

## Dynamic Programming | Set 14 (Maximum Sum Increasing Subsequence)

Given an array of  $n$  positive integers. Write a program to find the sum of maximum sum subsequence of the given array such that the integers in the subsequence are sorted in increasing order. For example, if input is {1, 101, 2, 3, 100, 4, 5}, then output should be 106 (1 + 2 + 3 + 100), if the input array is {3, 4, 5, 10}, then output should be 22 (3 + 4 + 5 + 10) and if the input array is {10, 5, 4, 3}, then output should be 10

### Solution

This problem is a variation of standard [Longest Increasing Subsequence \(LIS\) problem](#). We need a slight change in the Dynamic Programming solution of [LIS problem](#). All we need to change is to use sum as a criteria instead of length of increasing subsequence.

Following is C implementation for Dynamic Programming solution of the problem.

```
/* Dynamic Programming implementation of Maximum Sum Increasing
Subsequence (MSIS) problem */
#include<stdio.h>

/* maxSumIS() returns the maximum sum of increasing subsequence in arr[] of
size n */
int maxSumIS( int arr[], int n )
{
    int *msis, i, j, max = 0;
    msis = (int*) malloc ( sizeof( int ) * n );

    /* Initialize msis values for all indexes */
    for ( i = 0; i < n; i++ )
        msis[i] = arr[i];

    /* Compute maximum sum values in bottom up manner */
    for ( i = 1; i < n; i++ )
        for ( j = 0; j < i; j++ )
            if ( arr[i] > arr[j] && msis[i] < msis[j] + arr[i] )
                msis[i] = msis[j] + arr[i];

    /* Pick maximum of all msis values */
    for ( i = 0; i < n; i++ )
        if ( max < msis[i] )
            max = msis[i];

    /* Free memory to avoid memory leak */
    free( msis );

    return max;
}
```

```
/* Driver program to test above function */
int main()
{
    int arr[] = {1, 101, 2, 3, 100, 4, 5};
    int n = sizeof(arr)/sizeof(arr[0]);
    printf("Sum of maximum sum increasing subsequence is %d\n",
           maxSumIS( arr, n ) );

    getchar();
    return 0;
}
```

[Run on IDE](#)

Time Complexity:  $O(n^2)$

Source: [Maximum Sum Increasing Subsequence Problem](#)

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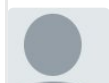
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Here's C++ code along with the elements of the subsequence