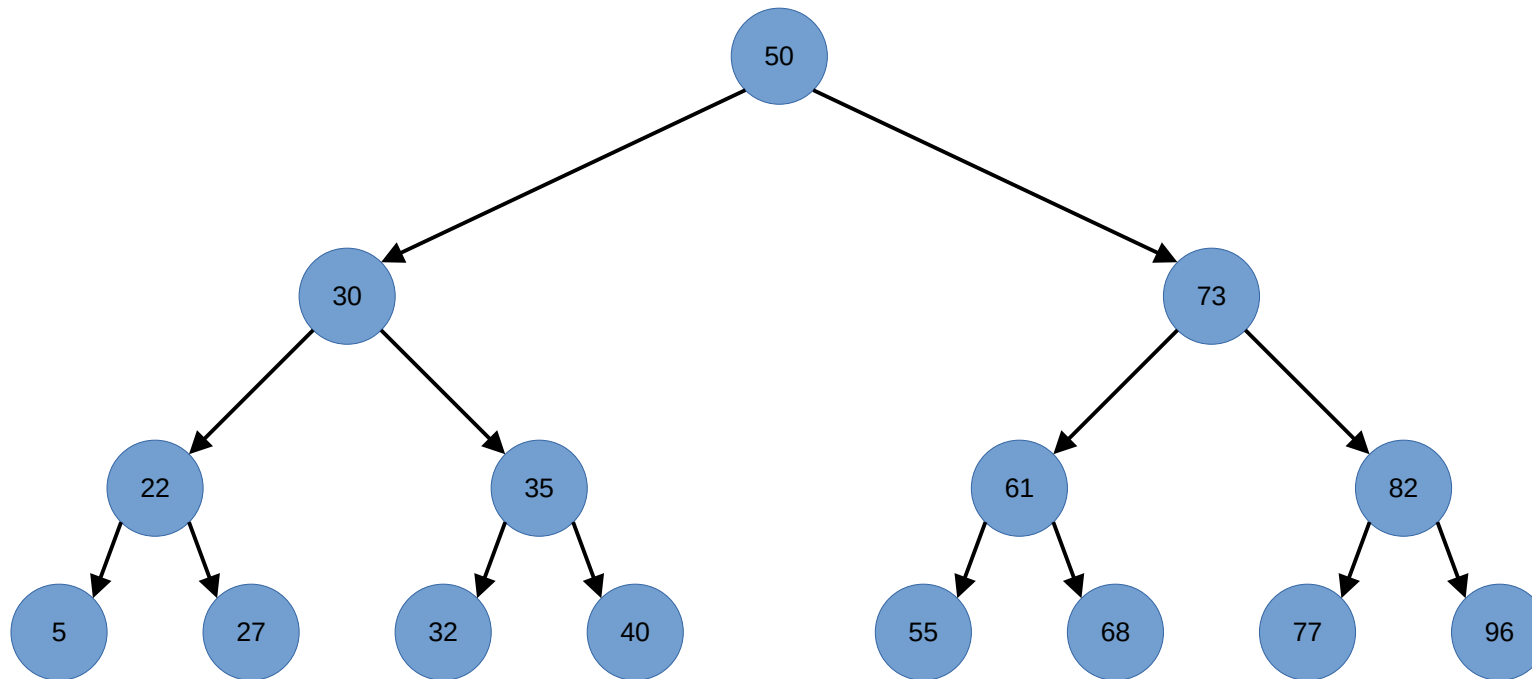


Tree traversal and expression trees

Simeon Monov

Tree traversal types

- InOrder (5, 22, 27, 30, 32, 35, 40, 50, 55, 61, 68, 73, 77, 82, 96)
- Pre-order (50, 30, 22, 5, 27, 32, 35, 40, 73, 61, 55, 68, 82, 77, 96)
- Post-order (5, 27, 22, 32, 40, 35, 30, 55, 68, 61, 77, 96, 82, 73, 50)

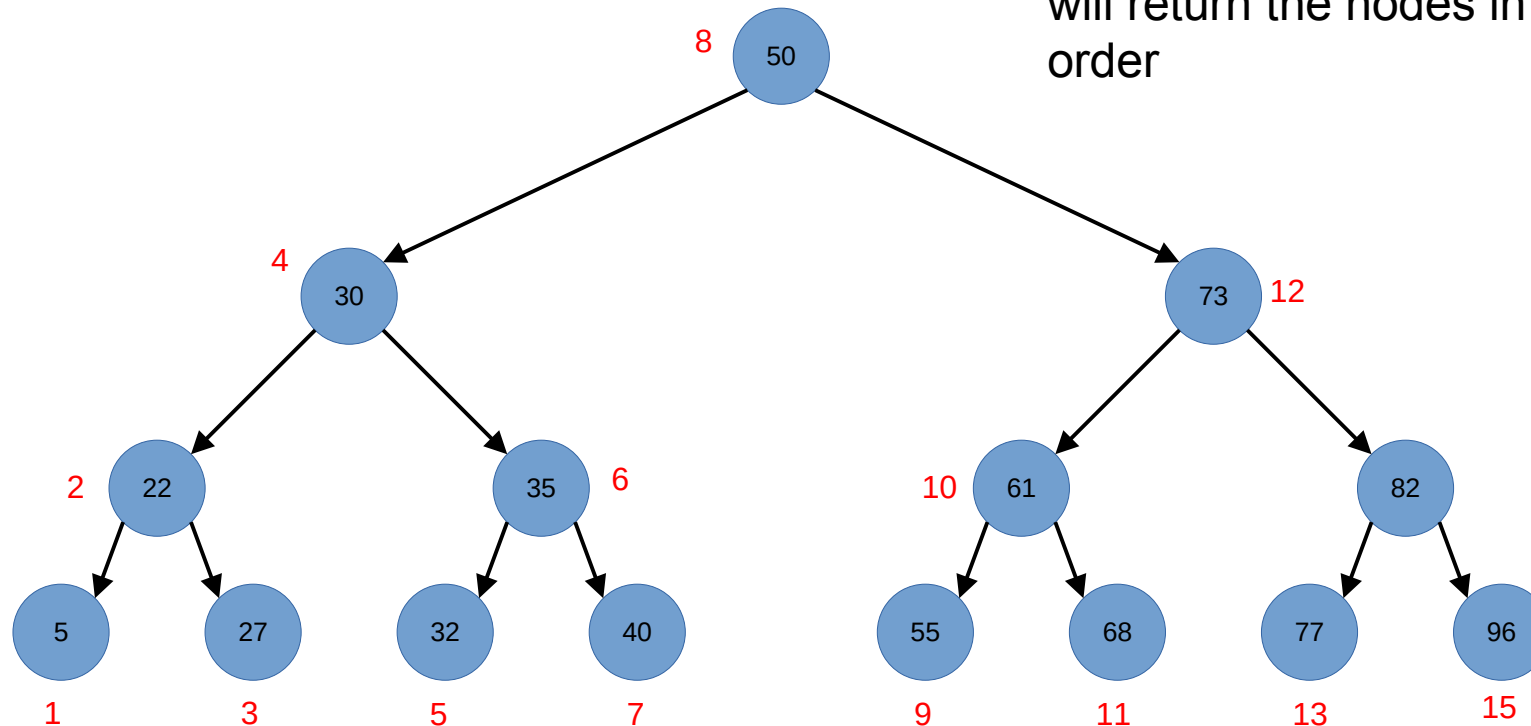


InOrder tree traversal

Algorithm:

- Traverse the left sub-tree: inorder(left)
- Visit the root
- Traverse the right sub-tree: inorder(right)

For Binary Search Tree InOrder traversal will return the nodes in non-decreasing order

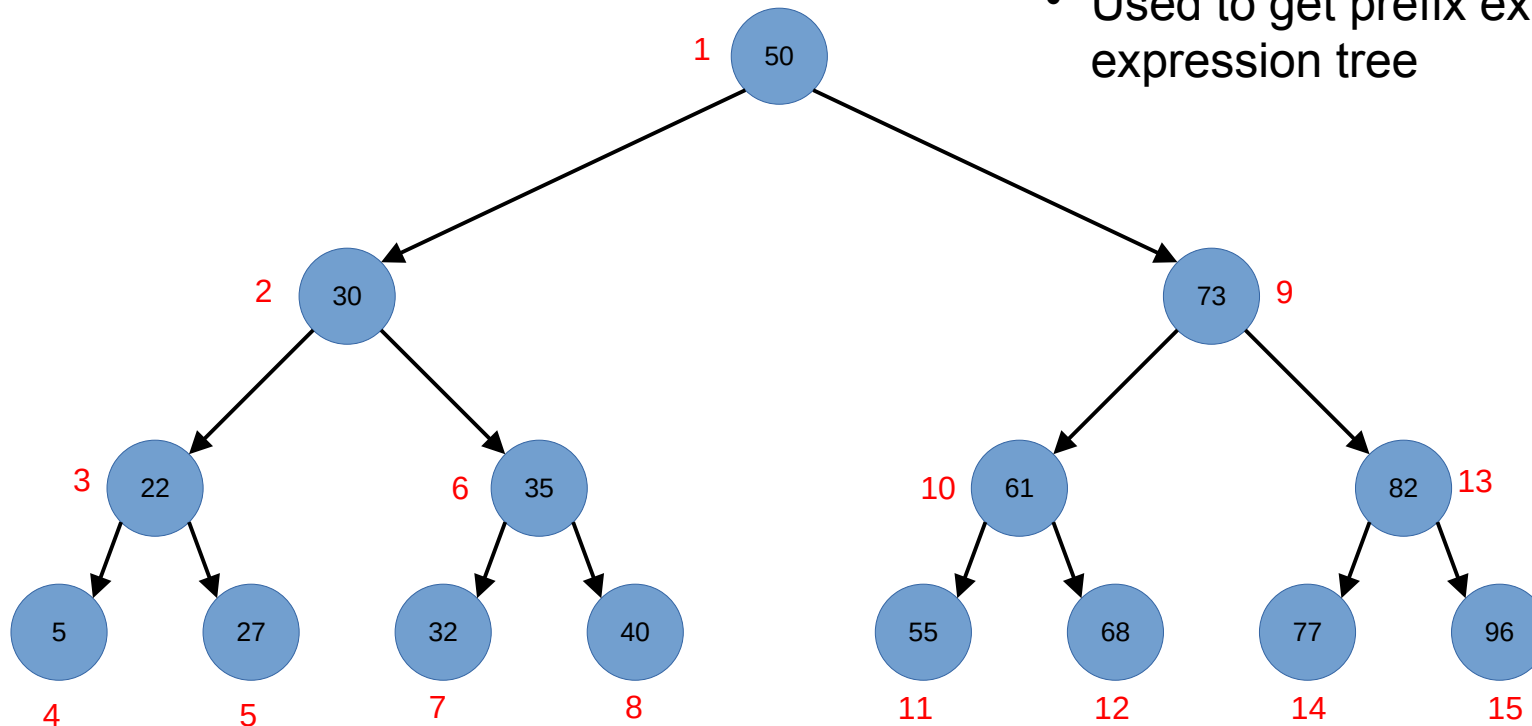


Pre-order tree traversal

Algorithm (DFS):

- Visit root
- Traverse the left sub-tree: preorder(left)
- Traverse the right sub-tree: preorder(right)

- Used to copy the tree
- Used to get prefix expression on expression tree

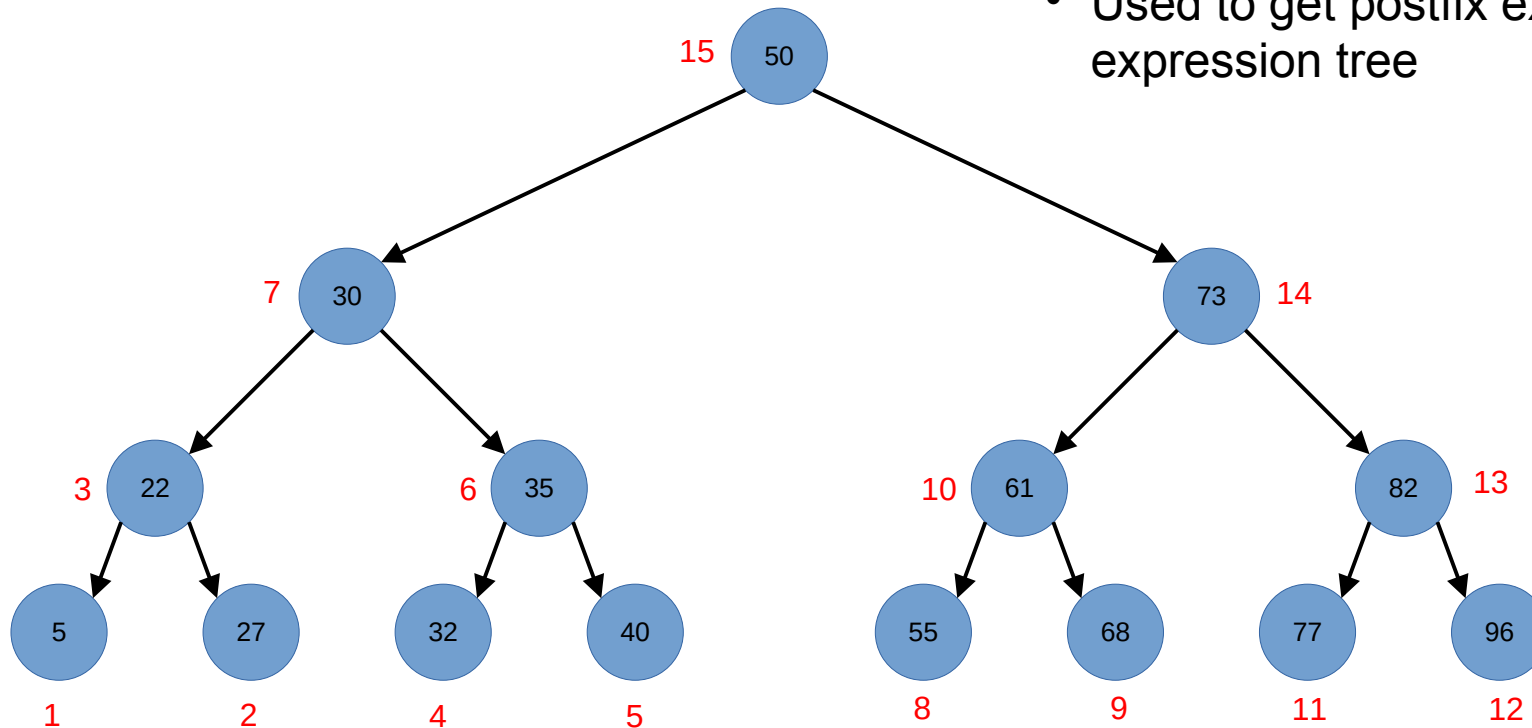


Post-order tree traversal

Algorithm:

- Traverse the left sub-tree: preorder(left)
- Traverse the right sub-tree: preorder(right)
- Visit root

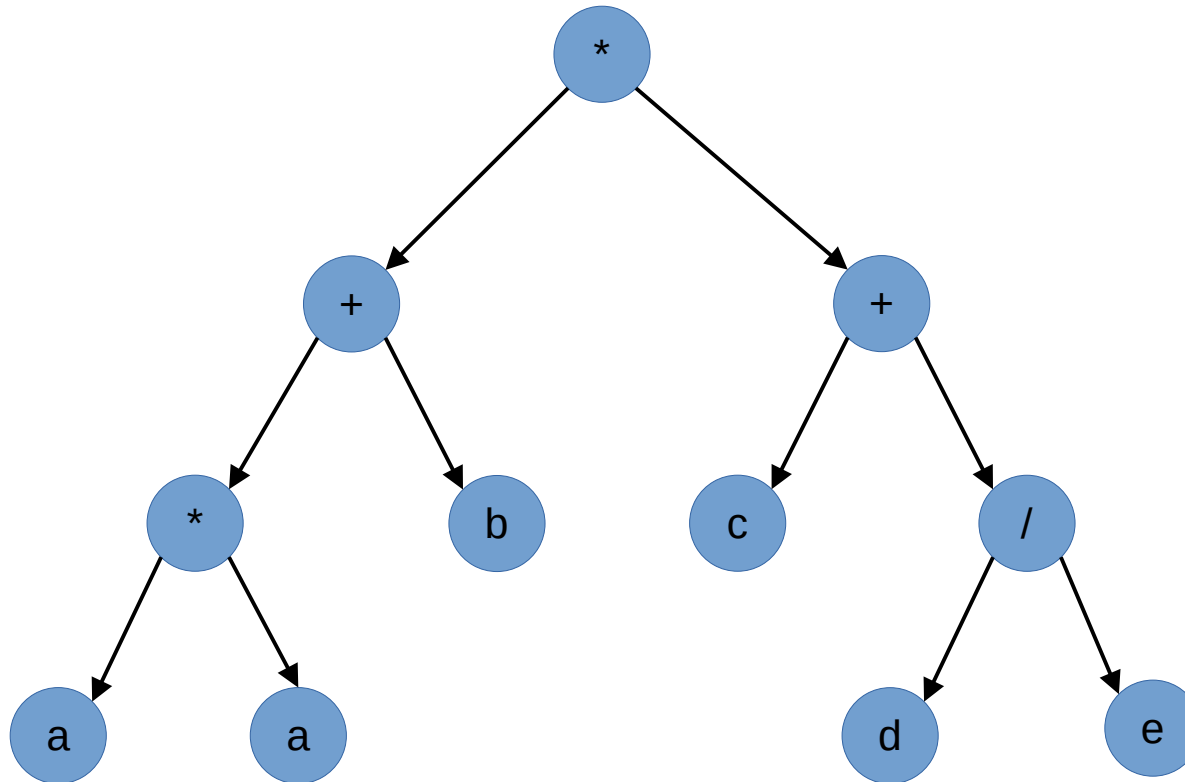
- Used to delete the tree
- Used to get postfix expression on expression tree



Expression tree

Example expression:

- Infix notation: $(a*a+b)*(c+d/e)$
- Postfix notation / reverse polish notation: $aa*b+cde/+*$
- Prefix notation / normal polish notation: $*+*aab+c/de$

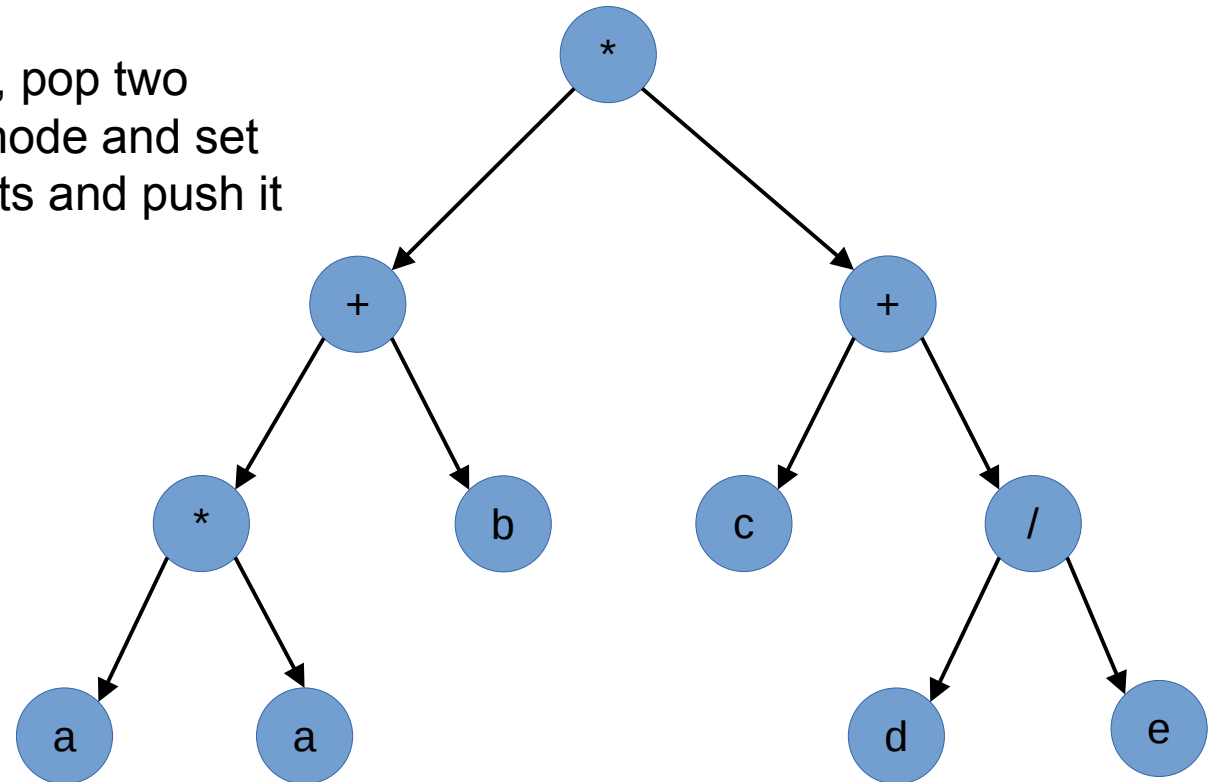


Building expression tree

Expression tree can be build very easy from a postfix:

- Create an empty stack
- Start parsing from the left to the right
- If current position is an operand, create a new node (leaf) and push it in the stack
- If current position is an operator (+-*/), pop two elements from the stack, create new node and set left and right to the respective elements and push it to the stack
- Repeat until input is empty

Postfix example: $aa*b+cde/+*$



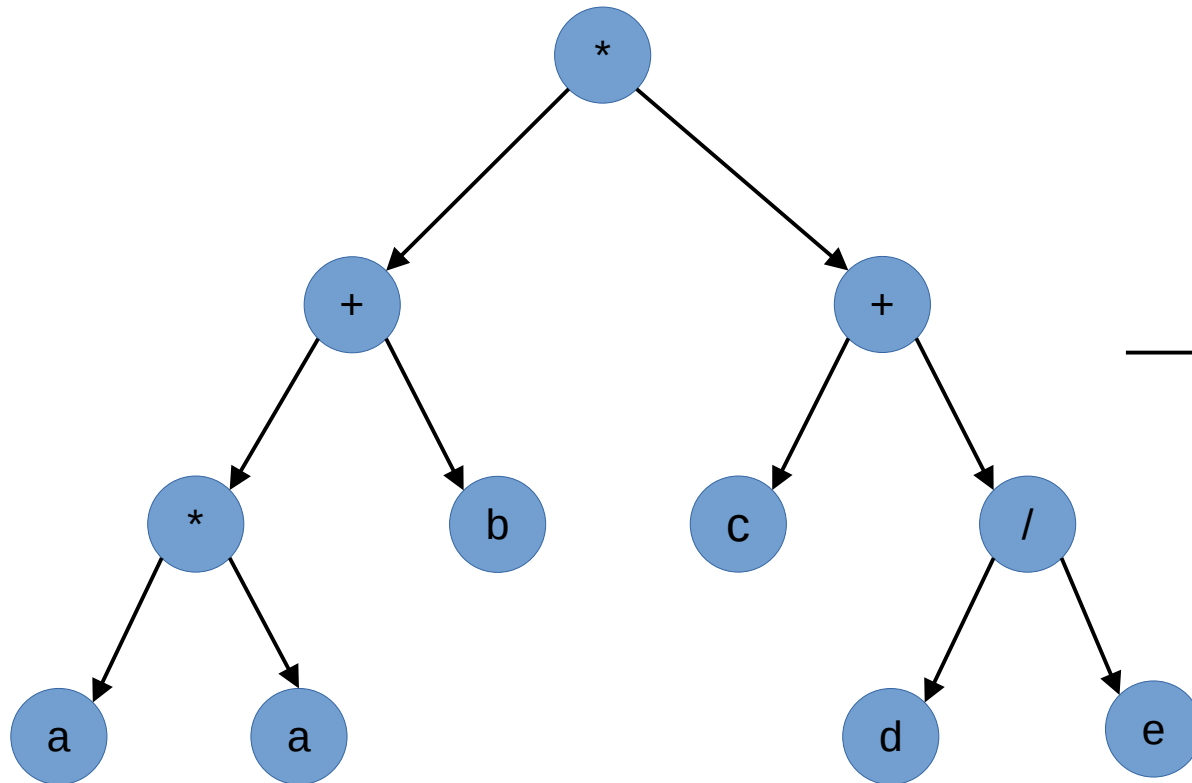
Evaluating expression tree

Expression trees are evaluated using inorder traversal algorithm:

For $a=5$, $b=3$, $c=1$, $d=8$, $e=2$:

Postfix: $aa*b+cde/+*$ $\rightarrow 55*3+182/+*$

Infix: $(a*a+b)*(c+d/e) \rightarrow (5*5+3)*(1+8/2) = 140$



$\rightarrow (((a * a) + b) * (c + (d / e))) \rightarrow$
 $((5 * 5) + 3) * (1 + (8 / 2)) = 140$