Short-Circuit Evaluation of Boolean Expressions

A compound boolean expression is one involving logical operators "`and`" (&&) and "`or`" (||). Short-circuit evaluation is an approach for evaluating compound boolean expressions where the evaluation can stop before the latter parts of a compound boolean expression are evaluated.

For example, consider the compound boolean expression $\texttt{expr}_1$ `and` $\texttt{expr}_2$, where $\texttt{expr}_1$ and $\texttt{expr}_2$ are boolean expressions (expressions that evaluate to `true` or `false`). A programming language without short-circuit evaluation would evaluate both expressions and then "`and`" the two results according to the usual rules of boolean algebra. Similarly for a compound boolean expression of the form `expr1 or expr2`.

A programming language with short-circuit evaluation works as follows:

- Given an expression of the form $\texttt{expr}_1$ `and` $\texttt{expr}_2$
  - The left operand ($\texttt{expr}_1$) is evaluated.
  - If $\texttt{expr}_1$ is false, then $\texttt{expr}_2$ **is not** evaluated and the truth value for the compound expression is considered to be `false`.
  - If $\texttt{expr}_1$ is true, then $\texttt{expr}_2$ **is** evaluated, and its value becomes the truth value for the compound expression.
- Given an expression of the form $\texttt{expr}_1$ `or` $\texttt{expr}_2$
  - The left operand ($\texttt{expr}_1$) is evaluated.
  - If $\texttt{expr}_1$ is true, then $\texttt{expr}_2$ **is not** evaluated and the truth value for the compound expression is considered to be `true`.
  - If $\texttt{expr}_1$ is false, then $\texttt{expr}_2$ **is** evaluated, and its value becomes the truth value for the compound expression.

Short-circuit evaluation is summarized in the following two truth tables.

$\texttt{expr}_1$	$\texttt{expr}_2$	$\texttt{expr}_1$ and $\texttt{expr}_2$
true	true	true
true	false	false
false	not evaluated	false

$\texttt{expr}_1$	$\texttt{expr}_2$	$\texttt{expr}_1$ or $\texttt{expr}_2$
false	true	true
false	false	false
true	not evaluated	true

Most programing languages, including C, C++, C#, Java, JavaScript, and Python support short-circuit evaluation of compound boolean expressions.