COP5621 Spring 2018 – Extra Credit Homework 1

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1. As discussed in class (see Ch.2 notes), complete the construction of an augmented attribute grammar for syntax-directed translation of expressions $expr$ to evaluate the value of an arithmetic expression that is composed of operations $+, -, *, /$ and operands that are single-digit numbers. Operations $*$ and $/$ take precedence over $+$ and $-$. All operations are left associative. Parenthesis are allowed in expressions. Show the annotated parse trees for $9 - 5 + 2$, $9 + 5 * 2$, and $2 * (1 + 3)$. The annotation should show the attribute values at the parse tree nodes.

2. Consider the grammar $G = \langle \{E\}, \{1, !, +\}, P, S \rangle$ with productions $P$

   $E \rightarrow E! | EE+ | 1$

   Show the parse tree for $1!1+!1+.$

3. Consider the grammar $G = \langle \{S\}, \{do, while\}, P, S \rangle$ with productions $P$

   $S \rightarrow do\ S\ while\ S\ |\ while\ S\ do\ S\ |\ \epsilon$

   Show that this grammar is ambiguous.

4. Consider the grammar $G = \langle \{S\}, \{a, if, then\}, P, S \rangle$ with productions $P$

   $S \rightarrow if\ S\ then\ S\ |\ if\ S\ |\ a$

   (a) Left factor the productions.

   (b) Then construct a recursive-descent parser in pseudo-code or C for this factored grammar.

5. Consider the grammar $G = \langle \{S\}, \{x, ;\}, P, S \rangle$ with productions $P$

   $S \rightarrow S; x \ |\ x$

   (a) By the definition of $G$ and the shape of the parse trees generated from this grammar, is the ; operator considered left- or right-associative?

   (b) Eliminate left recursion from this grammar. Explain what happened to operator associativity as a consequence?