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A postulate-based analysis of comparative preference statements ☆

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ABSTRACT

There has been a growing interest in the study of preferences for their utility in solving problems related to decision making. Most of the preference representation languages developed in the literature are based on comparative preference statements since they offer a simple and intuitive way for expressing preferences. They can be further interpreted following different semantics, imparting a greater flexibility on how outcomes can be compared. So far the main objective has been to rank-order the set of outcomes given a set of comparative preference statements and one or several semantics. Tackling this problem from a different angle, we look into the behavioural aspects of the preference semantics and statements by attempting to formalise the intuition behind them using postulates studied in preference logics and non-monotonic reasoning. We select the postulates w.r.t. three criteria: coherence, syntax independence and inference. Thus, our analysis provides a means to determine those properties that are satisfied for a given preference semantics.

1. Introduction

There has been a growing interest in the study of preferences for their utility in solving problems related to decision making, be it human or mechanical. This makes preferences a multidisciplinary topic, uniting researchers ranging from philosophy and psychology to economics and artificial intelligence.

Seen in the simplest way, making a decision requires considering all possible scenarios before choosing the more favourable ones. Using preferences, this boils down to ordering the different scenarios according to one's preferences and then choosing from the better ranked ones. When it comes to individuals making their own decisions using preferences, there is often a lack of thoroughness in the choice made, due to the cognitive overload caused by the sheer volume of alternatives that need to be evaluated. As an unfortunate consequence, any preference representation language based on the direct assessment of individual preferences

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over the complete set of outcomes is simply infeasible. This brings about the notion of compact preference representation languages, which do precisely what a human mind does in order to simplify the task of decision making: outcomes are interpreted by the means of partial descriptions which help to reduce the number of alternatives that need to be evaluated. For example, "I like London more than Paris" could be a partial description that can come in handy when an individual is faced with the task of choosing, say, a university for further studies, and is confused about the one (s)he would like to be in the most. These languages use different means of completion in order to compute a preference relation that can be induced by a set of preference statements (see [9] for a full review).

Amongst the different representations that are offered by these languages, comparative preference statements offer an intuitive and natural way to represent such partial descriptions of user preferences. Most of the preferences we express can be represented using these comparative statements. In situations where we might wish to consider additional factors to define our preferences, e.g., university ranking along with location in the task of choosing a university for further studies, there can be (1) general preferences of the form "I like a university in London more than one in Paris" and (2) specific preferences in a particular context such as "If a university in Paris is ranked higher than one in London, then I prefer the university in Paris to the one in London." For an example of a real-world application where such preferences are used we refer the reader to [14].

A critical point, when handling comparative preference statements, is their evaluation when dealing with statements which refer to a set of possible outcomes. Getting back to our example of choosing a university based on rank and location, if an individual expresses that (s)he prefers universities ranked within the top 20%, then (s)he has to distinguish between two sets of universities: those ranked within the top 20% and those ranked below. Naturally, there are different ways to compare universities from these two sets. These give rise to different preference semantics, founded principally in philosophy [8] and non-monotonic reasoning [3,15].

So far the main objective in artificial intelligence has been to rank-order the set of outcomes given a set of comparative preference statements and one or several semantics [12,4,22]. In this paper we tackle this problem from a different angle. We look into the behavioural aspects of the preference semantics and make a comparative analysis using postulates studied in preference logics and non-monotonic reasoning. These postulates formalise the intuition one may have regarding the behaviour of preference semantics and are therefore easier to relate to when attempting to describe one's preferences. In this way, we can determine those properties that are satisfied for a given semantics, to best describe one's preferences.

After laying out the necessary background for the present study, we discuss the different semantics proposed in the literature. We then provide a postulate-based analysis of these semantics and thereby conclude.

2. Background

We consider the following components of a formal language:

- A finite set V of variables which describe the attributes or characteristics of an object,
- A finite set $Dom(X)$ for each variable X in V, which contains all the values that can be assigned to that variable X,
- A possible outcome ω, which is the result of assigning a value to each variable X in V,
- The set of all possible outcomes Ω. We suppose that Ω is fixed and finite. We also suppose that there is no integrity constraint that restricts the set of possible outcomes. Therefore we suppose that all possible outcomes are feasible.