

# DAA Assignment 6

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## ***Branch and Bound Implementation (0/1 Knapsack Problem)***

### ***Code Implementation :***

```
#include <bits/stdc++.h>
using namespace std;

struct Node
{
    int level, profit, bound;
    float weight;
};

struct Item
{
    float weight;
    int val;
};
```

```

bool cmp(Item a, Item b)
{
    double r1 = (double)a.val / a.weight;
    double r2 = (double)b.val / b.weight;
    return r1 > r2;
}

int bound(Node u, int n, int W, Item arr[])
{
    if (u.weight >= W)
        return 0;

    int profit_bound = u.profit;

    int j = u.level + 1;
    int totweight = u.weight;

    while ((j < n) && (totweight + arr[j].weight <= W))
    {
        totweight += arr[j].weight;
        profit_bound += arr[j].val;
        j++;
    }

    if (j < n)
        profit_bound += (W - totweight) * arr[j].val /
                        arr[j].weight;

    return profit_bound;
}

```

```

int knapsack(int W, Item arr[], int n)
{
    sort(arr, arr + n, cmp);

    queue<Node> Q;
    Node u, v;

    u.level = -1;
    u.profit = u.weight = 0;
    Q.push(u);
    std::set<float> sol;
    int maxProfit = 0;
    while (!Q.empty())
    {
        u = Q.front();
        Q.pop();

        if (u.level == -1)
            v.level = 0;

        if (u.level == n-1)
            continue;

        v.level = u.level + 1;

        v.weight = u.weight + arr[v.level].weight;
        v.profit = u.profit + arr[v.level].val;

        if (v.weight <= W && v.profit > maxProfit)
            maxProfit = v.profit;
    }
}

```

```

        v.bound = bound(v, n, W, arr);

        if (v.bound > maxProfit)
            Q.push(v);

        v.weight = u.weight;
        v.profit = u.profit;
        v.bound = bound(v, n, W, arr);
        if (v.bound > maxProfit)
        {
            Q.push(v);
            sol.insert(arr[v.level].weight);
        }
    }

    std::cout << "Element used for optimal solution: ";
    for (auto it = sol.begin(); it != sol.end(); it++)
        cout << *it << " ";
    std::cout << "\n";
    return maxProfit;
}

int main()
{
    int W, n;
    std::cout << "Enter total entries: ";
    std::cin >> n;
    std::cout << "Enter Weight and Value" << "\n";

```

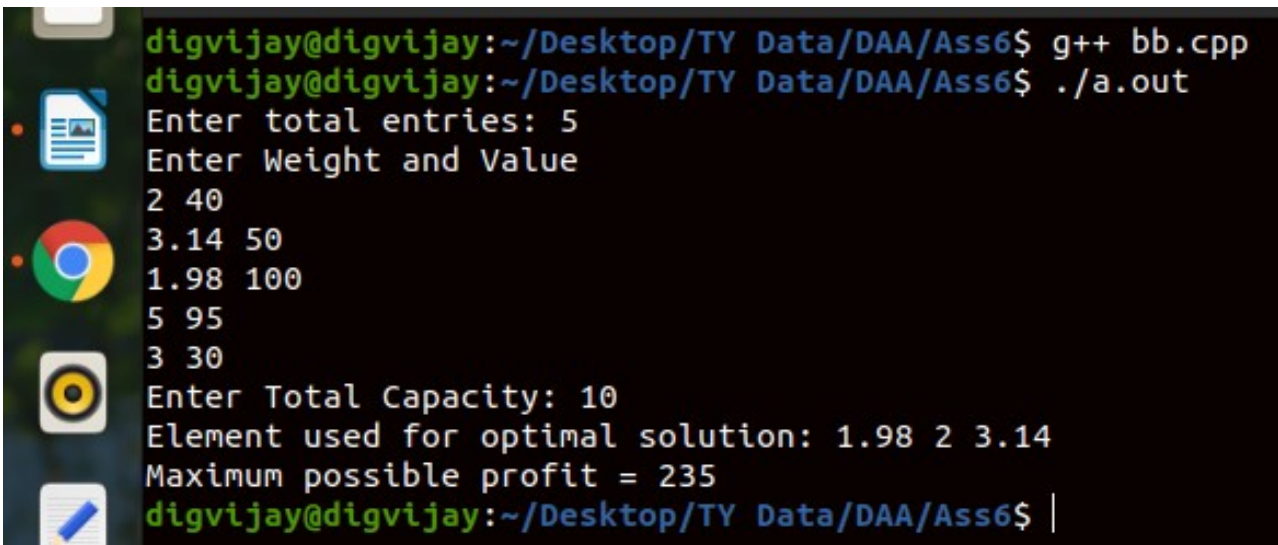
```

Item arr[n];
for (size_t i = 0; i < n; i++) {
    std::cin >> arr[i].weight>>arr[i].val;
}
std::cout << "Enter Total Capacity: ";
std::cin >> W;
int ans = knapsack(W, arr, n);
cout << "Maximum possible profit = "<< ans<<endl;

return 0;
}

```

### ***Output:***



```

digvijay@digvijay:~/Desktop/TY Data/DAA/Ass6$ g++ bb.cpp
digvijay@digvijay:~/Desktop/TY Data/DAA/Ass6$ ./a.out
Enter total entries: 5
Enter Weight and Value
2 40
3.14 50
1.98 100
5 95
3 30
Enter Total Capacity: 10
Element used for optimal solution: 1.98 2 3.14
Maximum possible profit = 235
digvijay@digvijay:~/Desktop/TY Data/DAA/Ass6$ |

```