CSE2315 — Assignment 2

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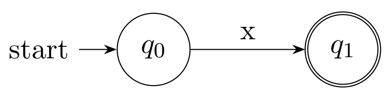
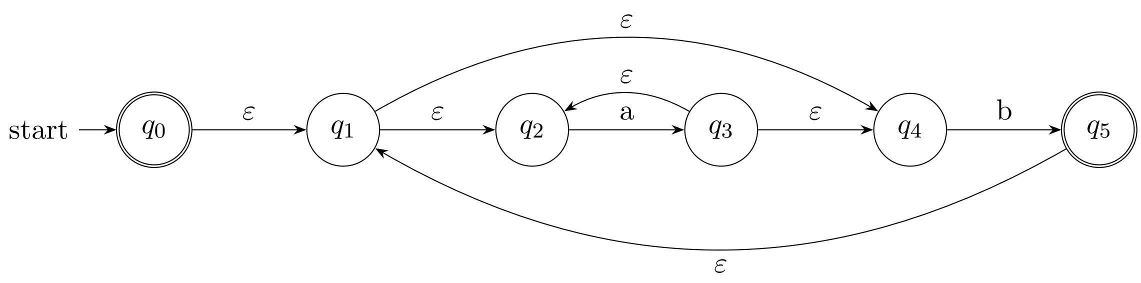
Exercise 1

Consider the language $L = (a^*b)^*$. Construct an NFA N for which $L(N) = L$. To this end, answer the following:

(a) Construct an NFA N_1 for which $L(N_1) = \{x\}$.

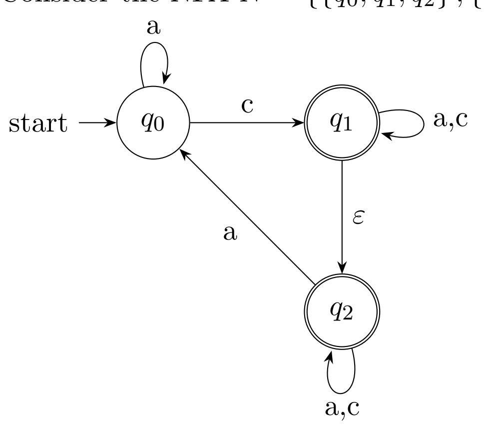


(b) Construct N in a systematic way starting from N_1.

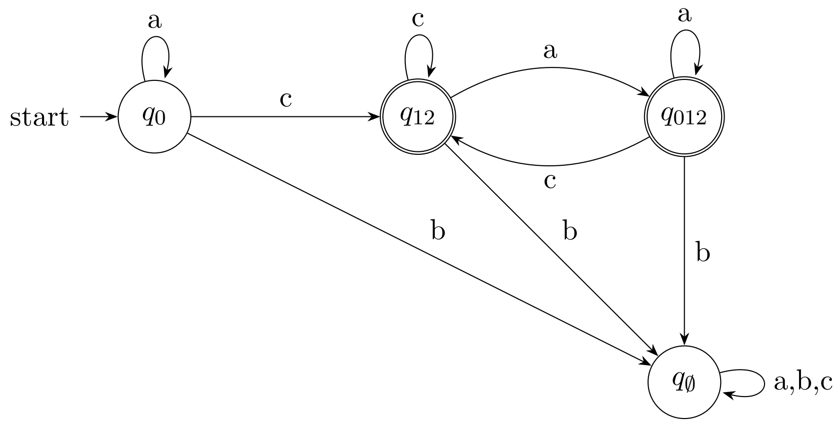


Exercise 2

Consider the NFA $N = \{\{q_0, q_1, q_2\}, \{a, b, c\}, \delta, q_0, \{q_1, q_2\}\}$ depicted below:

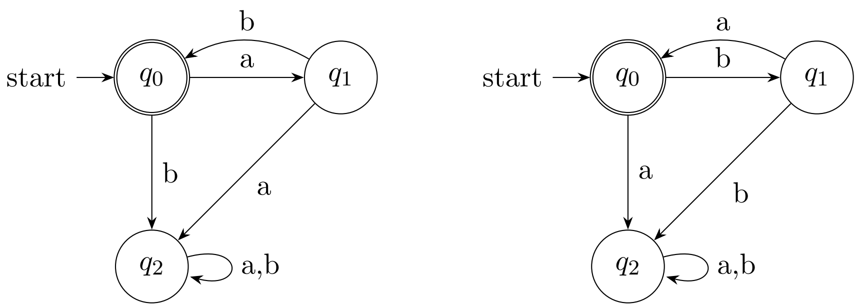


Construct a DFA D such that $L(D) = L(N)$:



Exercise 3

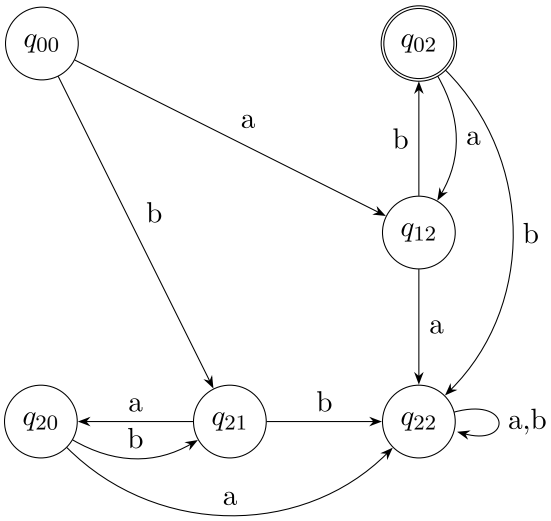
Consider the following two DFAs D_1,D_2:



(a) Describe the languages of D_1 and D_2

$$L(D_1) = (ab)^*, L(D_2) = (ba)^*$$

(b) Construct a DFA D such that $L(D) = L(D_1) \cap L(D_2)^c$.



Exercise 4

Suppose we have the following language L over the alphabet $\Sigma = \{a, b, c\}$:

$$L = \{w \in \Sigma^* | w \text{ has an } a \text{ and every } a \text{ after the first } a \text{ in } w \text{ is immediately followed by a } c\}$$

(a) Give a regular expression R such that $L(R) = L$.

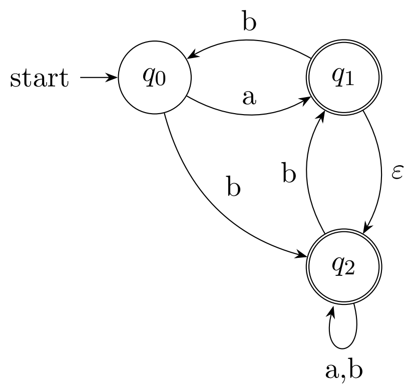
$$R = (b \cup c)^* a (b \cup c \cup ac)^*$$

(b) Explain the answer

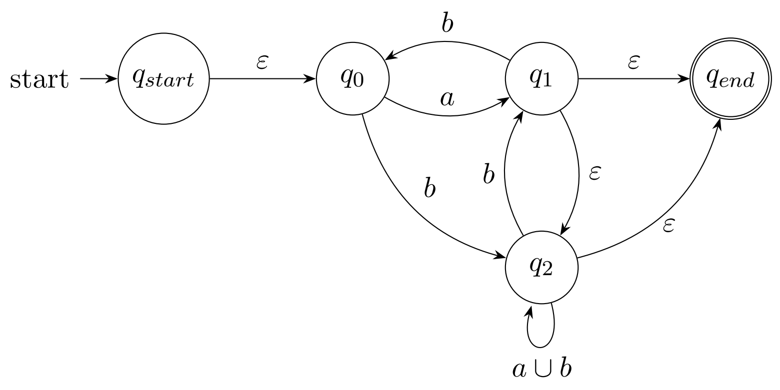
In order to enforce the one a in the word, we have to go $(b \cup c)^* a (b \cup c)^*$. And then to add ac blocks after the first a, we simply or those ac blocks with the $b \cup c$.

Exercise 5

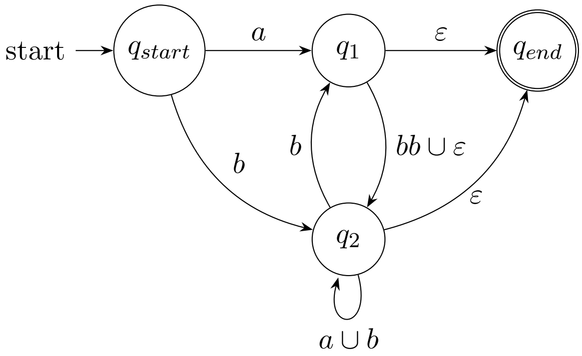
Convert the following NFA N to a regular expression R such that $L(R) = L(N)$



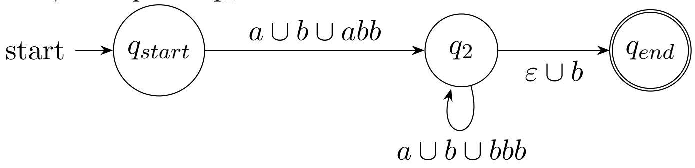
We begin by converting it to a GNFA (I omit arrows on which the regular expresion would be $\emptyset$):



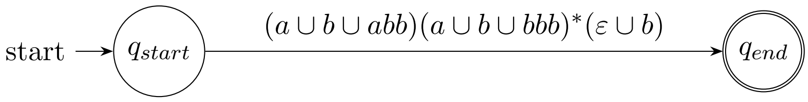
Then, we rip out the state q_0:



Now, we rip out q_1:



Now, we rip out q_2

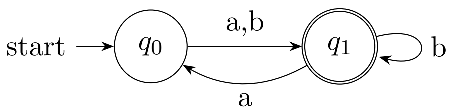


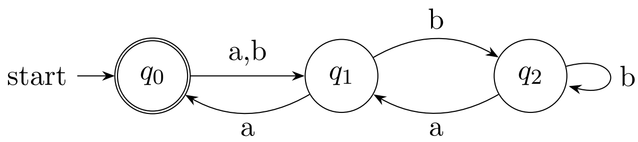
Therefore, $R = (a \cup b \cup abb)(a \cup b \cup bbb)^*(\varepsilon \cup b)$, which simplifies nicely to:

$$\boxed{R = \Sigma^+}$$

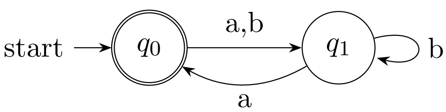
Exercise 6

Consider the following two DFAs, D on the left, D' on the right:



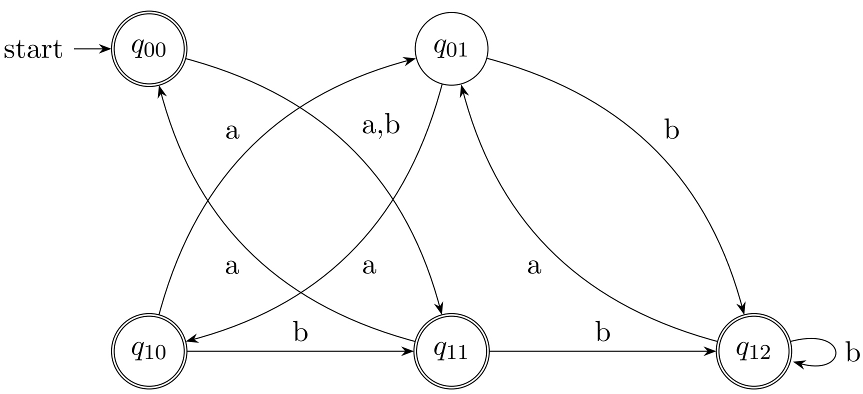


(a) Construct a new DFA D'' of at most 2 states, such that $L(D'') = \overline{L(D)}$



All you have to do is invert accepting and non-accepting states.

(b) Construct a DFA D''', such that $L(D''') = L(D) \cup L(D')$



Bonus Exercise