Comparison of dynamic programming and greedy algorithms and the way to solve 0-1 knapsack problem

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Abstract. The 0-1 knapsack problem is widely used in reality and it belongs to NP-hard problems. Starting from the basic ideas and time complexity of the algorithm, this paper analyzes how to choose a strategy to solve the problem. This paper aims to solve practical problems and analyzes the 0-1 knapsack problem in combination with the real-life cargo delivery problems. Dynamic programming and greedy algorithms are used to tackle the problem respectively, and the advantages and disadvantages of two strategies are discussed, so as to analyze how to decide which strategy to adopt to solve the problem when encountering the 0-1 knapsack problem in an actual situation. In the face of large-scale problems, this paper suggests choosing greedy algorithm because it will save a lot of time. In the face of small-scale problems that require absolute solutions, this paper suggests choosing dynamic programming to solve the problem.

Keywords: 0-1 Knapsack Problem, Dynamic Programming, Greedy Algorithm, Maximal Knapsack Packing, Optimal Solution.

1. Introduction

The knapsack problem was proposed by Merkel and Heilmann in 1978. Later, by studying its characteristics, it is shown that this problem is a typical NP-complete problem. It is widely used in various industrial situations, such as capital budget, cargo handling, and storage allocation problems, which can be transformed into the 0-1 knapsack problem, so the study of the solution of the 0-1 knapsack problem has important practical significance [1]. At present, the existing solution methods can be divided into two categories: the exact algorithm, such as dynamic programming algorithms, backtracking method, and branch and bound method. The other is approximate algorithms, such as greedy, ant colony algorithm and genetic algorithm. This paper mainly selects a typical algorithm for analysis from two types of algorithms, namely dynamic programming algorithm and greedy algorithm [2]. In the early 1950s, the American mathematician R. Behlman and others proposed the famous optimization principle when studying the optimization problem of a multi-stage decision-making process, and thus established dynamic programming. Dynamic programming has a wide range of applications, including engineering technology, the economy, industrial production, military and automation control, and other fields. Greedy algorithm was first proposed by J. C. Wnsdorff in 1823, which means that the current optimal choice is always made when solving a problem, that is, the local optimal solution. Greedy algorithms have two basic elements: greedy selection and optimal substructure. It is the closest to the human daily thinking of a problem-solving strategy and is essentially an improved

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