**Explanation for Algorithm Project Knapsack Problem Codes**

**Constraints for the knapsack problem:**

* 3 ≤ **N** ≤ 100000;
* 1 ≤ W ≤ 2, fоr eасh item;
* 1 ≤ С ≤ 109, fоr eасh item.
* Time Limit: 1 Sec.
* Source File Limit: 50000 Bytes

Here,

N = Number of items

W = The weight of the item

C = The Cost of the item

**Greedy:**

The code implements the fractional knapsack problem, which is a classic optimization problem in computer science. The problem involves selecting a subset of items with maximum value from a set of items, where each item has a weight and a value, and a knapsack with a maximum weight capacity.

The KnapsackPackage class represents an individual item in the problem, with attributes for its weight, value, and cost (value per unit weight). The FractionalKnapsack class contains the algorithm for solving the problem, implemented in the knapsackGreProc method.

The knapsackGreProc method takes four arguments: W, V, M, and n. W and V are lists of weights and values for each item, M is the maximum weight capacity of the knapsack, and n is the total number of items.

First, the method creates a list of KnapsackPackage objects from the W and V lists, and sorts them in descending order based on their cost. It then initializes variables for the remaining capacity of the knapsack and the total value of the selected items.

The method then iterates through the sorted list of items and selects each one that can fit in the knapsack, adding its value to the total value and subtracting its weight from the remaining capacity. The method prints out information about each selected item.

If an item cannot fit in the knapsack, the method moves on to the next item. When all items have been considered or the knapsack is full, the method terminates and prints out the total value of the selected items.

The main function creates an instance of the FractionalKnapsack class and calls its knapsackGreProc method with sample input values for W, V, M, and n. The output of the program is the total value of the selected items.

**Brute:**

This code implements the 0/1 Knapsack problem using a recursive approach. The goal of this problem is to find the maximum total value that can be obtained by selecting a subset of items, given their weights and values, and a weight limit for the knapsack. The "0/1" in the problem name indicates that each item can either be selected entirely (1) or not selected at all (0).

Let's go through the code step by step:

**def knapSack(W, wt, val, n):**

**# Base case**

**if n == 0 or W == 0:**

**return 0**

The function knapSack takes four arguments: the weight capacity W, the array of weights wt, the array of values val, and the number of items n. The function first checks for a base case, where either the number of items or the weight capacity is zero. In that case, the function returns zero, since there is no value to be obtained.

**# If weight is higher than capacity, item cannot be included**

**if wt[n-1] > W:**

**return knapSack(W, wt, val, n-1)**

If the weight of the last item in the array is greater than the remaining capacity, then the item cannot be included. In that case, the function recursively calls itself with the same arguments, but with the last item removed.

**# Return the maximum value that can be obtained by either including or excluding the current item**

**else:**

**return max(val[n-1] + knapSack(W-wt[n-1], wt, val, n-1),**

**knapSack(W, wt, val, n-1))**

If the last item can be included, the function calculates the maximum value that can be obtained by either including or excluding the current item. If the item is included, the value of the item is added to the total value, and the weight capacity is reduced by the weight of the item. If the item is not included, the weight capacity remains the same. The function recursively calls itself twice, once with the item included and once with the item excluded. The maximum value of the two possibilities is returned.

**# Test the function**

**val = [60, 100, 120]**

**wt = [10, 20, 30]**

**W = 50**

**n = len(val)**

**print(knapSack(W, wt, val, n))**

This code section sets up an example problem with three items and a weight capacity of 50. The val array contains the values of the items, and the wt array contains their weights. The function is called with these arguments, and the result is printed to the console. In this case, the result is 220, which is the maximum value that can be obtained by selecting the first and third items.

**Dynamic Programming Algorithm:**

This code solves the Knapsack problem using dynamic programming. The Knapsack problem is a well-known optimization problem in computer science, where given a set of items with a weight and a value, the goal is to select a subset of the items such that their total weight is less than or equal to a given capacity, and their total value is maximized.

The code defines a function called "knapSack" that takes four parameters: W, wt, val, and n. W is the capacity of the knapsack, wt is a list of item weights, val is a list of item values, and n is the number of items.

The function first initializes a 2D table called K with zeros, where K[i][w] represents the maximum value that can be obtained using the first i items and a knapsack of capacity w.

Then, the function iterates through all possible combinations of items and knapsack capacities using two nested loops. If the weight of the current item is less than or equal to the current knapsack capacity, the function either includes or excludes the current item based on which choice would result in a higher value. If the weight of the current item is greater than the current knapsack capacity, the function excludes the current item.

Finally, the function returns the maximum value that can be obtained using all the items and the knapsack capacity W.

The code also includes a test case where the knapsack function is called with a capacity of 50 and a list of three items with weights [10, 20, 30] and values [60, 100, 120]. The output is the maximum value that can be obtained.