Morris traversal for Preorder

Using Morris Traversal, we can traverse the tree without using stack and recursion. The algorithm for Preorder is almost similar to Morris traversal for Inorder.

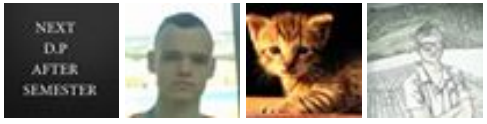
1...**If** left child is null, print the current node data. Move to right child.
....**Else**, Make the right child of the inorder predecessor point to the current node. Two cases arise:
.....**a)** The right child of the inorder predecessor already points to the current node. Set right child to NULL. Move to right child of current node.
.....**b)** The right child is NULL. Set it to current node. Print current node's data and move to left child of current node.
2...Iterate until current node is not NULL.

Following is C implementation of the above algorithm.

```
// C program for Morris Preorder traversal
#include <stdio.h>
#include <stdlib.h>

struct node
{
    int data;
    struct node *left, *right;
};

/* Helper function that allocates a new node with the
   given data and NULL left and right pointers. */
struct node* newNode(int data)
{
    struct node* temp = (struct node*) malloc(sizeof(struct node));
    temp->data = data;
```

```
    temp->left = temp->right = NULL;
    return temp;
}
```

```
// Preorder traversal without recursion and without stack
void morrisTraversalPreorder(struct node* root)
{
    while (root)
    {
        // If left child is null, print the current node data. Move to
        // right child.
        if (root->left == NULL)
        {
            printf( "%d ", root->data );
            root = root->right;
        }
        else
        {
            // Find inorder predecessor
            struct node* current = root->left;
            while (current->right && current->right != root)
                current = current->right;

            // If the right child of inorder predecessor already point
            // this node
            if (current->right == root)
            {
                current->right = NULL;
                root = root->right;
            }

            // If right child doesn't point to this node, then print t
            // node and make right child point to this node
            else
            {
                printf("%d ", root->data);
                current->right = root;
                root = root->left;
            }
        }
    }
}
```

```
// Function for sStandard preorder traversal
void preorder(struct node* root)
{
    if (root)
```

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```
    {
        printf( "%d ", root->data);
        preorder(root->left);
        preorder(root->right);
    }
}

/* Driver program to test above functions*/
int main()
{
    struct node* root = NULL;

    root = newNode(1);
    root->left = newNode(2);
    root->right = newNode(3);

    root->left->left = newNode(4);
    root->left->right = newNode(5);

    root->right->left = newNode(6);
    root->right->right = newNode(7);

    root->left->left->left = newNode(8);
    root->left->left->right = newNode(9);

    root->left->right->left = newNode(10);
    root->left->right->right = newNode(11);

    morrisTraversalPreorder(root);

    printf("\n");
    preorder(root);

    return 0;
}
```

Output:

```
1 2 4 8 9 5 10 11 3 6 7
1 2 4 8 9 5 10 11 3 6 7
```

Limitations:

Morris traversal modifies the tree during the process. It establishes the right links while moving down the tree and resets the right links while moving up the tree. So the algorithm cannot be

applied if write operations are not allowed.

This article is compiled by **Aashish Barnwal** and reviewed by GeeksforGeeks team. Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above.

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AlienOnEarth • 3 days ago
Excellent
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X • 2 months ago
A correction in the if conditions for current.right != null:

In the traversal, if current.right == root, it means we have reached a node that' this can be printed and the link reverted back to null. If current.right == null, it m this first time and this needs to linked to the inorder successor. So, I think the following. Please correct me if I 'am wrong:

```
if(current.right == null)
{
current.right = root;
root = root.left;
}
else
{
print(current.data);
current.right = null;
root = root.right;
```

}

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Intelligent :D

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why is it printing the tree twice??

```
/* Paste your code here (You may delete these lines if not writing co
```

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Debjit • a year ago

Viky,

Linear time complexity and constant space complexity

```
/* Paste your code here (You may delete these lines if not writing co
```

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ubiquitous ➦ Debjit • 9 months ago

this is not linear time complexity. it's O(NLogN) and constant space. S
so much that this traversal helps in great time rathe then O(N) recursiv

1 ^ | v • Reply • Share ›

Madhav • a year ago

Great Solution.
Thanks.

1 ^ | v • Reply • Share ›

Viky • a year ago

What is the complexity of this algorithm?

^ | v • Reply • Share ›

Nitin Sharma ➦ Viky • 4 months ago

Time Complexity -> n Log(n)

where n -> number of nodes.

As
you can see there are two while loops.First while loop is iterating through each and every node and second while loop is helping to find t inorder predecessor .

1. Due to outer loop -> O(n)

2. Due to inner loop -> O(Log(n))

^ | v • Reply • Share ›

Shyam Raj • a year ago

This is really an interesting algorithm :).

Had to debug a lot to figure out what&#039s really happening.

But loved it indeed :).

^ | v • Reply • Share ›