Tree Traversals

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Outline

1. Binary Tree Traversals (Using a Stack)
2. Level-Order Traversal
3. Additional Binary Tree Operations

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Binary Tree Traversals

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Binary Tree Traversals

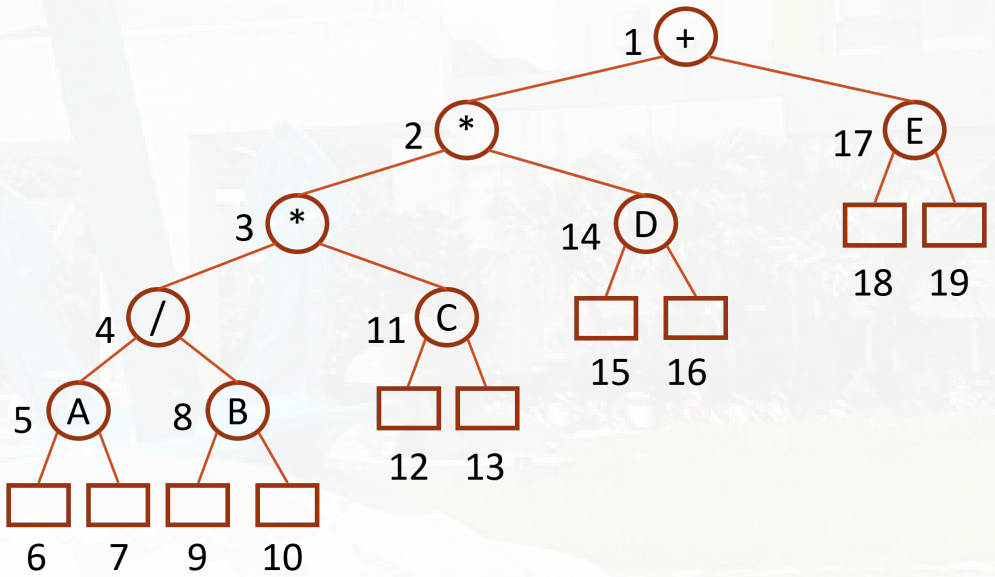
Question

How to visit each node of a tree exactly once?

- Let *V*, *L*, *R* stand for visiting the node, moving left, and moving right, resp.
  - Six possible combinations: *LVR*, *LRV*, *VLR*, *VRL*, *RVL*, *RLV*.
- Adopting the convention that we traverse left before right, only three combinations of *VLR* remains:
  - inorder (中序走訪法)
  - postorder (後序走訪法)
  - preorder (先序走訪法)

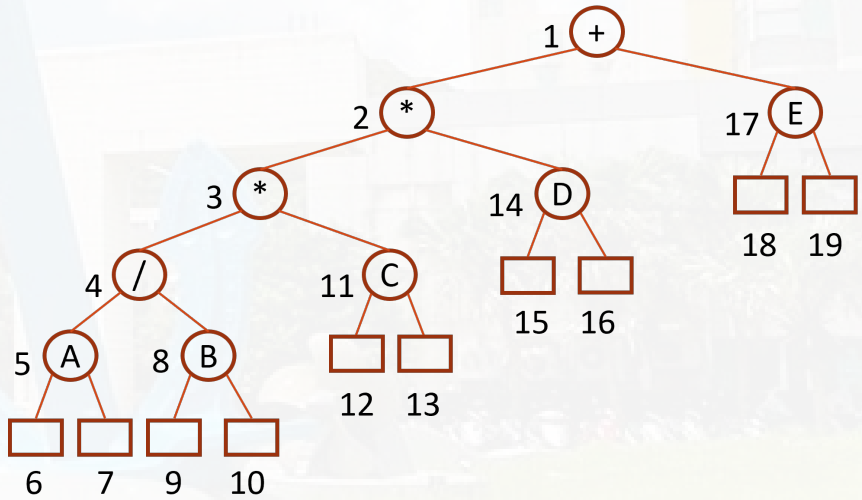
Tree Traversals

- Inorder traversal (*LVR*):
  `A/B*C*D+E`
- Preorder traversal (*VLR*):
  `+**/ABCDE`
- Postorder traversal (*LRV*):
  `AB/C*D*E+`



Code for Inorder Traversal

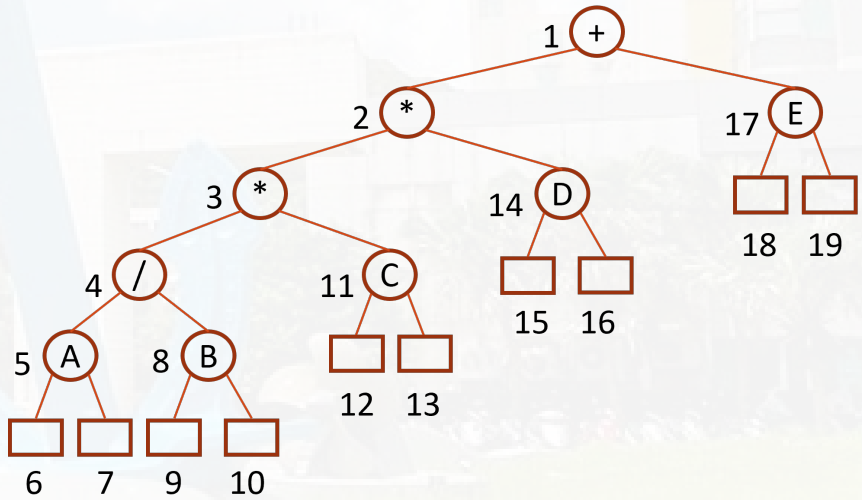
```
void inorder (treePointer ptr) {
/* inorder tree traversal */
    if (ptr) {
        inorder (ptr->leftChild);
        printf ("%d", ptr->data);
        inorder (ptr->rightChild);
    }
}
```



A/B*C*D+E

Code for Preorder Traversal

```
void Preorder (treePointer ptr) {
/* inorder tree traversal */
    if (ptr) {
        printf ("%d", ptr->data);
        inorder (ptr->leftChild);
        inorder (ptr->rightChild);
    }
}
```



+**/ABCDE

Code for Postorder Traversal

```
void Postorder (treePointer ptr) {
/* inorder tree traversal */
    if (ptr) {
        inorder (ptr->leftChild);
        inorder (ptr->rightChild);
        printf ("%d", ptr->data);
    }
}
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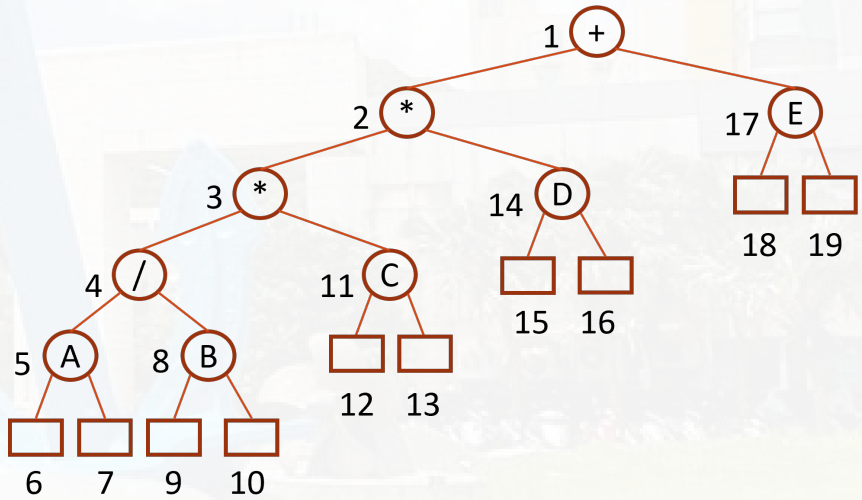

AB/C*D*E+

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2 Level-Order Traversal

3 Additional Binary Tree Operations


Level-Order Traversal

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Steps of a Level-Order Traversal

1. visit the root first.
2. then the root's left child followed by the right child.
3. visit next level from leftmost node to right most node.


Code for the Level-Order Traversal

```
void levelOrder(treePointer ptr) {
    int front = rear = 0;
    treePointer queue[MAX_QUEUE_SIZE];
    if (!ptr) return; /* empty tree */
    add(ptr); // enqueue
    while (1) {
        ptr = delete(); // dequeue
        if (ptr) {
            printf("%d",ptr->data);
            if (ptr->leftChild)
            // leftChild exists
                add(ptr->leftChild);
                // enqueue
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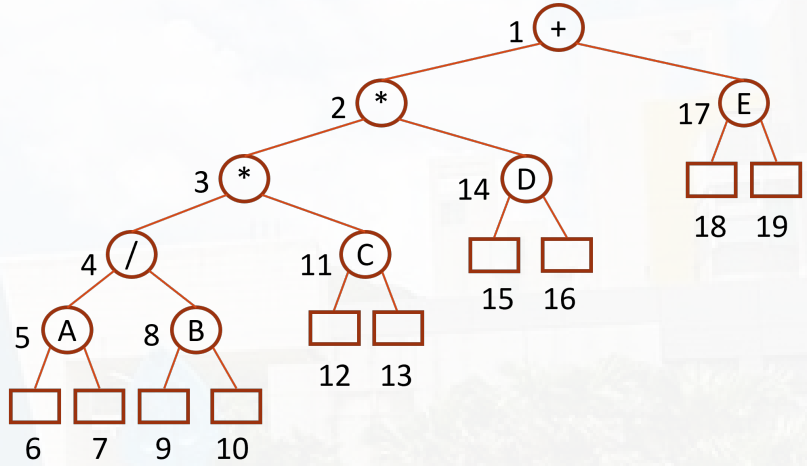

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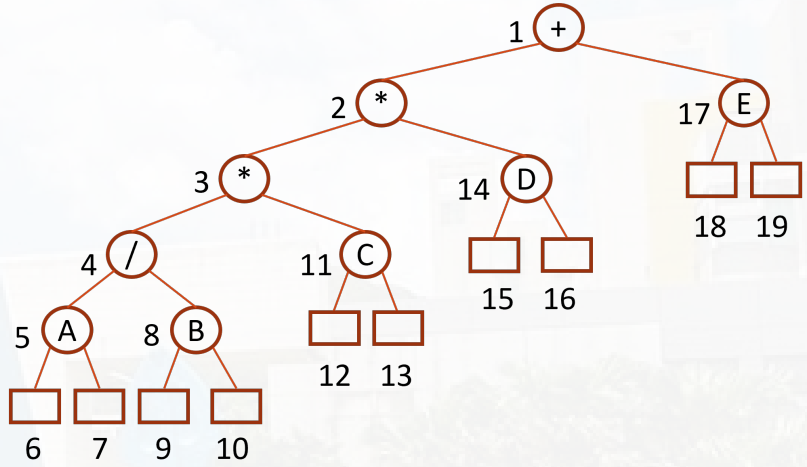

+*

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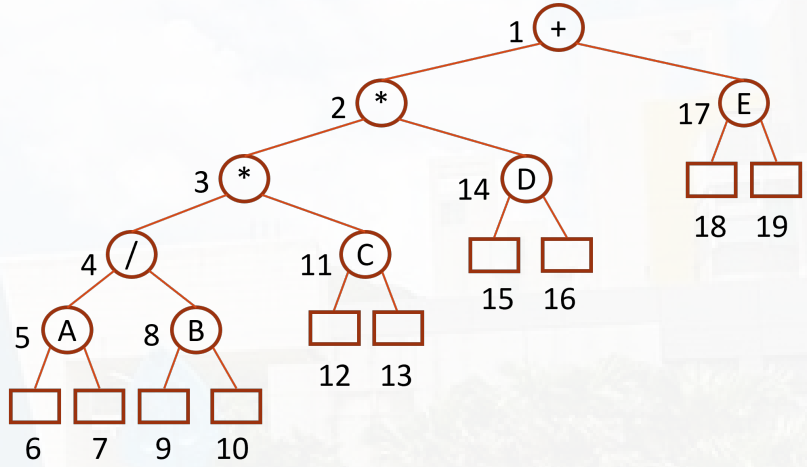

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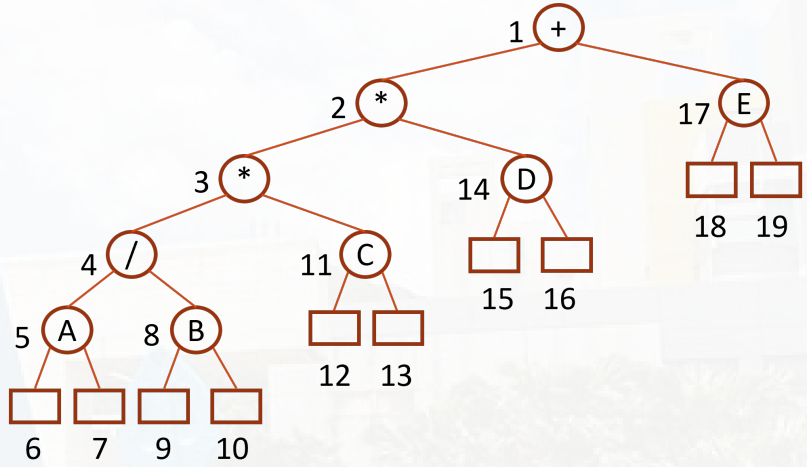

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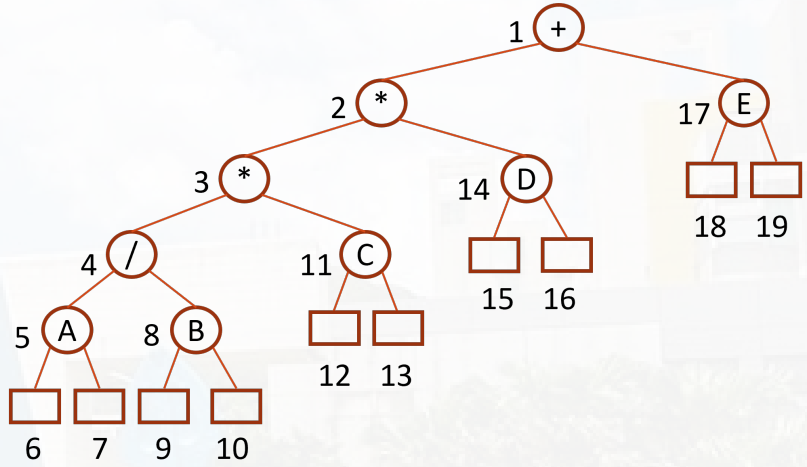

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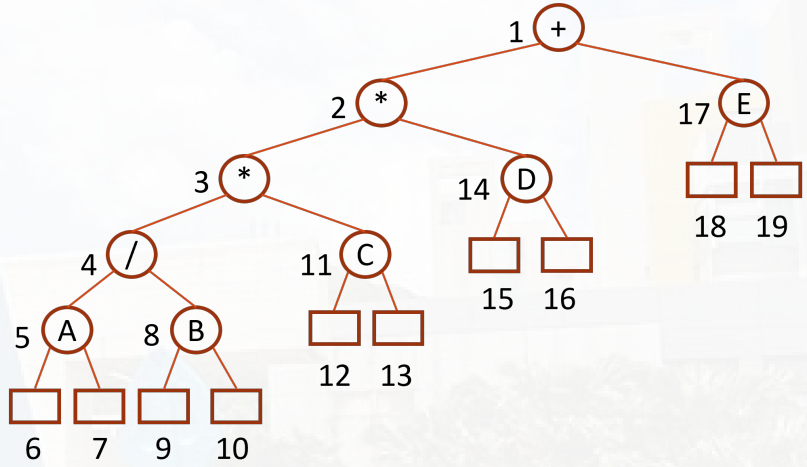

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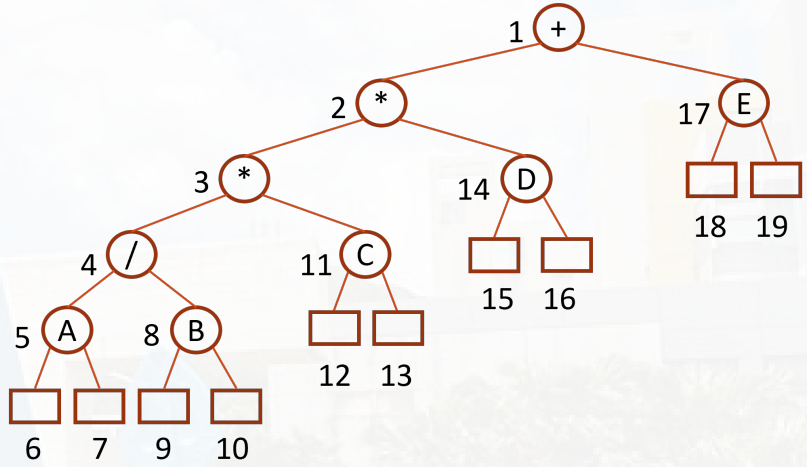

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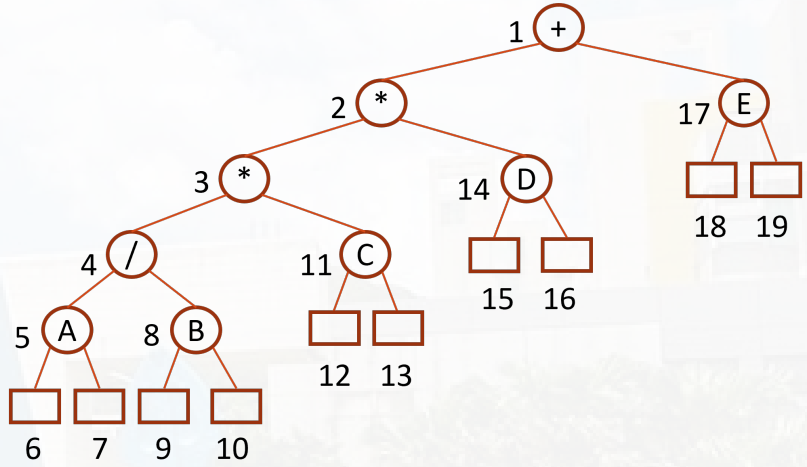

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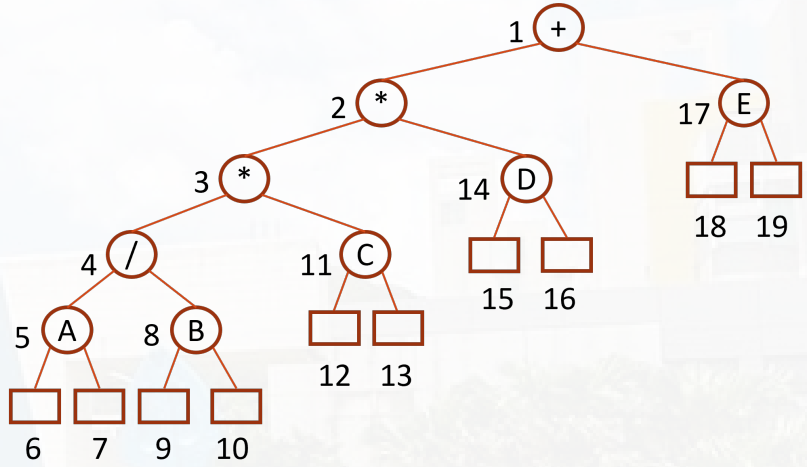

+*E*D/CAB

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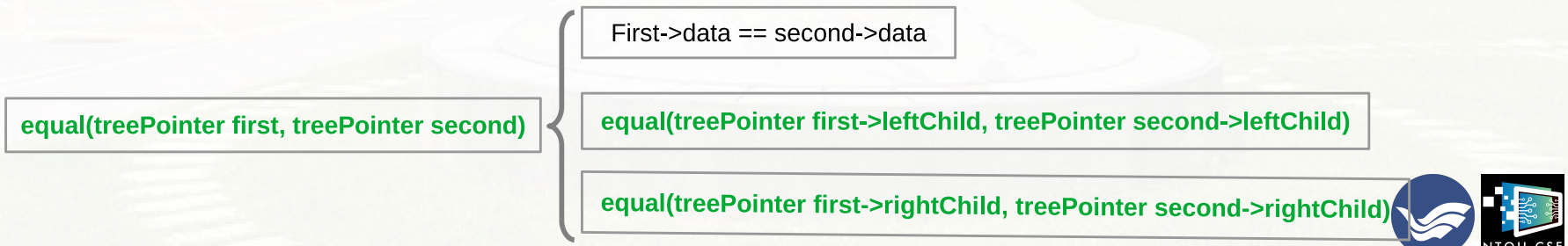
Copying a Binary Tree

```
treePointer copy(treePointer original) {
/* return a tree_pointer to an exact copy of the original tree */
    treePointer temp;
    if (original) {
        MALLOC(temp, sizeof(*temp));
        temp->leftChild = copy(original->leftChild);
        temp->rightChild = copy(original->rightChild);
        temp->data = original->data;
        return temp;
    }
    return NULL;
}
```

Testing for Equality of Binary Trees

```
int equal(treePointer first, treePointer second) {
 /* function returns FALSE if the binary trees first and second are not equ
 Otherwise it returns TRUE */
    return (
        (!first && !second) || (first && second &&
        (first->data == second->data) &&
        equal(first->leftChild, second->leftChild) &&
        equal(first->rightChild, second->rightChild))
    }
}
```



Discussions