CSCI 447 – Summer 2002

Context-Free Grammars

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1. Given the grammar $A \rightarrow AA \mid \mathbf{(}\ A\ \mathbf{)} \mid \varepsilon$

a. Describe the language it generates.

b. Show that this grammar is ambiguous.

c. Write an unambiguous grammar that generates the same language

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

rexp → *rexp* **'|'** *rexp*
→ *rexp* *rexp*
→ *rexp* **'*'**
→ **'('** *rexp* **')'**
→ **letter**

a. Show that this grammar is ambiguous

b. 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. What associativity does your answer in **(b)** give to operators and why?

3. Write a grammar for Boolean expressions that include the constants **true** and **false**, identifiers, the operators **and**, **or**, **not**, and parentheses. Be sure to give **or** a lower precedence than **and** and **and** a lower precedence than **not** and to allow repeated **not**'s. The associativity of **or** and **and** is left-to-right, while the associativity of **not** is right-to-left. Be sure that your grammar is not ambiguous.

4. The following grammar has been proposed to remedy the **else** ambiguity in **if** statements:

stmt → *matched* | *unmatched*
matched → **if** *expr* **then** *matched* **else** *stmt*
matched → *other-stmt*
unmatched → **if** *expr* **then** *stmt*

Show that this grammar is still ambiguous

5. **a.** Write a regular expression that generates the same language of the grammar:

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

b. Write a regular grammar for: **(a|c|ba|bc)*(b|ε)**.