CSC 320 Fall 2024
Assignment 3

This assignment has 6 written questions and is out of a total of 29 marks. Submit one PDF file containing your solutions on Brightspace.

Questions

1. **[3 marks]** Give a context-free grammar (including 4-tuple) for the following language:

$$L = \{a^i(ba)^j \mid i \geq j\}$$

2. **[6 marks]** Consider the following language:

$$L = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i = j \text{ or } i = k\}$$

   (a) Give a context-free grammar (without 4-tuple) for L.

   (b) Give the state diagram for a PDA which recognizes L (without CFG to PDA conversion).

3. **[6 marks]** Consider the following language:

$$L = \{a^n b^{2n} c^m \mid n, m \geq 0\}$$

   (a) Give a context-free grammar (without 4-tuple) for L.

   (b) Give the state diagram for a PDA which recognizes L (without CFG to PDA conversion).

4. **[6 marks]** Consider the following language:

$$L = \{0^{2n} 1^{3n} \mid n \geq 0\}$$

   (a) Give a context-free grammar (without 4-tuple) for L.

   (b) Give the state diagram for a PDA which recognizes L (without CFG to PDA conversion).

5. **[4 marks]** Consider the following context-free grammar G:

$$S \rightarrow ASA \mid A \mid \varepsilon$$
$$A \rightarrow aa \mid \varepsilon$$

   Convert G into Chomsky Normal Form. Show all of your steps.

6. **[4 marks]** Consider the following CFG $G = (\{R, S, T, X\}, \{a, b, c\}, R, S)$ where R is as follows:

$$S \to TSX \mid R$$
$$R \to aTb \mid cTa$$
$$T \to XTR \mid X \mid \varepsilon$$
$$X \to a \mid b \mid c$$

Convert G to an equivalent PDA following the steps of the CFG to PDA proof.