ABCGEN – Generator for Assumption-based Argumentation Frameworks with a Clustered Structure

Andreas Niskanen
University of Helsinki
Finland

Masood Feyzbakhsh Rankooh
University of Helsinki
Finland

Tuomo Lehtonen
Aalto University
Finland

Matti Järvisalo
University of Helsinki
Finland

***Abstract*—ABCGEN is a generator for ABAFs with a clustered structure, inspired by StableGenerator for AFs. The aim is to be able to generate instances that admit multiple stable extensions (and by extension complete and preferred ones) and having moderate cyclicity in the rules. These qualities make the instances challenging for solvers.**

I. INTRODUCTION

In this system description, we give an overview on ABCGEN, a benchmark generator for assumption-based argumentation (ABA) frameworks [1]. The generator is submitted for the first time to the dedicated ABA track of the sixth International Competition on Computational Models of Argumentation (ICCMA 2025).

We propose a scheme to generate ABAFs that admit multiple stable assumption sets by partitioning the assumptions of the ABAF and having the assumptions of each partition attack the majority of assumptions outside of it. Our aim is to have many stable (and thus complete and preferred) assumption sets while having acyclicity in the rules. The scheme is based on ideas from the existing abstract argumentation benchmark generator StableGenerator [2], [3].

II. GENERATOR ARCHITECTURE

We have the following parameters: the number of partitions/clusters P, the numbers of assumptions $P_{\mathcal{A}}$ and non-assumption atoms $P_{\mathcal{L}}$ in each partition, the maximum number of rules per atom mra, the maximum rule size mrs, and a contrary probability C. For each i in $1, \dots, P$, let $\mathcal{A}_i$ be a set of $P_{\mathcal{A}}$ fresh assumptions for partition i, let each assumption in $\mathcal{A}_i$ have a fresh contrary atom, and let $\mathcal{L}_i$ be a set of $P_{\mathcal{L}}$ fresh non-assumption atoms.

The generator works as follows. For each $x \in \mathcal{L}_i$, generate $r \in [1, mra]$ rules for x of size $s \in [1, mrs]$ (r and s selected uniformly at random) such that the rule body consists of s atoms from $\mathcal{L}_i \cup \mathcal{A}_i$. Finally, for each assumption $a \in \mathcal{A} \setminus \mathcal{A}_i$, generate a rule ($\overline{a} \leftarrow x$) for a randomly selected $x \in \mathcal{L}_i$ with probability C. As a result, ABAFs from ABCGEN cannot have a strongly connected component (SCC) in the underlying rule graph larger than $P_{\mathcal{L}}$, but many of the atoms within each cluster will belong to the same SCC. There are no attacks within the partitions. With C close to 1, the assumptions in each partition attack most assumptions outside the partition. This results in an ABAF with many stable extensions: in particular, if all atoms are derivable, then with $C = 1$ each partition by itself is a stable extension.

III. SUGGESTED PARAMETER VALUES

All of the parameters mentioned can be set by the user. In addition, one can set a random seed (or simply log the random seed used by a particular run of the generator) in order to reproduce the same benchmark set in the future.

In initial tests we have found that with $mra = 3$ and $mrs = 2$ and $P_{\mathcal{A}}$ not much smaller than $P_{\mathcal{L}}$ virtually all atoms within each partition are derivable, and the size of SCCs typically equal roughly half or more $P_{\mathcal{L}}$. In particular, we have tested two sets of benchmarks from ABCGEN, one with a larger number of small clusters, and one with a smaller number of large clusters. We let $C = 0.8$ or $C = 0.9$, and in one set let P, $P_{\mathcal{A}}$ and $P_{\mathcal{L}}$ take a value from $\{25, 30, 35\}$, and in the other set let $P \in \{5, 7\}$ and let $P_{\mathcal{A}}$ and $P_{\mathcal{L}}$ take a value from $\{100, 150, 200\}$. We observed desired effects: reasonably hard instances for common reasoning problems (i.e. the state-of-the-art ABA solver ASPFORABA [4] usually takes multiple seconds to solve an instance and takes more than 900 seconds on multiple instances) with many stable extensions, almost all atoms being derivable, and some cyclicity occurring in rules.

Beyond these concrete values which we have tested, hard instances with the desired properties can be generated with different combinations. For example, having the number of clusters P somewhere between 7 and 25, and $P_{\mathcal{A}}$ and $P_{\mathcal{L}}$ somewhere between 35 and 100 would likely generate similarly interesting instances. Furthermore, different values of mra, mrs and C likely work as well. The lower C is, the fewer stable extensions there is expected to be, and thus a lower value of C might offer an interesting comparison to the instances with a high number of stable extensions, resulting in the values described above.

For acceptance problems, it might make sense to separately query an assumption, a contrary atom, and an atom that is neither an assumption nor a contrary. The reason is that different atom types might behave differently due to the structure of the ABAFs: contrary atoms are derivable from multiple clusters while other atoms only from a single cluster. Thus, for example, skeptical acceptance for atoms or assumptions might be easier than for contraries.

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REFERENCES

[1] A. Bondarenko, P. M. Dung, R. A. Kowalski, and F. Toni, "An abstract, argumentation-theoretic approach to default reasoning," *Artificial Intelligence*, vol. 93, pp. 63–101, 1997.

[2] F. Cerutti, N. Oren, H. Strass, M. Thimm, and M. Vallati, "A benchmark framework for a computational argumentation competition," in *Proc. COMMA*, ser. FAIA, S. Parsons, N. Oren, C. Reed, and F. Cerutti, Eds., vol. 266. IOS Press, 2014, pp. 459–460.

[3] M. Thimm and S. Villata, "The first international competition on computational models of argumentation: Results and analysis," *Artificial Intelligence*, vol. 252, pp. 267–294, 2017.

[4] T. Lehtonen, J. P. Wallner, and M. Järvisalo, "Declarative algorithms and complexity results for assumption-based argumentation," *Journal of Artificial Intelligence Research*, vol. 71, pp. 265–318, 2021.