# Deciding the Winner of a Debate Using Bipolar Argumentation

Demonstration

Amin Karamlou
Imperial College London
London, United Kingdom
mak514@imperial.ac.uk

Kristijonas Čyras
Imperial College London
London, United Kingdom
k.cyras@imperial.ac.uk

Francesca Toni
Imperial College London
London, United Kingdom
f.toni@imperial.ac.uk

## ABSTRACT

Bipolar Argumentation Frameworks (BAFs) are an important class of argumentation frameworks useful for capturing, reasoning with, and deriving conclusions from debates. They have the potential to make solid contributions to real-world multi-agent systems and human-agent interaction in domains such as legal reasoning, healthcare and politics. Despite this fact, practical systems implementing BAFs are largely lacking. In this demonstration, we provide a software system implementing novel algorithms for calculating extensions (winning sets of arguments) of BAFs. Participants in the demonstration will be able to input their own debates into our system, and watch a graphical representation of the algorithms as they process information and decide which sets of arguments are winners of the debate.

## KEYWORDS

Argumentation; Structured Argumentation; Bipolar Argumentation

**ACM Reference Format:**
Amin Karamlou, Kristijonas Čyras, and Francesca Toni. 2019. Deciding the Winner of a Debate Using Bipolar Argumentation. In *Proc. of the 18th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2019), Montreal, Canada, May 13–17, 2019,* IFAAMAS, 3 pages.

## 1 INTRODUCTION

In recent years many software solutions for reasoning with argumentation frameworks have been created (see [2] for a survey). Almost all of these tools focus exclusively on reasoning using Abstract Argumentation Frameworks (AFs) [5]. An AF is a directed graph, where the nodes are arguments and edges represent attacks between the arguments. A shortcoming of AFs (and existing argumentation software) is that they have no way of directly representing a support relationship between arguments.

Bipolar Argumentation Frameworks (BAFs) (e.g. [1, 3]) are a family of frameworks which take support, in addition to attacks between arguments into account. Similarly to AFs, they can be represented as directed graphs where the nodes represent arguments. These graphs have two different types of edges, one representing attacks and another representing support. Admittance of different interpretations of support and divergent semantics has arguably impinged the practical deployment of systems using BAFs for reasoning.

Bipolar Assumption-based Argumentation (bipolar ABA) frameworks have recently been shown to subsume various BAFs under different interpretations of support [4]. This development has allowed for the consolidation of the theoretical foundations of bipolar argumentation, and as a result novel labelling based algorithms for enumerating extensions of various BAFs have recently been proposed in [6]. This demonstration focuses on a software system implementing these algorithms.

## 2 SYSTEM DESCRIPTION

Our system is written in Python. It can easily be installed and used as a CLI tool via the pip package management system. The source code for the system is available at www.github.com/AminKaram/FYP.

We now look at the control flow of our system. We describe what happens from when the user inputs an argumentation framework to the system until the extensions are outputted by the system.

(1) **Input argumentation framework.** The user inputs an argumentation framework to the system and specifies which semantics they would like the system to calculate extensions under (admissible, preferred or stable/set-stable). The argumentation framework must be an AF, BAF (necessary), BAF (deductive) or bipolar ABA framework.
(2) **Parse argumentation framework.** The system parses the input and generates an internal representation of the input framework.
(3) **Perform standard mapping.** If the input framework is not a bipolar ABA framework, then an appropriate mapping is used in order to transform it into a bipolar ABA framework. Recall that these mappings preserve the extensions of the frameworks.
(4) **Perform labelling algorithms.** The bipolar ABA framework is inputted to the appropriate labelling algorithm defined in [6], which are used to calculate extensions.
(5) **Output Extensions.** Our system terminates after outputting the extensions calculated by the labelling algorithms.

## 3 EXAMPLE APPLICATIONS

We now briefly describe two application areas in which our system can be useful.

*Deciding the winner of a presidential debate.* A natural use case for bipolar argumentation systems is to decide the winner of a debate. To this end, we have used our tool to analyse a recently published corpus of arguments from the 1960 US presidential debate between John F. Kennedy and Richard Nixon. The corpus is taken from [7].

The dataset consists of 1462 pairs of arguments, which are statements made by either John F. Kennedy or Richard Nixon, during

*This article complements the AAMAS 2019 publication [6].

*Proc. of the 18th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2019), N. Agmon, M. E. Taylor, E. Elkind, M. Veloso (eds.), May 13–17, 2019, Montreal, Canada*. 

the televised presidential debates. Each pair of arguments is annotated to say whether the first argument 'attacks', 'supports' or has 'no_relation' with the second argument. For example, the first argument in Example 3.1 was annotated as attacking the second argument. The dataset splits the arguments by topic. This topic is one of *Cuba*, *Disarmament*, *Medical care*, *Minimum Wage*, *Unemployment*.

*Example 3.1.* (Taken from [7]).

***Nixon:*** *And here you get the basic economic principles. If you raise the minimum wage, in my opinion - and all the experts confirm this that I have talked to in the Government above $1.15, it would mean unemployment; unemployment, because there are many industries that could not pay more than $1.15 without cutting down their work force. $1.15 can be absorbed, and then at a later time we could move to $1.25 as the economy moves up.*

***Kennedy:*** *The fact of the matter is that Mr. Nixon leads a party which has opposed progress for 25 years, and he is a representative of it. He leads a party which in 1935 voted 90 percent against a 25-cent minimum wage. He leads a party which voted 90 percent in 1960 against $1.25 an hour minimum wage.*

We analysed this dataset as follows. First, we wrote a script which generates five BAFs (one for each topic) from the argument pairs which are annotated with 'attack' or 'support' (we ignore the no_relation pairs). We then inputted these frameworks to our system's CLI tool and generated the extensions of each framework. Both the script and the generated argumentation frameworks are available in our projects GitHub repository.

Our system was able to generate the extensions of all five frameworks very quickly. In the longest case, this process took 0.25 seconds. This is a good indication that our system is capable of handling argumentation frameworks created from real discussions.

*Building a Clinical Decision Support System.* The authors of this work are currently researchers on the ROAD2H (Resource Optimisation, Argumentation, Decision support and knowledge transfer to create value via learning Health systems) project,[1] an international research collaboration between computer scientists, healthcare professionals and policymakers which aims to design a Learning Health System (LHS) that take steps towards achieving Universal Health Coverage in low and middle income countries.

As part of ROAD2H we are creating a medical decision support system that combines data from medical guidelines with patient-specific information (e.g. drug history, blood pressure level) in order to suggest actions that should be taken in the treatment of a given patient. Patients often suffer from multiple morbidities, which results in the relevant medical guidelines suggesting conflicting actions. This presents a challenge to automated reasoning with clinical guidelines.

To address this challenge, we need a computational method for inferring suitable treatment actions taking into account the many conflicts that could arise between different guideline recommendations. One solution would be to represent clinical guidelines, relevant patient information and possible treatment actions in the form of a BAF. This BAF can then be inputted to our system in order to decide the best course of action for any given patient.

[1] www.road2h.org

# 4 DEMONSTRATION

During the demonstration participants will interact with our system by representing their own debates as BAFs and using the system to calculate their extensions. The system includes a graphical UI, which shows the relevant BAF as a graph with nodes representing arguments and edges representing attacks or supports between these arguments. Throughout the process of applying the labelling algorithms in order to find extensions, this graph will be updated to show the current status of each argument with respect to being part of the eventual winning set. Figure 1 shows an example of our system calculating the extensions of a BAF, in this case the users are trying to decide which film they should watch this evening.

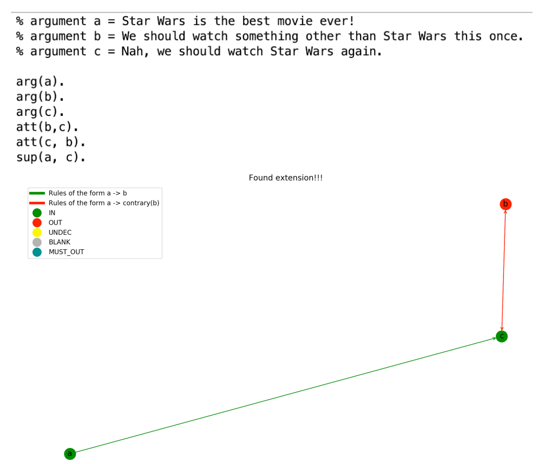


**Figure 1: Example of our system deciding the winning arguments of a debate. The top picture shows the input file to our system, the bottom picture shows the calculated extension (under preferred semantics). In this case arguments a and c constitute the winning set of arguments.**

An early demo is available at https://youtu.be/a2XzwtD-mFQ.

*Acknowledgements.* The authors were supported by the EPSRC project **EP/P029558/1** ROAD2H: *Resource Optimisation, Argumentation, Decision Support and Knowledge Transfer to Create Value via Learning Health Systems.*

**Data access statement**: All data created during this research is available at www.github.com/AminKaram/FYP. For more information please contact Amin Karamlou at mak514@ic.ac.uk.

# REFERENCES

[1] Claudette Cayrol and Marie-Christine Lagasquie-Schiex. 2013. Bipolarity in argumentation graphs: Towards a better understanding. *Int. J. Approx. Reasoning* 54, 7 (2013), 876–899. https://doi.org/10.1016/j.ijar.2013.03.001

[2] Federico Cerutti, Sarah Alice Gaggl, Matthias Thimm, and Johannes Peter Wallner. 2017. Foundations of Implementations for Formal Argumentation. *FLAP* 4, 8 (2017). http://www.collegepublications.co.uk/downloads/ifcolog00017.pdf

[3] Andrea Cohen, Sebastian Gottifredi, Alejandro Javier García, and Guillermo Ricardo Simari. 2014. A survey of different approaches to support in argumentation systems. *Knowledge Eng. Review* 29, 5 (2014), 513–550. https://doi.org/10.1017/S0269888913000325

[4] Kristijonas Čyras, Claudia Schulz, and Francesca Toni. 2017. Capturing Bipolar Argumentation in Non-flat Assumption-Based Argumentation. In *PRIMA 2017: Principles and Practice of Multi-Agent Systems - 20th International Conference*

*(Lecture Notes in Computer Science)*, Bo An, Ana L. C. Bazzan, João Leite, Serena Villata, and Leendert van der Torre (Eds.). Springer, Nice, 386–402. https://doi.org/110.1007/978-3-319-69131-2_23

[5] Phan Minh Dung. 1995. On the Acceptability of Arguments and its Fundamental Role in Nonmonotonic Reasoning, Logic Programming and n-Person Games. *Artif. Intell.* 77, 2 (1995), 321–358. https://doi.org/10.1016/0004-3702(94)00041-X

[6] Amin Karamlou, Kristijonas Čyras, and Francesca Toni. 2019. Complexity Results and Algorithms for Bipolar Argumentation. In *18th International Conference on Autonomous Agents and MultiAgent Systems, AAMAS, to appear*.

[7] Stefano Menini, Elena Cabrio, Sara Tonelli, and Serena Villata. 2018. Never Retreat, Never Retract: Argumentation Analysis for Political Speeches. In *Proceedings of the Thirty-Second AAAI Conference on Artificial Intelligence, (AAAI-18), the 30th innovative Applications of Artificial Intelligence (IAAI-18), and the 8th AAAI Symposium on Educational Advances in Artificial Intelligence (EAAI-18), New Orleans, Louisiana, USA, February 2-7, 2018*. 4889–4896. https://www.aaai.org/ocs/index.php/AAAI/AAAI18/paper/view/16393