CSCI 330 Homework #2
Due Friday, February 15 @ 11:59PM

1. [10pts] Rewrite the BNF grammar above to give + precedence over * and force + to be right associative.

2. [10pts] Using the grammar above, show a parse tree and a leftmost derivation for each of the following statements:
   a. \( A = ( A + B ) \times C \)
   b. \( A = B \times ( C \times ( A + B ) ) \)

3. [5pts] Rewrite the BNF grammar above in EBNF

4. [10pts] Prove that the following grammar is ambiguous:

\[
\begin{align*}
<S> & \rightarrow <A> \\
<A> & \rightarrow <A> + <A> + <A> \mid <id> \\
{id} & \rightarrow a \mid b \mid c
\end{align*}
\]

5. [10pts] Consider the following grammar:

\[
\begin{align*}
<S> & \rightarrow <A> \ a \ <B> \ b \\
<A> & \rightarrow <A> \ b \mid b \\
<B> & \rightarrow a \ <B> \mid a
\end{align*}
\]

Which of the following sentences are in the language generated by this grammar?

a. baab
b. bbbab
c. bbbaaaaa
d. bbaab
e. babab

6. [10pts] Write a grammar for the language consisting of strings that have \( n \) copies of the letter \( a \) followed by the same number of copies of the letter \( b \), where \( n > 0 \).

7. [5pts] Write an attribute grammar whose BNF basis is the grammar below but whose language rules are as follows: Data types cannot be mixed in expressions, but assignment statements need not have the same types on both sides of the assignment operator.

\[
\begin{align*}
<assign> & \rightarrow <var> = <expr> \\
<expr> & \rightarrow <var>[2] + <var>[3] \mid <var> \\
<var> & \rightarrow A \mid B \mid C
\end{align*}
\]

8. [10pts] Compute the weakest precondition for each of the following:

a. \( a = 2 \times (b - 1) - 1 \)
   \( \{a > 0\} \)

b. \( a = 2 \times b + 1; \)
   \( b = a - 3; \)
   \( \{b < 0\} \)