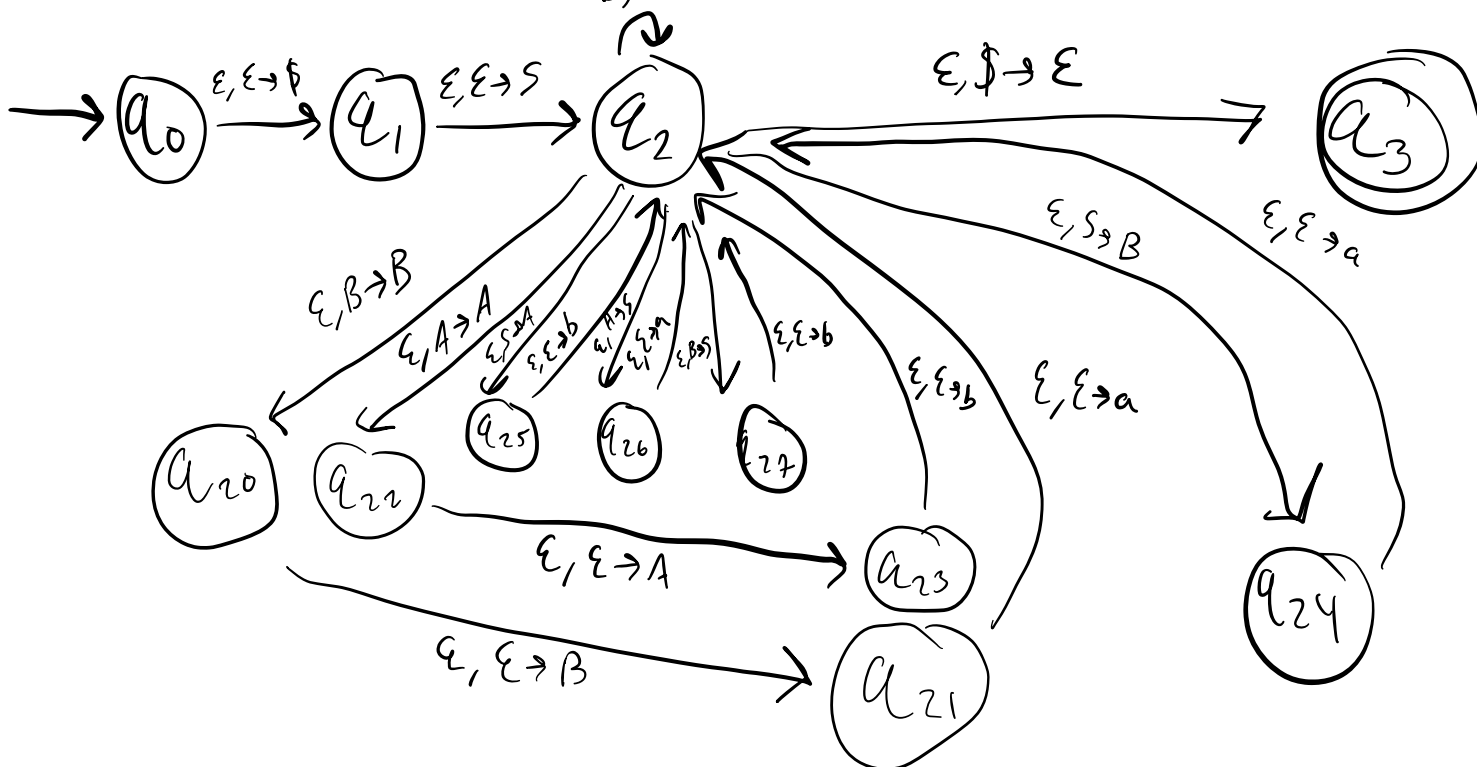
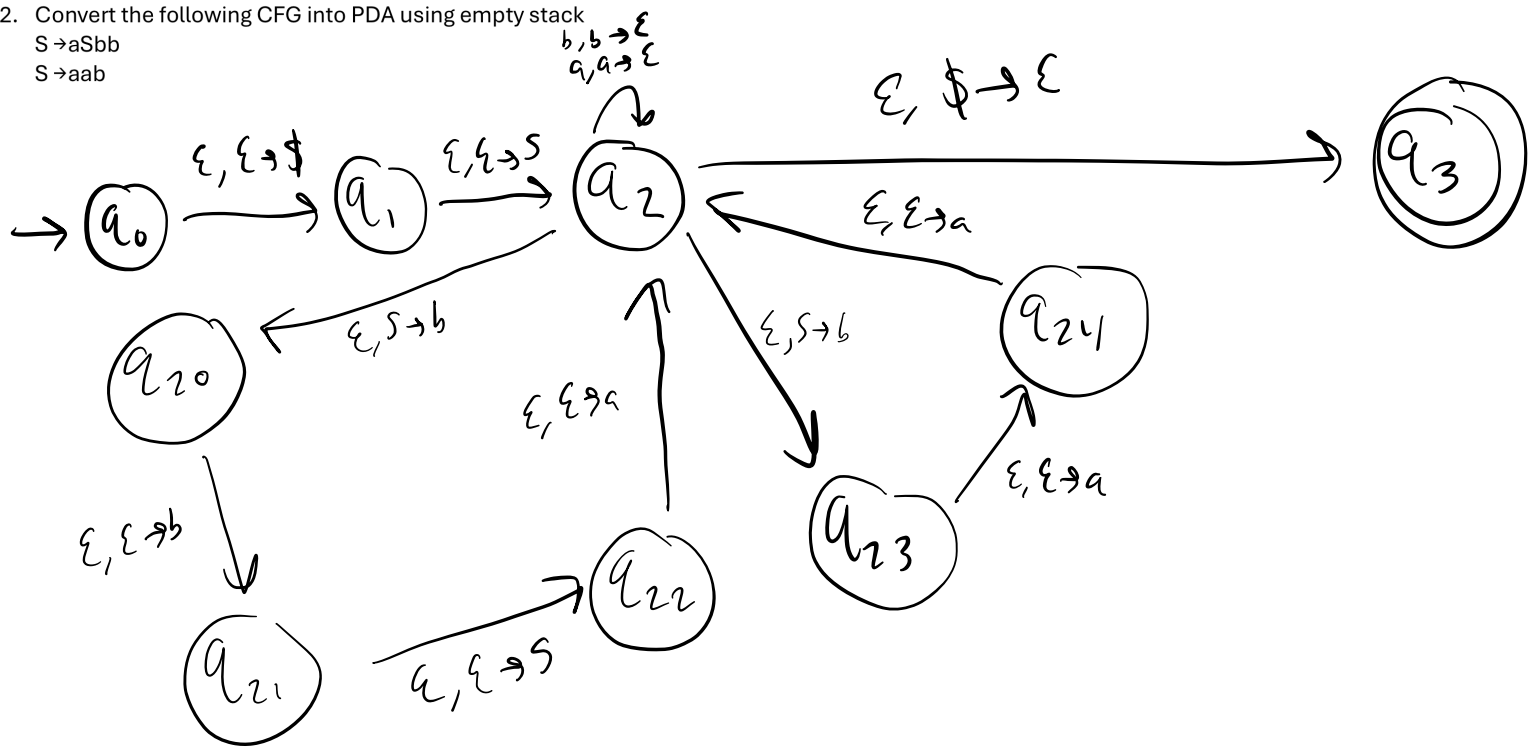


- $B \rightarrow aBB/bS/b$, and trace the input string $w = aaabbabbba$

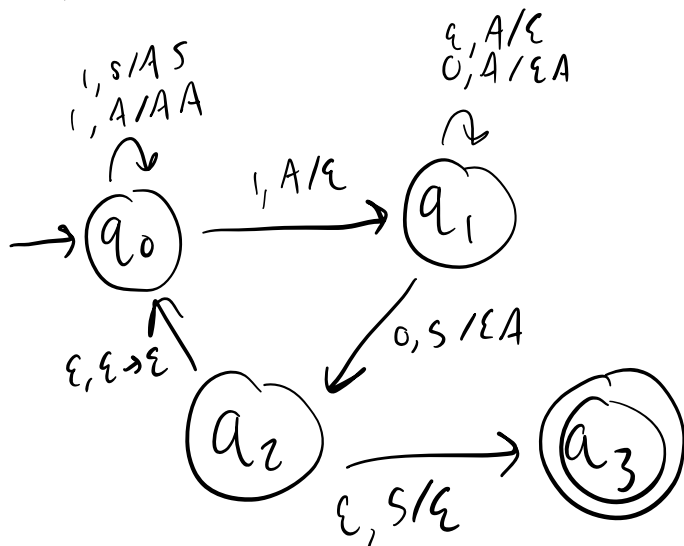
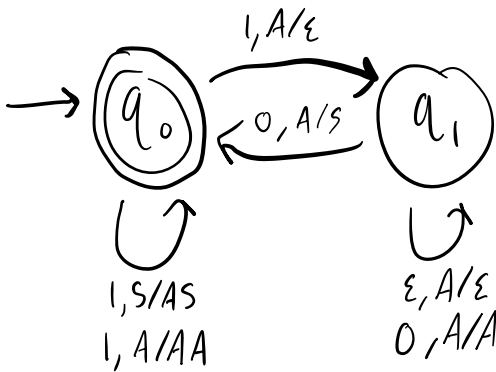
$a, a \rightarrow \epsilon$
 $b, b \rightarrow \epsilon$
 $A, \epsilon \rightarrow a$
 $B, \epsilon \rightarrow b$



2. Convert the following CFG into PDA using empty stack
- $S \rightarrow aSbb$
 $S \rightarrow aab$



3. Convert the given PDA to CFG,
 $\delta(q_0, 1, S) = (q_0, AS)$ $\delta(q_1, e, A) = (q_1, e)$ $\delta(q_0, 1, A) = (q_0, AA)$ $\delta(q_1, 0, A) = (q_1, A)$
 $\delta(q_0, 1, A) = (q_1, e)$ $\delta(q_1, 0, A) = (q_0, S)$
 [Hint: Convert the given transitions into state diagram]



$A_{00} \rightarrow \epsilon$

$A_{11} \rightarrow \epsilon$

$A_{22} \rightarrow \epsilon$

$A_{33} \rightarrow \epsilon$

$A_{01} \rightarrow A_{00} A_{01} | A_{01} A_{11} | A_{11} 0$

$A_{02} \rightarrow A_{01} A_{12}$

$A_{03} \rightarrow \epsilon A_{12} \epsilon$

$A_{10} \rightarrow A_{12} A_{20}$

1. Single accept state

2. Each transition is either pushing or popping

3. Stack is empty at final state

$A_{12} \rightarrow A_{11} A_{12} | A_{12} A_{22} |$

$0 A_{22} \epsilon$

$A_{13} \rightarrow A_{12} A_{23}$

$A_{20} \rightarrow A_{22} A_{20} | A_{20} A_{00}$

$A_{21} \rightarrow A_{20} A_{01}$

$A_{23} \rightarrow A_{22} A_{23} | A_{23} A_{33} |$

$\epsilon A_{23} \epsilon$

4. State that pumping lemma for regular sets and show that the regular set $L = \{0^p / p \text{ is prime number}\}$ is not context free.

$$s = 0^q$$

$$s = xyz \quad |xy| \leq p \quad |y| > 0 \quad |xy| \leq p, y = 0^k \quad |k| \geq 1$$

$$s' = xy^2z = 0^{(q+k)}$$

$q+k$ is not always prime. Therefore it is not regular.

5. State that pumping lemma for regular sets and show that the regular set $L = \{(a)^n b^{2n} \mid n \geq 1\}$ is not context free.

$$|s| \geq p$$

$$s = uvwxy$$

$$|vwx| \leq p$$

$$|vx| > 0$$

$$i \geq 0, uv^iwx^iy \in L$$

$$s = a^p b^{2p} \in L$$

$$i = 2$$

$$s = uv^2wx^2y$$

$$s \in L$$

It is not context-free.