CS 3800, Fall 2015
Homework 3 (70 points)
Assigned: Friday, 2 October 2015
Due: Friday, 9 October 2015

1. [4 pts] Do exercise 2.2 in the textbook (both parts).

2. [8 pts] The following grammar is ambiguous:

$$
\begin{aligned}
E &\rightarrow \texttt{a} \\
E &\rightarrow \texttt{(} \ E \ \texttt{)} \\
E &\rightarrow E \ \texttt{\%} \ E \\
E &\rightarrow E \ \texttt{\$} \ E \\
E &\rightarrow E \ \texttt{\#} \ E
\end{aligned}
$$

   Give an equivalent CFG that is unambiguous and also says the $ operator has highest precedence and associates to the left, the # operator has middle precedence and associates to the right, and the % operator has lowest precedence and associates to the left.

3. [24 pts] Give state diagrams for pushdown automata that generate the following languages over the alphabet $\{0, 1\}$.

   (a) $\{0^i 10^j 10^k \mid i + j = k\}$
   (b) $\{0^i 0^j 0^k 1^k \mid i + j = k\}$
   (c) $\{0^i 1^j 0^k \mid i < j \text{ and } k = j - i\}$
   (d) $\{w \mid w \text{ contains twice as many 1s as 0s }\}$

4. [24 pts] Give context-free grammars that generate the languages listed in the previous question.

5. [10 pts] Do problem 2.32 in the textbook.