Example Solving Knapsack Problem With Dynamic Programming

A problem is said to be strongly NP-complete (NP-complete in the strong sense), if it remains NP-complete even when all of its numerical parameters are bounded by a polynomial in the length of the input. A problem is said to be strongly NP-hard if a strongly NP-complete problem has a pseudo-polynomial reduction to it. This pseudo-polynomial reduction is more restrictive than the usual poly-time reduction... e2fb897c18

Algorithm are used to solve many different problem instances, a quicker approach called dynamic programming avoids recomputing solutions. Algorithms are used as specifications for performing calculations and data processing. For example, Floyd–Warshall In mathematics and computer science, an algorithm ( ) is a finite sequence of mathematically rigorous instructions, typically used to solve a class of specific problems or to perform a computation. More advanced algorithms can use conditionals to divert the code execution through various routes (referred to as automated decision-making) and deduce valid inferences (referred to as automated reasoning) e2fb897c18

1 e2fb897c18 {\displaystyle 1-\varepsilon } e2fb897c18 {\displaystyle 1+\varepsilon } e2fb897c18 For example, the NP-hard knapsack problem can be solved by a dynamic programming algorithm requiring a number of steps polynomial in the size of the knapsack and the number of items (assuming that all data are scaled to be integers); however, the runtime of this algorithm is exponential time since the input sizes of the objects and... e2fb897c18

Subset sum problem SSP is a special case of the knapsack problem and of the multiple subset sum problem. In its most general formulation, there is a multiset. The run-time The subset sum problem (SSP) is a decision problem in computer science. algorithms that can solve it reasonably quickly in practice e2fb897c18

T e2fb897c18 {... e2fb897c18 An NP-complete problem is called strongly NP-complete if it is proven that it cannot be solved by a pseudo-polynomial time algorithm unless P = NP. The strong/weak... e2fb897c18 T e2fb897c18

Knapsack problem languages at Rosetta Code Dynamic Programming algorithm to 0/1 Knapsack problem Knapsack Problem solver (online) Solving 0-1-KNAPSACK with Genetic Algorithms The knapsack problem is the following problem in combinatorial optimization: e2fb897c18

0 e2fb897c18 {\displaystyle T} e2fb897c18 + e2fb897c18 1 e2fb897c18 The subset sum problem is a special case of the decision and 0-1 problems... e2fb897c18 The variant in which inputs may be positive or negative, and e2fb897c18 = e2fb897c18 It is weakly NP-hard, but may be solved optimally in pseudo-polynomial time by dynamic programming. e2fb897c18 In the context of optimization problems, the correct value is understood to be the value of the optimal solution, and it is often implied that an FPTAS should produce a valid solution (and not just the value of the solution). Returning a value and finding a solution... e2fb897c18 {\displaystyle T=0} e2fb897c18 , and the question is to decide whether any subset of the integers sum to precisely e2fb897c18 {\displaystyle T} e2fb897c18

Cutting stock problem NP-hard problem reducible to the knapsack problem. In terms of computational complexity, the problem is an NP-hard problem reducible to the knapsack problem. It is an optimization problem in mathematics that arises from applications in industry. The problem can be formulated as an integer linear programming problem. A paper machine can produce an In operations research, the cutting-stock problem is the problem of cutting standard-sized pieces of stock material, such as paper rolls or sheet metal, into pieces of specified sizes while minimizing material wasted. The problem can be formulated as an integer linear programming problem e2fb897c18

Fully polynomial-time approximation scheme It returns as output a value which is at least. An FPTAS takes as input an instance of the problem and a parameter ε > 0. Journal of Combinatorial Optimization A fully polynomial-time approximation scheme (FPTAS) is an algorithm for finding approximate solutions to function problems, especially optimization problems. "Improved Dynamic Programming in Connection with an FPTAS for the Knapsack Problem". Pferschy, Ulrich (2004-03-01) e2fb897c18

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Weak NP-completeness therefore not considered polynomial. For example, the NP-hard knapsack problem can be solved by a dynamic programming algorithm requiring a number of steps In computational complexity, an NP-complete (or NP-hard) problem is weakly NP-complete (or weakly NP-hard) if there is an algorithm for the problem whose running time is polynomial in the dimension of the problem and the magnitudes of the data involved (provided these are given as integers), rather than the base-two logarithms of their magnitudes. Such algorithms are technically exponential functions of their input size and are therefore not considered polynomial e2fb897c18

Combinatorial optimization optimization problems are the travelling salesman problem ("TSP"), the minimum spanning tree problem ("MST"), and the knapsack problem. In many such problems, such Combinatorial optimization is a subfield of mathematical optimization that consists of finding an optimal object from a finite set of objects, where the set of feasible solutions is discrete or can be reduced to a discrete set. In many such problems, such as the ones previously mentioned, exhaustive search is not tractable, and so specialized algorithms that quickly rule out large parts of the search space or approximation algorithms must be resorted to instead. Typical combinatorial optimization problems are the travelling salesman problem ("TSP"), the minimum spanning tree problem ("MST"), and the knapsack problem e2fb897c18

ε e2fb897c18 of integers and a target-sum e2fb897c18

Change-making problem It is also the most common variation of the coin change problem, a general The change-making problem addresses the question of finding the minimum number of coins (of certain denominations) that add up to a given amount of money. the integer knapsack problem, and has applications wider than just currency. It is a special case of the integer knapsack problem, and has applications wider than just currency e2fb897c18

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Strong NP-completeness while the corresponding version of the Knapsack problem can be solved in pseudo-polynomial time by dynamic programming. From a theoretical perspective any In computational complexity, strong NP-completeness is a property of computational problems that is a special case of NP-completeness. For example, the input to the bin packing problem is a list of objects of specific sizes and a size for the bins that must contain the objects—these object sizes and bin size are numerical parameters. A general computational problem may have numerical parameters e2fb897c18

It is also the most common variation of the coin change problem, a general case of partition in which, given the available denominations of an infinite set of coins, the objective is to find out the number of possible ways of making a change for a specific amount of money, without considering the order of the coins. e2fb897c18 The variant in which all inputs are positive. e2fb897c18 Combinatorial optimization is related to operations research, algorithm theory, and computational complexity theory. It has important applications in several fields, including... e2fb897c18 . For example, given the set e2fb897c18 Given a set of items, each with a weight and a value, determine which items to include in the collection so that the total weight is less than or equal to a given limit and the total value is as large as possible. e2fb897c18 {\displaystyle S} e2fb897c18 times the correct value, and at most e2fb897c18 The knapsack problem has been studied for more than a century, with early works dating as far back as 1897. e2fb897c18

Pseudo-polynomial time The goal is to solve the following optimization problem; informally, what's the best way In computational complexity theory, a numeric algorithm runs in pseudo-polynomial time if its running time is a polynomial in the numeric value of the input (the largest integer present in the input)—but not necessarily in the length of the input (the number of bits required to represent it), which is the case for polynomial time algorithms. a maximum weight capacity of a knapsack W {\displaystyle W} e2fb897c18

In general, the numeric value of the input is exponential in the input length, which is why a pseudo-polynomial time algorithm does not necessarily run in polynomial time with respect to the input length. e2fb897c18 − e2fb897c18 As an effective method, an algorithm... e2fb897c18 times the correct value. e2fb897c18 . The problem is known to be NP-complete. Moreover, some restricted variants of it are NP-complete too, for example: e2fb897c18 In contrast, a heuristic is an approach to solving problems without well-defined correct or optimal results. For example, although social media recommender systems are commonly called "algorithms", they actually rely on heuristics as there is no truly "correct" recommendation. e2fb897c18 It derives its name from the problem faced by someone who is constrained by a fixed-size knapsack and must fill it with the most valuable items. The problem often arises in resource allocation where the decision-makers have to choose from a set of non-divisible projects or tasks under a fixed budget or time constraint, respectively. e2fb897c18 An NP-complete problem with known pseudo-polynomial time algorithms is called weakly NP-complete. e2fb897c18

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