Title : **Cross-Domain Mining of Argumentative Text through Distant Supervision**
Writer : **Khalid Al-Khatib, HenningWachsmuth,Matthias Hagen, Jonas Köhler, Benno Stein**
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Anika Tasnim Preoty (160041044)

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Note: Distant Supervision : The basic idea of distant supervision is to generate annotations by automatically mapping unlabeled source data to a set of predefined class labels. This requires resources that are related to the given task as well as effective heuristic labeling functions

At a Glance : Argumentation mining is considered as a key technology for future search engines and automated decision making. In such applications, argumentative text segments have to be mined from large and diverse document collections. However, most existing argumentation mining approaches tackle the classification of argumentativeness only for a few manually annotated documents from narrow domains and registers. This limits their practical applicability. We hence propose a distant supervision approach that acquires argumentative text segments automatically from online debate portals.

Argumentation mining usually consists of solving three tasks for each document:

- (1) Identifying all argumentative text segments in the document,
- (2) classifying the type of each segment
- (3) classifying relations between the segments.

The following two key issues arise.

- 1) Existing approaches to classifying argumentativeness usually focus on specific text domains(e.g., education) and registers (e.g., student Essays)
- 2) All major existing approaches follow a supervised learning scheme based on manual annotation of argumentative text segments. However, the annotation of arguments is particularly intricate and thus expensive due to the complex linguistic structure and the partly subjective interpretation of argumentativeness. Different types of argumentative and non-argumentative segments may come in any order, segment boundaries are not always unambiguous, and parts of an argument may be implicit.

Proposal: distant Supervision

The idea of distant supervision to construct a large-scale corpus of text segments from diverse domains and registers annotated with respect to argumentativeness. Distant supervision is a well-known idea for training robust statistical classifiers. Here, we exploit online debate portals that (1) contain argumentative and non-argumentative text segments for several controversial topics, and that (2) are organized in a semi-structured form, allowing to derive annotations from it.

Mining Argumentative Text through Distant Supervision

Goal: classifier that can robustly mine argumentative texts across domains. More precisely, we focus on the task of classifying each segment of a text as being argumentative or not.

Our approach consists of three high-level building blocks:

- (1) Mapping functions that allows an automatic acquisition of argumentativeness annotations from debate portals
- (2) A corpus with argumentative and non-argumentative text segments created using the functions.
- (3) A classifier that can distinguish the two classes of text segments. All building blocks are detailed in the following. Figure 1 depicts an overview of the approach.

Mapping Function

For distant supervision technique we need aa large source of data and its metadata. Online debate portals serve as a rich source of argumentative texts on diverse topics. Thus, mapping text segments from debate portals to classes for argumentation mining is a promising instance of distant supervision

A Classifier for Argumentativeness

User supervised machine learning technique to train classifer based on Stab and Gurevych (2014a), Palau and Moens (2009), and Habernal and Gurevych (2015)

- **Token n-grams:** Unigrams, bigrams, and trigrams as Boolean features. In general, n-grams are themost powerful feature type in many related text classification problems (e.g., sentiment analysis).
- **Discourse markers:** Features that represent the existence of words such as “because”, which are frequently used in argumentative texts.
- **Syntax**: This feature category contains the number of sub-clauses and production rules.
  - Number of sub-clauses: Counter for the number of SBAR tags in the constituency parse tree of a text segment, referring to subordinate clauses in the Penn treebank syntactic tagset.

  - Production rules: Boolean features capturing the specific production rules extracted from the constituency parse tree

- **Part of speech:** Features that capture information related to the parts of speech in a text segment:

  - Verbs: A Boolean feature capturing whether a segment contains a verb. Verbs such as "believe" strongly indicate of argumentative text.
  - Adverbs: A Boolean feature capturing whether a segment contains an adverb. Many adverbs such as "personally" can play a role in identifying argumentative text.
  - Modals: A Boolean feature capturing whether a segment contains a modal verb. Modal verbs such as "should" can be important for argumentativeness.
  - Verb tense: Boolean features capturing whether a segment contains a past or present tense verb.
  - First person pronouns: Pronouns such as "I" and "myself" can be good indicators of claims, a major component of argumentative texts.

Using these features, we train a binary statistical classifier for argumentativeness. Given a set of text segments, the classifier decides for each text segment whether it is argumentative or not. Following Stab and Gurevych (2014b), we consider all sentences that do not have an annotation as being non-argumentative, and the annotated segments as argumentative.

Results :

In domain: N-grams denote the most effective single feature type on the Essays corpus and on the Webis-Debate-16 corpus, while the syntax features outperform the n-grams on the Web discourse corpus. On the Essays and on the Webis-Debate-16 corpus, the syntax features are sometimes better and sometimes worse than the part of speech features. The discourse markers are the least effective single feature type, largely failing on all test sets, especially in terms of F1-score.

Cross domain: obtained cross-domain effectiveness values are lower than the in-domain values in most cases. For testing on the Web discourse corpus, training on the Webis-Debate-16 corpus using the full features gives the best cross-domain performance. For testing on the Webis-Debate-16 corpus, training on the Web discourse corpus using the n-gram feature type achieves the best cross-domain performanc

Conclusion:

Finally, we observe that the n-grams feature type turns out to be the most domain-dependent in our evaluation. In contrast, both the syntax and the part of speech features appear quite robust across domains. The performance of the discourse markers greatly depends on how frequent they are used in the target domain and register

From Argumentativeness to Relevance:

A retrieval system for arguments not only requires the identification and classification of argumentative text segments. A successful future search engine taking argument 1402 features into account additionally needs a way of ranking arguments according to their relevance. In this regard, we propose a "PageRank for arguments" based on the link network of support and attack relations between arguments.

In particular, given robust algorithms to identify arguments and their relations across web pages (e.g., via distant supervision), we could build an argument graph for the web.