Intentional Process Mining: Discovering and Modeling the Goals Behind Processes using Supervised Learning

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ABSTRACT

Understanding people’s goals is a challenging issue that is met in many different areas such as security, sales, information retrieval, etc. Intention Mining aims at uncovering intentions from observations of actual activities. While most Intention Mining techniques proposed so far focus on mining individual intentions to analyze web engine queries, this paper proposes a generic technique to mine intentions from activity traces. The proposed technique relies on supervised learning and generates intentional models specified with the Map formalism. The originality of the contribution lies in the demonstration that it is actually possible to reverse engineer the underlying intentional plans built by people when in action, and specify them in models e.g. with intentions at different levels, dependencies, links with other concepts, etc. After an introduction on intention mining, the paper presents the Supervised Map Miner Method and reports two controlled experiments that were undertaken to evaluate precision, recall and F-Score. The results are promising since the authors were able to find the intentions underlying the activities as well as the corresponding map process model with satisfying accuracy, efficiency and performance.

Keywords: Event Log, Goal Modeling, Hidden Markov Model, Intention Mining, Supervised Learning, Trace

1. INTRODUCTION

Process Mining has been a topic of interest that has attracted a growing number of publications for the past 10 years (Tiwari et al., 2008). The need of companies to better know their processes, model them, check their alignment with strategic goals, monitor their evolutions has generated a wealth of applications, from business process monitoring to reverse engineering and software process modeling, which in their turn raise new research issues.

Most of the existing process mining approaches deal with process specified with
notations that belong either the activity-driven or to the product-oriented paradigm such as BPMN, EPC, Petri Nets, etc. (van der Aalst, 2011; van der Aalst & Weijters, 2004; Pérez-Castillo et al., 2011). Although extremely interesting to deal with a number of issues, process models specified with these notations are difficult to exploit when it comes to tracing their rational and measuring. More importantly, process models specified in this way lack of flexibility (Nurcan, 2008) making difficult their alignment with strategic goals, measuring their degree of variability, or even trying to monitor their underlying strategies. This paper builds upon a thread of research works on intentional process modeling (Yu & Mylopoulos, 1994) (Nurcan et al., 2005) (Yu, 1995), i.e. were process models are specified notations that belong to the intentional paradigm, in other word goal-oriented process models.

 Intentions are a first class concept of Information System (IS) engineering (Rolland & Salinesi, 2005). In the early 80s, Intentional models were proposed in the IS community (Swanson, 1982) (Christie, 1981) as a “potential theoretical foundation” to determine users’ behavior (Davis et al., 1989). Intention modeling takes root in a former work (Ajzen & Fishbein, 1975) that introduced the Theory of Reasoned Action (TRA) designed to model human’s behavioral intention. The TRA has proven effective in predicting and explaining human behavior through various domains as consumer behavior…Later on in the early 90s, intention analysis and modeling have been promoted as a driving paradigm to study strategic alignment, to define actors and roles, to specify the outcome of business process models and name them, to guide requirements elicitation, analysis, traceability, to study users behavior to identify and name use cases, etc. If intentions are referred to as goals, then intentional process modeling refers to modeling the goals underlying the studied processes (Kaabi & Souveyet, 2007). Notations used in intentional process modeling, and therefore intentional process mining are thus goal modelling notations (Nurcan et al., 2005) (Yu, 1995).

 Several methods were recently proposed to mine intentions from observed behaviors. The key idea is to extract sequences of activities from records to evaluate and predict the users’ intentions that resulted in those activities (Khodabandelou et al., 2013). In these works, intentions are considered as “goals to be achieved by performing processes” (Bonito et al., 2009). As a result, mining intention from process traces or logs can be considered an inverse problem, i.e. drawing intentions backward from process performance.

 The mainstream research on intention mining lies in the domain of information retrieval (Jathava et al., 2011), (Baeza-Yates et al., 2006) (González-Caro & Baeza-Yates, 2011), (Hashemi et al., 2008), (Sadikov et al., 2010), (Strohmaier & Kröll, 2012), (Zheng et al., 2002). Other applications have also been published, e.g. contents analysis (Mei et al., 2005), or business process models improvement (Outmazgin & Soffer, 2013). The common characteristic of the aforementioned methods is that they almost systematically generate individual intentions. This is interesting, but in the context of IS Engineering, intentions must be modeled, and dependencies between them and other concepts such as resources, tasks, strategy, systems functions, etc. be specified. The main contribution of this paper is a mining method that produces intentional process models, i.e. conceptual models of the intentions behind processes.

 We believe new applications will be found in the near future. Intentional process mining might help improving guidance, provide better recommendations, facilitate process modeling and process model quality assessment, identify the gap between prescribed business requirements and goals, help CEOs assess and monitor strategic goal implementation, etc.

 In the context of Information Systems (IS) engineering, intentional process mining can be useful at different stages of the process model lifecycle, for instance (i) at the requirements level, to elicit actual users’ goals rather than inferred ones, (ii) at the project management level, to check the alignment between a prescribed
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