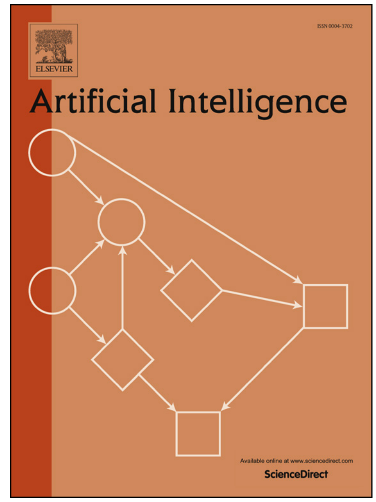
Accepted Manuscript



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PII: S0004-3702(18)30441-7
DOI: https://doi.org/10.1016/j.artint.2018.08.001
Reference: ARTINT 3089

To appear in: *Artificial Intelligence*

Received date: 24 November 2017
Revised date: 31 July 2018
Accepted date: 8 August 2018

Verification in Incomplete Argumentation Frameworks☆

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Abstract

We tackle the problem of expressing incomplete knowledge in abstract argumentation frameworks originally introduced by Dung [26]. In applications, incomplete argumentation frameworks may arise as intermediate states in an elicitation process, or when merging different beliefs about an argumentation framework's state, or in cases where complete information cannot be obtained. We consider two specific models of incomplete argumentation frameworks, one focusing on attack incompleteness and the other on argument incompleteness, and we also provide a general model of incomplete argumentation framework that subsumes both specific models. In these three models, we study the computational complexity of variants of the verification problem with respect to six common semantics of argumentation frameworks: the conflict-free, admissible, stable, complete, grounded, and preferred semantics. We provide a full complexity map covering all three models and these six semantics. Our main result shows that the complexity of verifying the preferred semantics rises from coNP- to Σ_2^p-completeness when allowing uncertainty about either attacks or arguments, or both.

Keywords: abstract argumentation, argumentation framework, incomplete knowledge, verification, computational complexity
2017 MSC: 00-01, 99-00

1. Introduction

Abstract argumentation frameworks are a simple, yet powerful tool for nonmonotonic reasoning that were originally introduced by Dung [26]. In this model, individual arguments are considered to be abstract entities, disregarding their internal structure and focusing only on the attack relation between them. Various semantics defined by Dung and others allow to investigate the acceptability status of sets of arguments based on the attack relation. However, abstract argumentation frameworks are suitable to describe an argumentation's state only in an optimal situation—they require that *all* relevant arguments are included and that there is no uncertainty regarding the attacks between them. If these conditions are not met, the existing methods for semantic analysis cannot be applied.

To capture uncertainty in various real-world settings like intermediate states of an evolving argumentation, partial-information settings (and, in particular, permanently unavailable information), and the task of merging

☆This paper merges and extends preliminary versions presented at the *32nd AAAI Conference on Artificial Intelligence* (AAAI'18, [8]), at the *4th International Conference on Algorithmic Decision Theory* (ADT'15, [6, 11]), and at the *6th* and the *7th International Workshop on Computational Social Choice* (COMSOC'16 and COMSOC'18), both with nonarchival proceedings. Extending these preliminary conference versions, this paper describes the model of incomplete argumentation framework in more detail, contains all proofs, establishes links between the previous versions, unifies notation and all results, and provides more examples, discussion, and motivation.

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