Good Evening Everyone!!

- L.I.S
- Russian Doll Envelopes
- Count of palindromic substrings.
- Palindromic partition

Longest Increasing Subsequence (L.I.S)

arr[] → [6, 9, 10, 13, 20] ans = 5.

arr[] → [13, 6, 2, 1] ans = 1

[0, 2, 6, 9, 13, 15]

arr[] → [0, 8, 4, 12, 2, 10, 6, 14, 1, 9, 5, 13, 3, 11, 7, 15]

ans = 6

B.F idea. → Consider all the subsequences. T.C - $O(2^N \times N)$

2nd Approach -

arr[] → [10, 3, 12, 7, 9, 11, 20, 11, 13, 6, 8]

0 1 2 3 4 5 6 7 8 9 10

dp →

1	1	2	2	3	4	5	4	5	2	3
0	1	2	3	4	5	6	7	8	9	10

[10] [3] [10,12] [3,7] [3,7,9] [3,7,9,11,20] [3,7,9,11,13] [3,6] [3,6,8]

[3,12] [3,7,9,11] [3,7,9,11] [3,7,8]

dp[i] → Longest increasing subsequence ending at index-i.

code →

```
int dp[N];

dp[0] = 1 , ans = 1;

for( i = 1; i < n; i++){
        max = 0;
        for( j = 0; j < i; j++){
            if(arr[j] < arr[i]){
                max = Math.max(max, dp[j]);
            }
        }
        dp[i] = 1 + max ;
        ans = Math.max(ans, dp[i]);
}

return ans;
```

T.C → O(N²)
S.C → O(N)

→ Longest Increasing Subarray (L.I.S)

[1 2 3 7 | 5 | 3 11 25 30 40 | 20]
(4) (1) (5) (1)

T.C → O(N)

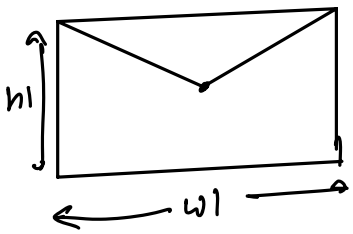
```
main ( ) {
    int ans = 0;
    int dp[N],   ∀i, dp[i] = -1;
    for( i = 0; i < N; i++){
        ans = max(ans, lis(arr[], i, dp));
    }
    print(ans);
}

int lis ( int[] arr, int i, dp[N]) {
    if(dp[i] != -1) {return dp[i]}
    int max = 0;
    for( j = 0; j < i; j++){
        if(arr[j] < arr[i]){
            max = Math.max(max, lis(arr[], j, dp));
        }
    }
    dp[i] = max + 1;
    return dp[i];
}
```

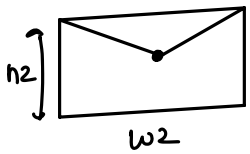
⑤ Russian Doll Envelopes.

N- different envelopes.

find max count of envelopes that can be put in a single envelope.

* Rotation of envelope is not allowed.

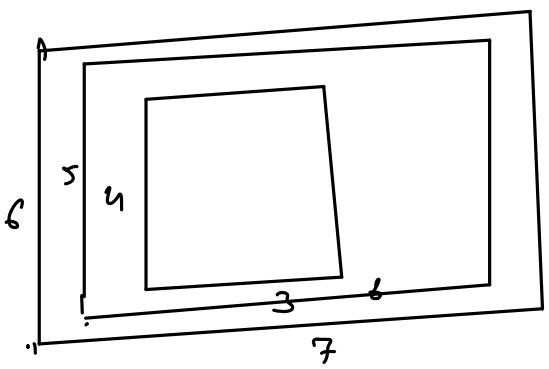




$[h2 < h1$
$w2 < w1]$

	h	w	
A →	5	6	→ 20
B →	6	4	→ (24)
C →	6	7	→ 42
D →	4	3	→ (12)

ans = 3



h → [9 5 10 3 4 2]

w → [3 4 8 2 3 7]

↓ ↓ ↓ ↓ ↓ ↓

27 20 80 6 12 14

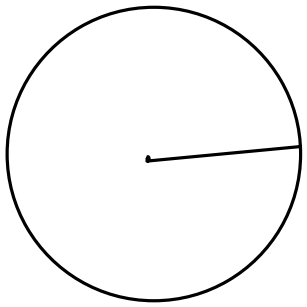
ans = 4.

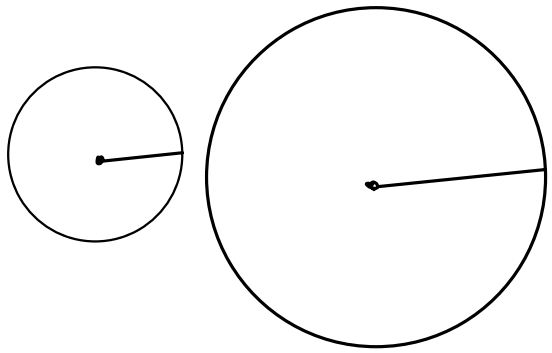
Sorting on the basis of

- ht → ht ✗
- wd → wd ✗
- Area → Area ✓
- ht/wd → ht/wd ✗

r → 5, 6, 7, 3, 9, 4, 9

3, 4, 5, 6, 7, 9





idea → Sort on 1 dimension & apply l.i.s on 2nd dimension.

ht[] → [1 2 3 4 4 5 7 10 10 12 15]

wt[] → [10 3 7 9 11 20 11 6 13 8 2]

list[] → [1 1 2 3 3 4 4 2 5 3 1]

code →

① Sort on the basis of ht.

②
```
int dp[N];
dp[0]= 1 , ans= 1;
for( i = 1; i < n; i++){
    max=0;
    for( j=0; j < i ; j++){
        if( wt[j] < wt[i] && ht[j] < ht[i]){
            max = Math.max(max, dp[j]);
        }
    }
    dp[i] = 1 + max ;
    ans = Math.max(ans, dp[i]);
}
return ans;
```

T.C → O(N²)

S.C → O(N)

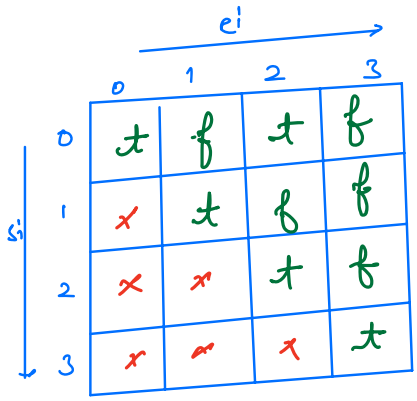
③ Given a string. For every substring, check if that is a palindrome or not.

$1 \le N \le 10^3$

S = "abac"
0 1 2 3

a ab aba abac
b ba bac
a ac
c

Expected o/p.



B.f. ⇒ Consider all the substrings & for every substring check if it is a palindrome or not.

T.C → O(N³)

observation

{ str[i] == str[j], copy the ans present at dp[i+1][j-1]
str[i] != str[j], dp[i][j] = false }

gap=0	gap=1	gap=2	gap=3
0,0	0,1	0,2	0,3
1,1	1,2	1,3	
2,2	2,3		
3,3			

#code.→

```
boolean dp[N][N];

for( gap = 0 ; gap < N ; gap++){
    for( i=0, j=gap ; j < N ; i++, j++){
        if(gap==0){ dp[i][j] = true }
        else if(gap==1){ dp[i][j] = (str[i] == str[j]) }
        else{
            if( str[i] == str[j]){ dp[i][j] = dp[i+1][j-1] }
            else { dp[i][j] = false }
        }
    }
}
return dp[][];
```

T.C → O(N²)
S.C → O(1)

→ Count all palindromic substrings → no. of true's in dp[][]

→ longest palindromic substring → max gap where true is present

ans → gap+1

④ Find min no. of cuts to partition the string such that all the partitions are palindrome.

Eg → x x | y ans = 1

x | a | b a a b | p ans = 3

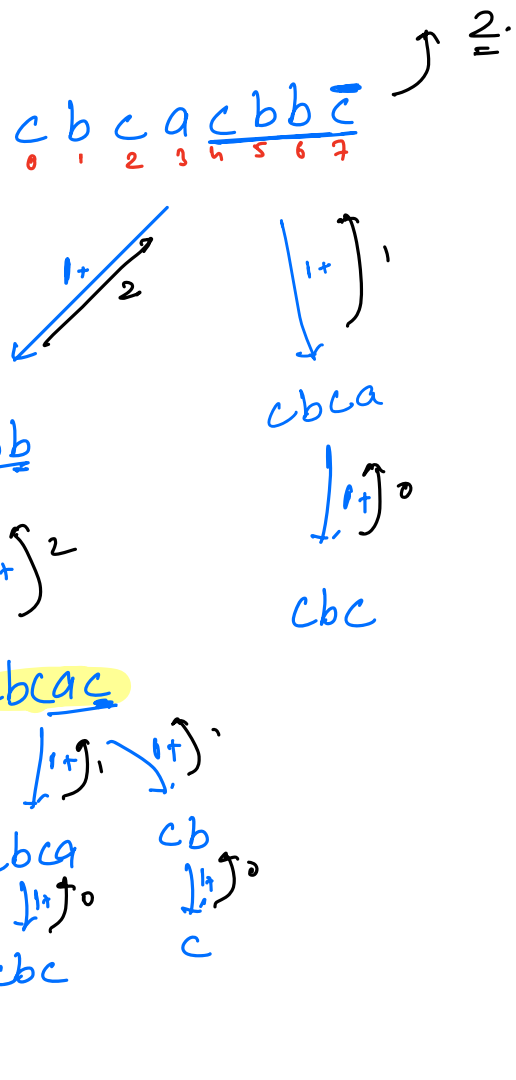
a b b a | c ans = 1

a | b b | c b c ans = 2

Greedy → select the longest palindromic substring first ✗

c | b c a c b | b | c

c b c | a | c b b c



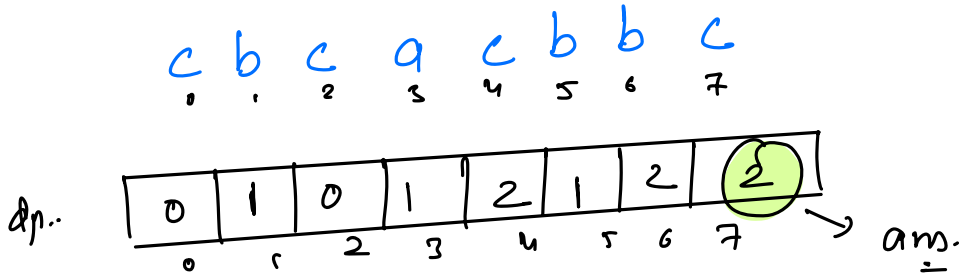
#code:-

```
int minCuts( str, j (N-1), int dp[N] ){
    if( checkPalindrome(str,0,j) == true ){        → dp2[0][j]
        return 0;
    }
    if(dp[j] != -1) { return dp[j] }
    min → ∞
    for( int cut = j ; cut > 0 ; cut--){
        if( checkPalindrome( str, cut, j) == true ){    dp2[cut][j]
            min = Min( min , minCuts(str, cut-1, dp) );
        }
    }
    dp[j] = min + 1 ;
    return dp[j];
}
```

T.C → $O(N^2 + N^2)$

S.C → $O(N^2 + N)$

→ bottom-up



dp(i) → min no. of cuts required to partition the str[0,i] such that every substring is a palindrome.