

CSCI 447 – Fall 2003

Context-Free Grammars

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Due Date: Wednesday, October 29, 2003

1. a. (3 pts) Write an unambiguous context-free grammar for nested blocks of statements where the semicolon separates the statements within a block. A block is surrounded by **begin** and **end** and should have at least one statement. The last statement in a block should NOT be followed by a semicolon. Here is an example:

begin statement ; **begin** statement ; statement **end** ; statement **end**

- b. (2.5 pts) Write an unambiguous context-free grammar for non-empty balanced and nested parentheses, square brackets, and curly braces.

Example: ([[]]({}[()]{})]).

- c. (2.5 pts) Write an unambiguous context-free grammar for $\{ w a^n b^n w^R \mid n > 0 \}$ where w is a string of a 's and b 's, which can be empty, and w^R is the reverse of w .

2. The following grammar generates all regular expressions over the alphabet of letters

$exp \rightarrow exp \mid exp$
 $\rightarrow exp \exp$
 $\rightarrow exp \ast$
 $\rightarrow (exp)$
 $\rightarrow \text{letter}$

- a. (2 pts) Show that this grammar is ambiguous
- b. (2 pts) Rewrite the above grammar to establish correct precedence of operators. Parentheses are given highest precedence, then Kleene closure (*), then concatenation (no operator symbol), then alternation (|).
- c. (1 pt) What associativity does your answer in **b** give to operators and why?
3. (4 pts) The following grammar has been proposed to remedy the **else** ambiguity in **if** statements:

$stmt \rightarrow matched \mid unmatched$
 $matched \rightarrow \text{if } expr \text{ then } matched \text{ else } stmt$
 $matched \rightarrow other-stmt$
 $unmatched \rightarrow \text{if } expr \text{ then } stmt$

Show that this grammar is still ambiguous

4. a. (1 pt) Write a regular expression that generates the same language of the grammar:

$A \rightarrow aA \mid B \mid \epsilon$
 $B \rightarrow bB \mid A$

- b. (2 pts) Write a regular grammar for: $(a \mid c \mid ba \mid bc) \ast (b \mid \epsilon)$.