Small-Step Semantics Evaluation

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1.Small-Step Semantics Warm-up

From the given boolean language, we evaluate the term as follows:

$$t ::= \text{true} \mid \text{false} \mid \text{if } t \text{ then } t \text{ else } t$$

1.a) Single-Step Evaluation:

For the term:
$$\text{if true then if false then false else false else true}$$

The single-step evaluation is:

$$\text{if true then if false then false else false else true} \quad \xrightarrow{\text{IfTrue}} \quad \text{if false then false else false}$$

1.b) Final Result of Evaluation:

Evaluating the next step:

$$\text{if true then if false then false else false else true} \quad \xrightarrow{\text{IfTrue}} \quad \text{if false then false else false} \quad \xrightarrow{\text{IfFalse}} \quad \text{false}$$

Thus the final result is as follows:

$$\text{if true then if false then false else false else true} \quad \implies \quad \text{false}$$

1.c) All Intermediate Steps for evaluation:

The complete evaluation with all intermediate steps is:

$$\text{if true then if false then false else false else true} \quad \xrightarrow{\text{IfTrue}} \quad \text{if false then false else false} \quad \xrightarrow{\text{IfFalse}} \quad \text{false}$$

In total, it takes **2 steps** to evaluate to the value **false**.