CS 3101 - Monsoon 2023

Homework 2 – Upload online by 11:59pm on Monday, September 18.

22 points.

(1) Translate the following regular expression into a context-free grammar: (ab*)+(bc)?. See section 2.2 of the textbook for the meaning of ? in regular expressions. (**Convention**: For easy mnemonics, use non-terminal names like BSTAR, BCQUESTION etc.). **(6 points)**

S → ABSTARPLUS BCQUESTION
ABSTARPLUS → ABSTAR ABSTARSTAR
ABSTARSTAR → ABSTAR ABSTARSTAR
ABSTARSTAR → ϵ
ABSTAR → a BSTAR
BSTAR → b BSTAR
BSTAR → ϵ
BCQUESTION → b c
BCQUESTION → ϵ

(2) Write an unambiguous grammar that accepts strings that match the regular expression a*b* and have more a's than b's. **(7 points)**

S → APLUS MATCH
MATCH → a MATCH b
MATCH → ϵ
APLUS → a ASTAR
ASTAR → a ASTAR
ASTAR → ϵ

(3) Write an unambiguous grammer over the alphabet {a, b, c, +, . , !} that accepts all boolean expressions over three input binary signals {a, b, c}, operated upon by three boolean operators AND (.), OR (+) and NOT (!). Break the ambiguity using the following precedence order from highest to lowest: !, ., +. In addition, enforce association from the left. Assume that no more than one NOT operator can be applied to a single expression, e.g., !!a is never present in the input string. **Clarification:** the input strings do not contain parentheses. **(9 points)**

EXPR → EXPR + ANDNOTEXPR
EXPR → ANDNOTEXPR
ANDNOTEXPR → ANDNOTEXPR . NOTEXPR
ANDNOTEXPR → NOTEXPR
NOTEXPR → SIGNAL
NOTEXPR → !SIGNAL
SIGNAL → a
SIGNAL → b
SIGNAL → c