1. Let $\Sigma = \{a, b, \#\}$. Give a pushdown automaton for the language

$$\{u\#v \mid u, v \in \{a, b\}^* \text{ and } v^R \text{ is a substring of } u\}.$$ 

$v^R$ denotes the reversal of the string $v$. You should specify the transition function by giving the state diagram. You need not turn in a proof of correctness, though it would be good reassurance for yourself to do such a proof.

2. Give a pushdown automaton for the language

$$\{a^m b^n \mid n \leq m \leq 2n\}.$$ 

You should specify the transition function by giving the state diagram. You need not turn in a proof of correctness, though it would be good reassurance for yourself to do such a proof.

3. Use the procedure of Lemma 2.21 [1st Ed: Lemma 2.13] to convert the grammar $G_3$ of Example 2.3 [1st Ed: Example 2.2] into an equivalent pushdown automaton $M$. You may use the shorthand allowing the automaton to push more than one symbol in a single step in your state diagram. Show an accepting computation of $M$ on the input $aababb$, together with the corresponding derivation of this string in $G_3$. 