



SAGAR INSTITUTE OF RESEARCH AND TECHNOLOGY BHOPAL
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Semester

IV

Subject Code

CS402

Subject Name

Analysis Design of Algorithm

Unit-5

Topic: Tree Traversal



As Per

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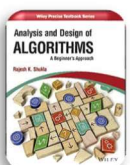
New Scheme Based on AICTE Flexible Curricula
Computer Science and Engineering

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Traversal of Binary Tree

Traversing is a process in which each node is visited exactly once. Like other data structures, the elements (nodes) of a tree can also be traversed therefore when each node (element) of the Tree is traversed exactly once, it is called as Tree Traversal. We can perform any operation (depends on the application) on the node traversed; Traversal of a tree includes traversal of **Root**, traversal of **Left sub tree** and traversal of **Right sub tree**. There are three different methods of Tree traversal.

All these traversal methods perform the same steps but the sequences of these steps differ. The common steps for all traversal techniques are as follows:

1. Traverse (visit) the root denoted by N.
2. Traverse (visit) the left subtree denoted by L.
3. Traverse (visit) the right subtree denoted by R.

The different traversal methods are as follows:

Pre-order traversal (**NLR**)

1. Traverse the node (N)
2. Traverse the left sub tree (L) in *pre-order*
3. Traverse the right sub tree (R) in *pre-order*

In-order traversal (**LNR**)

1. Traverse the left sub tree (L) in *in-order*
2. Traverse the node (N)
3. Traverse the right sub tree (R) in *in-order*

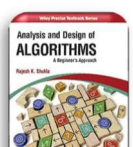
Post-order traversal (**LRN**)

1. Traverse the left sub tree (L) in *post-order*
2. Traverse the right sub tree (R) in *post-order*
3. Traverse the node (N)



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Pre-order traversal

N L R

In-order traversal

L **N** R

Post-order traversal

L R **N**

We can observe here that the **left subtrees are always traversed before the right subtrees** in all the three-traversal techniques

The different traversal order depends on the sequence when root is traversed

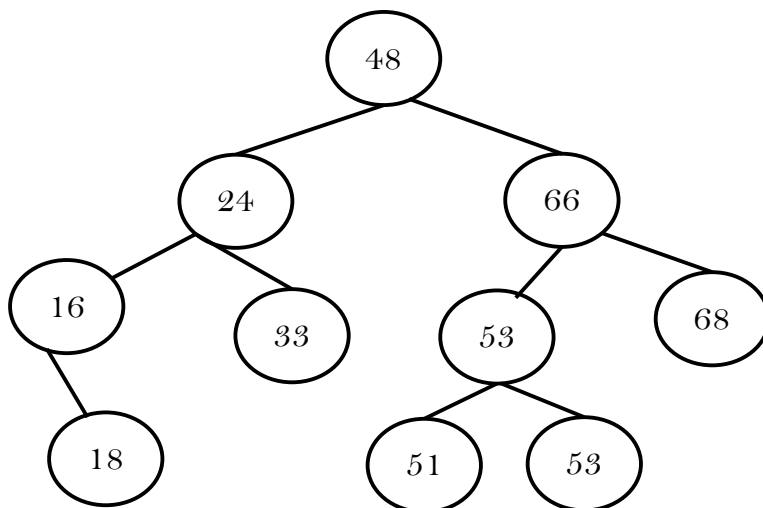
If **Root node (N)** is traversed first then it is **pre order traversal**

If **Root node (N)** is traversed in between then it is **in order traversal**

If **Root node (N)** is traversed last then it is **post order traversal**

Let us explain with an example

Example: Find the Pre order Traversal Sequence of the following tree



Solution: Pre-order traversal (**NLR**) is

1. Traverse the node (N)
2. Traverse the left sub tree (L) in *pre-order*
3. Traverse the right sub tree (R) in *pre-order*

As we know that the root node is traversed first in pre-order traversal followed by left subtree in pre-order and then right subtree in pre-order.



Let us redraw the Tree as shown in figure 1 for our better understanding. We can see that Root Node N is 48 and L1 is a left subtree of node N = 48 and R1 is a right subtree of N. The pre-order traversal of this tree will be 48 L1 R1 (node, left subtree, right subtree), *here the root node N (48) is traversed first followed by the left subtree (L1) and right subtree (R1).*

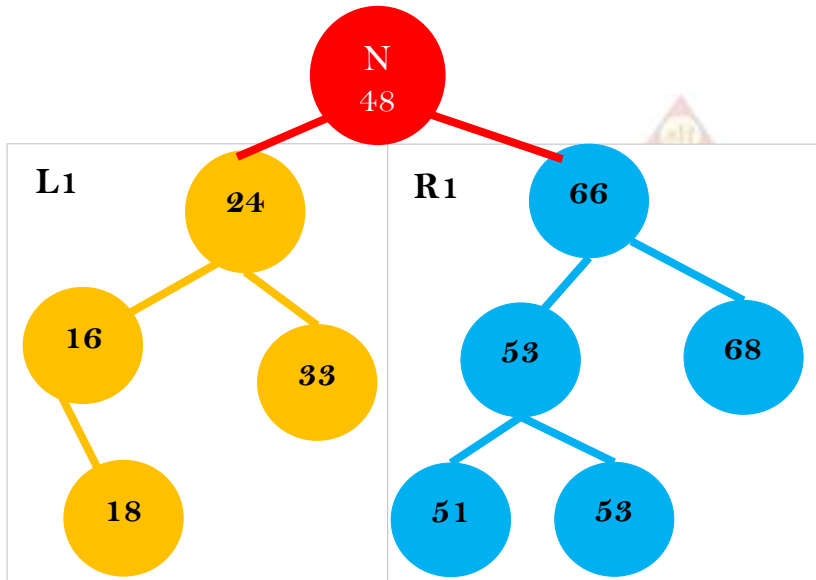


Figure 1



Figure 2

Now L1 is traversed in pre-order (NLR) as shown in figure 2. We can see that 24 is the root node N for L1 and L2 is a left subtree of node 24 and R2 is a right subtree of 24 as shown in figure 3. The pre-order traversal of this tree will be N L2 R2 (node, left subtree, right subtree), *here the root node N (24) is traversed first followed by the left subtree (L2) and right subtree (R2).*

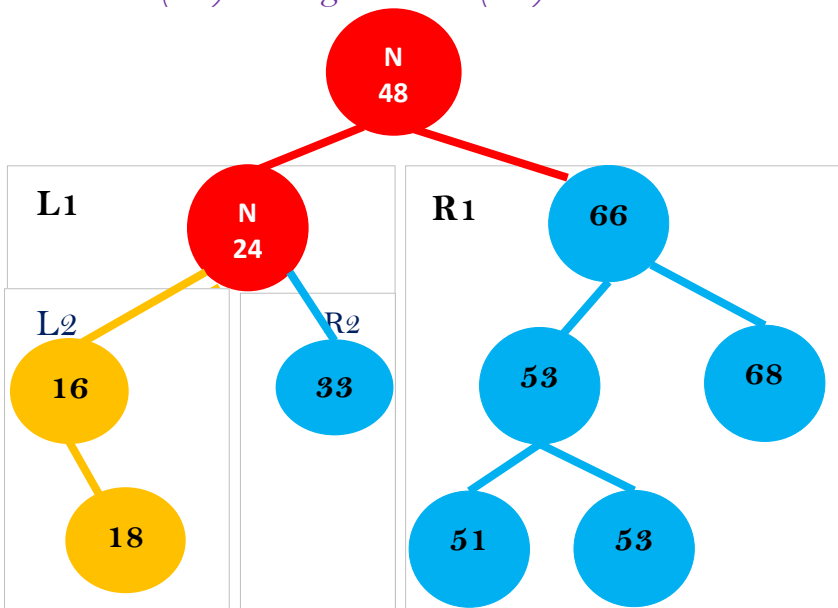


Figure 3

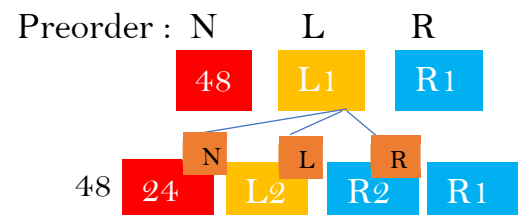
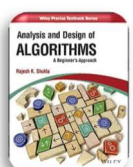


Figure 4



Now L2 is traversed in pre-order (NLR) as shown in figure 4. We can see that N is 16 for L2 i.e. 16 is the root node for L2. There is no left subtree of 16 and R3 is a right subtree of 16 as shown in figure 5. The pre-order traversal of this tree will be 16 **NULL** R3 (node, left subtree, right subtree), *here the root node N (16) is traversed first followed by the left subtree (NULL) and right subtree (R3).*

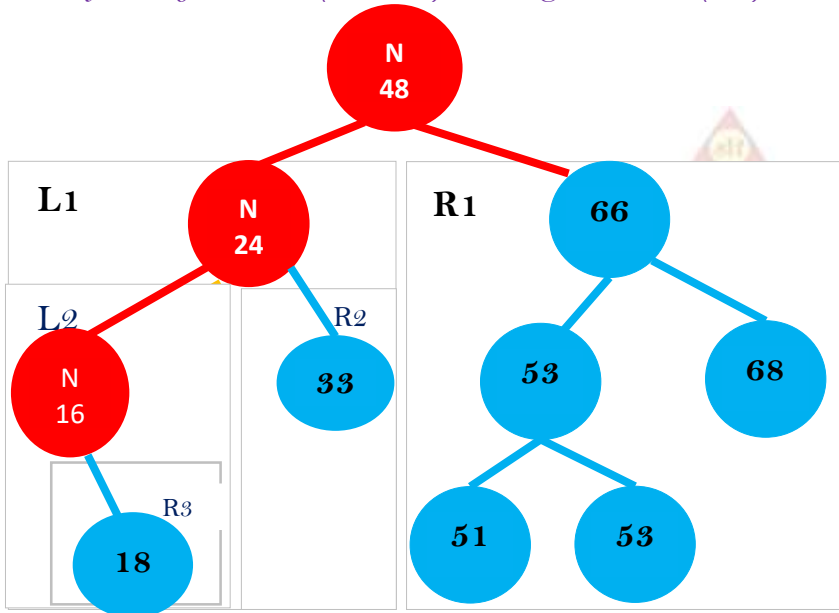


Figure 5

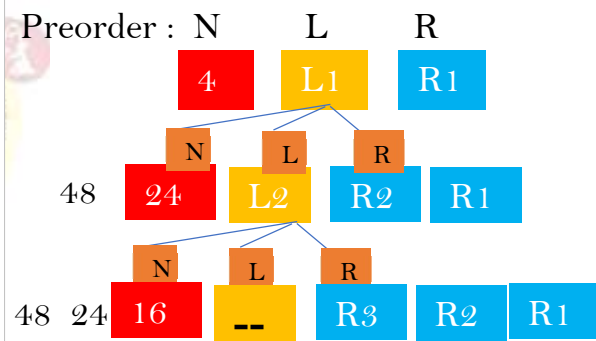


Figure 6

Now we have to find the pre-order traversal of right subtree R3 as shown in figure 6. We can see that 18 is the root node for R3 and there is no left subtree and no right subtree as well as shown in figure 7. The pre-order traversal of this tree will be 18 **NULL NULL** (node, left subtree, right subtree).

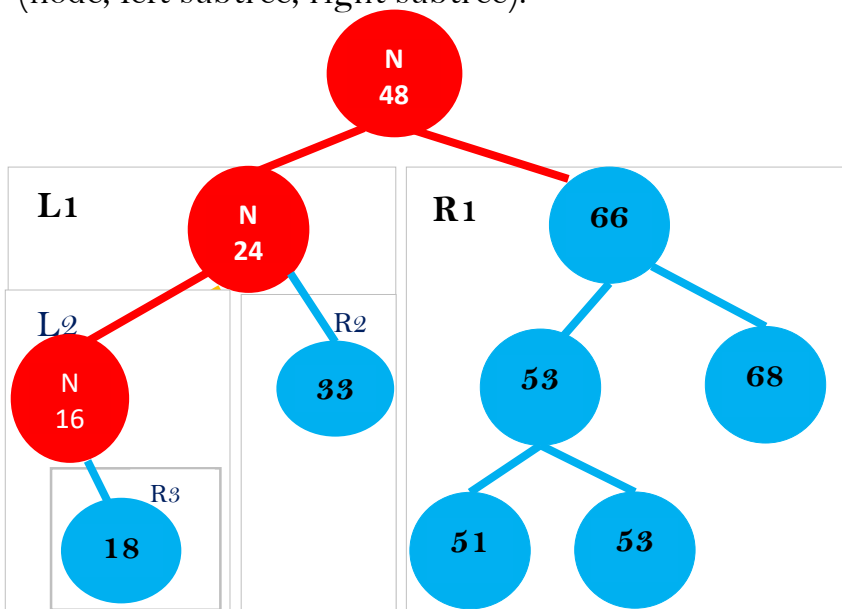


Figure 7

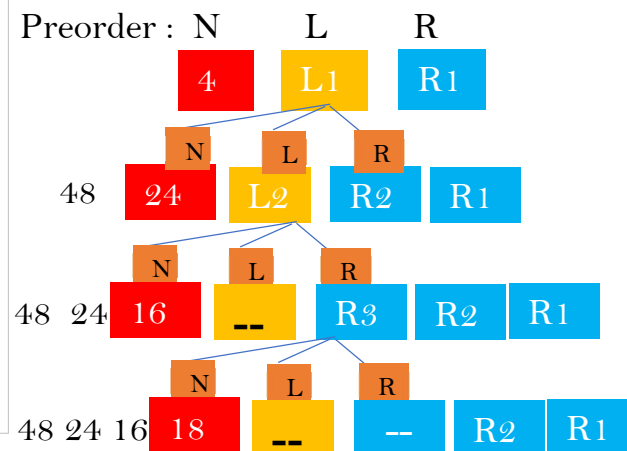


Figure 8

Now we have to find the pre-order traversal of right subtree R2 as shown in figure 8. We can see that 33 is the root node N for R2 and there is no left subtree and no right subtree as well as shown in figure 9. The pre-order traversal of this tree will be 33 NULL NULL (node, left subtree, right subtree).

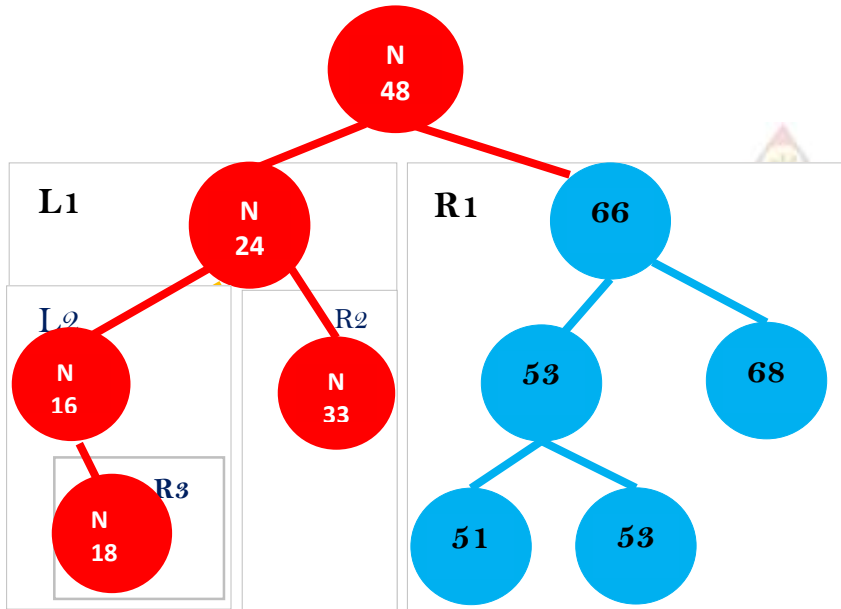


Figure 9

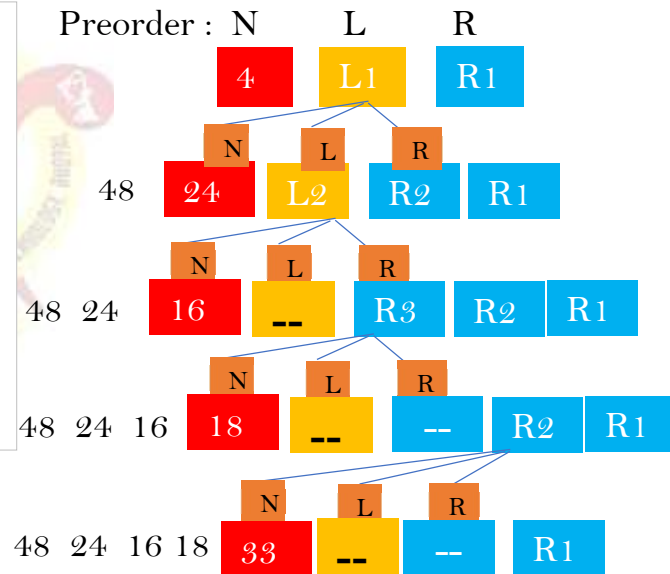


Figure 10

Now we have to find the pre-order traversal of right subtree R1 as shown in figure 10. We can see that 66 is the root node N for R1 and L3 is a left subtree of node of 66 and R4 is a subtree of 66 as shown in figure 11. The pre-order traversal of this tree will be 66 L3 R4 (node, left subtree, right subtree), *here the root node N (66) is traversed first followed by the left subtree (L3) and right subtree (R4).*

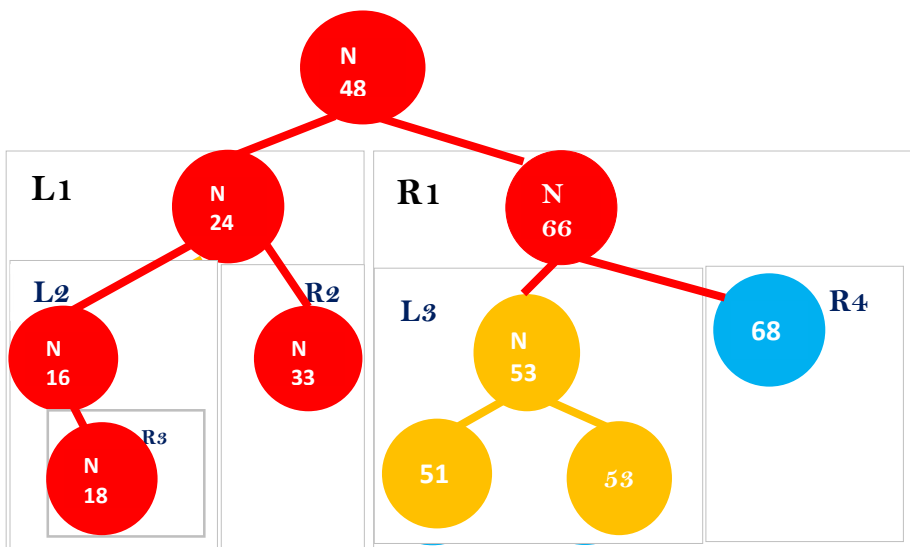


Figure 11

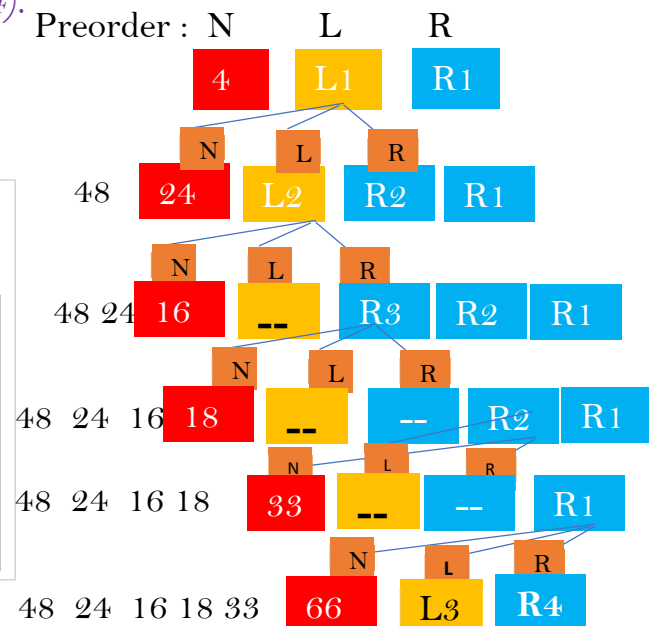


Figure 12



Now we have to find the pre-order traversal of left subtree L3 as shown in figure 12. We can see that node 53 is the root node N for L3 ; L4 is the left subtree for 53 and R5 is the right subtree for 53 as shown in figure 13. The pre-order traversal of this tree will be 53 L4 R5 (node, left subtree, right subtree).

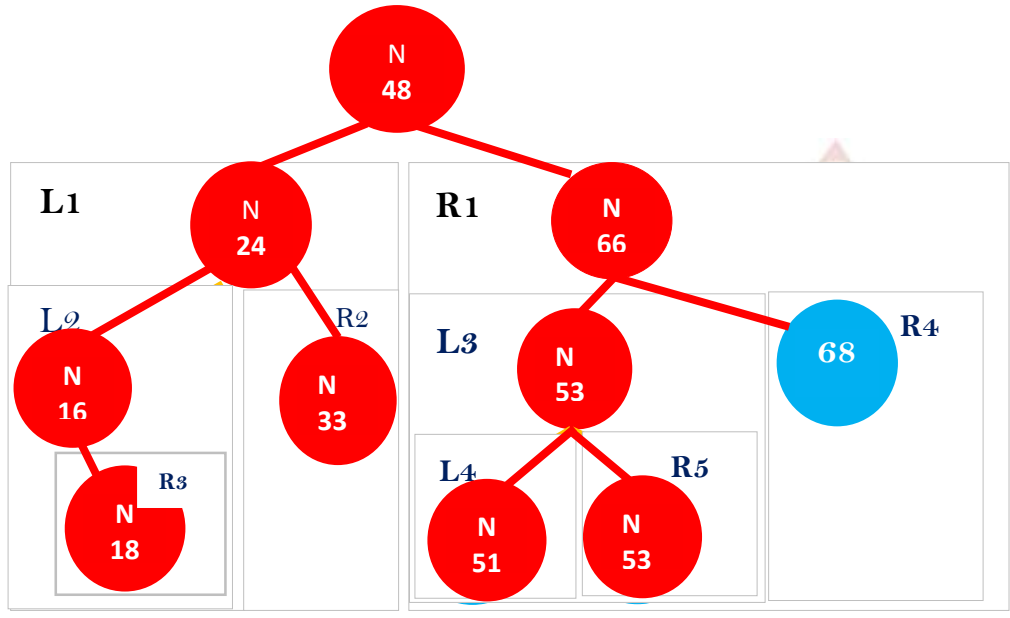


Figure 13

Pre order : Continued from previous page

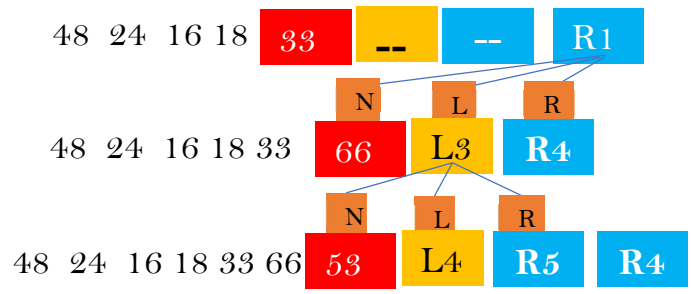
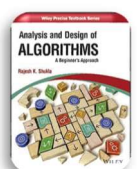


Figure 14

Now we have to find the pre-order traversal of left subtree L4 as shown in figure 14 . 51 is the root node N for L4 and there is no left and right subtree for 51. The pre-order traversal of this tree will be 51 NULL NULL (node, left subtree, right subtree) similarly the pre order traversal of R5 is to be found next as clear from figure 14. 53 is the root node N for R5 and there is no left and right subtree for 53. The pre-order traversal of this tree will be 53 NULL NULL (node, left subtree, right subtree).





In the last the pre order traversal sequence of R4 is to be found. We can see that 68 is the root node N for R4 and there is no left or right sub tree for 68 as shown in figure 15. The pre order sequence for R4 as 68 **NULL NULL**(node, left subtree, right subtree) so R will generate 68 -- as shown in figure 16

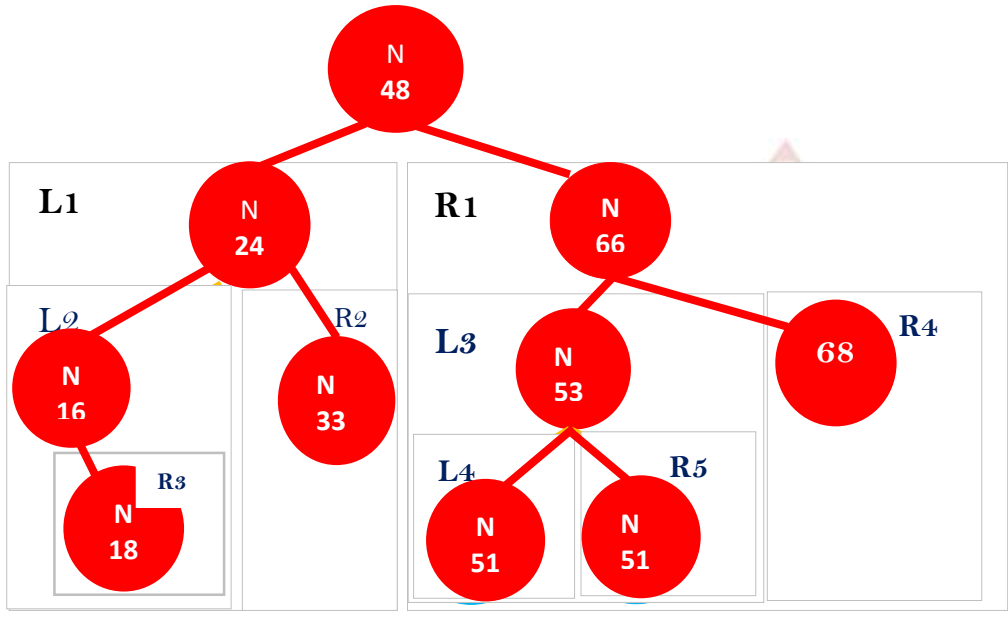


Figure 15

Pre order : Continued from previous page

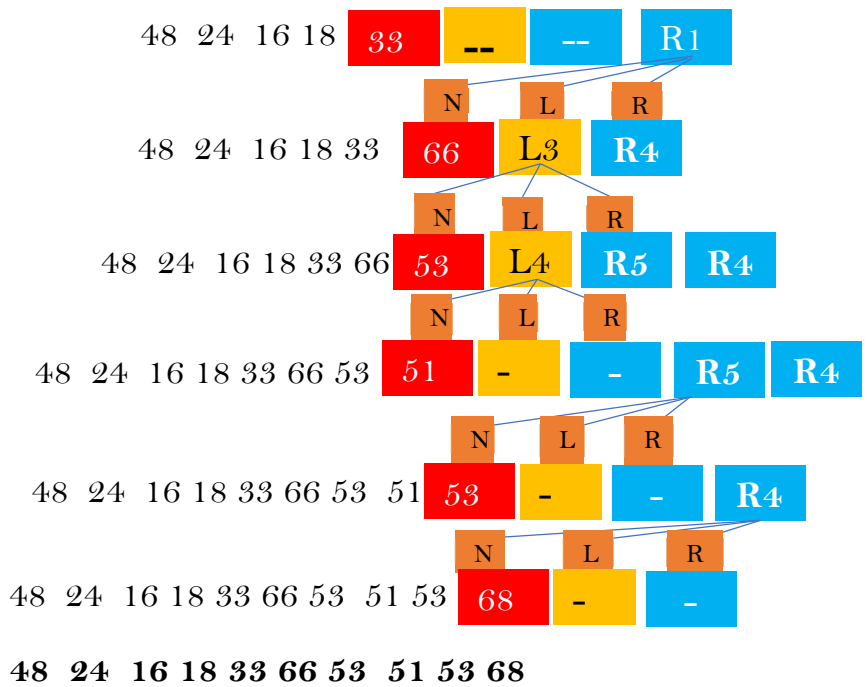
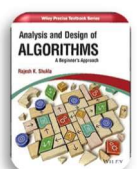


Figure 16

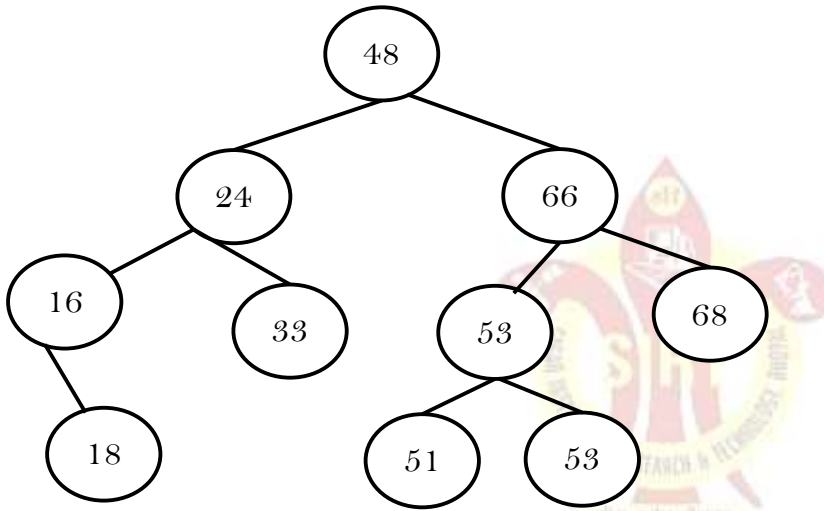
Final Pre order Sequence is 48 24 16 18 33 66 53 51 53 68





In a Similar way we can find the In-order traversal sequence and pots-order traversal sequence

Example: Find the Pre order Traversal Sequence of the following tree



Solution: In-order traversal (**LNR**) is

1. Traverse the left sub tree (L) in *in-order*
2. Traverse the node (N)
3. Traverse the right sub tree (R) in *in-order*

As we know that the left subtree is traversed first in in-order traversal followed by root and then right subtree in in-order. Let us take the tree shown in figure 17

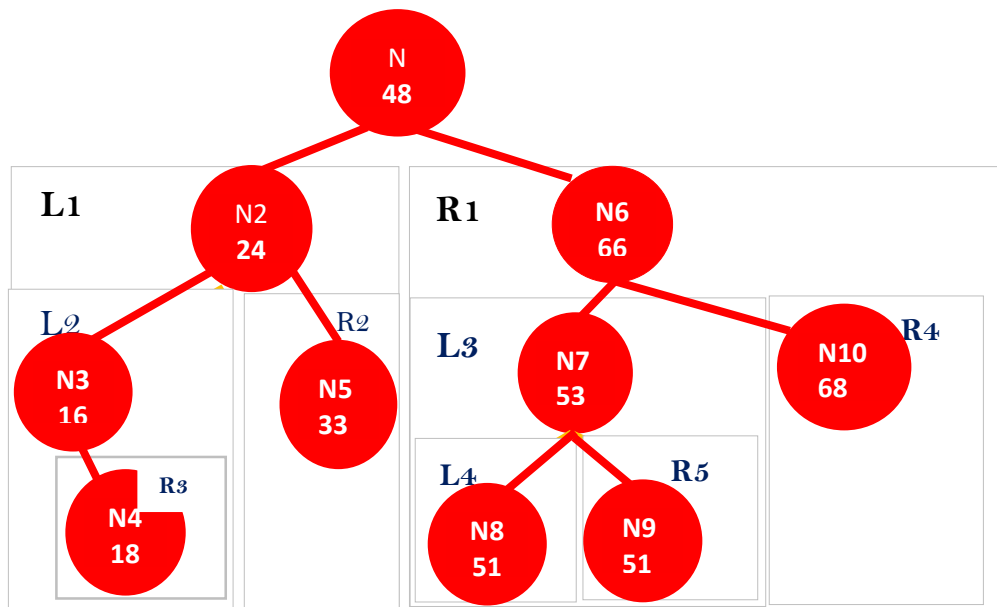
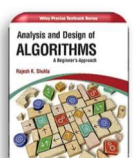
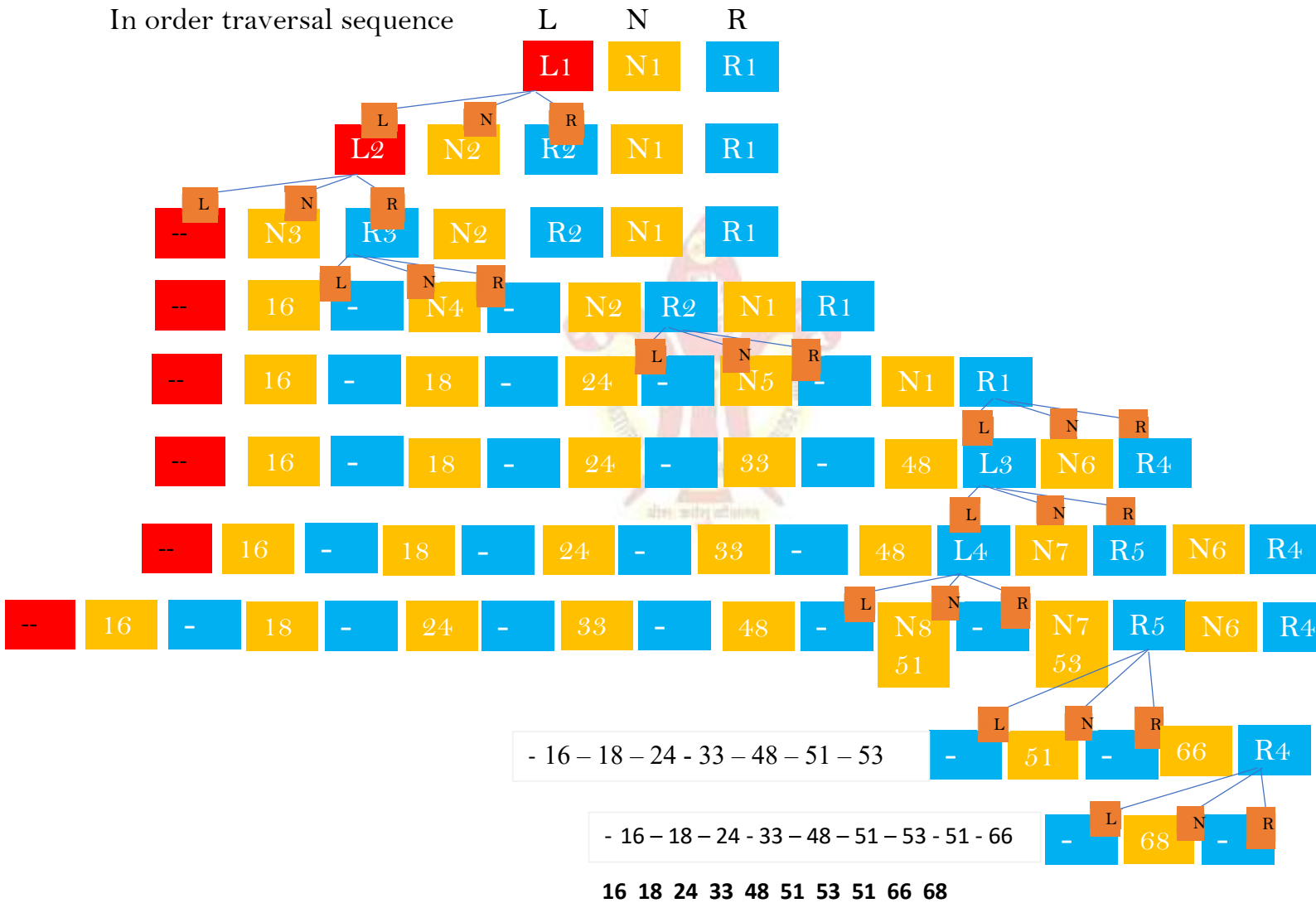


Figure 17

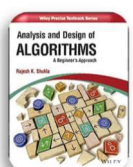




In order traversal sequence



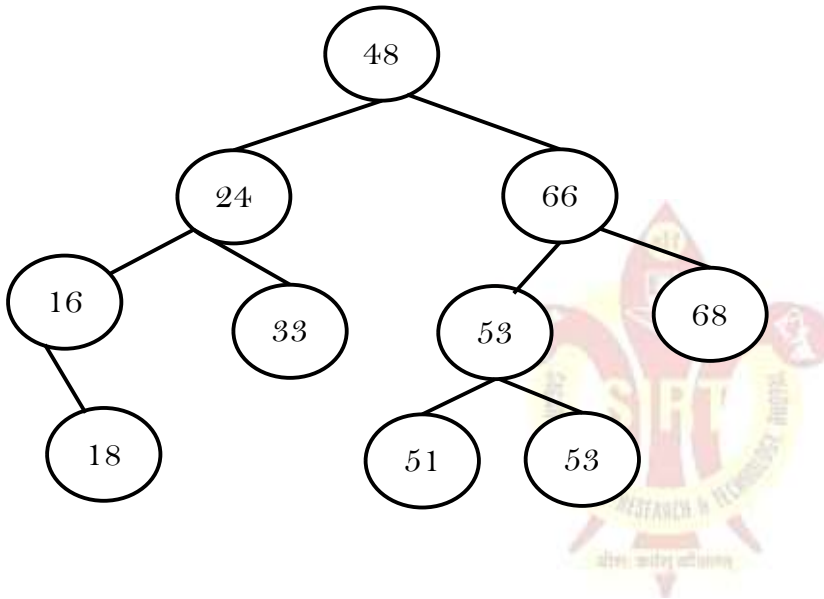
Final in order Sequence is 16 18 24 33 48 51 53 51 66 68





In a Similar way we can find the Post-order traversal sequence

Example: Find the Post order Traversal Sequence of the following tree



Solution: Post-order traversal (**LRN**) is

1. Traverse the left sub tree (L) in *post-order*
2. Traverse the right sub tree (R) in *post-order*
3. Traverse the node (N)

As we know that the left subtree is traversed first in post-order traversal followed by right subtree in post-order and then root. Let us take the tree shown in figure 18

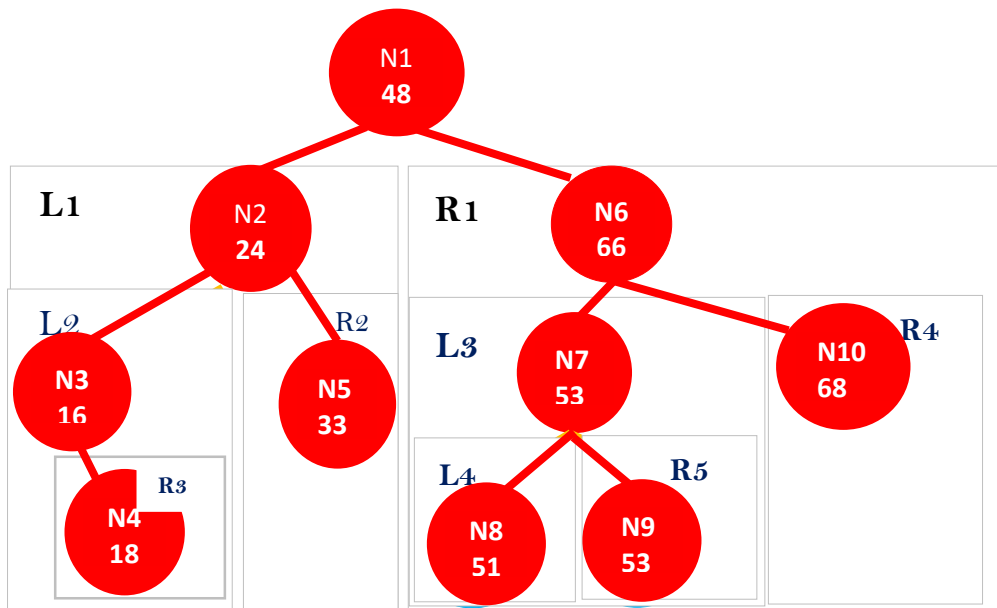
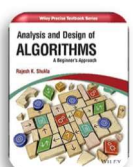


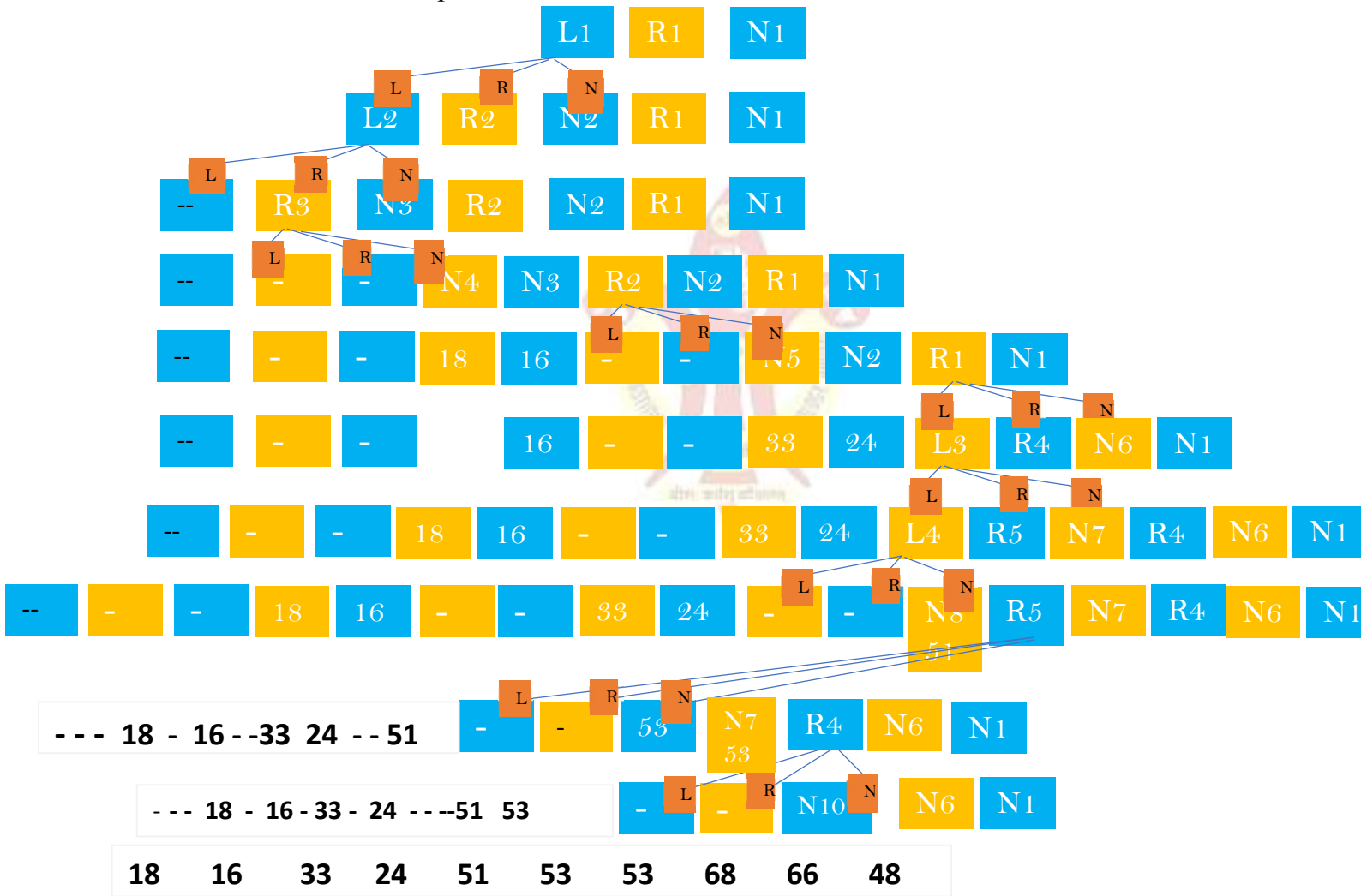
Figure 18





Post order Traversal sequence

L R N



Final Post order Sequence is 18 16 33 24 51 53 53 68 66

Final Pre order Sequence is 48 24 16 18 33 66 53 51 53 68

Final In order Sequence is 16 18 24 33 48 51 53 51 66 68

Final Post order Sequence is 18 16 33 24 51 53 53 68 66

