Florida Atlantic University

COP 4020 Programming Languages
Fall 2015

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Assignment 1: Description of Syntax and Semantics

Due: Monday October 5, 2015 at 11:59pm via Blackboard

1. Given the following grammar, rewrite the BNF to give + precedence over * and force + to be right associative. Show your parse tree to demonstrate that your answer is correct.

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

2. Using the grammar given in question 1, show a parse tree and a leftmost derivation for each of the following statements:

   A = (A + B) * C

3. Given the grammar in question 1, modify the grammar to add a unary minus operator that has higher precedence than either + or *. (Assume the unary operator can precede any operand).

4. Describe, in English or in mathematic notation, the language defined by the following grammar:

<S> → <A> <B> <C>
<A> → a <A> | a
<B> → b <B> | b
<C> → c <C> | c

5. Please explain your answers.

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*. For example, the strings *ab*, *aaaabbbb* and in the language, but *a*, *abb*, *ba*, and *aaabb* are not.

6. Compute the weakest precondition for each of the following assignment statements and post conditions

   a = 2 * (b – 1) – 1 { a > 0 }

   b = (c + 10) / 3 { b > 6 }

7. Compute the weakest precondition for each of the following sequences of assignments statements and their post-conditions

   a = 2 * b + 1; -------- S1

   b = a – 3; ----------S2

   { b < 0}

8. Let $\sum = \{a, b\}$, For the following language, find a grammar that generates it.

   $L = \{a^n b^{n-3} : n >= 3\}$

9. [No grading] Practice derivations of the following English sentences from the grammar given below.

   The following example of CFG describes a fragment of the English sentence

   <SENTENCE> → <NOUN-PHRASE><VERB-PHRASE>

   <NOUN-PHRASE> → <CMPLX-NOUN> | <CMPLX-NOUN><PREP-PHRASE>

   <VERB-PHRASE> → <CMPLX-VERB> | <CMPLX-VERB><PREP-PHRASE>

   <PREP-PHRASE> → <PREP><CMPLX-NOUN>

   <CMPLX-MOUN> → <ARTICLE><NOUN>

   <CMPLX-VERB> → <VERB> | <VERB> <NOUN-PHRASE>

   <ARTICLE> → a | the

   <NOUN> → boy | girl | flower

   <VERB> → touches | likes | sees

   <PREP> → with

   This L(G) include the following three examples

   a boy sees

   the boy sees a flower

   a girl with a flower likes the boy