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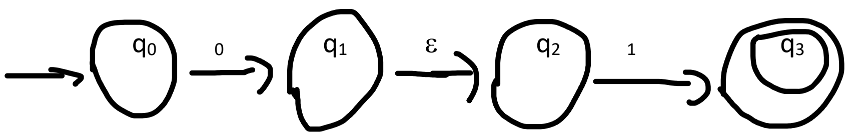
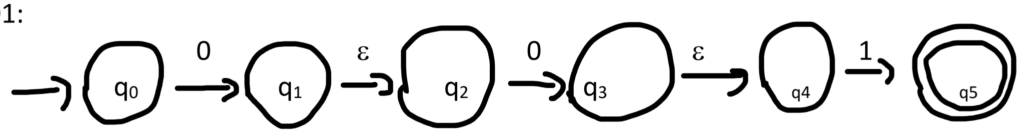
Assignment #2

1.17(a) Given an NFA recognizing the language (01 U 001 U 010)*.

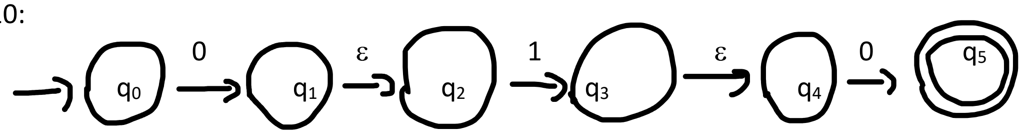
01:



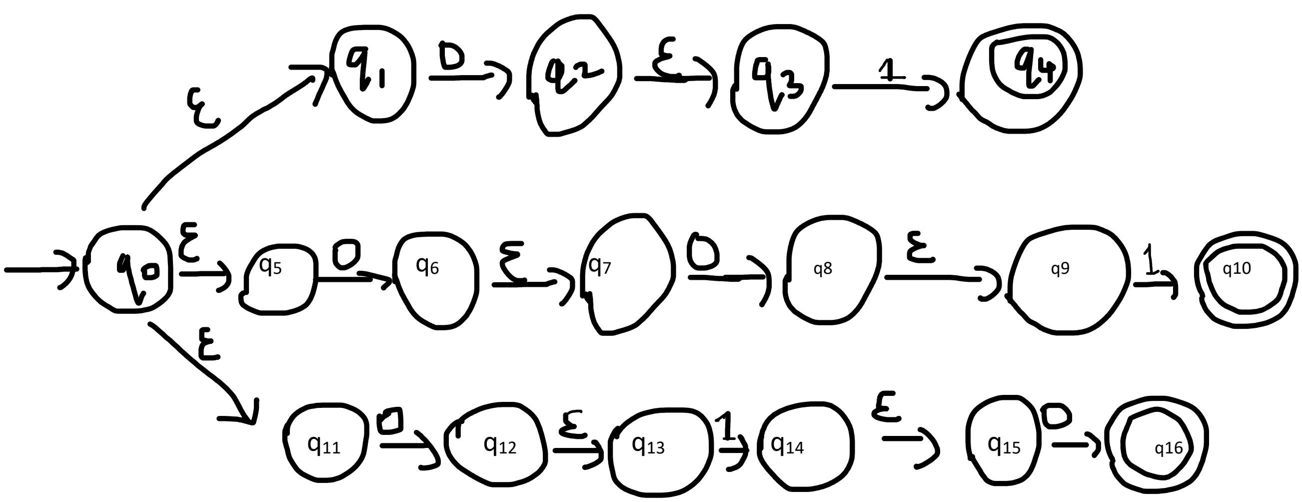
001:



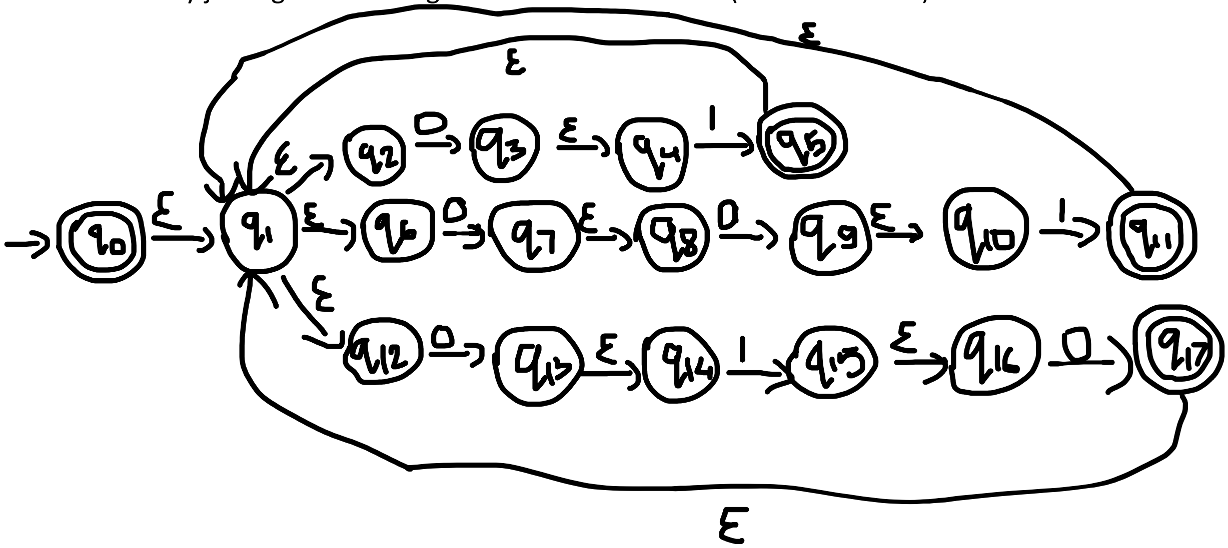
010:



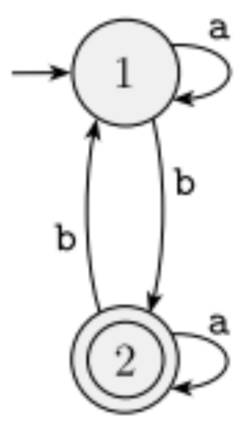
Now when we find the union (01 U 001 U 010)
we will get this:



By joining all the strings in the final NFA for L = (01 U 001 U 010)* is shown below:



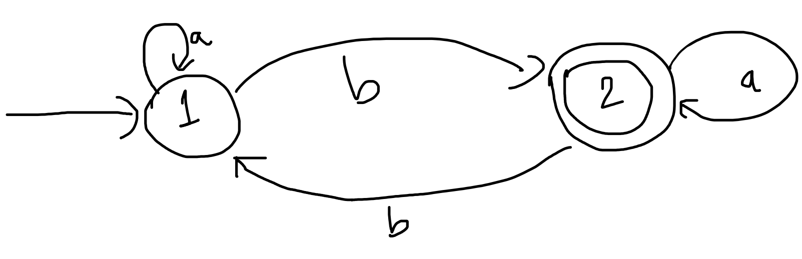
1.21 Use the procedure described in Lemma 1.60 to convert the following finite automata to regular expressions.



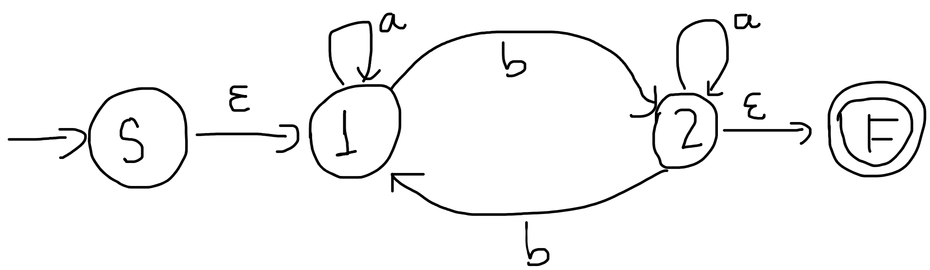
(a)

Solution for 1.21.a:

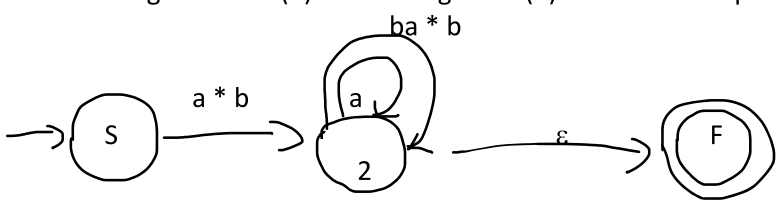
Considering the given finite automata:



Step 1: Adding the Initial state (S) and the new accept state/final state (F) to make the original accept state as non-accepting state as shown in the diagram below:

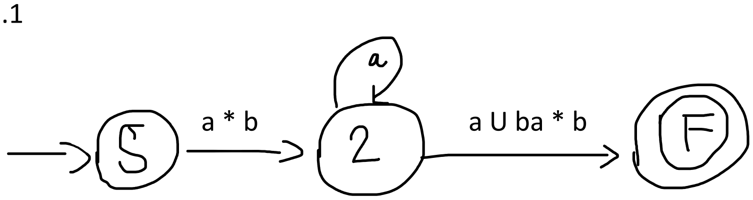


Step 2: Eliminating the state (1) and adding state (2). Here is the expression by pumping state (S)

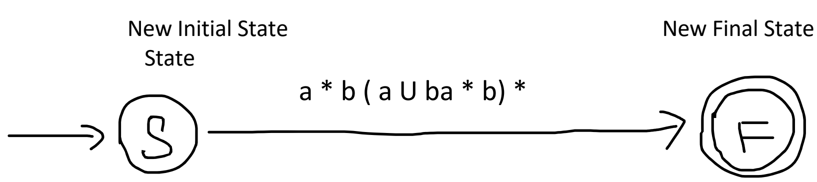


Step 3: Eliminating the state (2) with these following two steps first by making the union and then removing the loop and removing the state 2.

Step 3.1



Step 3.2 - Putting it all together:



The resultant regular expression that we get is: a* b (a U ba * b) *

1.29.b. Use the pumping lemma to show that the following languages are not regular.

$A_2 = \{www \mid w \in \{a, b\}^*\}$

Proof: Using proof of contradiction

Considering the given regular language, $A_2 = \{www \mid w \in \{a, b\}^*\}$

First, we assume A_2 is a regular language.
Let p be the pumping length given by the pumping lemma.
Considering a string $S \in A_2$, $|S| \geq p$.

$S = a^p b^p a^p b^p a^p b^p \in A_2$

By pumping lemma, the string can be divided into three pieces xyz such that

$$|xy| \leq p,$$
$$|y| > 0$$

Let, $a^p b^p a^p b^p a^p b^p$ be the string that belongs to A_2.
We can take,

$x = a^k$, $0 \leq k < p$

$y = a^m$, $0 < m \leq p$

$xy = a^k.\ b^m = a^{k+m}$

$|xy| = k + m \leq p$

$z = a^{p-k-m} b^p a^p b^p a^p b^p$

$xy^2z = a^k a^m a^m\ a^{p-k-m} b^p a^p b^p a^p b^p$

$= a^{k+m+m+p-k-m}\ b^p a^p b^p a^p b^p$

$= a^{m+p}\ b^p a^p b^p a^p b^p$

Here, $a^{m+p}\ b^p a^p b^p a^p b^p \notin A_2$. Our assumption saying A_2 is a regular language is wrong.
Therefore, A_2 is not a regular language.