

# Data Structure

## Tree

DPP-01

[NAT]

1. A binary tree has 1024 leaves. The number of nodes in the tree having two children is \_\_\_\_\_.

[MCQ]

2. The height of a tree is the length of the longest root-to-leaf path in it. The maximum and minimum number of nodes in a binary tree of height 9 are-
- (a) 1024, 9                      (b) 1023, 10  
(c) 511, 9                      (d) 512, 10

[NAT]

3. In a binary tree, the number of internal nodes of degree 1 is 6, and the number of internal nodes of degree 2 is 12. The number of leaf nodes in the binary tree is \_\_\_\_\_.

[MCQ]

4. A strict k-ary tree T is a tree that contains exactly 0 or k children. The number of leaf nodes in tree T if there are exactly 'p' internal nodes is-
- (a)  $(k-1)p + 1$               (b)  $pk + 1$   
(c)  $pk + 1 + p$               (d) None

[NAT]

5. A linked list is used to store a binary tree with 1024 nodes. The number of null pointers present is \_\_\_\_\_.

[NAT]

6. Let T be a full binary tree with 4 leaves. (A full binary tree has every level full). Suppose two leaves x and y of T are chosen uniformly and independently at random. The expected value of the distance between x and y in T (i.e., the number of edges in the unique path between x and y) is (rounded off to 2 decimal places) \_\_\_\_\_.

[MCQ]

7. The number of leaf nodes in a rooted tree of n nodes, with each node having 0 or 2 children is-
- (a)  $\frac{n+1}{2}$                       (b)  $\frac{n-1}{2}$   
(c)  $\frac{n}{2}$                       (d)  $n-1$

## Answer Key

1. (1023)
2. (b)
3. (13)
4. (a)

5. (1025)
6. (2.5)
7. (a)



## Hints and Solutions

1. (1023)

If there are 'n' leaf nodes, the number of internal nodes with 2 children is 'n - 1'.

2. (b)

Minimum number of nodes in a binary tree of height 9 = 10

Maximum number of nodes in a binary tree of height 9 =  $2^{10} - 1 = 1023$

3. (13)

If there are 'n' internal nodes of degree 2, the number of leaf nodes is 'n + 1'.

4. (a)

Number of internal nodes	Number of leaf nodes
0	1
1	k
2	$k + k - 1$ i.e $2k - 1$
3	$2(2k - 1) - k$ i.e $3k - 2$
.	.
.	.
.	.
p	$pk - (p - 1)$ i.e $(k - 1)p + 1$

5. (1025)

The number of null pointers =  $1024 + 1 = 1025$

6. (2.5)

Any two leaf nodes can be selected in  $4 * 4 = 16$  ways

Path length between x and y (i)	0	2	4
Number of ways	4	4	8
P(i)	$\frac{4}{16}$	$\frac{4}{16}$	$\frac{8}{16}$

The expected value of the distance between x and y in T-

$$E(i) = \sum i * P(i) = 0 \times \frac{4}{16} + 2 \times \frac{4}{16} + 4 \times \frac{8}{16} = 2.50$$

7. (a)

Number of nodes	Number of leaf nodes
1	1
3	2
5	3
7	4
.	.
.	.
.	.
n	$\frac{n + 1}{2}$



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