CECS 329 Midterm, Part 2 of 3, Fall 2021, Dr. Ebert

A. Provide a context-free grammar that accepts the *complement* of the language $L = \{a^n b^n | n \geq 0\}$. For each rule, provide a brief explanation of its purpose in the goal of generating words in $\overline{L}$. (25 pts)

B. Provide the state diagram of a PDA that accepts the language $L = \{a^m b^n c^m | m \geq 1, n \geq 0\}$ (25 pts)

C. Given the CFG

$$G = (\{S\}, \{a, b\}, \{S \rightarrow aSb, S \rightarrow \epsilon\}, S),$$

the following is a structural definition of the set of words over $\{a, b, S\}^*$ that are derivable by G, i.e. are members of $D(G)$.

Atom $S \in D(G)$.

ϵ-Rule If $uSv \in D(G)$, where $u, v \in \{a, b, S\}^*$, then $uv \in D(G)$.

ab-Rule If $uSv \in D(G)$, where $u, v \in \{a, b, S\}^*$, then $uaSbv \in D(G)$.

Use this structural definition and the method of structural induction to prove that every derivable word has an equal number of a's and b's. (25 pts)