Design of a generic selection hyper-heuristic

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Abstract

Hyper-heuristics have been studied to reach efficient solutions for a diverse range of problems in a fast and easy manner. Their problem-independent nature provides an advantage concerning the applicability to distinct problems. This characteristic is accommodated by guaranteeing a strict separation between hyper-heuristics and problems. From this perspective, hyper-heuristics are considered as high-level generic search strategies. However, the generality aspect of the hyper-heuristics is a rarely studied subject. In the present study, certain issues related to the generality of hyper-heuristics will be discussed. Then, a hyper-heuristic for tackling the mentioned generality issues with a detailed performance analysis will be presented.

Keywords: hyper-heuristic, generality

Design of a dedicated algorithm is a time-consuming process requiring an in-depth analysis of the problem. The resulting algorithm is expected to be effective for solving some target problem instances. However, since the algorithm is dedicated, it is hard to adapt and to apply to other problems. Meta-heuristics have been used to handle this drawback. Nevertheless, in most of the meta-heuristic studies, the employed meta-heuristics have been implemented as rather problem-dependent methodologies. Hyper-heuristics furnish problem-independent management opportunities differently from such search and optimisation algorithms.

In various studies, it was shown that hyper-heuristics are capable of finding satisfactory results without focusing on the problem, just by managing a suite of heuristics [3]. This type of hyper-heuristics is categorised as *selection hyper-heuristics*. The primary motivation of the selection hyper-heuristics is the efficient use of existing low-level search mechanisms with reference to their strength and weaknesses [2]. A traditional selection hyper-heuristic consists of a heuristic selection mechanism and a move acceptance strategy. Heuristic selection works to select appropriate heuristics at each decision step. A

move acceptance strategy is a decision maker that is responsible for deciding whether a constructed/visited solution(s) is accepted.

The performance of a selection hyper-heuristic is connected to the characteristics of the heuristic set. The number of available heuristics, the speed and improvement capabilities of the low-level heuristics are the factors that need to be taken into account. These performance elements may change over time. Thus, adaptive approaches have a higher probability to yield superior results. This entails focusing on adaptive solution strategies that proceed relying on the behavioural changes of the heuristics.

In this study, the requirements regarding the generality of selection hyper-heuristics are investigated. Possible solution strategies to enable fulfilling these requirements will be discussed. A case study with a comprehensive empirical analysis on a number of problems using a hyper-heuristic framework, HyFlex [1], will be presented.

References

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