Homework Assignment 4

1. Give the CFG that recognizes $L_1 = \{\mathtt{a}^i\mathtt{b}^j\mathtt{a}^k \mid j = i+k\}$. *Hint:* Try replacing j by $i+k$ in the set builder expression.

2. Give the CFG that recognizes $L_2 = \{a^i b^j \mid j = 2i\}$.

3. Create the new start symbol and remove nullable reductions of the following grammar. This exercise concerns step 1 and step 2 of the CNF algorithm taught in class.

$$
\begin{aligned}
C &\to BbA \\
A &\to BAC \mid \epsilon \\
B &\to \epsilon \mid AA
\end{aligned}
$$

4. Remove the unit transitions from the following grammar. This exercise concerns step 3 of the CNF algorithm taught in class.

$$
\begin{aligned}
A &\to 0 \mid B \\
B &\to BA \mid E \\
C &\to 10A \mid C \mid F \\
D &\to 010 \mid C \\
E &\to A \mid DE \\
F &\to AB \mid DE
\end{aligned}
$$

5. Restructure rules with long (≥ 3) righthand side in the grammar below. This exercise concerns step 4 of the CNF algorithm taught in class.

$$
\begin{aligned}
A &\to BC\mathtt{ac} \mid \mathtt{c} \mid \mathtt{a}B \\
B &\to A\mathtt{b}BA \mid CAB \\
C &\to \mathtt{c} \mid \mathtt{d}
\end{aligned}
$$