

```

1  #include <iostream>
2  #include <vector>
3  #include <algorithm>
4  #include <thread>
5  #include <chrono>
6
7  using namespace std;
8
9  // Structure to represent an item with value, weight, and index
10 struct Item {
11     int value;
12     int weight;
13     int index;
14     double ratio; // Value to weight ratio
15 };
16
17 // Comparator function to sort items based on their value-to-weight ratio in descending order
18 bool compare(Item a, Item b) {
19     return a.ratio > b.ratio;
20 }
21
22 // Function to clear the screen for visualizing steps
23 void clearScreen() {
24     #ifdef _WIN32
25         system("cls");
26     #else
27         system("clear");
28     #endif
29 }
30
31 // Function to display items and their status at each step
32 void displayItems(const vector<Item>& items, int knapsackWeight, double totalValue) {
33     cout << "Knapsack Weight: " << knapsackWeight << endl;
34     cout << "Total Value: " << totalValue << endl << endl;
35
36     cout << "Items in the knapsack:" << endl;
37     for (const auto& item : items) {
38         cout << "Item " << item.index + 1 << " | Value: " << item.value << " | Weight: " << item.weight
39             << " | Ratio: " << item.ratio << endl;
40     }
41     cout << endl;
42 }
43
44 // Function to solve the Fractional Knapsack problem and visualize the process
45 void fractionalKnapsackVisualization(vector<Item>& items, int capacity) {
46     // Sort items based on their value/weight ratio in descending order
47     for (auto& item : items) {
48         item.ratio = (double)item.value / item.weight;
49     }
50     sort(items.begin(), items.end(), compare);
51
52     int knapsackWeight = 0;
53     double totalValue = 0.0;
54     clearScreen();
55
56     for (const auto& item : items) {
57         if (knapsackWeight + item.weight <= capacity) {
58             // If the full item fits, take it
59             knapsackWeight += item.weight;
60             totalValue += item.value;
61             clearScreen();
62             displayItems(items, knapsackWeight, totalValue);
63             cout << "Full item " << item.index + 1 << " taken!" << endl;
64             std::this_thread::sleep_for(std::chrono::seconds(1));
65         } else {
66             // Take the fraction of the item that fits

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67         int remainingWeight = capacity - knapsackWeight;
68         double fraction = (double)remainingWeight / item.weight;
69         knapsackWeight += remainingWeight;
70         totalValue += item.value * fraction;
71         clearScreen();
72         displayItems(items, knapsackWeight, totalValue);
73         cout << "Fraction of item " << item.index + 1 << " taken: "
74             << fraction * 100 << "%" << endl;
75         break; // After fractional inclusion, the knapsack is full
76     }
77 }
78 }
79
80 // Main function
81 int main() {
82     int n, capacity;
83
84     cout << "Enter number of items: ";
85     cin >> n;
86
87     vector<Item> items(n);
88
89     cout << "Enter capacity of the knapsack: ";
90     cin >> capacity;
91
92     for (int i = 0; i < n; ++i) {
93         cout << "Enter value and weight of item " << i + 1 << ": ";
94         cin >> items[i].value >> items[i].weight;
95         items[i].index = i;
96     }
97
98     fractionalKnapsackVisualization(items, capacity);
99
100     return 0;
101 }
102

```