# DISPUTool 2.0: A Modular Architecture for Multi-Layer Argumentative Analysis of Political Debates

**Pierpaolo Goffredo[1], Elena Cabrio[1], Serena Villata[1], Shohreh Haddadan[2], Jhonatan Torres Sanchez[3]**

[1] Université Côte d'Azur, CNRS, Inria, I3S, France
[2] Zortify, Luxembourg
[3] Université Côte d'Azur, 3IA Techpool, France
goffredo@i3s.unice.fr, elena.cabrio@univ-cotedazur.fr, serena.villata@univ-cotedazur.fr, shohreh.haddadan@gmail.com, Jhonatan.Torres-Sanchez@univ-cotedazur.fr

**Abstract**

Political debates are one of the most salient moments of an election campaign, where candidates are challenged to discuss the main contemporary and historical issues in a country. These debates represent a natural ground for argumentative analysis, which has always been employed to investigate political discourse structure and strategy in philosophy and linguistics. In this paper, we present DISPUTool 2.0, an automated tool which relies on Argument Mining methods to analyse the political debates from the US presidential campaigns to extract argument components (i.e., premise and claim) and relations (i.e., support and attack), and highlight fallacious arguments. DISPUTool 2.0 allows also for the automatic analysis of a piece of a debate proposed by the user to identify and classify the arguments contained in the text. A REST API is provided to exploit the tool's functionalities.

## Introduction

Argumentation in political context has been studied since antiquity, and it still raises a continuous inquiry given the challenging topic (Mohammed and Lewinski 2013). The design of Digital Humanities frameworks to support historians and social scientists in their investigation of political discourse through (semi-)automatic approaches to identify, classify and analyse such a kind of textual content is a key test-bed for Artificial Intelligence and Natural Language Processing (NLP) methods.

The issue of analyzing argument structures through NLP methods led to a new research field called Argument(-ation) Mining (AM) (Cabrio and Villata 2018; Lawrence and Reed 2019). AM deals with the ability of identifying argumentative components (e.g., premise, claim, warrant, backing) and predicting their relations (e.g., attack, support, undercut, rebut) in texts to analyze argumentation in various domains.

In this paper, we present a new version of DISPUTool, a web tool conceived to support humanities scholars in the exploration and evaluation of textual political debates in English (Haddadan, Cabrio, and Villata 2019). To the best of our knowledge, DISIPUTool 2.0 is the only automated tool which allows to automatically identify and classify argumentative components (i.e., premise and claim) and relations (i.e., attack and support) from the transcripts of political debates in English through AM methods. Despite the plethora of existing AM approaches and annotated corpora, very few of them apply AM to political text, and none of them addresses the issue of mining full argument structures from such texts, supporting *intelligent* data exploration, as in DISPUTool 2.0. More precisely, (Menini et al. 2018) predict relations but in a different setup (i.e., speeches in monological form). (Lippi and Torroni 2016) and (Naderi and Hirst 2015) focus on predicting argument relations only. (Duthie and Budzynska 2018) apply methods to mine ethos arguments from UK parliamentary debates, and (Visser et al. 2020) present a corpus from the political scenario annotated with the Inference Anchoring Theory (Budzynska and Reed 2011), to extract propositional structures anchored on the speakers' locutions.



## DISPUTool 2.0 Main Functionalities

DISPUTool 2.0 allows exploring the official transcripts of the televised presidential debates in the US from 1960 until 2016, from the website of the Commission on Presidential Debates (CPD)[1]. It gives also tho possibility to automatically analyze political debates from the argumentative point of view, trained on the official transcripts of these debates. More specifically, the functionalities of DISPUTool are the followings:

**US Presidential Debate Argumentative Analysis.** It is possible to explore the corpus made of 39 US presidential debates annotated with argumentative components and relations. When the user selects one of the debates, three argumentative elements are shown: *i)* the argumentative components are highlighted in the textual arguments put forward by each candidate, and a label 'claim' or 'premise' is associated to these pieces of text (as in DISPUTool 1.0); *ii)* the relations holding between the identified components are identified and labeled to indicate whether it is a support or an attack relation, and *iii)* fallacious arguments are highlighted in the text and associated to one of the following 6 classes of fallacies: *ad hominem*, *appeal to authority*, *appeal to emotion*, *false cause*, *slogan*, *slippery slope* (Goffredo et al. 2022). The last two points are peculiar of DISPUTool 2.0.

[1] www.debates.org

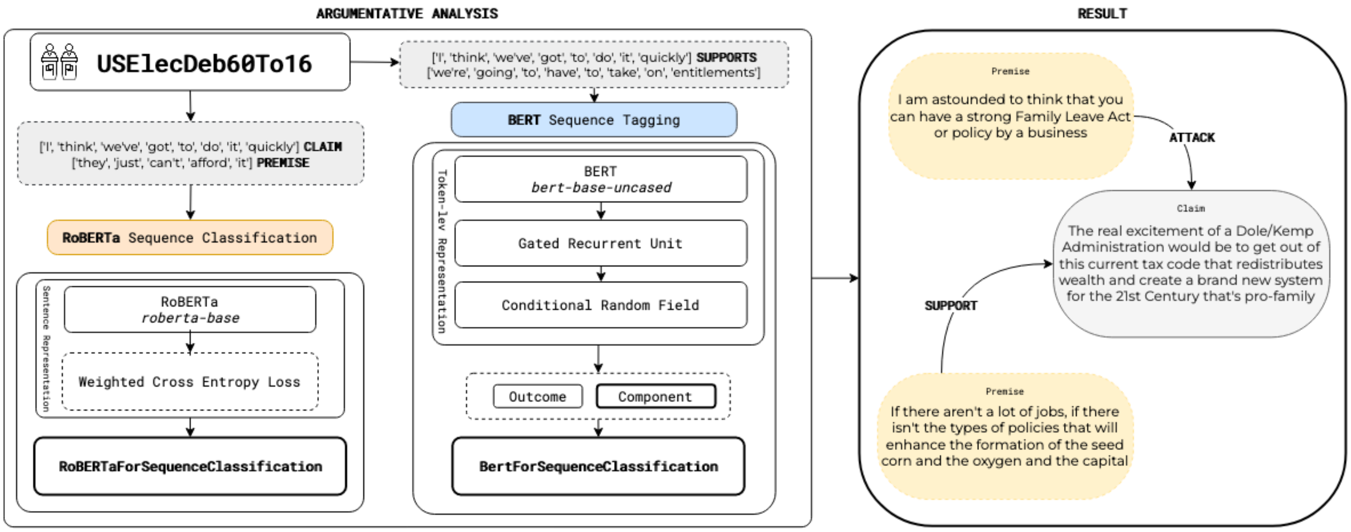


Figure 1: DISPUTool 2.0 new pipeline based on transformer models.

**Analyze Your Debate.** The tool offers the user the possibility to paste a political debate in English to identify and classify the argumentative components and relations (new from version 2.0) present in the text. The output consists of the components associated to a label 'premise' or 'claim', and a tabular view of the relations of support and attack holding between the identified components.

**Named Entity Recognition for Political Debates.** The user can search for the Named Entities (NEs) the system identifies, using the Stanford Named Entity Recognizer[2] with the possibility to filter the results based on the type of NE (e.g., religion, location, organization, nationality, and person), on the year of the debate, and on the speaker.

## Experimental Setting and Results

DISPUTool is trained on the ElecDeb60To16 dataset[3]. The overall new architecture of DISPUTool 2.0[4] is visualized in Figure 1.

**Argument Component Detection.** For the argumentative analysis, we adopt the architecture of (Mayer, Cabrio, and Villata 2020). We cast the argument component detection task as a sequence tagging problem, using the BIO-tagging scheme for the pre-trained bidirectional transformer language model (Mayer et al. 2021). Thus, the token-level representation of contextualized sentences is computed by the BERT base model (Devlin et al. 2018), fine-tuned during 15 epochs with an Adam optimizer, a learning rate of 6e-5 and a maximum sentence length of 64. The sentence representation is passed into a Recurrent Neural Network, i.e., a Gated Recurrent Unit (GRU (Cho et al. 2014)) and then into a Conditional Random Field (CRF (Lafferty, McCallum, and Pereira 2001)). The dataset splits are 80% for the train set, and 10% for the validation and test set, respectively. The obtained f1-score on the test set is 0.79.

**Relation Prediction.** For the relation prediction task, the sequence classification problem jointly models the relations by classifying all the argumentative component combinations using a bidirectional transformer architecture. Thus, the linear layer with a softmax manages this new representation which allows classifying the identified relations into three target classes (i.e., *Support*, *Attack* and *NoRelation*). The base model used with pre-trained weights for the sentence representation is RoBERTa (Liu et al. 2019), then fine-tuned with a learning rate of 6e-5, batch size of 8, maximum sentence length of 64 sub-words tokens per input example during 15 epochs. We take into consideration the weight factor of the 3 classes[5] in the weighted Cross Entropy Loss, normalizing the number of training samples of this class. These settings achieve a macro f1-score of 0.60 on the test set.

**DISPUTool 2.0 API** To foster versatility and re-usability, we also enhance DISPUTool 2.0 such that each of the processing step (e.g., argument component detection and relation prediction) can be executed as independent units via our public available REST API.

## Concluding Remarks

In this paper, we presented DISPUTool 2.0, a tool which allows to automatically analyse political debates from the argumentation perspective (components, relations, and fallacies). In addition to the visual exploration of the training dataset of US presidential debates, DISPUTool allows the user to analyse her own political debate to identify the underlying argumentative structure.

[2]https://nlp.stanford.edu/software/CRF-NER.html

[3]https://github.com/pierpaologoffredo/disputool2.0/tree/main/Dataset/ElecDeb60To16

[4]https://3ia-demos.inria.fr/disputool/

[5]Due to an high level of unbalancing, we also undersampled the most represented label, i.e., *NoRelation*.

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## References


Budzynska, K.; and Reed, C. 2011. Whence inference. Technical report, University of Dundee.

Cabrio, E.; and Villata, S. 2018. Five Years of Argument Mining: a Data-driven Analysis. In *Proceedings of the Twenty-Seventh International Joint Conference on Artificial Intelligence (IJCAI 2018)*, 5427–5433.

Cho, K.; Van Merriënboer, B.; Gulcehre, C.; Bahdanau, D.; Bougares, F.; Schwenk, H.; and Bengio, Y. 2014. Learning phrase representations using RNN encoder-decoder for statistical machine translation. *arXiv preprint arXiv:1406.1078*.

Devlin, J.; Chang, M.-W.; Lee, K.; and Toutanova, K. 2018. Bert: Pre-training of deep bidirectional transformers for language understanding. *arXiv preprint arXiv:1810.04805*.

Duthie, R.; and Budzynska, K. 2018. A Deep Modular RNN Approach for Ethos Mining. In *Proceedings of the Twenty-Seventh International Joint Conference on Artificial Intelligence (IJCAI 2018)*, 4041–4047.

Goffredo, P.; Haddadan, S.; Vorakitphan, V.; Cabrio, E.; and Villata, S. 2022. Fallacious Argument Classification in Political Debates. In Raedt, L. D., ed., *Proceedings of the Thirty-First International Joint Conference on Artificial Intelligence (IJCAI 2022)*, 4143–4149. ijcai.org.

Haddadan, S.; Cabrio, E.; and Villata, S. 2019. DISPUTool–A tool for the Argumentative Analysis of Political Debates. In *Proceedings of the 28th International Joint Conference on Artificial Intelligence (IJCAI 2019)*, 6524–6526. International Joint Conferences on Artificial Intelligence Organization.

Lafferty, J.; McCallum, A.; and Pereira, F. C. 2001. Conditional random fields: Probabilistic models for segmenting and labeling sequence data. In *Proceedings of the Eighteenth International Conference on Machine Learning (ICML 2001)*.

Lawrence, J.; and Reed, C. 2019. Argument Mining: A Survey. *Comput. Linguistics*, 45(4): 765–818.

Lippi, M.; and Torroni, P. 2016. Argument mining from speech: Detecting claims in political debates. In *Proceedings of the AAAI Conference on Artificial Intelligence (AAAI 2016)*, volume 30.

Liu, Y.; Ott, M.; Goyal, N.; Du, J.; Joshi, M.; Chen, D.; Levy, O.; Lewis, M.; Zettlemoyer, L.; and Stoyanov, V. 2019. Roberta: A robustly optimized bert pretraining approach. *arXiv preprint arXiv:1907.11692*.

Mayer, T.; Cabrio, E.; and Villata, S. 2020. Transformer-based argument mining for healthcare applications. In *Proceedings of the 24th European Conference on Artificial Intelligenc (ECAI 2020)*, 2108–2115. IOS Press.

Mayer, T.; Marro, S.; Cabrio, E.; and Villata, S. 2021. Enhancing evidence-based medicine with natural language argumentative analysis of clinical trials. *Artificial Intelligence in Medicine*, 118: 102098.

Menini, S.; Cabrio, E.; Tonelli, S.; and Villata, S. 2018. Never Retreat, Never Retract: Argumentation Analysis for Political Speeches. In *Proceedings of the Thirty-Second AAAI Conference on Artificial Intelligence (AAAI 2018)*, 4889–4896.

Mohammed, D.; and Lewinski, M. 2013. Argumentation in political deliberation. *Journal of Argumentation in Context*, 2(NA): 1–9.

Naderi, N.; and Hirst, G. 2015. Argumentation mining in parliamentary discourse. In *Principles and practice of multi-agent systems*, 16–25. Springer.

Visser, J.; Konat, B.; Duthie, R.; Koszowy, M.; Budzynska, K.; and Reed, C. 2020. Argumentation in the 2016 US presidential elections: annotated corpora of television debates and social media reaction. *Lang. Resour. Evaluation*, 54(1): 123–154.