Assignment 3 Compiler Design

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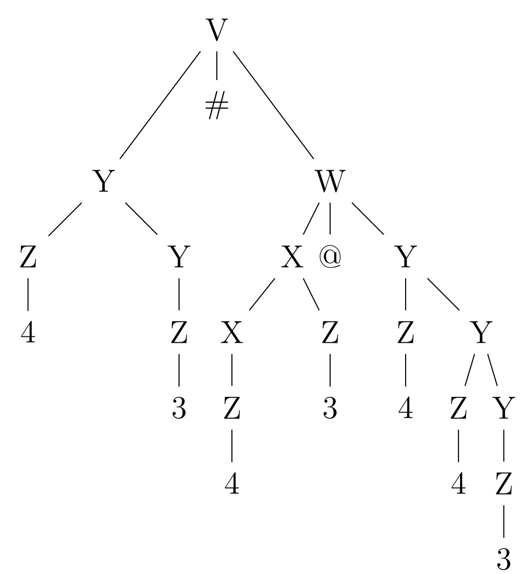
1 Question 1

1.1 part 1



Above is annotated parse tree for string 43#43@443

1.2 part 2

$$V \to Y\#W \quad \{V.val = W.val \bmod Y.val\}$$
$$\text{where} \quad Y \to ZY_1 \quad \{Y.val = 2 \times (Z.val + Y_1.val)\}$$
$$Z \to 4 \quad \{Z.val = 4\}$$
$$Y_1 \to Z \quad \{Y_1.val = 3 \times Z.val\}$$
$$Z \to 3 \quad \{Z.val = 3\}$$
$$Y.val = 2 \times (4 + (3 \times 3)) = 2 \times (4 + 9) = 2 \times 13 = 26$$
$$\text{and} \quad W \to X@Y \quad \{W.val = X.val + Y.val\}$$
$$X \to X_1Z \quad \{X.val = X_1.val + 3 \times Z.val\}$$
$$Z \to 3 \quad \{Z.val = 3\}$$
$$X_1 \to Z_1\{X_1.val = Z_1.val\}$$
$$Z_1 \to 4 \quad \{Z_1.val = 4\}$$
$$Y \to ZY_1 \quad \{Y.val = 2 \times (Z.val + Y_1.val)\}$$
$$Z \to 4 \quad \{Z.val = 4\}$$
$$Y_1 \to ZY_2 \quad \{Y_1.val = 2 \times (Z.val + Y_2.val)\}$$
$$Z \to 4 \quad \{Z.val = 4\}$$
$$Y_2 \to Z \quad \{Y_2.val = Z.val\}$$
$$Z \to 3 \quad \{Z.val = 3\}$$
$$X.val = 4 + (3 \times 3) = 4 + 9 = 13$$
$$Y.val = 2 \times (4 + (2 \times (4 + 3 \times 3))) = 60$$
$$W.val = 13 + 60 = 73$$
$$V.val = W.val \bmod Y.val = 73 \bmod 26 = 21$$

1.3 part 3

- The grammar uses synthesized attributes only, as each attribute is calculated from its child nodes' attributes.
- There's no instance where an attribute depends on a sibling attribute or a descendant's attribute.
- The attributes are computed in a depth-first.

Therefore, we can conclude that the given grammar is **S-attributed**.

2 Question 2

Annotated parse tree for $C[i][j][k] - A[i][k]/B[i][j]$ is on next page.
3AC code

$$
\begin{aligned}
t_1 &= i \times 40 \\
t_2 &= j \times 24 \\
t_3 &= t_1 + t_2 \\
t_4 &= k \times 4 \\
t_5 &= t_3 + t_4 \\
t_6 &= c[t_5] \\
t_7 &= i \times 32 \\
t_8 &= k \times 4 \\
t_9 &= t_7 + t_8 \\
t_{10} &= A[t_9] \\
t_{11} &= i \times 24 \\
t_{12} &= j \times 4 \\
t_{13} &= t_{11} + t_{12} \\
t_{14} &= B[t_{13}] \\
t_{15} &= \frac{t_{10}}{t_{14}} \\
t_{16} &= t_6 - t_{15}
\end{aligned}
$$