Homework 1–CSC 320 Spring 2020

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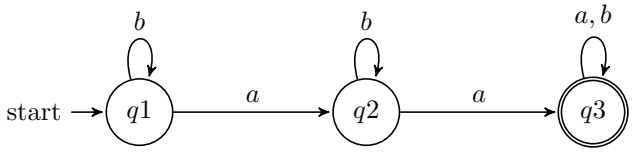
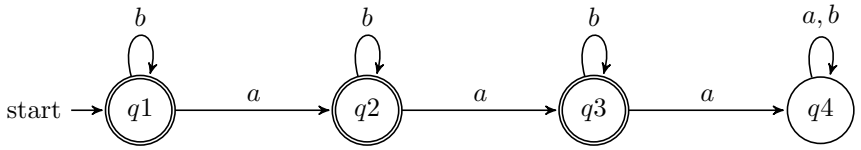
1. (20 Marks) Let L_1 be the set of strings over $\{a,b\}^*$ that contain at least two a's and L_2 be the set of strings over $\{a,b\}^*$ that contain at most two a's.

   (a) $L_1 = \{w \in \{a,b\}^* \mid |a| \leq 2\}$

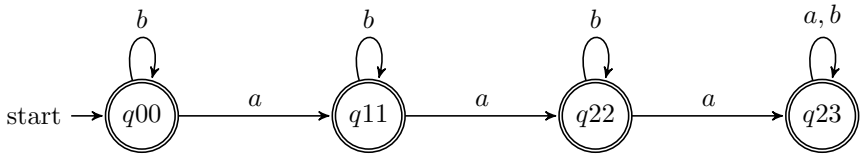


   (b) $L_2 = \{w \in \{a,b\}^* \mid |a| \geq 2\}$

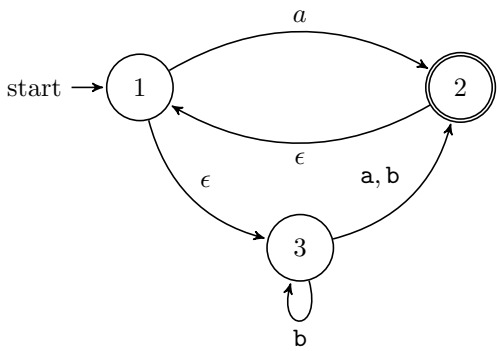


   (c)

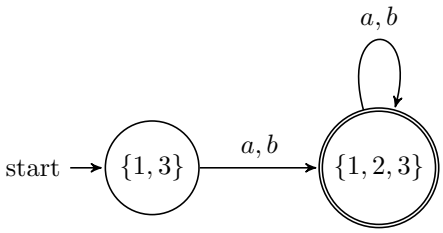
   $L_1 \cup L_2$



2. (20 Marks) Use the construction given in class to convert the following NFA to a DFA. Give a transition table *and* a transition diagram for the resulting DFA.



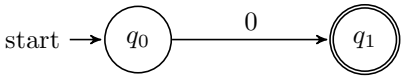
	a	b
{1,3}	{1,2,3}	{1,2,3}
{1,2,3}	{1,2,3}	{1,2,3}



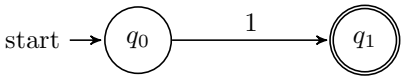
3. (20 Marks) Use the procedure given in class to convert the following regular expression to an NFA

$(((\texttt{00})^*(\texttt{11})) \cup \texttt{01})^*$

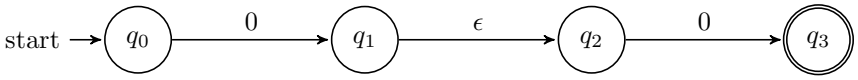
$R = 0$



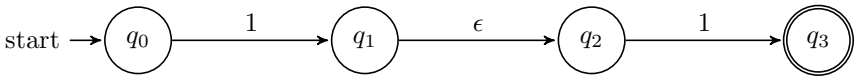
$R = 1$



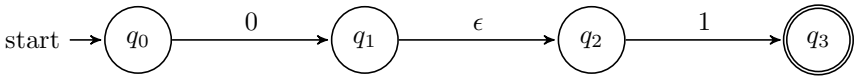
$R = \texttt{00}$



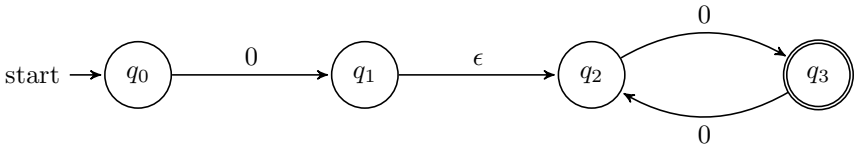
$R = \texttt{11}$



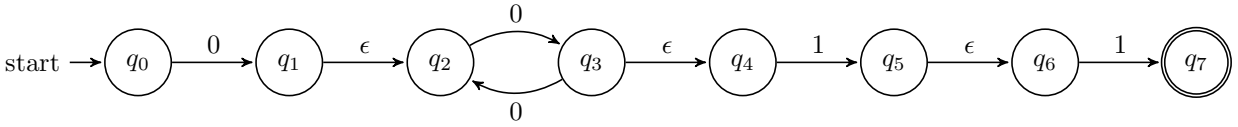
$R = \texttt{01}$



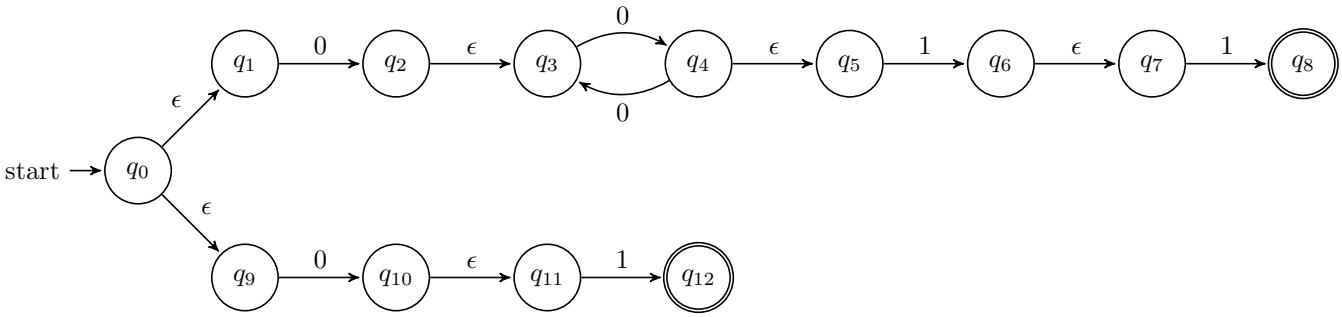
$R = (\texttt{00})^*$



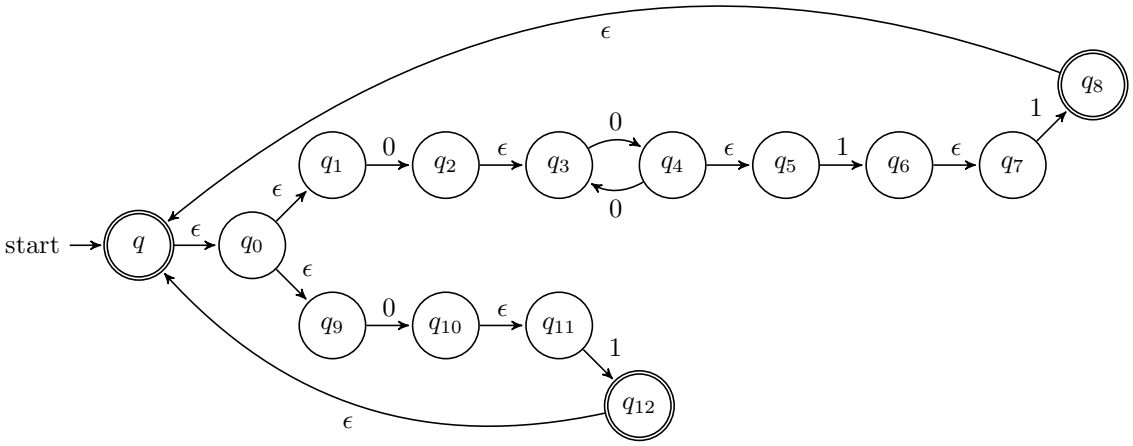
$R = (\texttt{00})^*(\texttt{11})$



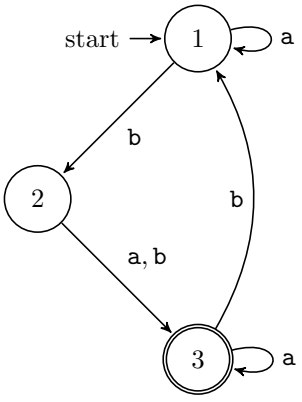
$R = ((\texttt{00})^*(\texttt{11})) \cup \texttt{01}$



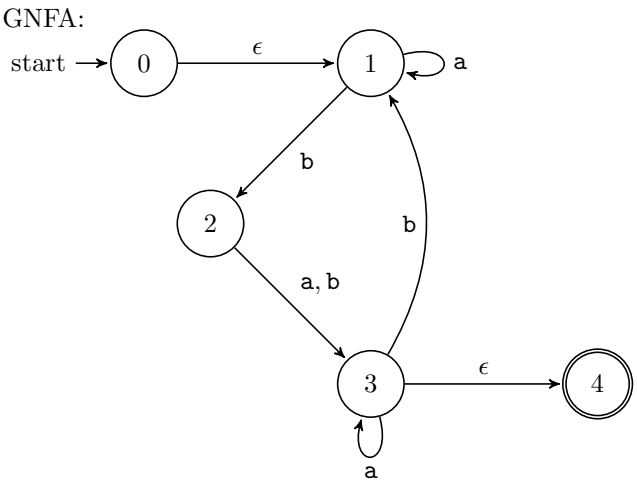
$R = (((\texttt{00})^*(\texttt{11})) \cup \texttt{01})^*$

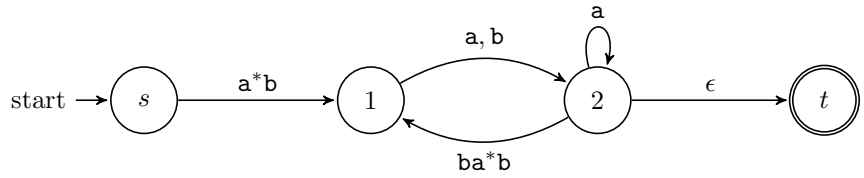


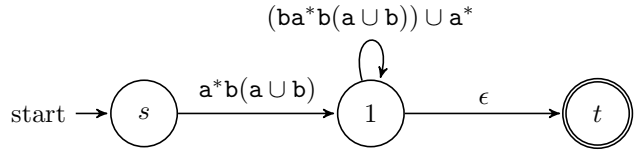
4. (20 Marks) Use the procedure given in class to convert the following DFA to a regular expression

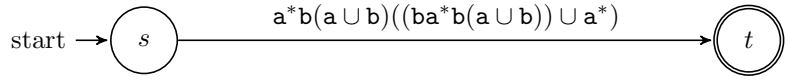


GNFA:









5. Assume the languages A and B are regular. Take the interleave of A with B, $A \wr B$. We want to show that $A \wr B$ is regular.
   The interleave of A and B $A \wr B$ gives:

$$w = a_1 b_1 a_2 b_2 \dots a_k b_k \text{ where } a_1 \dots a_k \in A, b_1 \dots b_k \in B \text{ and } a_i \in \Sigma^a, b_i \in \Sigma^b, 1 \leq i \leq k$$

   We construct the interleave of $A \wr B$ by concatenating $k \geq 1$ (not necessarily distinct) sets of strings, a_i, b_i, where $1 \leq i \leq k$. a_i and b_i are constructed by machines M_a and M_b respectively. We can form the interleave by concatenating a_i with b_i for k times. Since we can construct a machine that accepts the interleave of A and B, given that A and B are both regular, then $A \wr B$ is also regular.