# Fast Algorithms for the Preference Consistency Problem Based on Hierarchical Models

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## Summary

In fields like recommender systems and multi-objective decision making, one wants to reason over user preferences. It is often difficult or excessively time-consuming to elicit all user preferences. We aim to elicit only a few preferences from the user and deduce other preferences. Here, we need to check if the users statements are consistent, i.e., do not contradict each other. Otherwise, one could deduce any arbitrary preference statement. Checking consistency and deducing a preference statement is mutually expressive for hierarchical user models, and NP-complete and coNP-complete, respectively. In this paper, we construct and compare algorithmic approaches to solve the Preference Consistency Problem (PCP) for preference statements based on hierarchical models. Here, instances contain a set of preference statements that are direct comparisons (strict and non-strict) between some alternatives, and a set of evaluations functions by which all alternatives can be rated. An instance is consistent based on hierarchical preference models, if there exists an hierarchy of evaluation functions that induces an order relation on the alternatives by which all preference statements are satisfied. We develop three approaches to solve PCP. The first involves a Mixed Integer Linear Programming (MILP) formulation, the other two are recursive algorithms based on properties that allow to prune the search space and number of backtracks. Our experiments on synthetic data show that the recursive algorithms are extremely fast compared to solving the MILP formulation [1].

## References

1. George, A.M., Wilson, N., O'Sullivan, B.: Towards fast algorithms for the preference consistency problem based on hierarchical models. In: IJCAI '16, New York, USA, July 09-15, 2016, Proceedings. (2016)