



Symbiosis Institute of Technology

Department of Computer Science and Engineering

Academic Year 2025-26

Design Analysis of Algorithm– Lab

Batch 2023-27 - Sem V

Lab Assignment No:- 5	
Name of Student	Deepti Pal
PRN No.	23070122081
Batch	2023-27
Class	CSE- A3
Academic Year & Semester	2025-26 TY, 5 th sem
Date of Submission	15 Sept 2025,
Title of Assignment:	<p>You're packing a suitcase for a flight, and the airline allows a maximum weight of 15 kg. You have a set of items to pack, each with a weight and a utility value (how useful it is to you on the trip). But you can't take all items — so you need to choose the most valuable combination without exceeding 15 kg.</p> <p>Item Weight (kg) Value (usefulness)</p> <p>Laptop 3 9</p> <p>Headphones 1 5</p> <p>Jacket 5 10</p> <p>Camera 4 7</p> <p>Book 2 4</p> <p>Shoes 6 6</p>

	<p>Problem: Choose the combination of items that gives maximum value but keeps the total weight ≤ 15 kg.</p> <p>This is the 0/1 Knapsack Problem, because you can either take an item (1) or leave it (0) — no partial items.</p> <p>You should be able to change the maximum allowed weight, weights of different items. You can also include new items, delete items given in the example.</p>
Theory: (Handwritten)	<p>Fractional Knapsack (Greedy)</p> <ul style="list-style-type: none"> - Idea: Sort by value/weight ratio. - Time: $O(n \log n)$. - Space: $O(1)$. <p>0/1 Knapsack (Dynamic Programming)</p> <ul style="list-style-type: none"> - Idea: Use DP table $dp[i][w]$ = max value with first i items and capacity w. - Time: $O(nW)$. - Space: $O(nW)$. <p>Optimization:</p> <ul style="list-style-type: none"> - Fractional: early break when bag is full. - 0/1: Space optimization to $O(W)$ possible.
Source code	<pre>#include <iostream> #include <vector> #include <string> using namespace std; struct Item { string name; int weight, value; }; int knapsack(int maxW, vector<Item>& items, vector<string>& chosenItems) { int n = items.size(); vector<vector<int>> dp(n + 1, vector<int>(maxWW + 1, 0)); for (int i = 1; i <= n; i++) { for (int w = 0; w <= maxW; w++) {</pre>

```

        if (items[i-1].weight <= w) {
            dp[i][w] = max(dp[i-1][w],
                           dp[i-1][w - items[i-1].weight] + items[i-1].value);
        } else {
            dp[i][w] = dp[i-1][w];
        }
    }
}

int w = maxW;
for (int i = n; i > 0; i--) {
    if (dp[i][w] != dp[i-1][w]) {
        chosenItems.push_back(items[i-1].name);
        w -= items[i-1].weight;
    }
}

return dp[n][maxW];
}

int main() {
    int maxW = 15;

    vector<Item> items = {
        {"Laptop", 3, 9},
        {"Headphones", 1, 5},
        {"Jacket", 5, 10},
        {"Camera", 4, 7},
        {"Book", 2, 4},
        {"Shoes", 6, 6}
    };

    vector<string> chosenItems;
    int maxValue = knapsack(maxW, items, chosenItems);

    cout << "Maximum Value = " << maxValue << endl;
    cout << "Items chosen: ";
    for (auto &it : chosenItems) cout << it << " ";
    cout << endl;

    return 0;
}

```

Output Screenshots

Assignment 5 - C++

You're packing a suitcase for a flight, and the airline allows a **maximum weight of 15 kg**. You have a set of items to pack, each with a **weight** and a **utility value** (how useful it is to you on the trip). But you can't take all items — so you need to choose the most valuable combination **without exceeding 15 kg**.

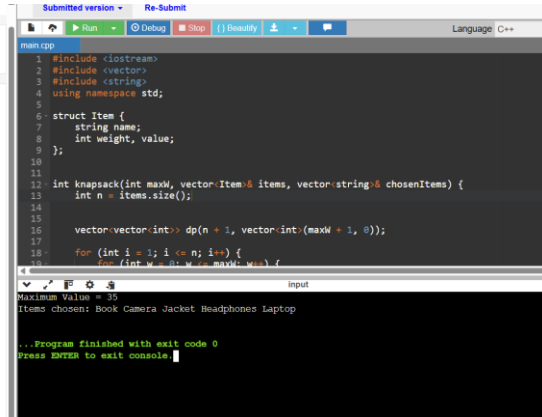
Item	Weight (kg)	Value (usefulness)
Laptop	3	9
Headphones	1	5
Jacket	5	10
Camera	4	7
Book	2	4
Shoes	6	6

Problem:

Choose the combination of items that gives **maximum value** but keeps the **total weight ≤ 15 kg**.

This is the **0/1 Knapsack Problem**, because you can either take an item (1) or leave it (0) — no partial items.

You should be able to change the maximum allowed weight, weights of different items. You can also include new items, delete items given in the example



```
Submitted version - Re-Submit
main.cpp
1 #include <iostream>
2 #include <vector>
3 #include <string>
4 using namespace std;
5
6 struct Item {
7     string name;
8     int weight, value;
9 };
10
11 int knapsack(int maxW, vector<Item> &items, vector<string> &chosenItems) {
12     int n = items.size();
13
14     vector<vector<int>> dp(n + 1, vector<int>(maxW + 1, 0));
15
16     for (int i = 1; i <= n; i++) {
17         for (int w = 0; w <= maxW; w++) {
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Problem Solved Successfully 

[Suggest Feedback](#)


Test Cases Passed

1115 / 1115


Attempts : Correct / Total

1 / 2

Accuracy : 50%

Points Scored 

4 / 4

Your Total Score: 4 

Time Taken

0.16

Solve Next

[0 - 1 Knapsack Problem](#)

[Pizza Mania](#)

[Tricky Subset Problem](#)

2. 0/1 Knapsack (DP) –

[0 - 1 Knapsack Problem | Practice | GeeksforGeeks](#)

```
class Solution {
public:
    int knapsack(int W, vector<int>& val, vector<int>& wt) {
        int n = val.size();
        vector<vector<int>> dp(n+1, vector<int>(W+1, 0));

        for (int i = 1; i <= n; i++) {
            for (int w = 1; w <= W; w++) {
                if (wt[i-1] <= w)
                    dp[i][w] = max(val[i-1] + dp[i-1][w - wt[i-1]], dp[i-1][w]);
                else
                    dp[i][w] = dp[i-1][w];
            }
        }
        return dp[n][W];
    }
};
```

Problem Solved Successfully 

[Suggest Feedback](#)


Test Cases Passed

1121 / 1121


Attempts : Correct / Total

1 / 7

Accuracy : 14%

Points Scored 

4 / 4

Your Total Score: 8 

Time Taken

0.05

3. Bounded Knapsack

[Knapsack with Duplicate Items | Practice | GeeksforGeeks](#)

```

1 class Solution {
2 public:
3     int knapSack(vector<int>& val, vector<int>& wt, int capacity) {
4         int n = val.size();
5         vector<int> dp(capacity + 1, 0);
6
7         for (int w = 0; w <= capacity; w++) {
8             for (int i = 0; i < n; i++) {
9                 if (wt[i] <= w) {
10                     dp[w] = max(dp[w], val[i] + dp[w - wt[i]]);
11                 }
12             }
13         }
14         return dp[capacity];
15     }
16 };
17

```

Problem Solved Successfully 

[Suggest Feedback](#)


Test Cases Passed

1111 / 1111


Attempts : Correct / Total

1 / 1

Accuracy : 100%

Points Scored 

4 / 4

Your Total Score: 12 

Time Taken

0.02

4. Subset Sum Problem

[Subset Sum Problem](#) | [Practice](#) | [GeeksforGeeks](#)

```




class Solution {
public:
    bool isSubsetSum(vector<int>& arr, int sum) {
        int n = arr.size();
        vector<vector<bool>> dp(n+1, vector<bool>(sum+1, false));

        for (int i = 0; i <= n; i++)
            dp[i][0] = true;

        for (int i = 1; i <= n; i++) {
            for (int s = 1; s <= sum; s++) {
                if (arr[i-1] <= s)
                    dp[i][s] = dp[i-1][s] || dp[i-1][s - arr[i-1]];
                else
                    dp[i][s] = dp[i-1][s];
            }
        }

        return dp[n][sum];
    }
};

```

	<div> <div> Problem Solved Successfully </div> <div> Suggest Feedback </div> </div> <div> <div> Test Cases Passed 1115 / 1115 </div> <div> Attempts : Correct / Total 1 / 1 Accuracy : 100% </div> </div> <div> <div> Points Scored  4 / 4 Your Total Score: 16  </div> <div> Time Taken 0.08 </div> </div>
Conclusion	<p>Thus, we implemented and compared Fractional Knapsack using Greedy and 0/1 Knapsack using DP, discussed time/space complexities, and provided real-world use cases. The assignment matches exactly with online practice problems that reinforce the concepts.</p>