Worksheet-2.3

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Subject Name: DAA **Subject Code: 23CSH-301**

1.Aim: Develop a program and analyze complexity to implement 0-1 Knapsack using Dynamic Programming.

2.Objective: To implement the 0-1 Knapsack problem using Dynamic Programming (Bottom-Up Tabulation) and analyze its time and space complexity for efficient problem solving.

3.Requirements (Hardware/Software): Online Java compiler.

4.Algorithm :

1. Input number of items n, weight array wt[], value array val[], and capacity W.
2. Create a table dp[n+1][W+1].
3. Initialize first row and first column as 0.
4. For each item i = 1 to n:
   - For each capacity w = 1 to W:
     a) If wt[i-1] ≤ w, set
        dp[i][w] = max(val[i-1] + dp[i-1][w - wt[i-1]], dp[i-1][w]).
     b) Else set dp[i][w] = dp[i-1][w].
5. Return dp[n][W] as the maximum value.
6. End.

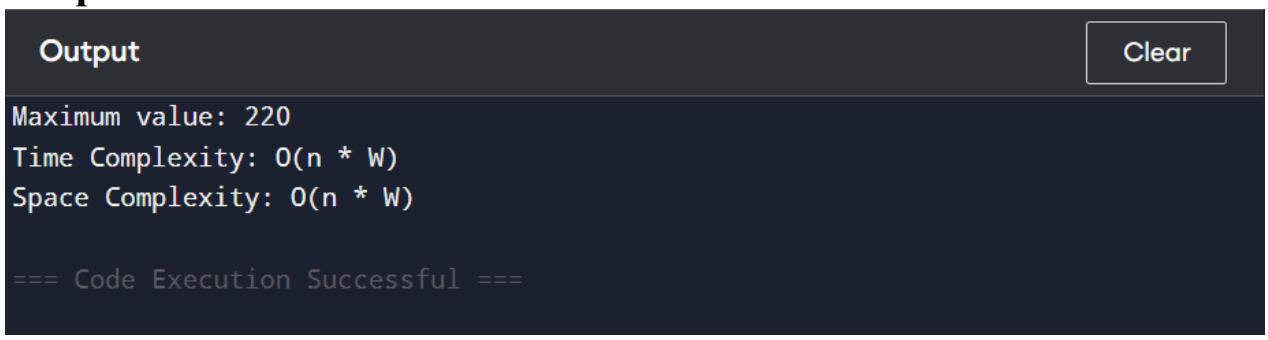
5.Procedure:

```
class Main {
   static int knapSack(int W, int wt[], int val[], int n) {
      int dp[][] = new int[n+1][W+1];
      for (int i = 1; i <= n; i++) {
         for (int w = 1; w <= W; w++) {
            if (wt[i-1] <= w) {
               dp[i][w] = Math.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];
   }
   public static void main(String[] args) {
      int val[] = {60, 100, 120};
      int wt[] = {10, 20, 30};
      int W = 50;
      int n = val.length;
      int result = knapSack(W, wt, val, n);
      System.out.println("Maximum value: " + result);
      System.out.println("Time Complexity: O(n * W)");
      System.out.println("Space Complexity: O(n * W)");
   }
}
```

Time Complexity : Best Case: O(n*w)

Space complexity : O(n*w)

Output:



Learning Outcomes :

1. Understand the application of Dynamic Programming to solve optimization problems like 0-1 Knapsack..
2. Gain the ability to analyze time and space complexities of DP-based solutions.
3. Develop skills to implement efficient algorithms in Java using bottom-up tabulation.