CSE3502 - Theory of Computation March 4, 2014

Due: Before class on March 11, 2014

Homework 4

1. Did you do the reading? Yes/No/Sorta
2. Did you do the reading before class? Yes/No/Sorta
3. How long did you spend on this homework (rounding up)? ___________hours.

1 Context-Free Grammars

1.1 We have used the convention that uppercase letters are variables and lowercase letters are terminals, but that is not required. Consider the following grammar G_1.

$$\begin{aligned} q &\to a \mid ab \mid abc \mid A \mid AB \mid ABC \\ a &\to A \\ b &\to C \\ A &\to b \mid bb \mid AAq \mid c \end{aligned}$$

- What are the variables of G_1?
- What are the terminals of G_1?
- What is the start variable?

1.2 Consider the following grammar G_2.

$$\begin{aligned} A &\to BB \mid C \\ B &\to xB \mid Bx \mid y \\ C &\to xxCx \end{aligned}$$

Answer the following questions. Don't forget that there is a difference between $\Rightarrow$ and $\overset{*}{\Rightarrow}$.

- What are the variables of G_2?
- What are the terminals of G_2?
- What is the start variable?
- True or False: $B \overset{*}{\Rightarrow} BB$?
- True or False: $xBx \Rightarrow xxBx$?
- True or False: $xBx \Rightarrow xxBxx$?
- True or False: $C \overset{*}{\Rightarrow} xxxxxxCxxx$?
- True or False: $A \overset{*}{\Rightarrow} xxxxyxx$?
- True or False: $A \overset{*}{\Rightarrow} xxxyxxy$?
- Give an informal description of $L(G_2)$.

2 Ambiguous Grammars

2.1 Show that the following grammar is ambiguous over the alphabet of parentheses $\Sigma = \{(,)\}$. Then, give an unambiguous grammar that recognizes the same language.

$$A \to (A) \mid (A)(A) \mid B$$
$$B \to BB \mid AA \mid CC$$
$$C \to ABA|\varepsilon$$

3 Pushdown Automata

3.1 Give an informal description and a state diagram for a PDA that recognizes the language of all palindromes over the alphabet $\{0, 1\}$. Recall that a palindrome is a string that is the same forwards and backwards. Some examples include 0, 010, and 00111100.

3.2 Let A be a regular language recognized by an NFA $M = (Q_M, \Sigma, \delta_M, q_M, F_M)$ and let B be a context-free language recognized by a PDA $P = (Q_P, \Sigma, \Gamma, \Delta_P, q_P, F_P)$. Prove that $A \cap B$ is context-free by constructing a PDA using M and P that recognizes $A \cap B$. **To think about:** Why might the same construction not work for two CFLs?