Lecture No.24

Data Structures and Algorithms

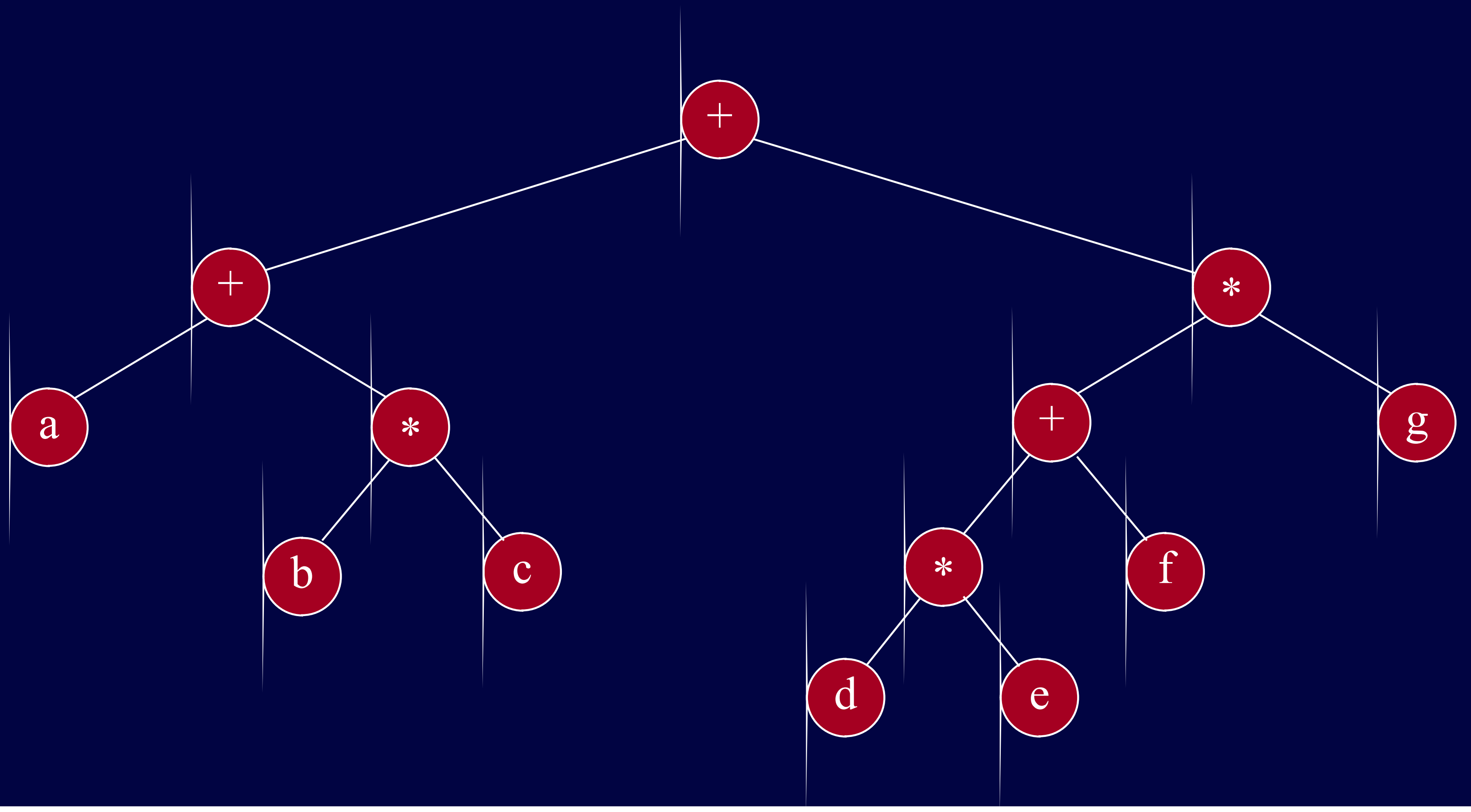
Dr. Islam Zada

Expression Trees

- *Expression trees*, and the more general parse trees and abstract syntax trees are significant components of compilers.
- Let us consider the expression tree.

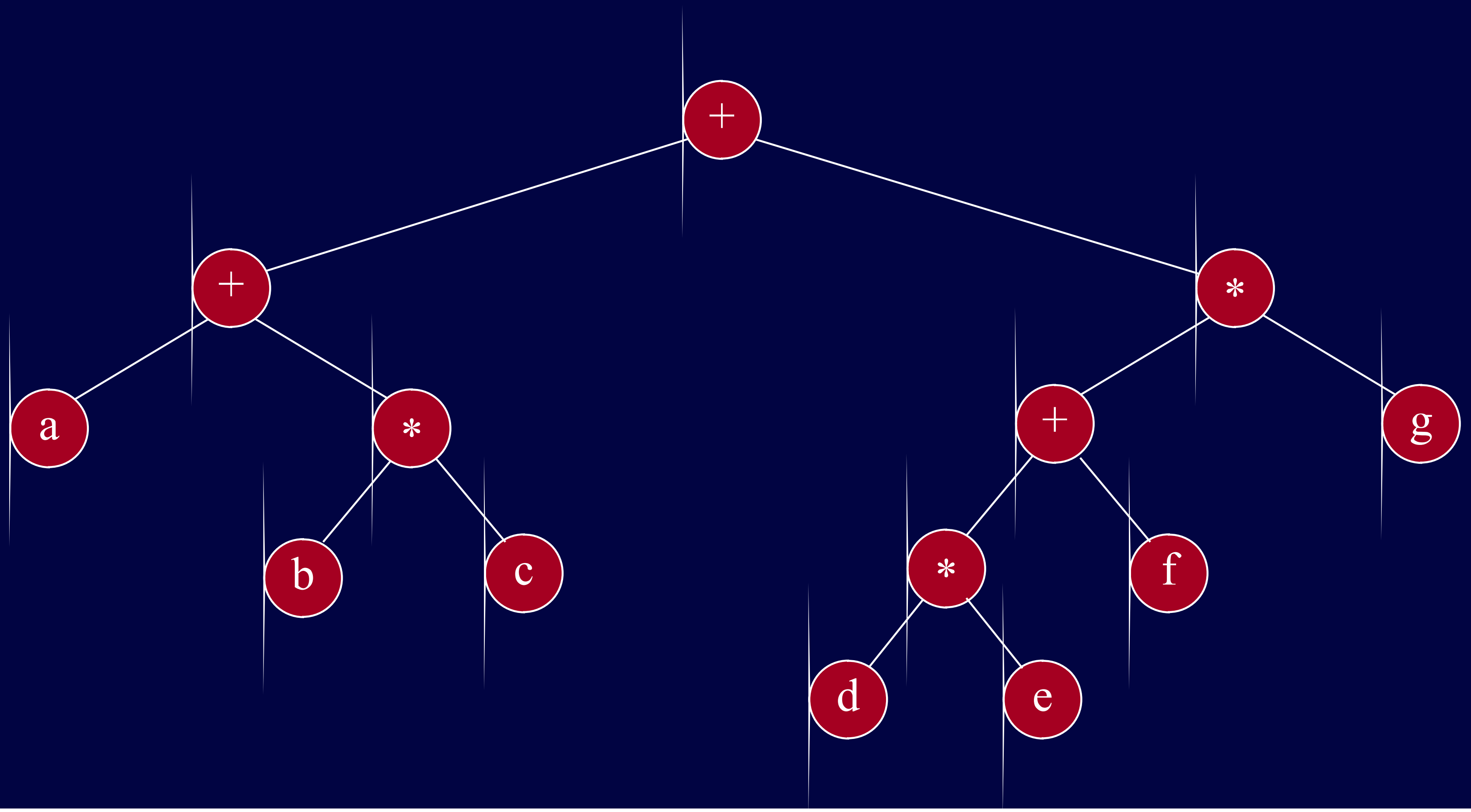
Expression Tree

- The inner nodes contain operators while leaf nodes contain operands.



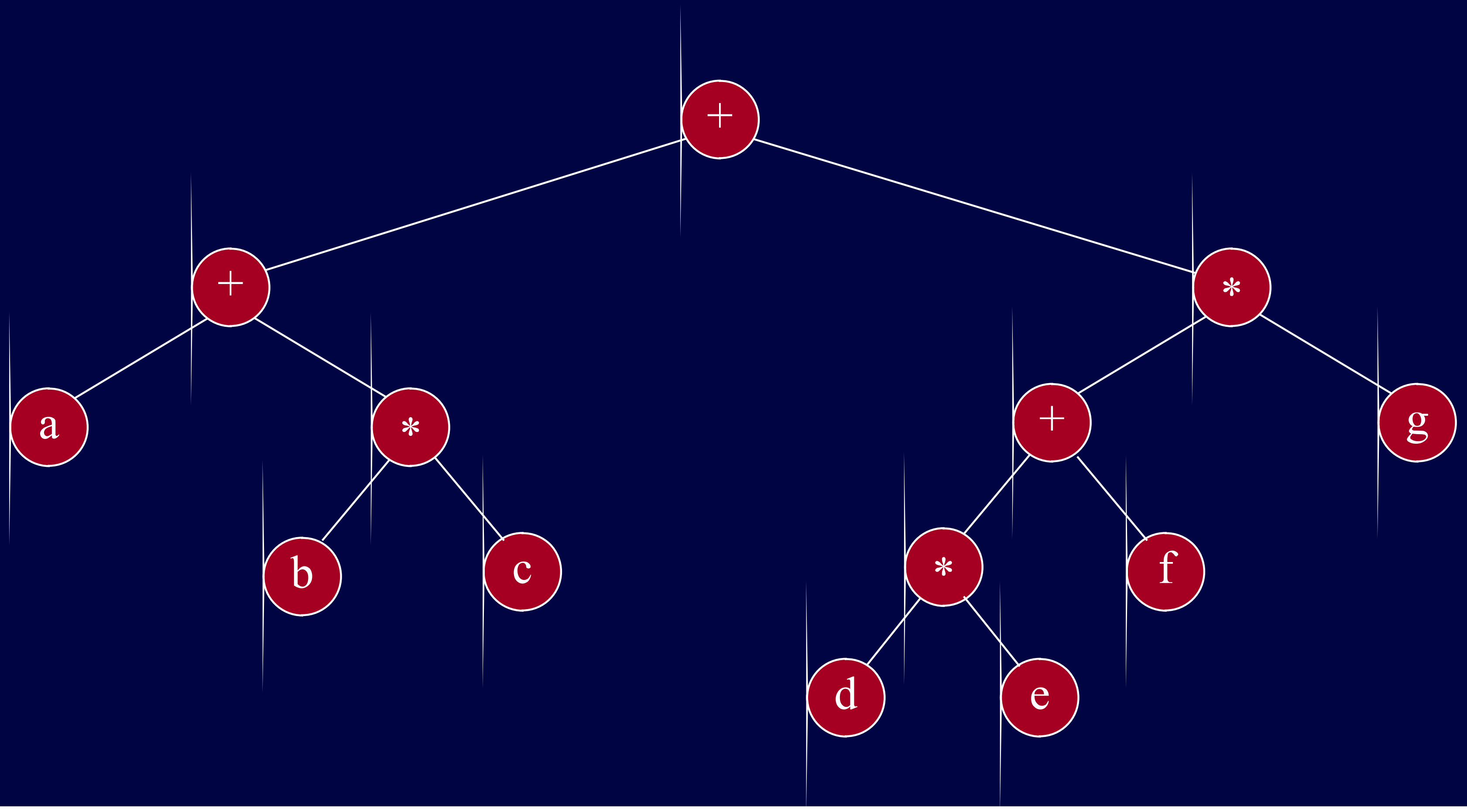
Expression Tree

- The tree is binary because the operators are binary.



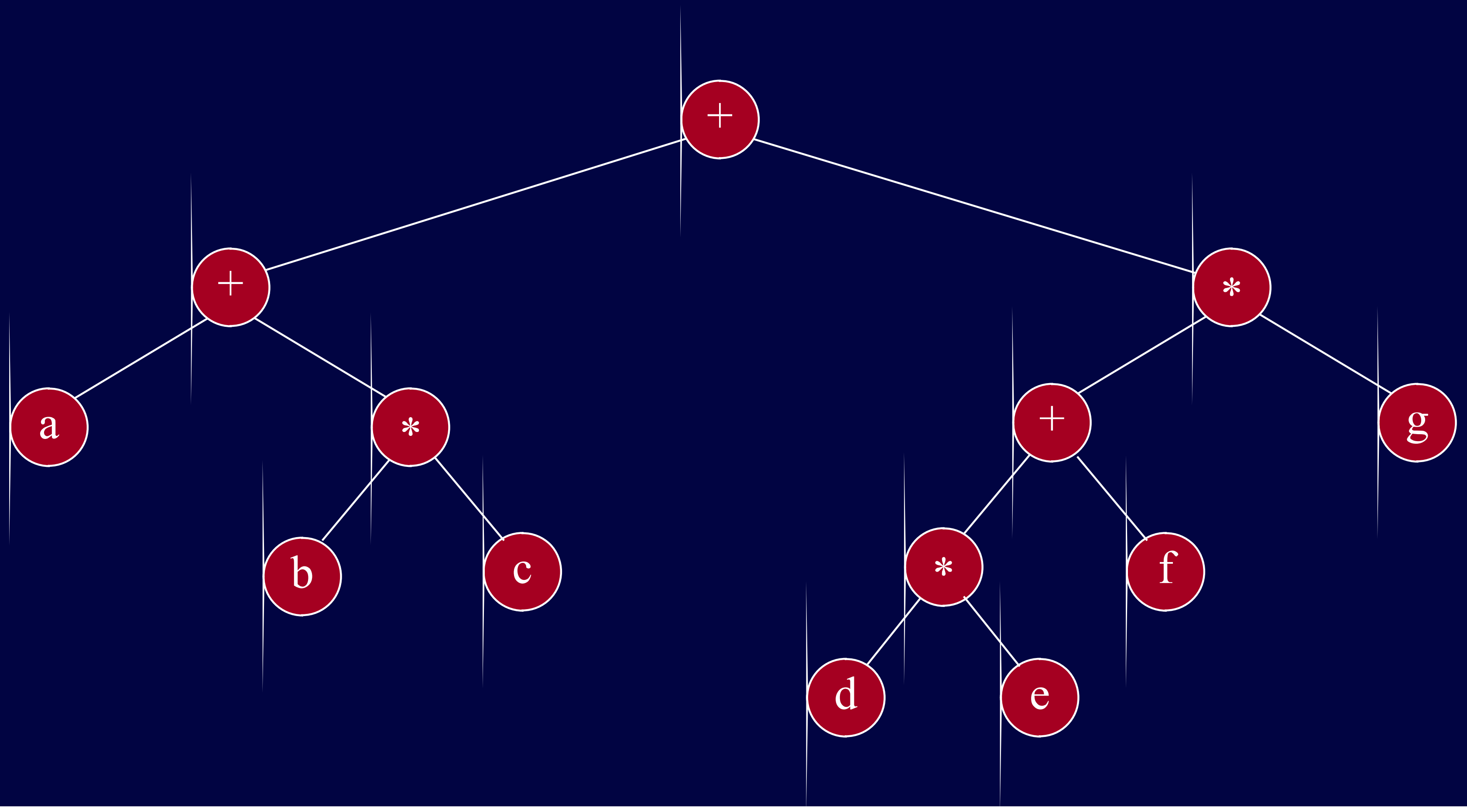
Expression Tree

- This is not necessary. A unary operator (!, e.g.) will have only one subtree.



Expression Tree

- Inorder traversal yields: a+b*c+d*e+f*g

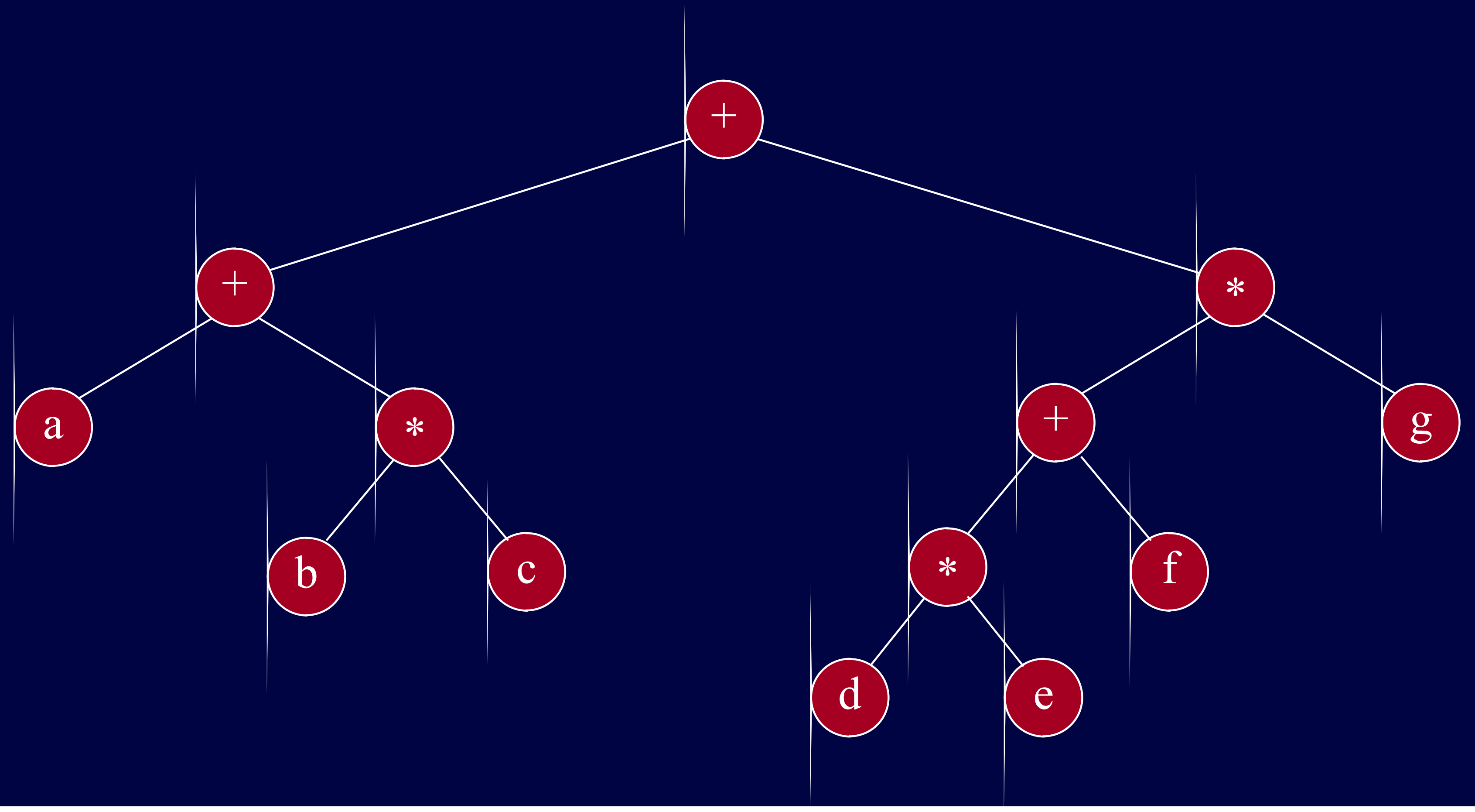


Enforcing Parenthesis

```
/* inorder traversal routine using the
   parenthesis */
void inorder(TreeNode<int>* treeNode)
{
  if( treeNode != NULL )
   {
     if(treeNode->getLeft() != NULL &&
    treeNode->getRight() != NULL) //if not leaf
        cout<<"(";
     inorder(treeNode->getLeft());
     cout << *(treeNode->getInfo())<<" ";
     inorder(treeNode->getRight());
     if(treeNode->getLeft() != NULL &&
    treeNode->getRight() != NULL) //if not leaf
        cout<<")";
   }
}
```

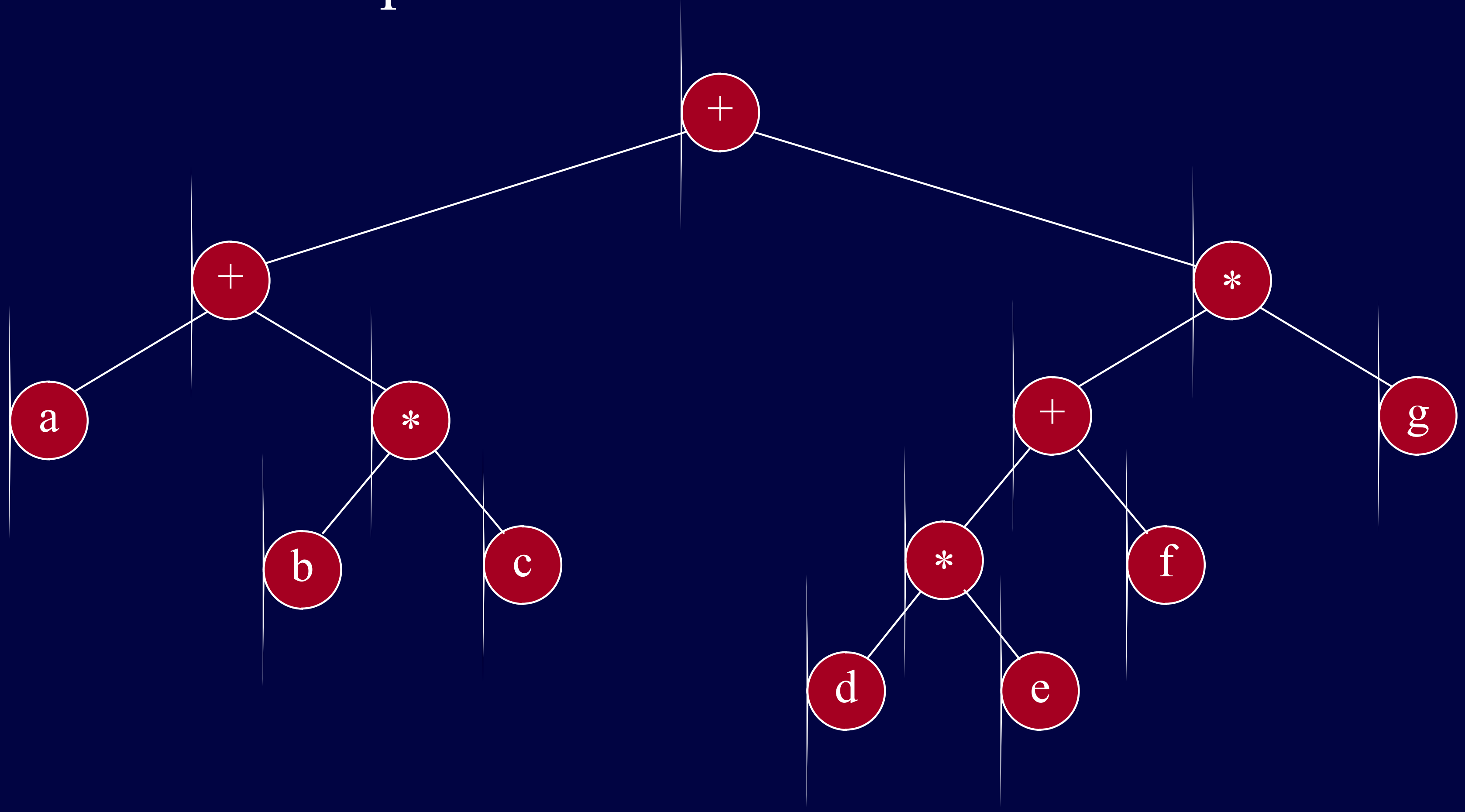
Expression Tree

- Inorder : (a+(b*c))+(((d*e)+f)*g)



Expression Tree

- Postorder traversal: a b c * + d e * f + g * + which is the postfix form.

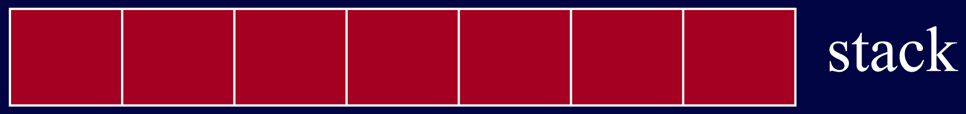


Constructing Expression Tree

- Algorithm to convert postfix expression into an expression tree.
- We already have an expression to convert an infix expression to postfix.
- Read a symbol from the postfix expression.
- If symbol is an operand, put it in a one node tree and push it on a stack.
- If symbol is an operator, pop two trees from the stack, form a new tree with operator as the root and T_1 and T_2 as left and right subtrees and push this tree on the stack.

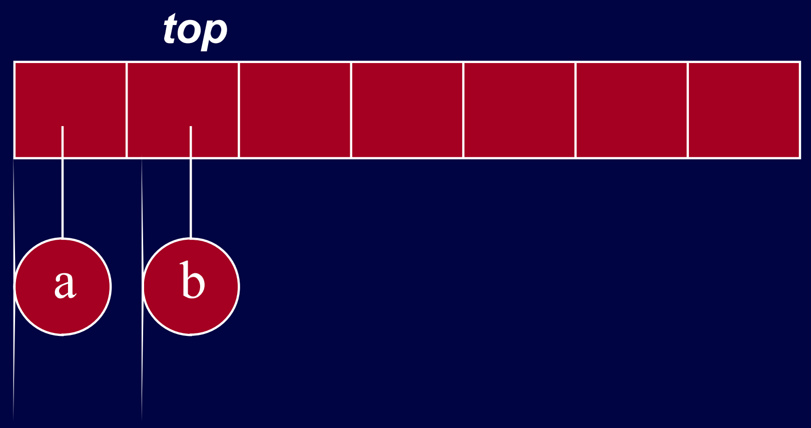
Constructing Expression Tree

- a b + c d e + * *



Constructing Expression Tree

- a b + c d e + * *

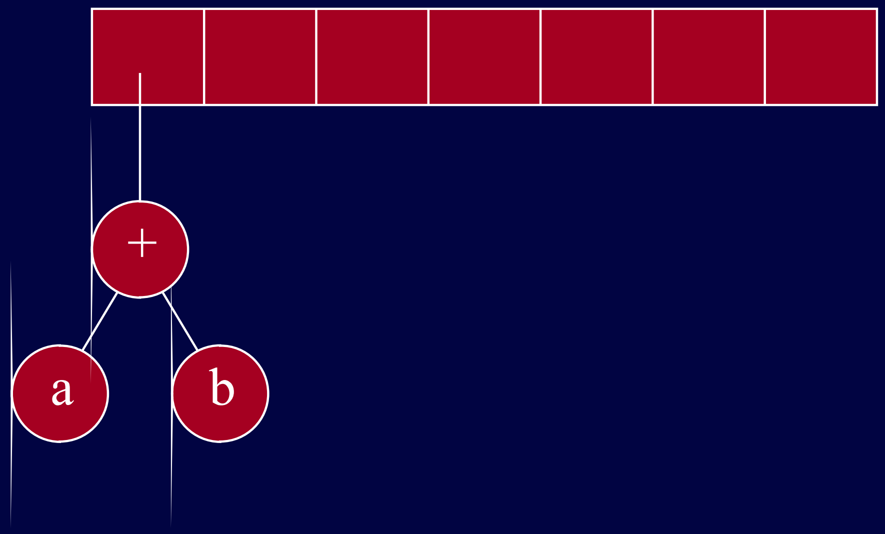


If symbol is an operand, put it in a one node tree and push it on a stack.

Stack is growing left to right

Constructing Expression Tree

- a b + c d e + * *

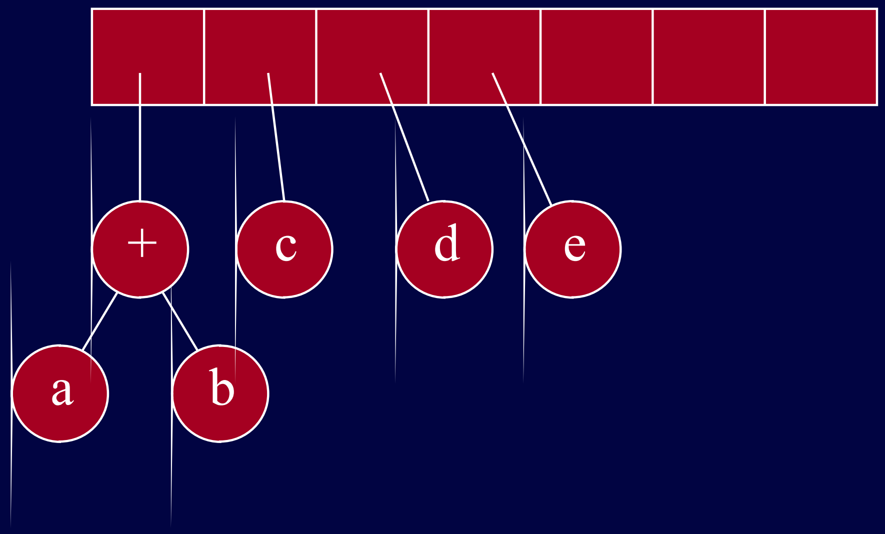


If symbol is an operator, pop two trees from the stack, form a new tree with operator as the root and T_1 and T_2 as left and right subtrees and push this tree on the stack.

Stack is growing left to right

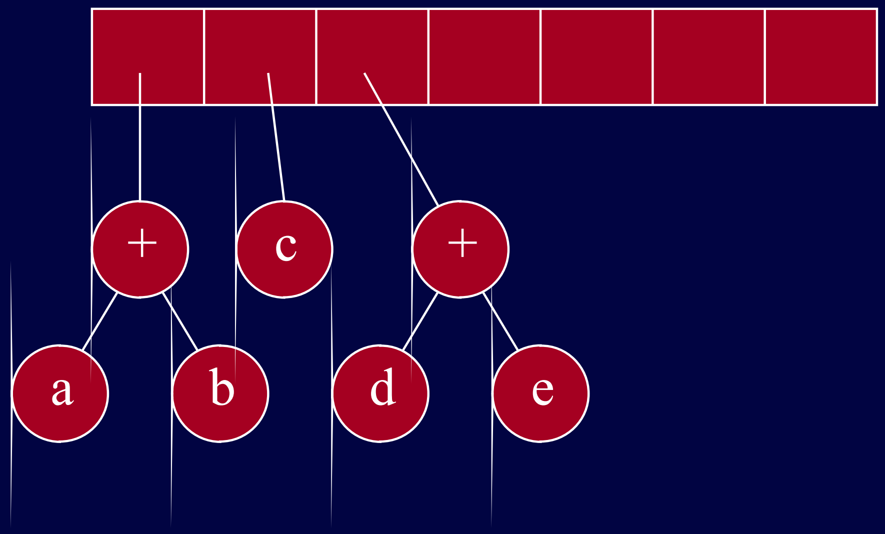
Constructing Expression Tree

- a b + c d e + * *



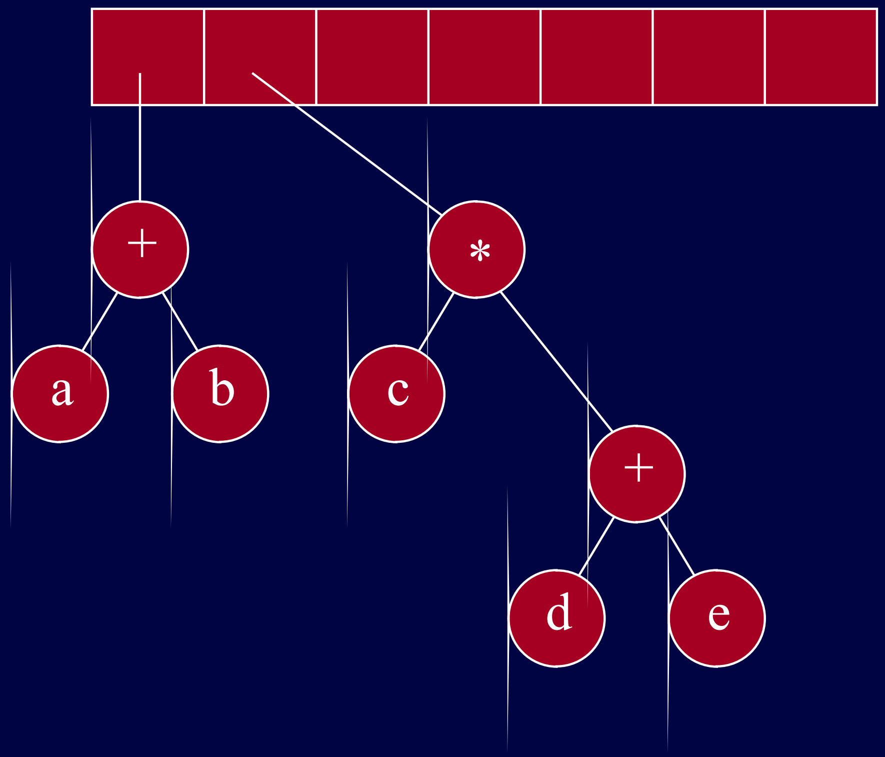
Constructing Expression Tree

- a b + c d e + * *



Constructing Expression Tree

- a b + c d e + * *



Constructing Expression Tree

- a b + c d e + * *