CS 420 Spring 2019
Homework 6

Due: March 20

1. Read Definition 2.8, Theorem 2.9 and Example 2.10 in the textbook (third edition) concerning Chomsky Normal Form and then put the following grammar into Chomsky Normal Form.

$$\begin{aligned} S &\rightarrow TaT \\ T &\rightarrow aTb|bTa|TT|\varepsilon \end{aligned}$$

2. Problem 2.26.

3. Let M be the PDA given at the end of class on March 6 that recognizes the language $\{w \in \{a,b\}^* | w \text{ has the same number of } a\text{'s as } b\text{'s}\}$. (You can find M in the final frame of the lecture video.)

   Show an accepting computation for M on the string *aabbbaab* by giving a chart with the state, tape contents, and stack contents after each step.

4. (a) Following up on a suggestion made by a student in class, give a PDA M' that recognizes the language of the previous problem, but does so in a non-deterministic way, meaning that whenever \$ comes to the top of the stack, the PDA can either guess that it has reached the end of the input and go to an accepting state which is a sink state, or it can guess that it has not reached the end of the input and read an a or a b without going to the accept state before reading the next symbol.

   (b) Show an accepting computation for M' on the string *aabbbaab* by giving a chart with the state, tape contents, and stack contents after each step

5. Give PDAs that recognize the following languages:

   (a) $\{0^n 1^n 2^m 3^m | n, m \geq 0\}$.

   (b) $\{x\#y | x, y \in \{0,1\}^* \text{ and } |x| = 2|y|\}$.

   (c) $\{x\#y | x, y \in \{0,1\}^* \text{ and } |x| \neq 2|y|\}$.

   Do not obtain your PDAs by converting context-free grammars for these languages into PDAs.