

Assignment 3 Compiler Design

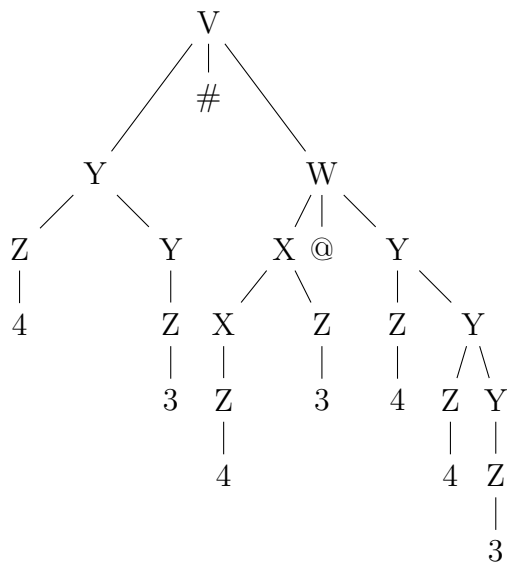
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1 Question 1

1.1 part 1



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

1.2 part 2

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

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

$$t_1 = i \times 40$$

$$t_2 = j \times 24$$

$$t_3 = t_1 + t_2$$

$$t_4 = k \times 4$$

$$t_5 = t_3 + t_4$$

$$t_6 = C[t_5]$$

$$t_7 = i \times 32$$

$$t_8 = k \times 4$$

$$t_9 = t_7 + t_8$$

$$t_{10} = A[t_9]$$

$$t_{11} = i \times 24$$

$$t_{12} = j \times 4$$

$$t_{13} = t_{11} + t_{12}$$

$$t_{14} = B[t_{13}]$$

$$t_{15} = \frac{t_{10}}{t_{14}}$$

$$t_{16} = t_6 - t_{15}$$

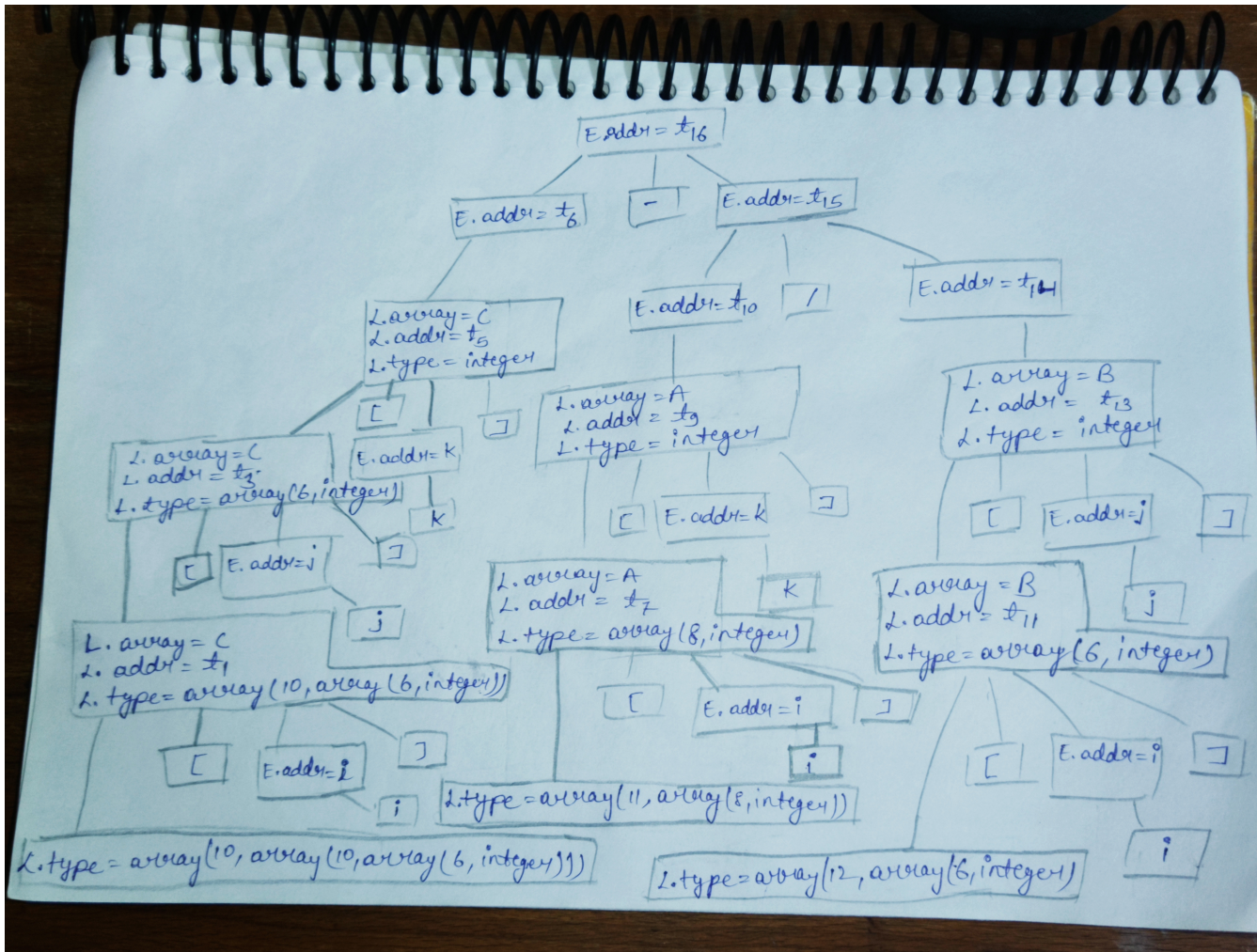


Figure 1: Annotated Parse Tree