

**CMSC 22610**  
**Winter 2004**

**Implementation**  
**of**  
**Computer Languages**

**Homework 2**  
**Due January 30**

1. Translate the following regular expressions into a context free grammar:
  - (a)  $(a \cdot b^* \cdot a) \mid (b \cdot a^* \cdot b)$
  - (b)  $(0 \mid 1)^+ \cdot (0 \mid 1)^+$  (here “.” is a terminal symbol).
2. Write an unambiguous grammar for palindromes over the alphabet  $\{0, 1\}$ .
3. Write an unambiguous grammar for a language of arithmetic expressions involving unsigned numbers (**num**), left-associative infix **+** and **-** operators, unary **-**, and parentheses.
4. Using your grammar from question 3, draw the *derivation tree* for **1-2+-3**.