CARLETON UNIVERSITY

Department of Systems and Computer Engineering

SYSC 3101 **Programming Languages** **Problem Analysis 1**

Monday January 30th, 2012.

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1. Write EBNF for the following:
   - a Java method call statement.
   - A C `float` literal.
2. Using the grammar in Figure 1, show a parse tree and a leftmost derivation for each of the following statements:
   - `A = A * (B + (C * A))`
   - `B = C * (A * C + B)`

```
<assign> -> <id> = <expr>
<id> -> A | B | C
<expr> -> <id> + <expr>
       | <id> * <expr>
       | ( <expr> )
       | <id>
```

Figure 1: A grammar for simple assignment statements

3. Using the grammar in Figure 2, show a parse tree and a left most derivation for each of the following statements.
   - `A = ( A + B ) * C`
   - `A = B + C + A`

```
<assign> -> <id> = <expr>
<id> -> A | B | C
<expr> -> <expr> + <term>
       | <term>
<term> -> <term> * <factor>
       | <factor>
<factor> -> ( <expr> )
       | <id>
```

Figure 2: An unambiguous grammar for expressions

4. Prove that the following grammar is ambiguous:

```
<S> -> <A>
<A> -> <A> + <A> | <id>
<id> -> a | b | c
```

5. Consider the following grammar:

```
<S> -> <A> a <B> b
<A> -> <A> b | b
<B> -> a <B> | a
```

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

- `baab`
- `bbbab`
- `bbaaaaa`

6. Write a grammar for the language consiting of strings that have *n* copies of the letter `a` followed by the same number of copies of the the letter `b`, where $n > 0$. For example, the strings `ab` and `aaaabbbb` are in the grammar, but `a` and `aaabb` are not.

7. Draw the parse tree for the sentences `aabb` and `aaaabbbb` using the grammar from the preceding problem.

8. Compute the weakest precondition for each of the following assignment statements and postconditions.

   - `a = 2 * (b - 1) - 1`, $\{a > 0\}$
   - `b = (c + 10) / 3`, $\{b > 6\}$