

1. What Does This Program Do? (Pascal)

When the following program is run, what is the final value of variable b?

```

program SR(input,output);
var a,b,c,x:integer;
begin
b:=0;
for a:=1 to 5 do begin
x:=0;
while x <= 5 do begin
c:=5;
repeat
b:=b+c;
c:=c-1;
until c=0;
x:=x+1;
end;
end
end;

```

2. Prefix/Infix/Postfix Notation

Translate the following from prefix to postfix:

- + * 2 x * 3 y z

3. Prefix/Infix/Postfix Notation

If the binary operator @ is the average of its two operands, evaluate the following postfix expression:

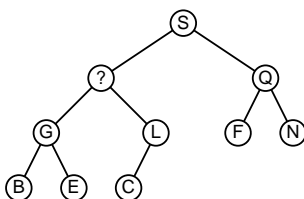
3 2 4 @ * 4 6 @ 3 * @

4. Data Structures

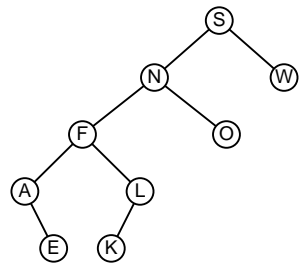
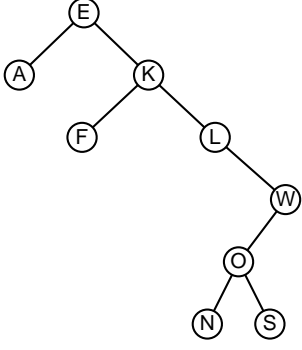
Consider the binary search tree that is formed from the letters S N O W F L A K E, in that order. Now consider the binary search tree built from the letter in reverse order (that is, the letters E K A L F W O N S, in that order). Both trees have 9 nodes. What is the sum of the internal path lengths of the two trees?

5. Data Structures

Consider the following heap of 10 distinct letters:



List all letters that could replace the blackened node.

<p>1. The body of the <code>for</code> loop is repeated 5 times. Each time, the body of the <code>while</code> loop is repeated 6 times (for $x=0, 1, 2, 3, 4,$ and 5). Each time in the while loop, the value of b is incremented by $5+4+3+2+1 = 15$. Thus, b is incremented by 15 a total of 30 times.</p>	450
<p>2. A straightforward approach to this problem is to convert the prefix expression to infix, and then the infix into postfix. The conversion to infix is as follows:</p> $\begin{aligned} -+*2x*3yz &= -+[2*x][3*y]z \\ &= -[2*x+3*y]z \\ &= [2*x+3*y-z] \end{aligned}$ <p>The conversion from infix to postfix is as follow:</p> $\begin{aligned} 2*x+3*y-z &= [2x*]+[3y*]-z \\ &= [2x*3y**]-z \\ &= [2x*3y**+z]- \end{aligned}$	2 x * 3 y * + z -
<p>3. The evaluation is as follows:</p> $\begin{aligned} &3\ 2\ 4\ @\ * \ 4\ 6\ @\ 3\ * \ @ \\ &3\ [3] \ * \ [5] \ 3 \ * \ @ \\ &[9] \ [15] \ @ \\ &[12] \end{aligned}$	12
<p>4. The two trees are shown below. The tree at the left (SNOWFLAKE) has an internal path length of 20; at the right (EKALFWONS) 23. There is no simple relationship between the pair of trees formed in this way.</p> <div style="display: flex; justify-content: space-around; align-items: center;">   </div>	43
<p>5. In a heap, every node must be larger than its children. So, the blackened node must be smaller than S (its parent) and larger than G and L (its children). This gives 6 possibilities: $M, N, O, P, Q,$ and R. However, two of those (Q and N) are already in the heap, so they cannot be in the blackened node.</p>	M, O, P, and R (in any order)