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AGNN: A Deep Learning Architecture for Abstract Argumentation Semantics

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1. Introduction

An increasing amount of research is being directed towards designing deep learning models that learn on problems from symbolic domains [2]. One domain in symbolic AI that is relatively unexplored in this regard is *computational argumentation*. Much of the theory in computational argumentation is built on Dung's [3] work on abstract argumentation frameworks, in which he introduces acceptability semantics that define which sets of arguments (*extensions*) can be reasonably accepted given an argumentation framework (AF) of arguments and attacks (often represented as a graph). With such semantics, it can be determined if an argument can be *credulously accepted* (it is contained in some extensions) or *sceptically accepted* (it is contained in all extensions).

In [1] we propose AGNN: a deep learning approach that is able to learn to solve several core problems in abstract argumentation almost perfectly. In this demonstration we show AGNN's underlying architecture; what the model learns in order to solve an argumentation problem and how it differs from symbolic algorithms.

2. Argumentation Graph Neural Network

Most current approaches solve acceptance problems by translating the problem to a symbolic formalism for which a dedicated solver exists. AGNN (argumentation graph neural network) learns a message passing algorithm to determine sceptical and credulous acceptance and enumerate extensions under 4 well-known argumentation semantics. Experimental results demonstrate that the AGNN can almost perfectly predict acceptability and enumerate extensions, and scales well for larger argumentation frameworks (100-200 arguments).Our learning-based approach to determining argument acceptance shows that sub-symbolic deep learning techniques can accurately solve a problem that could previously only be solved by sophisticated symbolic solvers. Furthermore, analysing the behaviour of the message-passing algorithm shows that the AGNN learns to adhere to ba-

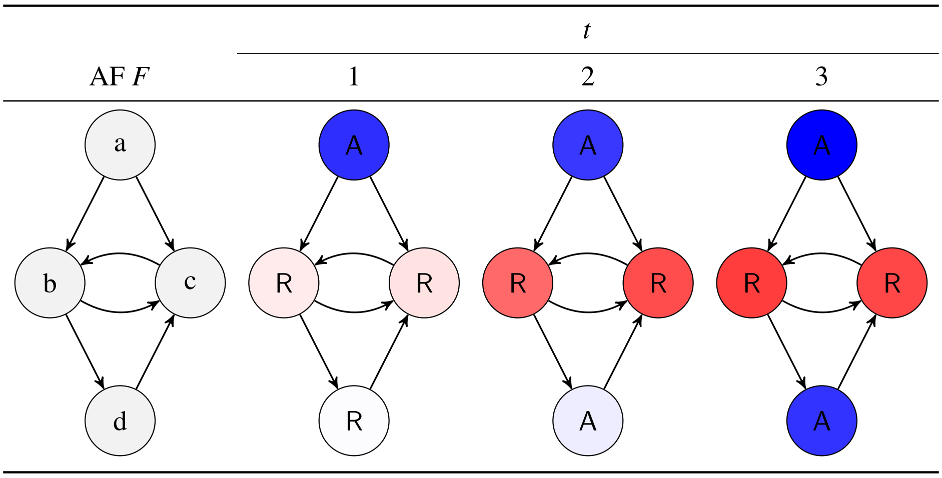

Figure 1. The acceptance predictions AGNN makes after the first three message passing iterations on the AF $F = (\{a,b,c,d\},\{(a,b),(a,c),(b,c),(b,d),(c,b),(d,c)\}$ with respect to the grounded semantics. The label and colour of each arguments denote whether the argument is predicted to be A accepted or R rejected where a darker colour indicates a higher confidence prediction (from: [1]).

sic principles of argument semantics as identified in the literature, and in the case of acceptance under the grounded semantics exhibits behaviour similar to a well-established symbolic labelling algorithm [4].

3. Demonstration

We demonstrate our Python implementation of an AGNN and show:

- how the AGNN architecture enables learning a neural message passing algorithm
- how the parameters of this algorithms can be optimised to predict argument acceptance almost perfectly under different semantics
- that the AGNN learns to adhere to basic principles of argument semantics
- how the learned algorithm differs from symbolic algorithms

We do so by graphically demonstrating AGNN's behaviour on an AF (cf. Figure 1).

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