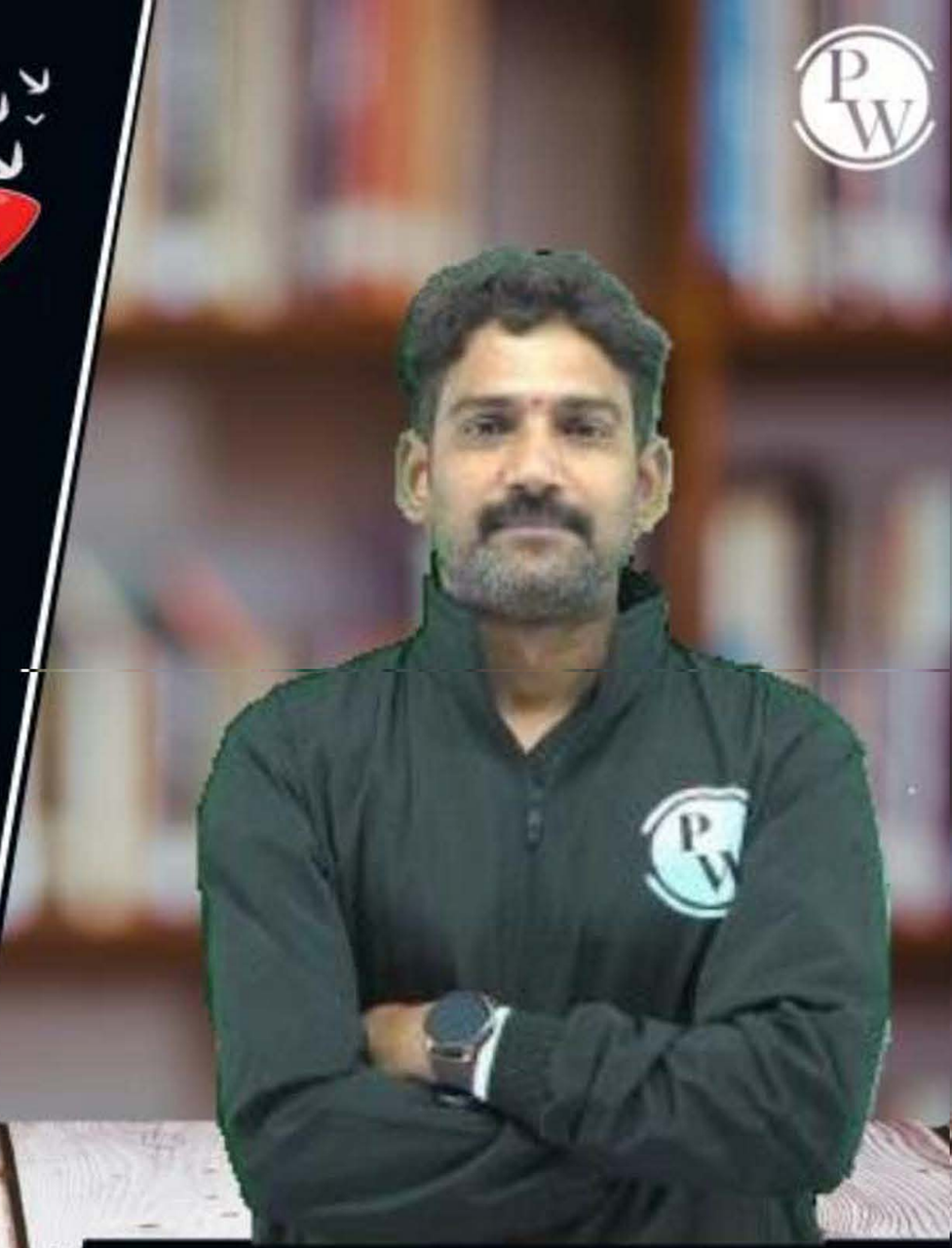
Data Science & Artificial Intelligence

Data Structure through Python

Super 1500+

Lecture No.- 01



By- Satya sir

Topics to be Covered

- Arrays Data Structure
- As Lists in Python
  - Time complexity
  - Number of Comparisons for an Operation
  - Storage Point of View

Prog + DS + Algo : Expected weightage : 15+ Marks

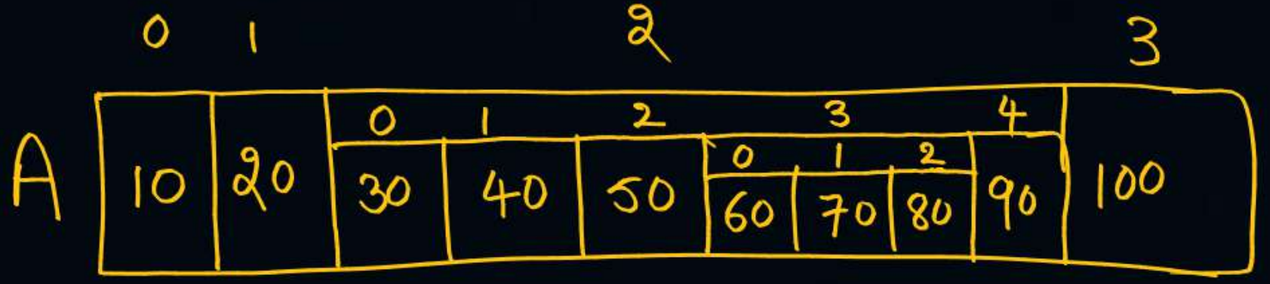
#Q. The value of answer = _____?

[Nested lists == multi-dimensional array]

```
A=[10,20,[30,40,50,[60,70,80],90],100]
answer=0
for i in range(len(A)):
    if i==2:
        for j in range(len(A[i])):
            if j==3:
                for k in range(len(A[i][j])):
                    answer=answer + k
            else:
                answer=answer + j
    else:
        answer=answer + i
print(answer)
```

#14

len(A) = 4



i=0 answer = 0+0 = 0

i=1 answer = 0+1 = 1

i=2 len(A[2]) == 5

i=3 ans = 11+3 = 14

j=0 1+0 =1

j=1 1+1 =2

j=2 2+2 =4

j=3 len(A[2][3]) == 3

k=0 4+0=4

k=1 4+1=5

k=2 5+2=7

j=4 ans = 7+4 = 11

C:

```
int A[ ][4] = {{1,2},{3},{5,6,7}}
```

No. of rows == 3

No. of cols in Each row == 4

A	0	1	2	3
0	1	2	0	0
1	3	0	0	0
2	5	6	7	0

```
Printf("%d", A[1][3]) # 0
```

```
int A[][4] = {1,2,3}
```

1	2	3	0
0	0	0	0
0	0	0	0

Python

```
A = [[1,2],[3],[5,6,7]]
```

No. of rows == 3

No. of cols in Each row ⇒ Not fixed

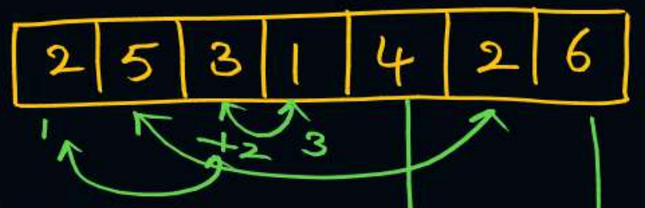
Row 0	1	2	
Row 1	3		
Row 2	5	6	7

```
print(A[1][3]) # Error index out of range.
```

```
A = [1,2,3] ⇒ 1-D array
A = [[1],[2],[3]] ⇒ 2-D array of 3×1
```

#Q. Let A be an array containing integer values. The distance of A is defined as the minimum number of elements in A that must be replaced with another integer so that the resulting array is sorted in non-decreasing order. The distance of the array [2,5,3,1,4,2,6] is _____ GATE 2024 CS

Given Array =



Result Array [Expected]

Minimum Number of elements to be replaced = 3

#Q. The Total number of values printed is 7

```
a=[[1,2,3,4],[1,2,3,3],[2,3,3,4],[2,4,4,6]]
for i in range(len(a)):
    for j in range(len(a[i])):
        if a[i][j]==i+j:
            print(a[i][j])
```

1 2 3 2 3 4 6

a	0	1	2	3
0	1	2	3	4
1	1	2	3	3
2	2	3	3	4
3	2	4	4	6

len(a) = 4

i	len(a[i])	j=0	j=1	j=2	j=3
0	4	1==0 False	2==1 False	3==2 False	4==3 False
1	4	1==1 True Print 1	2==2 True Print 2	3==3 True Print 3	3==4 False
2	4	2==2 True Print 2	3==3 True Print 3	3==4 False	4==5 False
3	4	2==3 False	4==4 True Print 4	4==5 False	6==6 True Print 6

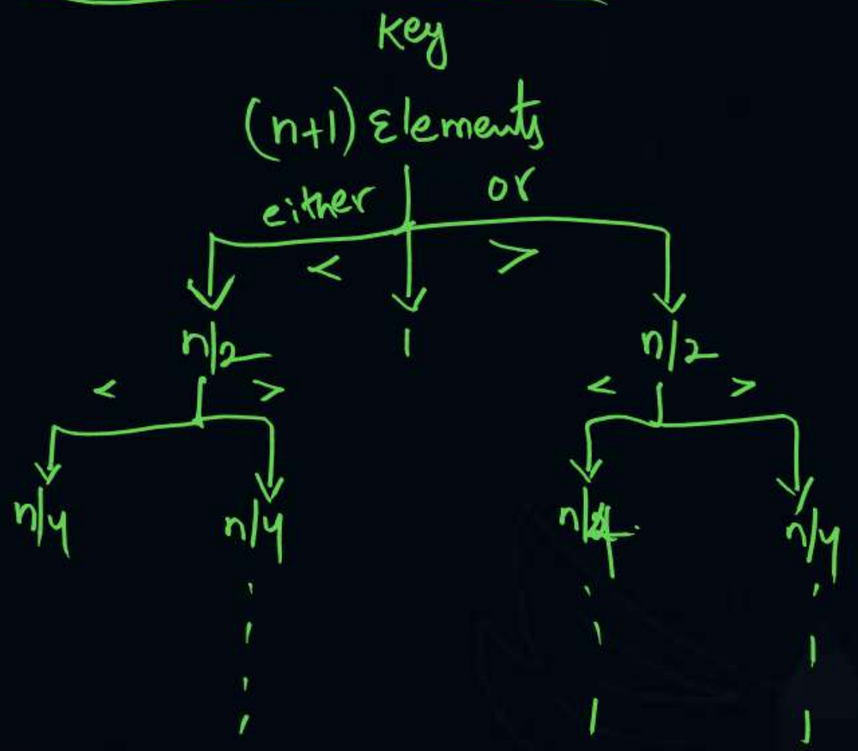
#Q. What is the worst-case number of arithmetic operations performed by recursive binary search on a sorted array of size n?

A. $\Theta(\sqrt{n})$

B. $\Theta(\log_2(n))$

C. $\Theta(n^2)$

D. $\Theta(n)$



$n/2^K = 1$

$\Rightarrow n = 2^K \Rightarrow K = \lceil \log_2 n \rceil$ time complexity

#Q. Let A be an array of 31 numbers consisting of a sequence of 0's followed by a sequence of 1's. The problem is to find the smallest index i such that A[i] is 1 by probing the minimum number of locations in A. The worst case number of probes performed by an optimal algorithm is_____.

Worst Case Scenario

Possibility 1: 0000000000 00000 00000 00000 00000 !

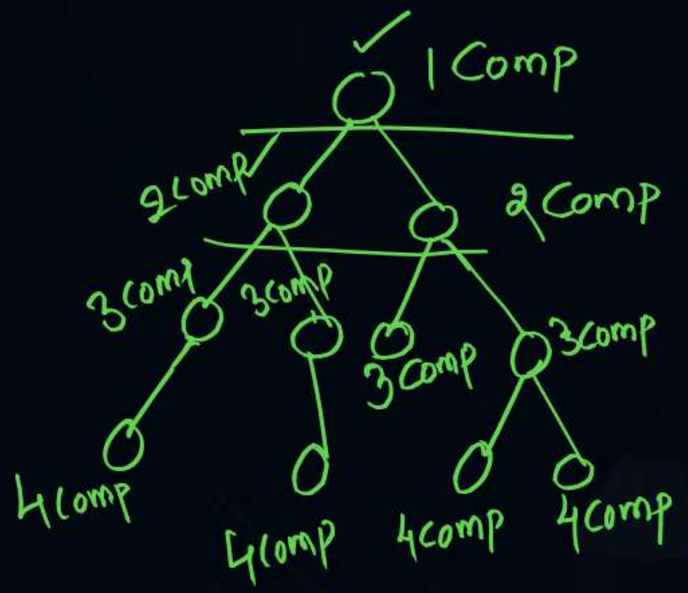
1 2 3 4 5 6 7 8 9 - - - - - - - - - 30

Possibility 2: 0 1111 11111 11111 11111 11111 11111 1

Binary search Algo is followed $\Rightarrow \lceil \log_2 n \rceil = \lceil \log_2 31 \rceil = 5$

#Q. Suppose there are 11 items in sorted order in an array. How many searches are required on the average, if binary search is employed and all searches are successful in finding the item?

A. 3.00
B. 3.46
C. 2.81
D. 3.33



Total Comparisions = 1+2+2+3+3+3+3+4+4+4+4

= 33 Comparisons

Average = $\frac{33}{11}$ = 3.00

#Q. Let A(1:8, -5:5, -10:5) be a three-dimensional array. How many elements are there in the array A?

Total

(End - Start) + 1

A. 1200
B. 1408
C. 33
D. 1050

1st dimension: 1, 2, 3, 4, 5, 6, 7, 8 ⇒ 8

2nd dim = -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5 ⇒ 11

3rd dim = (5 - (-10)) + 1 = 16

⇒ Total Elements = 8 * 11 * 16

= 8 * 176

= 1408

#Q. Consider the below Code:

a=[[[1,2],[2,3],[3,4]],[[3,1],[4,5],[2,3]]]

Let The dimension of array be d, respective count of dimensions be d1,d2 and so on.

Then d+Sum(Dimensions,d1) = _____ $d + d_1 + d_2 + d_3 + \cdots =$ _____

$d_2, d_3 \cdots$

Example:

if 2-dimensional array 3×4

$\Rightarrow d = 2$

$d_1 = 3$

$d_2 = 4$

$d + d_1 + d_2 + d_3$

$= 3 + 2 + 3 + 2$

$= 10$

1st dimension Count = 2 = d_1

2nd dimension Count = 3 = d_2

3rd dimension Count = 2 = d_3

It is a 3-D array $\Rightarrow d = 3$

#Q. Consider the following declaration of a two dimensional array in C:

Hlw-4

char a[100][100];

Assuming that the main memory is byte-addressable and that the array is stored starting from memory address 0, the address of a [40][50] is :

A. 4040
B. 4050
C. 5040
D. 5050

#Q. Consider the following two C code segments. Y and X are one and two dimensional arrays of size n and n × n respectively, where 2 ≤ n ≤ 10. Assume that in both code segments, elements of Y are initialized to 0 and each element X[i][j] of array X is initialized to i + j. Further assume that when stored in main memory all elements of X are in same main memory page frame.

#H/W-5

Code segment 1:

```
for i in range(n):
    y[i] + = X[0][i];
```

Code segment 2:

```
for i in range(n):
    y[i] + = X[i][0];
```

Which of the following statements is/are correct?

S1: Final contents of array Y will be same in both code segments.
S2: Elements of array X accessed inside the for loop shown in code segment 1 are contiguous in main memory.
S3: Elements of array X accessed inside the for loop shown in code segment 2 are contiguous in main memory.

(A) Only S2 is correct
(B) Only S3 is correct
(C) Only S1 and S2 are correct
(D) Only S1 and S3 are correct

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#Q. Suppose you are given an array s[1..n] and a procedure reverse (s, i, j) which reverses the order of elements in a between positions i and j (both inclusive). What does the following sequence do, where 1 <= k <= n:

```
reverse(s, 1, k) ;
reverse(s, k + 1, n);
reverse(s, l, n);
```

A. Rotates s left by k positions
B. Leaves s unchanged
C. Reverses all elements of s
D. None of the above

SUPER 1500+ - DSP- CLASS – 1 - Homework Question - 2

#Q. Consider a 2-dimensional array x with 10 rows and 4 columns, with each element storing a value equivalent to the product of row number and column number.

The array row major format. If the first element x[0][0] occupies the memory location with address 1000 and each element occupies only one memory location, which all locations (in decimal) will be holding a value of 10 ?

A. 1018, 1019
B. 1022, 1041
C. 1013, 1014
D. 1000, 1399

SUPER 1500+ - DSP- CLASS – 1 - Homework Question - 3

#Q. The minimum number of comparisons required to determine if an integer appears more than n/2 times in a sorted array of n integers is

A. $\Theta(n)$

B. $\Theta(\log n)$

C. $\Theta(n*\log n)$

D. $\Theta(1)$

2 mins Summary

- Arrays DS in Python

NEXT CLASS TOPIC: STACK

THANK - YOU