1. $L = \{wcw^R \mid w \text{ belongs to } \{a,b\}^*\}$

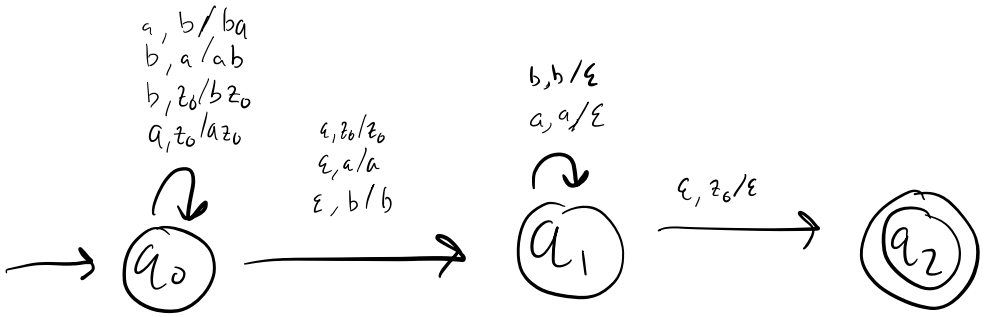
Logic:

Read a push a
Read b push a
Read a push a
show ½ done
Read w pop w
Read c pop c
Read w pop w

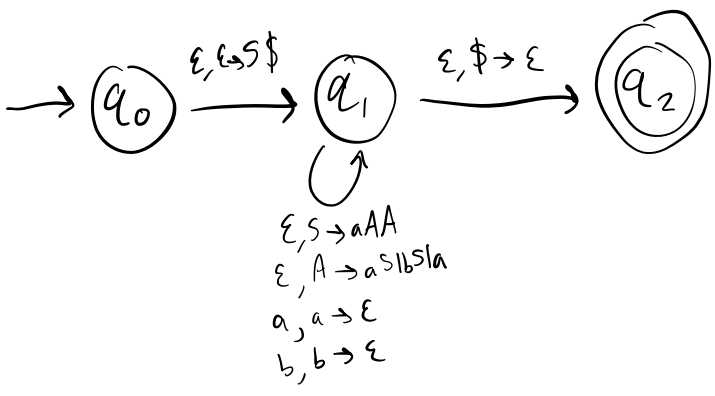
aba
bab

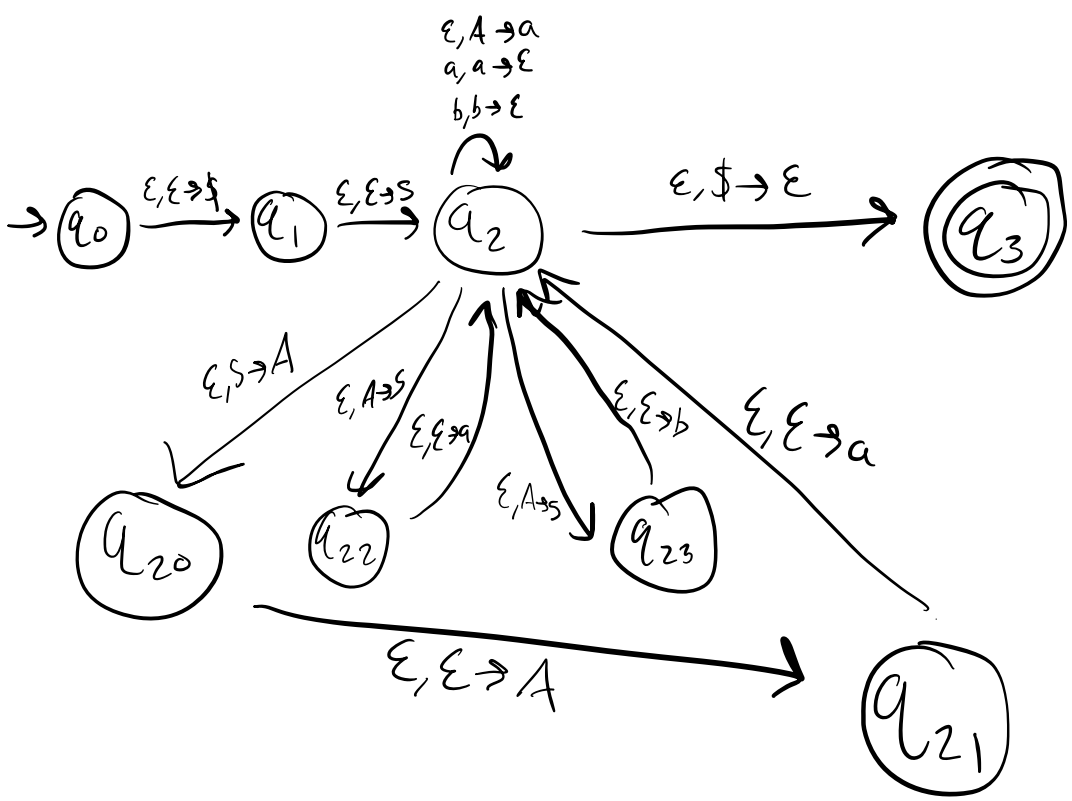
Read b push b
Read a push a
Read b push b
Show ½ done
Read b pop b
Read a pop a
Read b pop b

$\delta(q_0, a, z_0) = (q_0, a z_0)$
$\delta(q_0, b, z_0) = (q_0, b z_0)$
$\delta(q_0, b, a) = (q_0, ba)$
$\delta(q_0, a, b) = (q_0, ab)$
$\delta(q_0, a, b) = (q_0, ab)$
$\delta(q_0, b, a) = (q_0, ba)$
$\delta(q_0, \varepsilon, b) = (q_1, b)$
$\delta(q_0, \varepsilon, a) = (q_1, a)$
$\delta(q_1, a, a) = (q_1, \varepsilon)$
$\delta(q_1, b, b) = (q_1, \varepsilon)$
$\delta(q_1, \varepsilon, z_0) = (q_2, \varepsilon)$

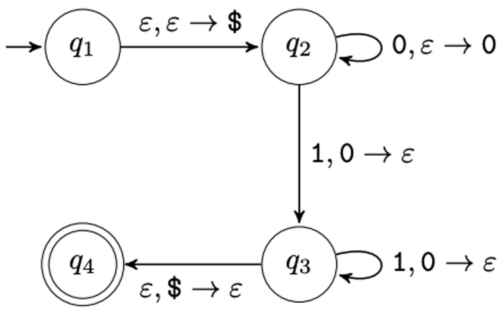

a, b / ba
b, a / ab
b, z0 / bz0
a, z0 / az0
q0
ε, z0 / z0
ε, a / a
ε, b / b
q1
b, b / ε
a, a / ε
ε, z0 / ε
q2

2. $S \to aAA$
   $A \to aS|bS|a$





3.



✓single accept state
✓ Each transition is pushing or poping
✓stack is empty at the end

A_{00}
A_{11}
A_{22}
A_{33}
A_{03} ← start state

$A_{00} \to \varepsilon$
$A_{11} \to \varepsilon$
$A_{22} \to \varepsilon$
$A_{33} \to \varepsilon$
$A_{01} \to A_{01}A_{11} \to \varepsilon A_{01} 0$
$A_{02} \to A_{01}A_{12} \to \varepsilon A_{02} 1$
$A_{12} \to A_{12}A_{22} \to 0 A_{12} 1$
$A_{13} \to A_{12}A_{23} \to 0 A_{13} \varepsilon$
$A_{23} \to A_{22}A_{23} \to 1 A_{23} \varepsilon$
$A_{03} \to \varepsilon A_{03} \varepsilon$