

# Longest Bitonic Subsequence

## Problem

Given an array  $a[]$  of size  $n$ , our task is to find the longest bitonic subsequence

Bitonic: Unlike LIS, it can first increase and then decrease.

Possible bitonic subsequences nature

1. First increases then decreases
2. Only increases
3. Only decreases

Example

4	1	3	6	8	7	12	10	5
---	---	---	---	---	---	----	----	---

Few subsequences which are valid

$\{4\}$ ,  $\{4,1,3\}$ ,  $\{8,7,5\}$ ,  $\{1,3,6,8\}$ ,  $\{1,3,6,8,12,10,5\}$ ,  $\{1,3,6,7,12,10,5\}$

Maximum Length = 7.

## Brute force approach

1. Compute all subsequences
2. Choose the one with maximum length and following the property of bitonic subsequences.

Time Complexity:  $O(2^n)$

Optimal Solution (Using dynamic programming)

1. Similar to the longest increasing subsequence question.
2. Make two tables of LIS,
  - a. One from starting (LIS1)
  - b. Other from end (LIS2)

3. Iterate over both the tables/ arrays and store the maximum of  $(lis1[i] + lis2[i]-1)$ .
4. Output this maximum value.

APNI KAKSHA