

Bilateral Multi-Issue E-Negotiation Model Based on Abductive Logic in E-Commerce Using DALI

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INTRODUCTION

Every day, everybody deals with negotiation in commercial transactions and different aspects of the life. This is sometimes a tiresome issue for vendors and customers. Existence of an automated system to do those negotiations is something worthy of research and application in AI and microeconomics (Ragone, Di Noia, Di Sciascio, & Donini, 2006). According to Bussmman and Muller (1992), negotiation is “the process by which a group of agents communicate with each other to try and come to a mutually acceptable agreement on some matter”. Since each agent is independent, seeking personal gain and has incomplete information about the whole system, they need to negotiate with each other in order to obtain the necessary information and resources for achieving their goals.

Abduction has long been recognized as a powerful mechanism for hypothetical reasoning in the lack of complete knowledge (Endriss, Mancarella, Sadri, Terreni, & Toni, 2004). In abduction, as shown in Figure 1, by observing the occurrence of an event, one concludes that the reason of this event has also occurred.

Abductive logic has been employed by Ragone et al. in a one-shot multi-issue bilateral approach for negotiation (Ragone et al., 2006). It was also used by Sadri et al. for solving resource allocation problem among agents (Sadri, Toni, & Torroni, 2001, 2002a, 2002b). Sakama and Inoue defined negotiable attributes as abducibles for the agent to construct counter proposals and neighborhood proposals using those conditions (Sakama & Inoue, 2007). This chapter considers abductive logic among agents in e-commerce. Moreover, as negotiation is a multi-step process, it considers a bilateral, multi-issue and multi-step negotiation by extending the works of Ragone et al. (2006) and Sadri et al. (2001, 2002a, 2002b) in e-commerce using abductive logic. The chapter employs a logical agent based programming language, called DALI, and a simple user interface, using C#, for the ease of access and use of DALI agents.

Figure 1. Example of a reasoning based on abductive logic

If it rains \rightarrow The grass gets wet
The grass is wet.

It has rained.

The next parts of the chapter are organized as follows: The second section reviews the literature, defining bilateral multi-issue negotiation, abductive logic and its utilization in the negotiation process. The third section proposes and explains the main part. In the fourth section, the implementation using DALI is discussed, and a simple user interface is employed on top of DALI. The last section concludes.

BACKGROUND

This section first reviews definitions of negotiation and abductive logic. Next, it shows how to use abductive logic in programming.

Negotiation

Negotiation occurs among nations, in organizations, in business, in everyday life, and in personal dealings such as marriage or even divorce. It helps two or more parties with opposing interests but intended to reach mutually beneficial agreements, to resolve their conflicts and gain individual or collective outcomes (Bussmann & Muller, 1992; Torroni, 2002).

Multi agent system, a branch of artificial intelligence, has brought automated negotiation into the field. Through automating time consuming and repetitive stages of the buying process, it helps the participants communicate to find agreements by searching and exchanging compromising proposals (Baarslag, 2014; Faratin, Sierra, & Jennings, 1998; Nassiri-Mofakham, Nematbakhsh, Ghasem-Aghaee, & Baraani-Dastjerdi, 2009; Zafari, Nassiri-Mofakham, & Hamadani, 2015).

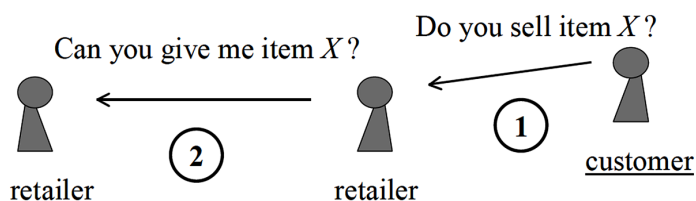
Figure 2 shows an example of negotiation.

Abductive Logic

Logic is often divided in three parts: inductive reasoning, abductive reasoning, and deductive reasoning. *Deductive* reasoning concerns IF—THEN rules and shows what necessarily will follow from given premises. However, *inductive* reasoning concerns generalization of a reliable derivation from observations. If there is no situation in which the premises are true but the consequence is false, then an inference is deductively valid, and vice versa. However, the conclusions in an inductive argument cannot be certainly valid.

Abduction, a less explored element of reasoning, relates explaining evidence as a hypothetical guess through reliable observation data. The term “guessing” was first introduced by the American philosopher Charles Sanders Peirce (1839–1914). To abduce *A* from *B* it is required to determine *A* is sufficient but not necessary for *A*. In other words, abduction determines which rules apply to a given case. The

Figure 2. An example of negotiation application (Torroni, 2002)



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