity of some three years ...

Although such conduct contributed ...., it is not ... sufficient to explain the length of the extensive proceedings.

The Court cannot find that the Government has given sufficient explanation for these delays that occurred.

The Court therefore finds that the overall length of the proceedings cannot be regarded as "reasonable".

Accordingly, there has been a violation of Article 6 § 1 of the Convention.

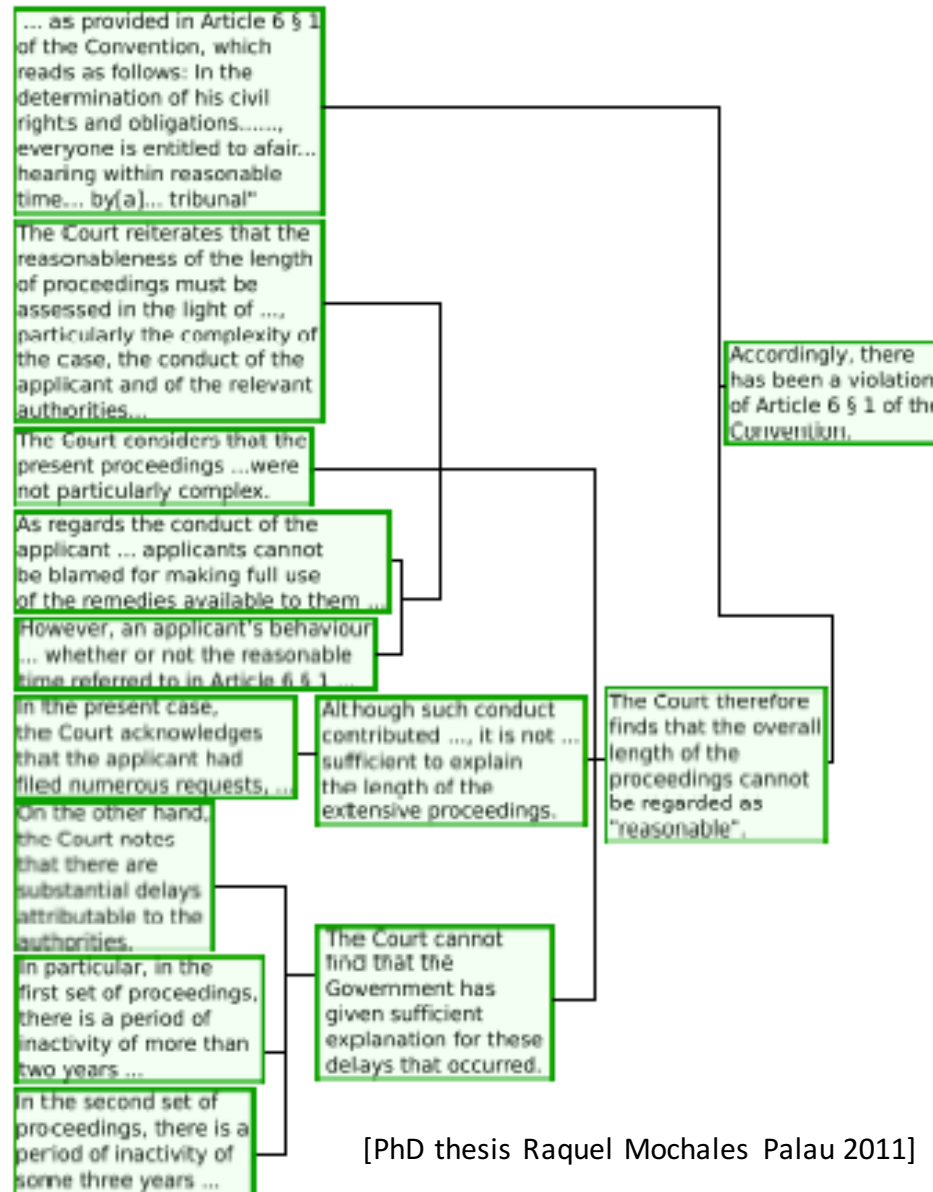[PhD thesis Raquel Mochales Palau 2011]

Figure 1.5: Closer view 3rd Argument

[PhD thesis of Raquel Mochales 2011]

- Argumentation: a process whereby arguments are constructed, exchanged and evaluated in light of their interactions with other arguments
- **Argument**: a set of **premises** - pieces of evidence - in support of a **claim**
- Claim: a proposition, put forward by somebody as true; the claim of an argument is normally called its conclusion
- Argumentation may also involve chains of reasoning, where claims are used as premises for deriving further claims

```
T
|--D
|  |--: For these reasons, the Commission by a majority declares the application admissible,
|         without prejudging the merits.
|--A
   |--A
   |  |--C
   |  |  |--: It follows that the application cannot be dismissed as manifestly ill-founded.
   |  |--A
   |     |--P
   |     |  |--: It considers that the applicant 's  complaints raise serious issues of fact
   |     |        and law under the convention, the determination of which should depend on
   |     |        an examination of the merits.
   |     |--P
   |        |--: The Commission has taken cognizance of the submissions of the parties.
   |--A
      |--C
      |  |--: In these circumstances, the Commission finds that the application cannot be
      |        declared inadmissible for non-exhaustion of domestic remedies.
      |--A
         |--P
         |  |--: The Commission recalls that article art. x of the convention only requires
         |        the exhaustion of such remedies which relate to the breaches of the
         |        convention alleged and at the same time can provide effective and sufficient
         |        redress.
         |--P
         |  |--: The Commission notes that in the context of the section powers the
         |        secretary of state has a very wide discretion.
         |--P
         |  |--: The Commission recalls that in the case of temple v. the united kingdom
         |        no. x dec. d.r. p.
         |--P
            |--: The Commission held that recourse to a purely discretionary power on
            |     the part of the secretary of state did not constitute an effective
            |     domestic remedy.
            |--: The Commission finds that the suggested application for discretionary
                  relief in the instant case cannot do so either.
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Fig. 6: Output of the automatic system: small fragment of the argumentation tree-structure of a document

[Mochales & Moens AI & Law 2011]

$$T \Rightarrow A^+ D$$
$$A \Rightarrow \{A^- C | A^* CnP^- | Cns | A^* sr_c C | P^-\}$$
$$D \Rightarrow r_c f \{v_c s | .\}^+$$
$$P \Rightarrow \{P_{verbP} | P_{art} | PP_{sup} | PP_{ag} | sP_{sup} | sP_{ag}\}$$
$$P_{verbP} = sv_p s$$
$$P_{art} = sr_{art} s$$
$$P_{sup} = \{r_s\}\{s | P_{verbP} | P_{art} | P_{sup} | P_{ag}\}$$
$$P_{ag} = \{r_a\}\{s | P_{verbP} | P_{art} | P_{sup} | P_{ag}\}$$
$$C = \{r_c | r_s\}\{s | P_{verbP} | C\}$$
$$C = s^* v_c s$$

Fig. 5: Context-free grammar used for argumentation structure detection and proposition classification

Experiments with decisions of the European Court of Human Rights (ECHR)

Table 9: Terminal and non-terminal symbols from the context-free grammar used in the argumentation structure detection

T	General argumentative structure of legal case.
A	Argumentative structure that leads to a final decision of the factfinder $A = \{a_1, ..., a_n\}$, each a_i is an argument from the argumentative structure.
D	The final decision of the factfinder $D = \{d_1, ..., d_n\}$, each d_i is a sentence of the final decision.
P	One or more premises $P = \{p_1, ..., p_n\}$, each p_i is a sentence classified as premise.
P_{ag}	Premise with at least one contrast rhetorical marker.
P_{art}	Premise with at least one article rhetorical marker.
P_{sup}	Premise with at least one support rhetorical marker.
P_{verbP}	Premise with at least one verb related to a premise.
C	Sentence with a conclusive meaning.
n	Sentence, clause or word that indicates one or more premises will follow.
s	Sentence, clause or word neither classified as a conclusion nor as a premise ($s! = \{C | P\}$).
r_c	Conclusive rhetorical marker (e.g. therefore, thus, ...).
r_s	Support rhetorical marker (e.g. moreover, furthermore, also, ...).
r_a	Contrast rhetorical marker (e.g. however, although, ...).
r_{art}	Article reference (e.g. terms of article, art. para. ...).
v_p	Verb related to a premise (e.g. note, recall, state,...).
v_c	Verb related to a conclusion (e.g. reject, dismiss, declare, ...).
f	The entity providing the argumentation (e.g. court, jury, commission, ...).

[Mochales & Moens AI & Law 2011]

Features of supervised classifier:
Clauses described by unigrams, bigrams, adverbs, legal keywords, word couples over adjacent clauses, ...

Table 7: Results from the classification of *Conclusions* in the ECHR

Classifier Combination	Precision	Recall	F-Measure
Max.Ent. and Support Vector Machine	77.49	60.88	74.07
Context-free Grammar	61.00	75.00	67.27

Table 8: Results from the classification of *Premises* in the ECHR

Classifier Combination	Precision	Recall	F-Measure
Maxt.Ent. and Support Vector Machine	70.19	66.16	68.12
Context-free Grammar	59.00	71.00	64.03

Context free grammar allows also to recognize the full argumentation structure: accuracy: 60%

[Mochales & Moens AI & Law 2011]

Argumentation mining

Argumentation mining needs a large amount of interrelated knowledge:

- Linguistic knowledge of the vocabulary, syntax and semantics of the language and the discourse
- Knowledge of possible argumentation structures
- Knowledge of the subject domains
- Background knowledge of the person who uses the texts at a certain moment in time

Focus on two problems

Argumentation mining : difficult task !

In what follows: focus on two problems and possible solutions:

- Learning models that recognize argumentation structures
- Learning representations that help detecting relationships between argumentation components

Learning models that recognize argumentation structures

Humans who recognize argumentation have some knowledge on what discourse structures to expect


[Toulmin 1958]
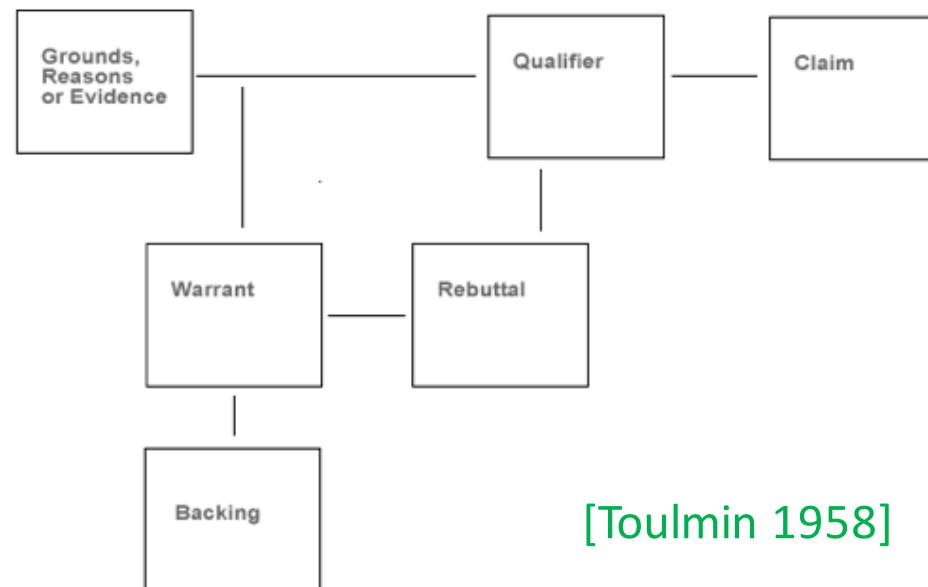
Other argumentation structures

Many different argumentation schemes/**structures** discussed in [Walton 1996]
Work of Prakken, Gordon, Bench-Capon, Atkinson, Wyner, Schneider, …
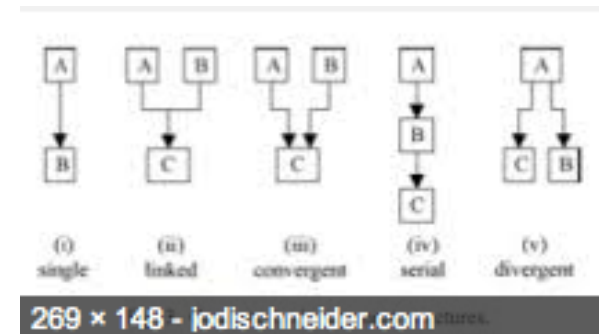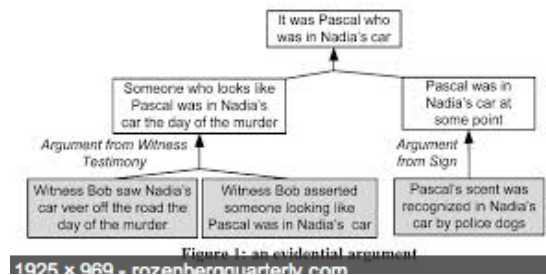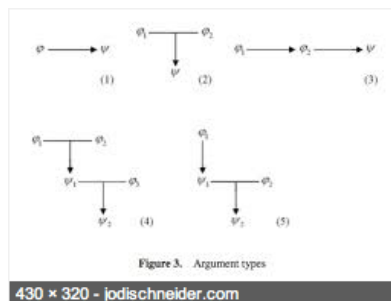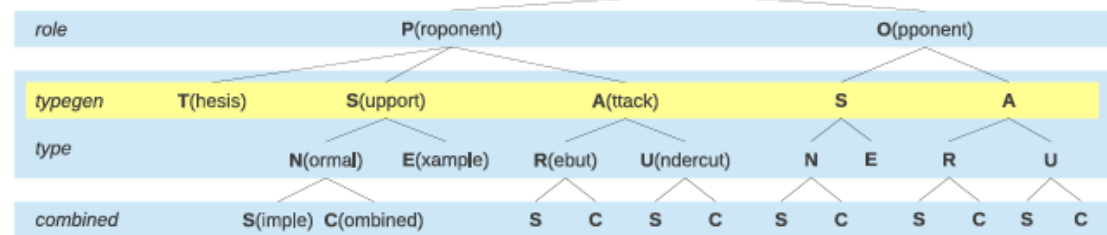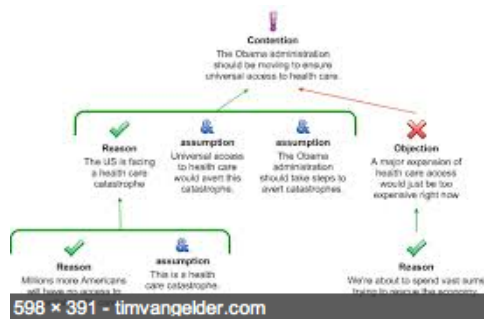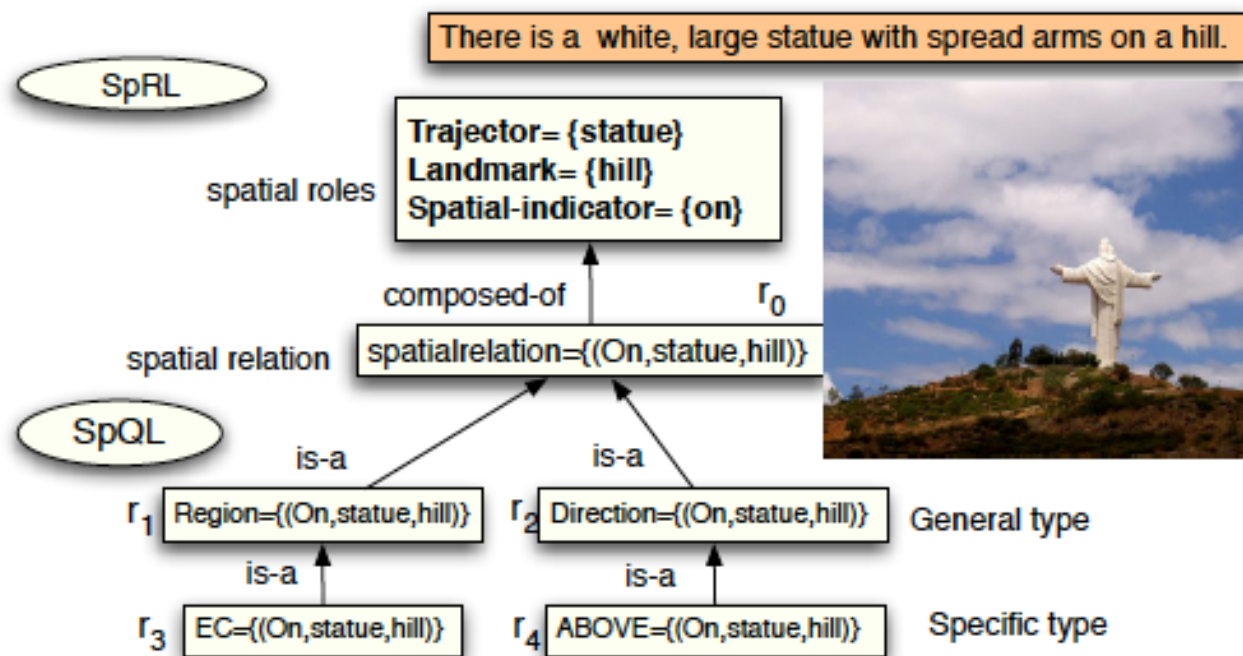
Structured machine learning

- Independent classifiers and combination of results (e.g., based on integer linear programming)

- Joint or global learning ≠ local learning of independent classifiers: joint training:
  - 1 classification model for the global structure
  - Output is = structure
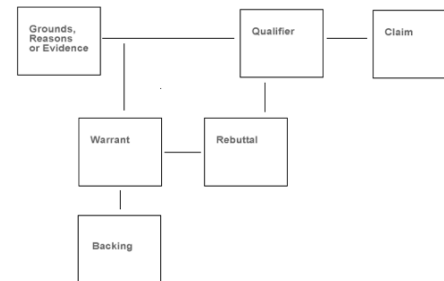
An example: spatial role labeling framework

[Kordjamshidi & Moens 2015]

Output
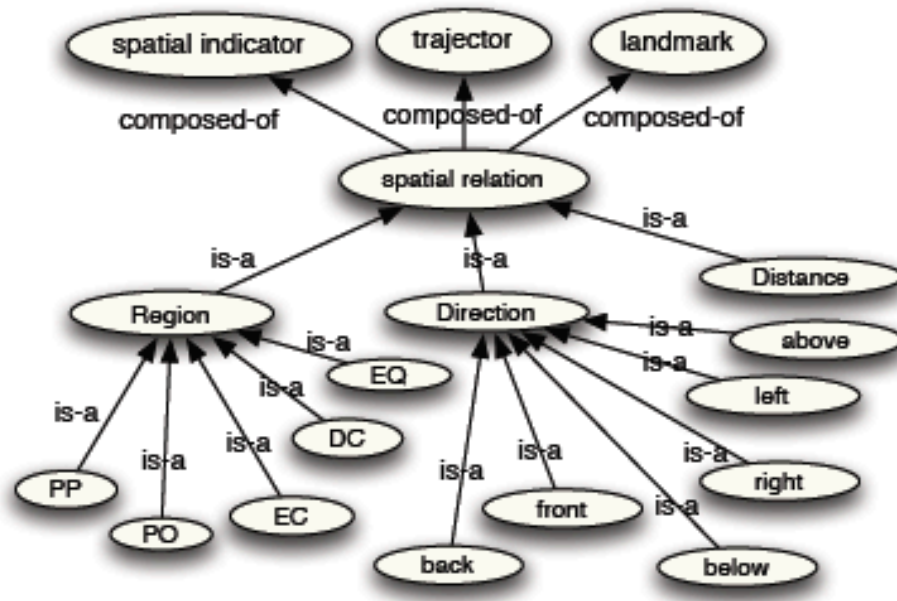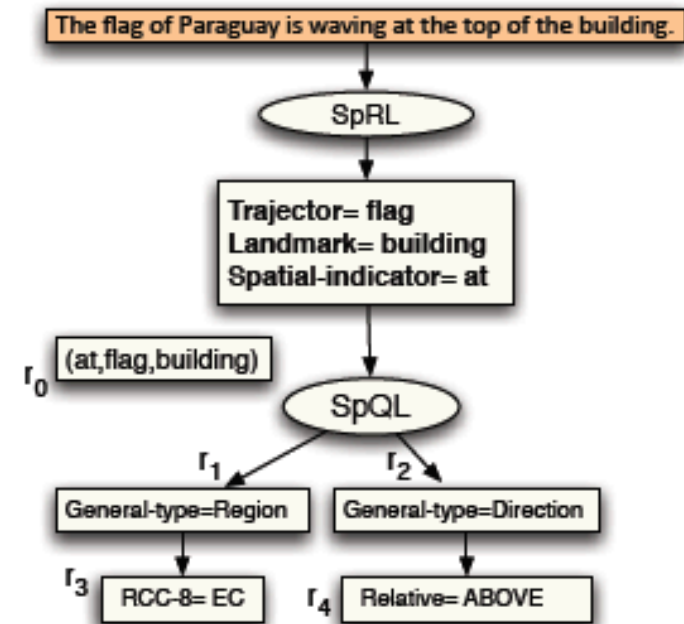
Output variables = labels in the structure

Figure 1. (a) The spatial ontology. (b) Example sentence and the recognized spatial concepts.

Learning models that recognize (argumentation) structures

Many possible approaches: e.g.,

- Conditional random fields: allow modeling dependencies between labels and relational constraints as features
- Structured SVM, structured perceptrons: allow relational constraints to be modeled as constraints in a cutting plane algorithm [Kordjamshidi & Moens 2015]

$$\forall k, \; tr_k + lm_k + nrol_k = 1$$
$$\forall i, j, \; loc_{ij} + nloc_{ij} = 1$$
$$\forall i, j, \; tr_i \geq loc_{ij}, \quad lm_j \geq loc_{ij}$$
$$\forall i, j, i', j' \; loc_{ij} \geq rr_{iji'j'}, \quad loc_{i'j'} \geq rr_{iji'j'}$$

See also ICML 2015 Tutorial on Advances in Structured Prediction by Hal Daumé III (University of Maryland) and John Langford (Microsoft Research)

Representation learning?

◦ Most difficult problem when detecting the argumentation structure:

  ◦ When are two text fragments related though an argumentation relationship, e.g., which premise/rebuttal belongs to which conclusion?

  ◦ Discourse markers might be ambiguous or missing

◦ **Learning better representations** that help detecting relationships between argumentation components?

Representation learning?

- ◦ When are two text fragments related though an argumentation relationship, e.g., which premise/rebuttal belongs to which conclusion?

- ◦ Often entails world knowledge or domain specific knowledge

- ◦ **Can we automatically learn better representations** that help detecting relationships between argumentation components?

National Rejectors Inc., v. Trieman

…

In 1957, National employees , defendants Trieman and Melvin started their own business for producing coin-handling devices, Melvin, working at his home, designed two rejectors that were as close as possible to the comparable National rejectors. He combined his knowledge of the National device with information obtained from measuring National rejectors. He also used production drawings, a few parts, and material obtained without consent from National.

…

Representation learning?

- [Boltužic & Šnajder 2015] recognize arguments in online discussions: e.g., entailment features (FE): from pretrained entailment decision algorithms (which a.o. use WordNet, VerbOcean); semantic text similarity features (STS), …
- Possibility of deep learning approaches, new models of compositionality?

Argumentation mining

Open field, awaiting research …

Main references

Boltužic, F. & Šnajder, J. (2015). Identifying prominent arguments in online debates using semantic textual similarity. In *Proceedings Second Workshop on Argumentation Mining at NAACL 2015*.

Kordjamshidi, P. & Moens, M.-F. (2015). Global machine learning for ontology population. *Journal of Web Semantics,* 30, 3-21.

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