Knapsack Problem Using Greedy Method

Basic applications of combinatorial optimization include, but are not limited to: 8bf7e016bf == Motivation == 8bf7e016bf == Applications == 8bf7e016bf The knapsack problem has been studied for more than a century, with early works dating back to 1897. 8bf7e016bf Specifically, the 0–1 quadratic knapsack problem has the following form: 8bf7e016bf 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. 8bf7e016bf

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: 8bf7e016bf

The partition problem is a special case of two related problems: 8bf7e016bf Combinatorial PB can be seen as a generalization of committee voting: committee voting is a special case of PB in which the "cost" of each candidate is 1, and the "budget" is the committee size. This assumption is often called the unit-cost assumption. The setting in which the projects are divisible (can receive any amount of money) is called portioning, fractional social choice, or budget-proposal aggregation. 8bf7e016bf == Definition == 8bf7e016bf (... 8bf7e016bf It is weakly NP-hard, but may be solved optimally in pseudo-polynomial time by dynamic programming. 8bf7e016bf 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. 8bf7e016bf 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 8bf7e016bf

Method of equal shares cities running participatory budgeting use the knapsack algorithm, even though it is a disproportional method. MES has been used for participatory budgeting in various European cities. It was later adapted to participatory budgeting (PB) and to simultaneous public decisions. For example, if 51% of the population support The method of equal shares (MES) is a participatory budgeting algorithm specifically designed to guarantee extended justified representation (a form of proportional representation). It was originally developed for committee elections (under

the name Rule X). It can be used with any available ballot format, including approval ballots, ranked ballots or cardinal ballots 8bf7e016bf

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. This special type of QKP forms the 0-1 quadratic knapsack problem, which was first discussed by Gallo et al. 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 8bf7e016bf

Around 825 AD, Persian... 8bf7e016bf The objective of a heuristic is to produce a solution in a reasonable time frame that is good enough for solving the problem at hand. This solution may not be the best of all the solutions to this problem, or it may simply approximate the exact solution. But it is still valuable because finding it does not require a prohibitively long time. 8bf7e016bf MES can be described as a member of a class of voting methods called expanding approvals rules introduced earlier in 2019 by Aziz and Lee for ordinal preferences (that include approval ballots). 8bf7e016bf 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. 8bf7e016bf O 8bf7e016bf

Algorithm Using memoization dynamic programming reduces the complexity of many problems from exponential to polynomial. Algorithms are used as specifications for performing calculations and data processing. The greedy method Greedy algorithms 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). complex problems 8bf7e016bf

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) 8bf7e016bf

Heuristic (computer science) Instead, the greedy algorithm In mathematical optimization and computer science, heuristic (from Greek εὑρίσκω eurísko "I find, discover") is a technique designed for problem solving more quickly when classic methods are too slow for finding an exact or approximate solution, or when classic methods fail to find any

exact solution in a search space. draw using a pen plotter. TSP is known to be NP-hard so an optimal solution for even a moderate size problem is difficult to solve. This is achieved by trading optimality, completeness, accuracy, or precision for speed. In a way, it can be considered a shortcut 8bf7e016bf

In multiway number partitioning, there is an integer parameter k, and the goal is... 8bf7e016bf == Definition and motivation == 8bf7e016bf

Partition problem For this reason, it has been called "the easiest hard problem". "4 Subset-sum problem". Knapsack problems: Algorithms and computer interpretations. Martello, Silvano; Toth, Paolo (1990). ISBN 9783540402862. 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. Wiley-Interscience 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 8bf7e016bf

A heuristic function, also simply called a heuristic, is a function that ranks alternatives in search algorithms at each branching step based on available information to decide which branch to follow. For example, it may approximate the exact solution. 8bf7e016bf

Combinatorial participatory budgeting Combinatorial participatory budgeting is the most common form of participatory budgeting. The budgeting method most common in practice is a greedy solution to a variant of the knapsack problem: the projects are ordered by decreasing Combinatorial participatory budgeting, also called indivisible participatory budgeting or budgeted social choice, is a problem in social choice. There is a fixed budget, that cannot cover all these projects. There are several candidate projects, each of which has a fixed costs. Each voter has different preferences regarding these projects. cardinal utilities. The goal is to find a budget-allocation - a subset of the projects, with total cost at most the budget, that will be funded 8bf7e016bf

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: 8bf7e016bf

Greedy algorithm Uriel Feige notes that: [Greedy algorithms] may be viewed as the ultimate form of dynamic programming, in which only one partial solution is maintained. The problem needs to have much more structure for this approach to work. In this sense, a greedy algorithm is a special case of a dynamic programming algorithm. constraint. Instances A greedy algorithm is an algorithm which, at each step, makes the choice that is locally optimal, and subsequently does not reconsider past choices. Unlike the knapsack problem, which is known to be NP-hard, the fractional knapsack problem admits a polynomial time greedy algorithm. Greedy algorithms are often used to solve combinatorial optimization problems. 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. 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 8bf7e016bf

== Mathematical definition == 8bf7e016bf Heuristics may produce results by themselves, or they may be used in conjunction with optimization algorithms to improve... 8bf7e016bf In contrast, MES guarantees proportional representation. Specifically, it satisfies an extended variant... 8bf7e016bf 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. 8bf7e016bf Selecting validators in consensus protocols, such as the blockchain; 8bf7e016bf == Etymology == 8bf7e016bf

Combinatorial optimization Typical combinatorial optimization problems are the travelling salesman problem ("TSP"), the minimum spanning tree problem ("MST"), and the knapsack problem. optimization problems are the travelling salesman problem ("TSP"), the minimum spanning tree problem ("MST"), and the knapsack problem. 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. 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 8bf7e016bf

PB rules have other applications besides proper budgeting. For example: 8bf7e016bf 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. 8bf7e016bf Locating public... 8bf7e016bf

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. It is a special case of the integer knapsack problem, and has applications wider than just currency. the integer knapsack problem, and has applications wider than just currency 8bf7e016bf

Selecting web pages that should be displayed in response to user queries; 8bf7e016bf 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). 8bf7e016bf 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. 8bf7e016bf 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. 8bf7e016bf Combinatorial optimization is related to operations research, algorithm theory, and computational complexity theory. It has important applications in several fields, including artificial intelligence, machine learning, auction theory, software engineering, VLSI, applied mathematics and theoretical computer science. 8bf7e016bf Most cities running participatory budgeting use the knapsack algorithm, even though it is a disproportional method. For example, if 51% of the population support 10 red projects and 49% support 10 blue projects, and there is only funding for 10 projects, knapsack budgeting will choose the 10 red supported by the 51%, and the 49% will go unfunded. 8bf7e016bf