Solving 0/1 Knapsack Problem Using Hybrid HS and Jaya Algorithms

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1. INTRODUCTION

Solving Knapsack problem consider a well-known test case for metaheuristic algorithms. Many researchers use Knapsack problem to test the metaheuristics effectiveness, since its consider NP-hard optimization problem. It also similar to lots of practical applications in different fields, like plan selection, decision making, and resource allocation. The idea of Knapsack is having variable number of items \( N \), each item \( j \)th have weight \( w_j \) and value \( v_j \), meanwhile the Knapsack able to carry a limited total weight \( C \), and the idea of this problem is to load the maximum total valuable items within the limited weight of the knapsack. The below formula describes the knapsack rules:

1) Maximum \( f(v) = \sum_{j=1}^{N} v_j \times x_j \)
   Subject to \( f(w) \leq C \)
   Where \( f(w) = \sum_{j=1}^{N} w_j \times x_j \), \( x_j \in \{0,1\}, 1 \leq i \leq N \)

Knapsack problem is a combinatorial optimization problem, where a fixed-size Knapsack must be filled with the most valuable items. Solving knapsack problem consider NP hard problem and many previous research tried to find optimal solution for it. In this research, a new hybrid algorithm of Harmony search and Jaya search algorithms applied on 0/1 Knapsack problem to find a near optimal results. HS algorithm has been modified to handle the 0/1 Knapsack problem, such as adding penalty function to cope the weight condition, exclude the harmony search bandwidth \( bw \) parameter, and use the current best result in the next iteration to obtain a better result. The new hybrid algorithm has been applied on different cases of Knapsack problem with different dimensions. 20 case studies have been evaluated by the new hybrid algorithm. The results obtained are competitive to previous HS variants that used to solve Knapsack problem.

Keywords: Meta-heuristics, Hybrid Algorithm, Harmony Search, Jaya Algorithm, Knapsack Problem.

Many researchers applied different metaheuristic algorithms to solve 0/1 Knapsack problem. Although many researchers solved the 0/1 knapsack problem for distinct size of knapsack, but the generous size of knapsack still complex to solved effectively. Hence, a bigger 0/1 knapsack problem need be optimized by an effective algorithm.

Harmony search is well-known metaheuristic algorithm, which used to solve many optimization problems. Zou used harmony search and its variant IHS to solve 0/1 Knapsack problem. Zou had created a new variant of HS called Novel Global Harmony Search NGHS and compare it with the original HS and the improved harmony search IHS. Zou compare his results using 10 test cases of Knapsack from previous literature and he created eight random cases with larger dimension to evaluate his new algorithm. Other researcher used HS variant to solve knapsack problem...