

# Preface

This book surveys the recent advances in the field of evolutionary multi-objective optimization. In fact, most real problems are multi-objective in nature, i.e. they involve multiple conflicting objectives to be minimized or maximized simultaneously in limited resources. The resolution of such type of problems gives rise to a set of non-dominated solutions forming the Pareto front. Evolutionary algorithms have been recognized to be well-suited to solve multi-objective problems, thanks to their ability in providing the decision-maker with a set of trade-off solutions in a single run in addition to their insensitivity to the geometrical features of the objective space. However, real-world applications usually have one or several aspects that need further efforts to be tackled. In this book, we survey recent achievements in handling five aspects. The first aspect is dynamicity where the objective functions and/or the constraints may change over time. In this case, the optimization algorithm should track the Pareto front after the occurrence of any change. The second aspect is the presence of hierarchy between the objectives. This kind of problems is called bi-level where an upper level problem has a lower level one in its constraints. The main difficulty in bi-level programming is that the evaluation of an upper level solution requires finding the optimal lower level one, which is computationally expensive. The third aspect is the objective space high dimensionality. This aspect means solving many-objective problems involving more than three objectives. The main difficulty in dealing with such type of problems is that most solutions become equivalent to each others; therefore making the algorithm behaving like random search. The fourth aspect is the emerging notion of evolutionary multitasking which is inspired by the cognitive ability to multitask. Shown to be a natural extension of population-based search algorithms, multitasking encourages multiple heterogeneous search spaces belonging to distinct tasks to be unified and searched concurrently. The resultant knowledge exchange provides the scope for improved convergence characteristics across multiple tasks at once, thereby facilitating enhanced productivity in decision-making processes. The fifth aspect is the presence of constraints where the evolutionary algorithm

should search for solutions in the decision space while respecting a set of predefined constraints so that it outputs a set of feasible non-dominated solutions.

This book provides both methodological treatments and real-world insights gained by experience, all contributed by specialized researchers. As such, it is a comprehensive reference for researchers, practitioners, and advanced-level students interested in both the theory and the practice of using evolutionary algorithms in tackling real-world applications involving multiple objectives. The book provides a comprehensive treatment of the field by offering chapters whose topics are disjoint or having minimal overlaps, each tackling a single multi-objective aspect. Moreover, the last chapter highlights a number of practical applications showing the usability of multi-objective evolutionary algorithms in practice; thereby motivating researchers and engineers to use evolutionary approaches in solving their encountered problems.

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