Knapsack Problem Greedy Algorithm

Continuous knapsack problem computer science, the continuous knapsack problem (also known as the fractional knapsack problem) is an algorithmic problem in combinatorial optimization In theoretical computer science, the continuous knapsack problem (also known as the fractional knapsack problem) is an algorithmic problem in combinatorial optimization in which the goal is to fill a container (with a fixed capacity) fractional amounts of different materials chosen to maximize the value of the selected materials. It is a variation of the classic knapsack problem, in which the items to be placed in the container are indivisible; however, the continuous knapsack problem may be solved in polynomial time whereas the classic knapsack problem is NP-hard. It is a classic example of how a seemingly small change in the formulation of a problem can have a large impact on its computational complexity 9c96141f1b

Coin values can be modeled by a set of n distinct positive integer values (whole numbers), arranged in increasing order as w1 through wn. The problem is: given an amount W, also a positive integer, to find a set of non-negative (positive or zero) integers {x1, x2, ..., xn}, with each xj representing how often the coin with value wj is used, which minimize the total number of coins f(W) 9c96141f1b Specifically, the 0–1 quadratic knapsack problem has the following form: 9c96141f1b

Merkle–Hellman knapsack cryptosystem It is based on the subset sum problem (a special case of the knapsack problem). A polynomial time attack was published by Adi Shamir in 1984. It was published by Ralph Merkle and Martin Hellman in 1978. As a result, the cryptosystem is now considered insecure. for decryption. The problem is as follows: given a set of integers A {\displaystyle The Merkle–Hellman knapsack cryptosystem was one of the earliest public key cryptosystems 9c96141f1b

== Problem definition == 9c96141f1b The knapsack problem has been studied for more than a century, with early works dating back to 1897. 9c96141f1b The subset sum problem is a special case of the decision and 0-1 problems where for each kind of item, the weight equals the value: 9c96141f1b There are m identical items and n different bidders. The preferences of each bidder i are given by two numbers: 9c96141f1b

Knapsack problem The knapsack problem is the following problem in combinatorial optimization: Given a set of items, each with a weight and a value, determine which items The knapsack problem is the following problem in combinatorial optimization: 9c96141f1b

In the special case in which all the agents' budgets and all tasks' costs are equal to 1, this problem reduces to the assignment problem. When the costs and profits of all tasks do not vary between different agents, this problem reduces to the multiple knapsack problem. If there is a single agent, then, this problem reduces to the knapsack problem. 9c96141f1b In multiway number partitioning, there is an integer parameter k, and the goal is... 9c96141f1b 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. 9c96141f1b

Generalized assignment problem Moreover, the size of each task might vary from one agent to the other. any algorithm for the knapsack problem into an approximation algorithm for the GAP. This problem is a generalization of the assignment problem in which both tasks and agents have a size. Using any α {\displaystyle \alpha } -approximation algorithm ALG for In applied mathematics, the maximum generalized assignment problem is a problem in combinatorial optimization 9c96141f1b

The 0-1 quadratic knapsack problem is a variation of the knapsack problem, combining the features of the 0-1 knapsack problem and the quadratic knapsack problem. 9c96141f1b == Mathematical definition == 9c96141f1b == History == 9c96141f1b In the subset sum problem, the goal is to find a subset of S whose sum is a certain target number T given as input (the partition problem is the special case in which T is half the sum of S). 9c96141f1b It is weakly NP-hard, but may be solved optimally in pseudo-polynomial time by dynamic programming. 9c96141f1b

Greedy algorithm Instances of A greedy algorithm is an algorithm which, at each step, makes the choice that is locally optimal, and subsequently does not reconsider past choices. In this sense, a greedy algorithm is a special case of a dynamic programming algorithm. If an optimization problem only depends on the partial solution of solving it for one subproblem, we can solve this problem by "greedily" considering only the locally optimal subproblem. The problem needs to have much more structure for this approach to work. In many cases, a greedy algorithm does not produce an exact solution, but can yield solutions that approximate an exact solution in a reasonable amount of time. Greedy algorithms are often used to solve combinatorial optimization problems. constraint. Uriel Feige notes that: [Greedy algorithms] may be viewed as the ultimate form of dynamic programming, in which only one partial solution is maintained. Unlike the knapsack problem, which is known to be NP-hard, the fractional knapsack problem admits a polynomial time greedy algorithm 9c96141f1b

Algorithm algorithm (/'ælgərɪðəm/) is a finite sequence of mathematically rigorous logical instructions, typically used to solve a class of specific problems or In mathematics and computer science, an algorithm ( ) is a finite sequence of mathematically rigorous logical 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). Algorithms are used as specifications for performing calculations and data processing 9c96141f1b

An example application of a knapsack auction is auctioning broadcast time among advertisers. Here, the items are the time units (e.g., seconds). Each advertiser has an advertisement of a different length (different number of seconds) and a different value for an advertisement. The goal is to select a subset of advertisements to serve in a time slot of a specific length to maximize the total value. 9c96141f1b == In special cases == 9c96141f1b Around 825 AD, Persian... 9c96141f1b The concept of public key cryptography was introduced by Whitfield Diffie and Martin Hellman in 1976. At that time they proposed the general concept of a "trap-door one-way function", a function whose inverse is computationally infeasible to calculate without some secret "trap-door information"; but they had not yet found a practical example of such a function. Several specific public-key cryptosystems were then proposed by other researchers over the next few years, such as RSA in 1977 and Merkle-Hellman in 1978. 9c96141f1b The partition problem is a special case of two related problems: 9c96141f1b 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. 9c96141f1b == Definition == 9c96141f1b O 9c96141f1b An example of a problem which admits an exact greedy solution, the activity selection problem. Given a collection of tasks which can be done between allotted time intervals, the problem is to determine the maximum number of tasks that can be done. A greedy algorithm in 9c96141f1b (... 9c96141f1b This problem in its most general form is as follows: There are a number of agents and a number of tasks. Any agent can be assigned to perform any task, incurring some cost and profit that may vary depending on the agent-task assignment. Moreover, each agent has a budget and the sum of the costs of tasks assigned to it cannot exceed this budget. It is required to find an assignment in which all agents do not exceed their budget and total profit of the assignment is maximized. 9c96141f1b

Knapsack auction The problem is NP-hard, but it has efficient constant-factor A knapsack auction is an auction in which several identical items are sold, and there are several bidders with different valuations interested in different amounts of items. bidders are publicly known, then the problem can be solved by any algorithm for the knapsack problem. The goal is to choose a subset of the bidders with a total demand, at most, the number of items and, subject to that, a maximum total value. Finding this set of bidders requires solving an instance of the knapsack problem, which explains the term "knapsack auction" 9c96141f1b

== Notation == 9c96141f1b 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. 9c96141f1b There is an optimization version of the partition problem, which is to partition the multiset S into two subsets S1, S2 such that the difference between the sum of elements in S1 and the sum of elements in S2 is minimized. The optimization version is NP-hard, but can be solved efficiently in practice. 9c96141f1b

Change-making problem the integer knapsack problem, and has applications wider than just currency. 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. It is a special case of the integer knapsack problem, and has applications wider than just currency 9c96141f1b

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 change for a specific amount of money, without considering the order of the coins. 9c96141f1b == Etymology == 9c96141f1b An instance of either the continuous or classic knapsack problems may be specified by the numerical capacity W of the knapsack, together with a collection of materials, each of which has two numbers associated with it: the weight wi of material that is available to be selected and the total value vi of that material. The goal is to choose an amount xi ≤ wi of each material, subject to the capacity constraint 9c96141f1b As an effective method, an algorithm can be expressed within a finite amount of space and time and in a well-defined formal language for calculating a function. Starting from an initial state and input, a computation occurs at each step, eventually producing output and terminating. The transition between states can be non-deterministic; randomized algorithms incorporate random input. 9c96141f1b

Partition problem pp. Wiley-Interscience. Knapsack problems: Algorithms and computer interpretations. "4 Subset-sum problem". For this reason, it has been called "the easiest hard problem". Martello, Silvano; Toth, Paolo (1990). Although the partition problem is NP-complete, there is a pseudo-polynomial time dynamic programming solution, and there are heuristics that solve the problem in many instances, either optimally or approximately. 105–136 In number theory and computer science, the partition problem, or number partitioning, is the task of deciding whether a given multiset S of positive integers can be partitioned into two subsets S1 and S2 such that the sum of the numbers in S1 equals the sum of the numbers in S2 9c96141f1b

Quadratic knapsack problem Usually, quadratic knapsack problems come with a restriction on the number of copies of each kind of item: either 0, or 1. The quadratic knapsack problem (QKP), first introduced in 19th century, is an extension of knapsack problem that allows for quadratic terms in the objective The quadratic knapsack problem (QKP), first introduced in 19th century, is an extension of knapsack problem that allows for quadratic terms in the objective function: Given a set of items, each with a weight, a value, and an extra profit that can be earned if two items are selected, determine the number of items to include in a collection without exceeding capacity of the knapsack, so as to maximize the overall profit. This special type

of QKP forms the 0-1 quadratic knapsack problem, which was first discussed by Gallo et al 9c96141f1b