Personalized Meta Actions

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INTRODUCTION

Recently, there has been an increasing interest in business analytics and big data tools to understand and drive industries evolution. Today's corporations are interested in understanding their customers and keeping them loyal. In fact keeping a loyal customer cost seven times less then getting a new one[1]. They are interested in understanding their manufacturing process and decreasing their costs. Distribution companies strive to optimize their distribution costs and improve their revenue. The healthcare industry is also interested in new methods to analyze data and provide better care. Given the wealth of data that corporations are accumulating, it is natural to take advantage of data driven decision-making solutions. Researchers proposed solutions ranging from data mining and pattern recognition to forecasting new trends. One of the most promising techniques in this field is action rule discovery.

Action rule discovery is a new efficient technique that drives evolution in desirable directions. Action rules are already adopted by the banking industry, distribution industry, and healthcare industry to discover the right actions and strategies to follow in order to increase their profit. For instance, (Wasyluk, Ras, & Wyrzykowska, 2008; Zhang, Ras, Jastreboff, & Thompson, 2010) studied action rules in the healthcare domain to improve patient's care.

Action rules can be further improved by the introduction of meta-actions that help corporations control their actions. Meta-actions trigger action rules in order to let corporations control their investment cost and return on investment before hand; thus, constructing their strategies. Depending on the meta-actions used.

Action rules are mined on entire objects' or customers' populations, or all aspects related to certain processes. Meta-actions, on the other hand, are chosen based on the action rules. However, applying those techniques blindly without studying the effects on customers or objects might result in negative side effects. Depending on the industry and the objects having actions upon them, an object centric approach is the most suitable approach to answer personalized needs of specific objects. Therefore, we felt the need to introduce personalization on meta-actions when executing action rules. Personalization is a very important aspect in driving evolution, and should be part of corporations' strategy. In this chapter, we propose the first personalized meta-action selection technique that takes into consideration the possible negative side effects on customers when applying such meta-actions. We further strive to optimize the cost and weight (features importance) effects of applying meta-actions on any action rule strategy for specific customers. In addition, we propose a more relaxed strategy to group patients and meta-actions based on negative side effects.

This chapter's contributions are as follow:

1. Optimizing the meta-actions selection by optimizing cost / weight effect.
2. Proposing a grouping mechanism for objects and meta-actions.
3. Providing an incremental study analysis.

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We start by introducing some preliminaries, and visit the related work. We then define the problem and challenges related to personalization. We describe our proposed approach in section 4, and the incremental behavior of the approach in section 5. We conclude and discuss the contributions and shortcomings of our approach in section 6.

PRELEMINARIES

Features are attributes describing objects' properties (i.e. customers properties), and are recorded in a database as transactions. For instance, a bank's customer might be described by his mortgage rate, his salary, and his address as features stored in one database transaction. A hospital's patient temperature, blood pressure, and age might be observed during his medical examination and stored in his electronic medical record as features. In addition, features are labeled with weights that represent their importance among other features. Experts knowledge need to be introduced in the system in order to label the features with weights, otherwise the weight is normalized to one.

Action rules defined in (Ras, & Wieczorkowska, 2000) and then investigated in (Qiao, Zhong, Wang, & Li., 2007; Zhang, Zhao, Cao, & Zhang, 2008) are composed of multiple features' transformations, called *atomic action terms* (or *atomic actions*) as described in (Ras, & Dardzinska, 2011; Ras, Wyrzykowska, & Wasyluk, 2007). They describe an object transition from one state to another desirable state. Thus, providing solutions and hints on what actions should be taken to improve the profitability of a specific object.

Atomic action transformations are the result of applying meta-actions (Wang, Jiang, & Tuzhilin, 2006; Tzacheva, & Ras, 2011) to objects. Formally, meta-actions trigger a set of atomic actions and might result in object's state transitions. They are seen in as a set of atomic action terms. The goal of applying meta-actions is to trigger action rules composed each of a subset of those atomic actions in their left hand side (antecedent side). Atomic actions are also described with their features' weight transition that model their features importance and effect on objects.

PROBLEM DEFINITION

An action rule provides a set of atomic actions on its antecedent side, which, if executed, will trigger the only atomic action on its right hand side. Meta-actions are the triggers for those atomic actions to happen. However, the current solution does not provide a personalized procedure for specific objects (or customers) to whom applying certain meta-actions may result in negative side effects. For example, given a bank customer that is 24 years old, has medium salary, medium monthly expenses, high savings, low interest rate, and average loan profitability, if we apply meta-actions to increase the interest rate that triggers an action rule increasing the loan profitability, we may as well trigger a decrease in customer's savings, thus affecting negatively the saving account profitability. This scenario may not be suitable for the bank decision maker, and may not respect the strategy of the bank.

We strive to find a personalized set of meta-actions that are of minimum cost and minimize the overall weight of negative side effects, while moving specific objects from a state to another more profitable state.

PROPOSED APPROACH

Given a system $S=(X, F \cup \{d\}, A)$ where X is a set of objects, F is a set of classification features, d is a decision feature, and A is a set of atomic actions associated with F, we define $\boldsymbol{M}(S)$ as a set of meta actions associated with S, triggering the atomic actions in A. Meta-actions are labeled with positive and negative side effects, or positive and negative atomic actions they trigger. Depending on the features' weight, atomic actions that are listed in the negative side effects of the meta-