CS 580 Homework 6
September 24, 2020 (due Tuesday, September 29, 4:00pm)

For all requested PDAs, please give the full seven-tuple with $\delta$ listed as a transition table. PDAs may accept by final state or by empty stack unless otherwise specified. You may assume that $\Sigma$ for each language consists of the symbols mentioned in its definition, and no others.

1. a. What language does the below PDA recognize?
   
   b. By which method does it accept?
   
   c. Add appropriate comments to the code.

   $$M = \langle \{q_0, q_1, q_2\}, \{a, b\}, \{A, z_0\}, \delta, q_0, z_0, \emptyset \rangle$$

   $$\delta(q_0, a, z_0) = (q_0, A z_0)$$

   $$\delta(q_0, a, A) = (q_0, A A)$$

   $$\delta(q_0, b, A) = (q_2, \lambda)$$

   $$\delta(q_2, \lambda, A) = (q_1, \lambda)$$

   $$\delta(q_1, b, A) = (q_2, \lambda)$$

   $$\delta(q_1, \lambda, z_0) = (q_1, \lambda)$$

2. Give a PDA that recognizes each of the following languages. State whether each PDA accepts according to $L(M)$ (final state) or $N(M)$ (empty stack).

   a. $\{ a^i b^{i+j} c^j \mid i + j \geq 1 \}$

   b. $\{ a^i b^j c^k \mid i = j \text{ or } j = k \}$

3. Give a PDA that recognizes $\{ s \mid s \in (a + b)^*, \text{ s contains twice as many a's as b's} \}$,

   a. accepting by final state.

   b. accepting by empty stack.

4. Give a PDA that recognizes the language generated by the following CFG. State whether your PDA accepts according to $L(M)$ or $N(M)$.

   $$S \rightarrow a S b \mid S S \mid \lambda$$