MA251 Data Structures Lab

Jul - Nov 2021

Assignment 7

An *arithmetic expression* can be represented by a binary tree whose leaves are associated with variables or constants, and whose internal nodes are associated with one of the operators $+, -, *$, and $/$. Each node in such a tree has a value associated with it.

- If a node is *leaf*, then its value is that of its variable or constand.

- If a node is *internal*, then its value is defined by applying its operation to the values of its children.

The following binary tree represents the expression $((((3 + 1) * 3)/((9 - 5) + 2)) - ((3 * (7 - 4)) + 6))$. The value associated with the internal node labeled "/" is 2.
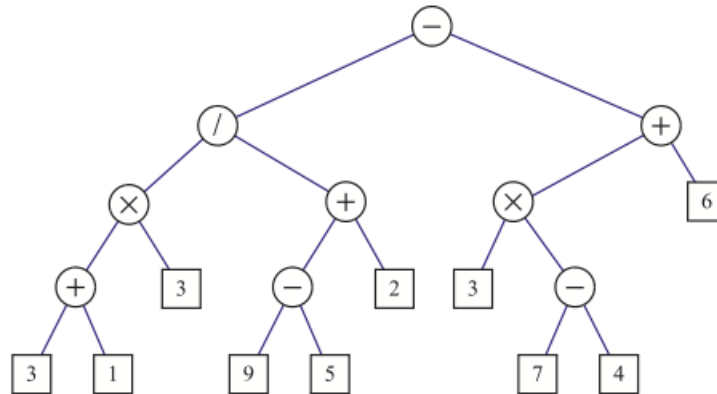
1. Write a program that takes as input a fully parenthesized, arithmetic expression and converts it to a binary expression tree. Your program should display the tree in the following way and also print the value associated with the root.

   Your program should draw the binary tree T by assigning $x-$ and $y-$coordinates to each node p such that $x(p)$ is the number of nodes preceding p in the preorder traversal of T and $y(p)$ is the depth of p in T. You may then use these values to fill a character matrix and print the tree.

   Challenge case: Allow the leaves to store variables of the form x_1, x_2, x_3, and so on, which are initially 0 and which can be updated interactively by your program, with the corresponding update in the printed value of the root of the expression tree.