Argumentation Mining : The Detection, Classification and Structuring of Arguments in Text

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Abstract

The full version of this paper is published in the *Proceedings of the 12th International Conference on Artificial Intelligence and Law (ICAIL'09), ACM press*, where it received the Donald H. Berman award for best student paper.

1 Argumentation Mining

The aim of argumentation mining is to detect the argumentation in a text document. This implies the detection of all the arguments involved in the argumentation process, their individual or local structure, i.e. rhetorical or argumentative relationships between their propositions, and the interactions between them, i.e. the global argumentation structure.

There are questions that need to be answered when dealing with argumentation mining. What is the "correct" abstract structure of argumentation? Should we represent argumentation as a tree-structure or is it better to use a graph-structure? What are the constraints that characterize this structure? What are the elementary units of argumentation? And of an individual argument? What are the relations that hold between two arguments and/or argumentation units? Are they grounded into the events and the world that the text describes, or into general principles of rhetoric and linguistics? Can the units of argumentation and/or arguments be determined automatically? Can argumentation structures be determined automatically?

Our paper answers most of these questions. After the analysis of different studies we agree with the majority that the elementary units of argumentation are arguments, which are formed by premises and one conclusion. We define the structures between arguments following [1], which allows to see argumentation as a tree-structure, instead of a more complex graph-structure. Concerning the relations between the premises and the conclusion we agree with the work on argumentation schemes by [2].

Furthermore, to prove the validity of our statements we propose methods to automatically detect argumentation, recognize its structure and classify its components. These methods, which are reported in our paper, are shortly described below.

1.1 Argumentation Detection

The detection of all the arguments presented in free text is similar to the binary classification of all the propositions of the text as argumentative or non-argumentative. If each proposition of the text can be classified as being part of the argumentation or not, then all units classified as argumentative constitute together all the arguments of the text. However, this approach presents a limitation, as the delimiters of each argument are not defined. Using different classification methods, such as naïve Bayes, and common linguistic features, such as rhetorical markers, punctuation marks or verbs, we obtain nearly 73% accuracy when detecting arguments in a general corpus. When using a domain specific corpus, i.e. a legal corpus, the accuracy increases to 80%. The argument segments can be then found using different methods. First, if we assume that an argument can not expand between sections or sub-sections, the structure of the document can determine some argument limits. However, this method works only in documents with a clear structure. A second method is to use semantic metrics that measure the semantic similarity between the different argument propositions. However, this method must deal with ambiguity, coreference and pronoun resolution.

1.2 Argumentation Proposition Classification

The classification of propositions by their argumentative role can be divided in two steps. In a firt step, where propositions are classified as being argumentative or not, which can be performed with a logistic regression classifier using general linguistic features. In a second step, where a support vector machine classifies each argumentative proposition found into a premise or conclusion. Here, the use of more sofisticated features, e.g. type of main verb, local context, article reference or argumentative rhetorical patterns is required. Our best results for the classification into premise and conclusion achieve a 68.12% and 74.07% F_1-measure respectively.

1.3 Argumentation Structuring

To determine argumentation structures we study the possibility of argumentative parsing. There exist different parsing approaches: rule-based (hand-crafted, transformation-based learning) or statistical (Hidden Markov Model, multinomial logistic regression, memory-based, decision tree, neural network, linear models), but for the time being we focus on parsing the texts by means of manually derived rules that are grouped into a context-free grammar (CFG). Using information extracted from ten legal documents we define a context-free grammar (Figure 1). We focus on common expressions encountered in the legal documents, such as *"For these reasons"*, *"in the light of all the material"* or *"see mutatis mutandis"*, and rhetorical markers, such as *"However"* or *"Furthermore"*. These common expressions allow drawing up rules such as: $\forall_x[\mathit{isPremise}(x_i) \wedge \mathit{startsHowever}(x_{i+1}) \rightarrow \mathit{isPremise}(x_{i+1})]$. We implement the grammar using java and JSCC[1], obtaining around 60% accuracy in argumentation structure detection, while maintaining around 70% F_1-measure for recognizing premises and conclusions. These results suggest that argumentative parsing is a valid and feasible method to solve the problems of argumentation mining, i.e. detection, classification and structuring of argumentation. Therefore, it is worth studying if other parsing approaches, e.g. based on hand-crafted patterns or machine learning techniques, could improve our results.

$$T \Rightarrow A^+D$$
$$A \Rightarrow \{A^+C|A^*CnP^+|Cns|A^*sr_cC|P^+\}$$
$$D \Rightarrow r_cf\{v_cs|.\}^+$$
$$P \Rightarrow \{P_{verbP}|P_{art}|PP_{sup}|PP_{ag}|sP_{sup}|sP_{ag}\}$$
$$P_{verbP} = sv_ps$$
$$P_{art} = sr_{art}s$$
$$P_{sup} = \{r_s\}\{s|P_{verbP}|P_{art}|P_{sup}|P_{ag}\}$$
$$P_{ag} = \{r_a\}\{s|P_{verbP}|P_{art}|P_{sup}|P_{ag}\}$$
$$C = \{r_c|r_s\}\{s|C|r_cP_{verbP}\}$$
$$C = s^*v_cs$$

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.
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, ...).

Figure 1: Context-free grammar used for argumentation structure detection and proposition classification

References

[1] F. H. Van Eemeren and Grootendorst. *A Systematic Theory of Argumentation. The pragma-dialectic approach*. Cambridge University Press, 2004.

[2] D. N. Walton. *The new dialectic, Conversational contexts of argument*. University of Toronto Press, 1998.

[1] http://jscc.jmksf.com/