Exercise 6.1 Attribute Grammar BoolExp (Points: 4+2+8+2+2)

Consider the attribute grammar \textit{BoolExp} for the short circuit evaluation of boolean expressions as presented in the lecture and specified on the slides about attribute grammars (pages 20 to 22).

a) For each grammar production, list all attribute occurrences and classify them as defining or applied occurrences. Note: Remember that some identity semantic rules may be omitted in the specification of the grammar, like for example for productions from non-terminal to non-terminal.

b) Draw the parse tree for the following word.

\begin{verbatim}
if a and ( b or c ) or d and e then yesStats else noStats fi
\end{verbatim}

Add to each node in the tree all the attribute instances calculated for that node according to the attribute grammar \textit{BoolExp}.

c) Give the equation system on the attribute instances of the tree nodes in exercise b).

Assume that \textit{a}, \textit{b}, \textit{c}, \textit{d} and \textit{e} are \textit{id} tokens and each of them has got its name as value of the \textit{identifier} field. Further assume that \textit{yesStats} and \textit{noStats} are instances of \textit{STATS} and each of them has got its name as value of the \textit{code} field. All these values are statically known before the evaluation of the attribute instances according to \textit{BoolExp}.

Evaluate the attribute instances.

d) Explain why the attribute grammar \textit{BoolExp} is non-circular.

e) Explain why a single top-down pass followed by a single bottom-up pass of an evaluator on a syntax tree is sufficient to determine the values of all attribute instances of the tree nodes according to the attribute grammar \textit{ BoolExp}. 