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Information Distribution Decisions Supported by Argumentation

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INTRODUCTION

Information and knowledge (IK) are each day more valuable assets in modern organizations (Atkinson, Court, & Ward, 1998; Carrillo, 1998; Liebowitz & Beckman, 1998). Distributing IK is indeed one of the main processes in knowledge management (Liebowitz & Wilcox, 1997; Horibe, 1999). Now, deciding which piece of IK goes to which member of an organization is a decision problem not simple in real organizations. There are many aspects that should be considered, such as what are the responsibilities and tasks of each person, which access rights they have, what are their preferences, and so on. Taking into account all these aspects requires either a huge amount of human labor or the help of an information-technology tool.

In this article we explore how a particular technology, automated argumentation, which is a kind of automatic reasoning, can be applied to solve decision problems related to information distribution in an organization.

BACKGROUND

Many technologies have been applied to distribute information to users, but they can be classified in "push" and "pull" modalities (Chin, 2003). Push modality means that a system delivers information to a user without the user initiative (like the e-mail delivery) whereas pull modality means that a user actively gets information from an electronic resource, typically the Web. The so-called "push technologies" (also called "Webcasting," "netcasting," and other names) were proposed in the 90's as an alternative way to distribute IK to users (Chin, 2003). In this type of systems, the user selects information "channels" and/or fills a "user profile" and gets updated information from these selected channels. Push systems sounded promising because the user could be relieved from getting information updated, which is for sure a boring and repetitive task. Advocators of push systems claimed that users would be poured with a wealth of useful information by just staying "plugged" to their information sources. Though push systems have made their way since the 90's (Himelstein, 1999), their application as a general information distribution paradigm is nowadays fairly restricted (Brena & Aguirre, 2004), mainly due to problems related to the bandwidth efficiency and the flooding of information to users. E-mail-based systems are indeed very popular today for distributing notifications, but is suffers of its basic limitations: it often requires human labor and/or it tends to overload users with information, many times irrelevant (Whittaker & Sidner, 1996).

The other possibility is to use pull systems, which today take the form of Web-based information systems. This approach has, however, many practical limitations, mainly due to the strain they put on the user, who is responsible for accessing the right knowledge and information at the right moments. Another problem is that individual users are not notified when important information can be consulted on the Web-based system, causing loss of opportunities.

In this article we explore one particular technology that enables the automation of information distribution in push mode, which is automated argumentation. In the following sections we will introduce this technology, focusing in one specific variant called defeasible reasoning, and then proceed to present how it can be applied to information distribution decision support.

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INFORMATION DISTRIBUTION USING DEFEASIBLE ARGUMENTATION

In this section we present one particular technology that enables the automation of information distribution in push mode, which is automated argumentation. In the following sections we will introduce this technology, focusing in one specific variant called defeasible reasoning, and then proceed to present how it can be applied to information distribution decision support.

Defeasible argumentation (Chesñevar, Maguitman, & Loui, 2000; Prakken & Vreeswijk, 2002) has evolved in the last decade as a successful approach to formalize commonsense reasoning and decision making problems as the ones discussed before. In the last few years particular attention has been given to several extensions of logic programming, which have turned out to be computationally manageable for formalizing knowledge representation and argumentative inference. Defeasible logic programming (DeLP) (García & Simari, 2004) is one of such extensions, which has proven to be successful for a number of real-world applications, such as Web recommendation systems (Chesñevar & Maguitman, 2004b), clustering classification (Gomez & Chesñevar, 2004), and natural language processing (Chesñevar & Maguitman, 2004a), among others.

A **defeasible logic program** is a set K = (Π, Δ) of horn-like clauses, where Π and Δ stand for sets of strict and defeasible knowledge, respectively. The set Π of strict knowledge involves strict rules of the form $p \leftarrow q_1, \ldots, q_k$ and facts (strict rules with empty body), and it is assumed to be non-contradictory. The set Δ of defeasible knowledge involves defeasible rules of the form $p \;{-\!\!-\!\!<}\; q_1, \ldots, q_k$, which stands for "$q_1, \ldots q_k$ provide a tentative reason to believe p." The underlying logical language is that of extended logic programming, enriched with a special symbol " −−< " to denote defeasible rules. Both default and classical negation are allowed (denoted "not" and "~," respectively). Syntactically, the symbol " −−< " is all that distinguishes a defeasible rule $p \;{-\!\!-\!\!<}\; q_1, \ldots q_k$ from a strict (non-defeasible) rule $p \leftarrow q_1, \ldots, q_k$.

- *Definition 1* (argument). Given a DeLP program P, an *argument* A for a query q, denoted <A,q> is a subset of ground instances of defeasible rules in P and a (possibly empty) set of default ground literals "not L," such that: 1) there exists a defeasible derivation for q from Π ⋃ A; 2) Π ⋃ A is non-contradictory (i.e., Π ⋃ A does not entail two complementary literals like p and ~ p), and 3) A is minimal with respect to set inclusion. An argument $<A_1, Q_1>$ is a sub-argument of another argument $<A_2, Q_2>$ if $A_1 \subseteq A_2$. Given a DeLP program P, Args(P) denotes the set of all possible arguments that can be derived from P.

- *Definition 2* (counterargument—defeat). An argument $<A_1, q_1>$ is a counterargument for an argument $<A_2, q_2>$ if (1) There is an subargument <A, q> of $<A_2, q_2>$ such that the set $\Pi \cup \{q_1, q\}$ is contradictory; (2) A literal not q_1 is present in some rule in A_1. A partial order ≤ will be used as a preference criterion among conflicting arguments. An argument $<A_1, q_1>$ is a defeater for an argument $<A_2, q_2>$ if $<A_1, q_1>$ counter argues $<A_2, q_2>$, and $<A_1, q_1>$ is preferred over $<A_2, q_2>$ with respect to order ≤ .

Specificity (Simari & Loui, 1992) is used in DeLP as a syntax-based criterion among conflicting arguments, preferring those arguments which are more informed or more direct (Simari & Loui, 1992; Stolzenburg, García, Chesñevar, & Simari, 2003). However, other alternative partial orders could also be used.

As defeaters are arguments, they can on its turn be defeated by other arguments. This leads to a recursive analysis, in which many alternative argumentation lines can be computed. An *argumentation line* starting in an argument $<A_0,Q_0>$ is a sequence $[<A_0,Q_0>, <A_1,Q_1>, <A_2,Q_2>, \ldots, <A_n,Q_n> \ldots]$ that can be thought of as an exchange of arguments between two parties, a *proponent* (evenly-indexed arguments) and an *opponent* (oddly indexed arguments). Each $<A_i,Q_i>$ is a defeater for the previous argument $<A_{i-1},Q_{i-1}>$ in the sequence, $i > 0$. In the same way as in an exchange of arguments between human contenders, an argumentation line $<A_0,q_0>$ is won by the proponent if he/she presents the last argument; otherwise the line is lost. An argument $<A_0, q_0>$ is warranted if all argumentation lines rooted in $<A_0, q_0>$ are won. In order to avoid fallacious reasoning, there are additional constraints (viz. disallowing circular argumentation, enforcing the use of proper defeaters to defeat blocking defeaters, etc.) on such an argument exchange to be considered rationally valid. On the basis of such constraints, argumentation lines can be proven to be finite.

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