Regular Expression to DFA conversion

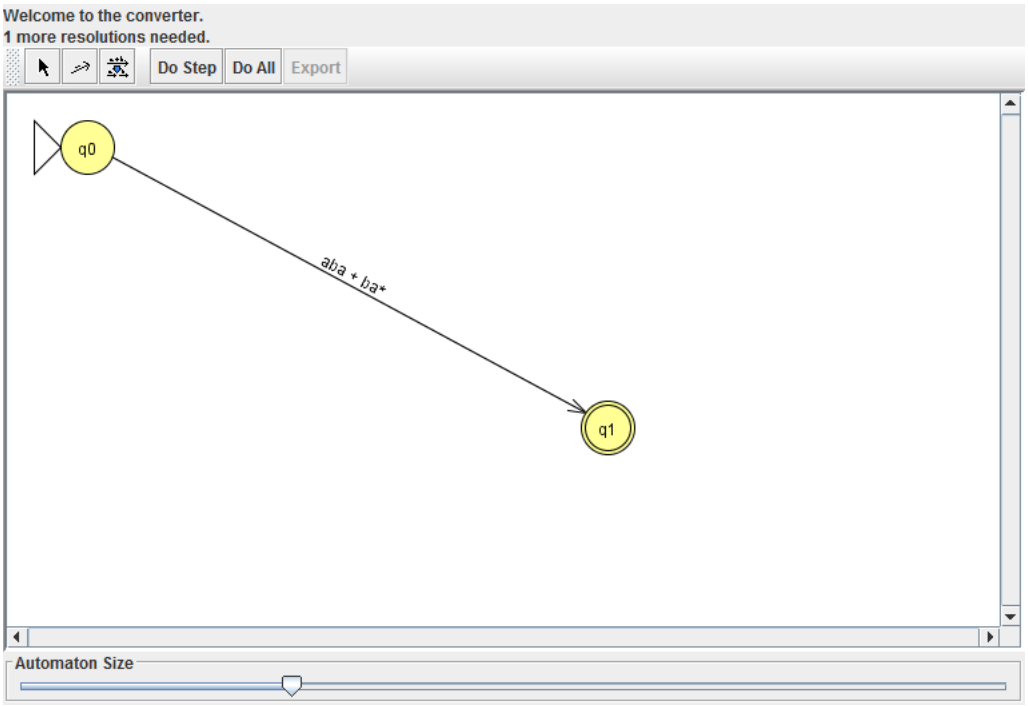
Convert the following Regular Expression to a DFA

$aba \cup ba^*$

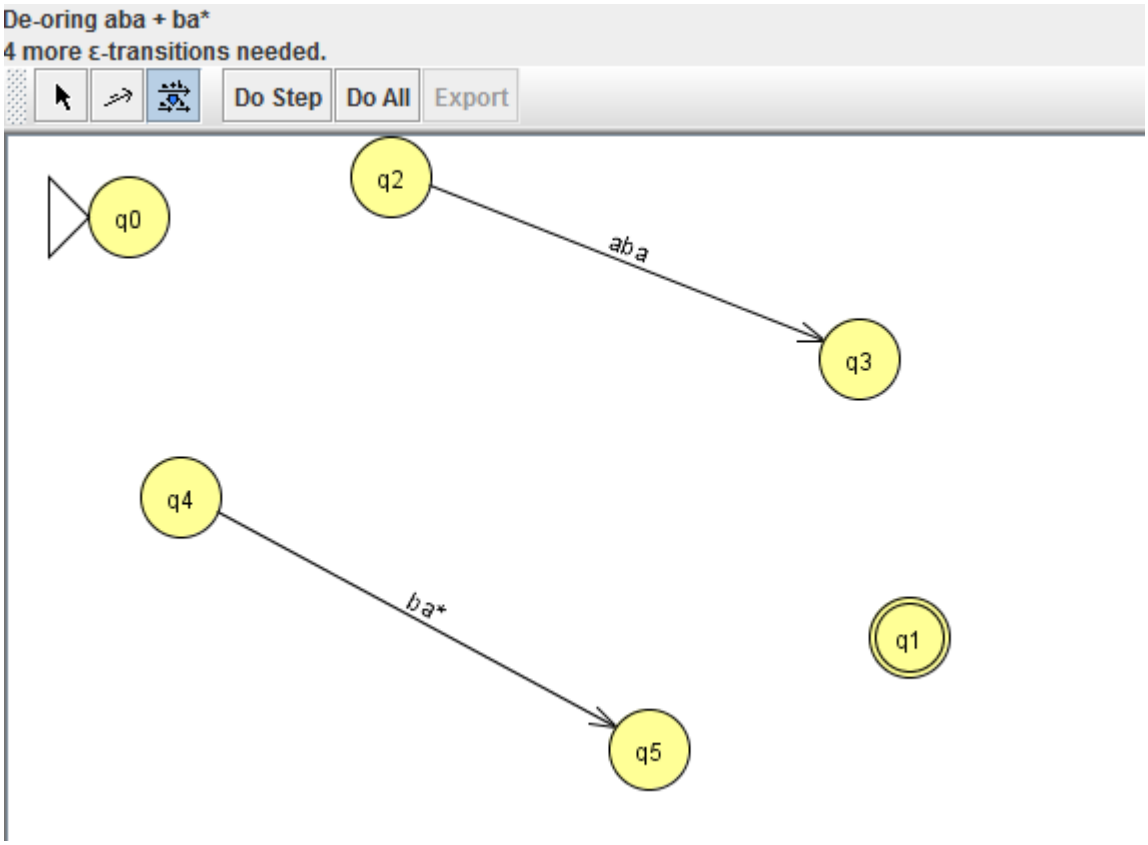
Solution

The regular expression can be entered into JFLAP by choosing the regular expression option and typing in $aba + ba^*$, since JFLAP uses $+$ to represent the $\cup$.

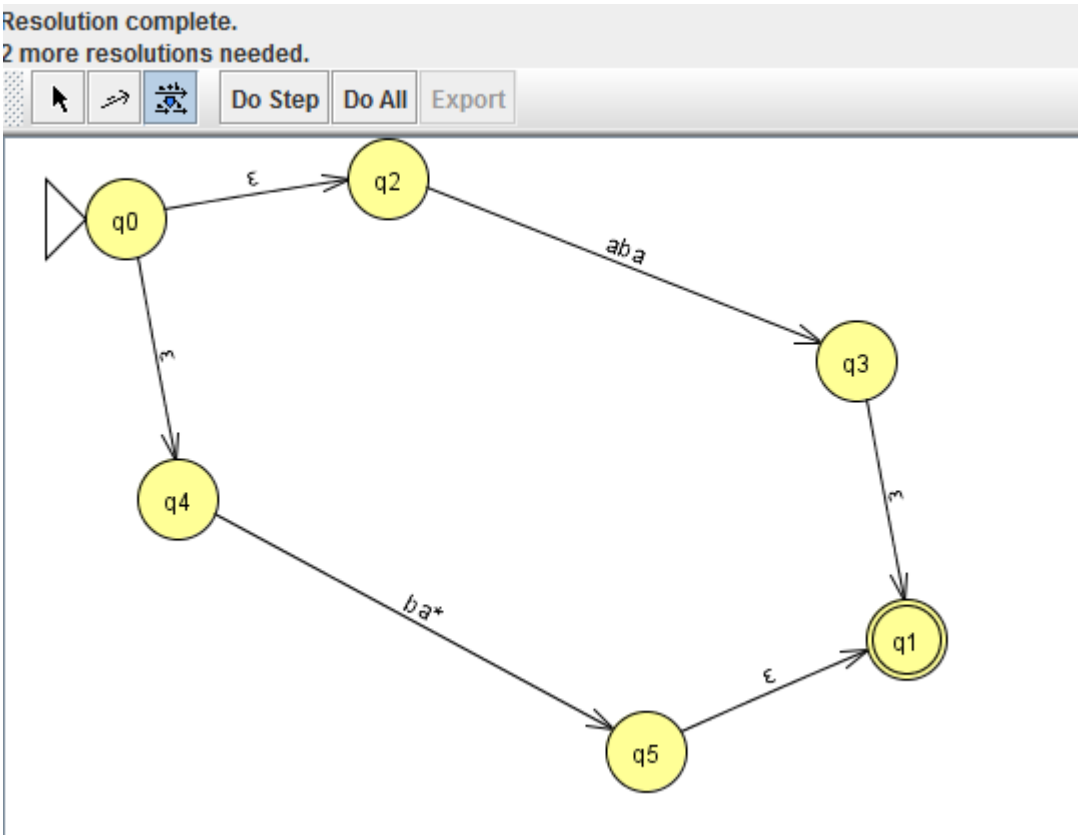
- The first step is to convert the regular expression to an NFA. This is done by breaking the regular expression down into its constituent parts. If you click the convert menu and choose 'Convert to NFA' you will see the following.



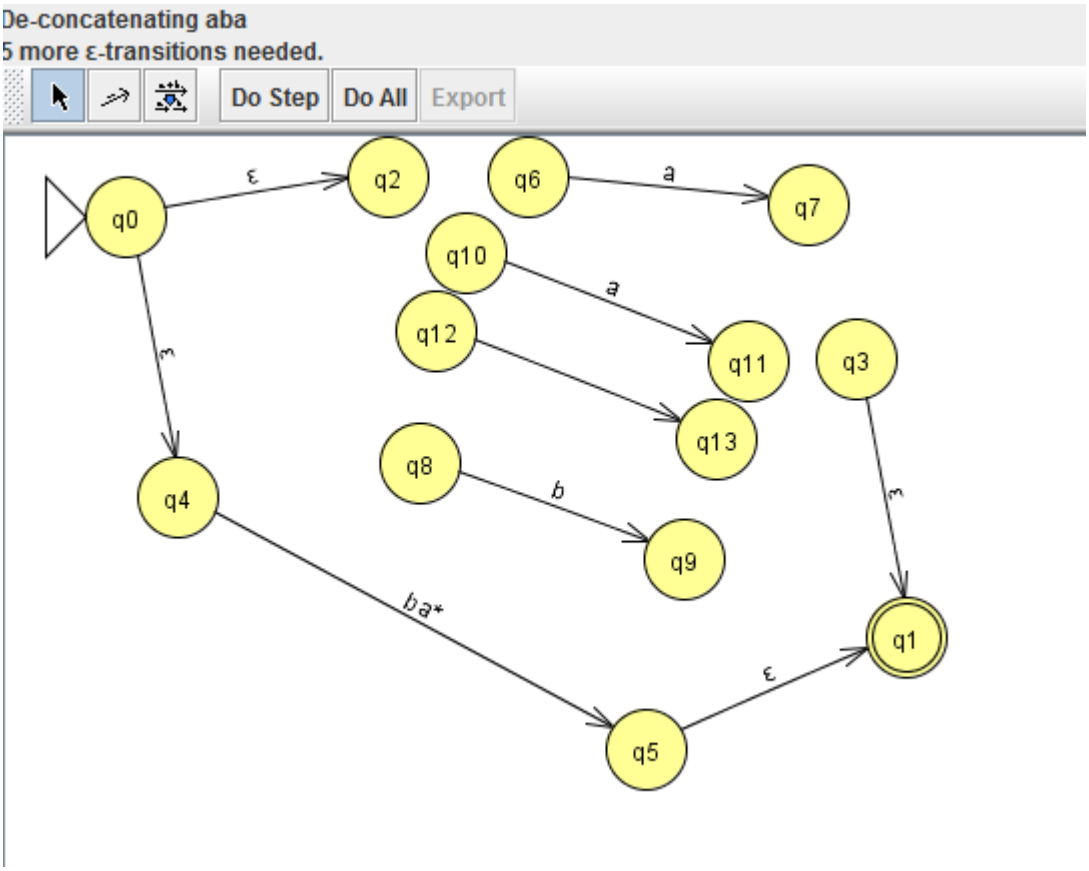
Click the 'de-expressionify' transtion button and then click the transition to get the two regular expressions that are separated by the union operator. So you get one transition of aba and one of ba.



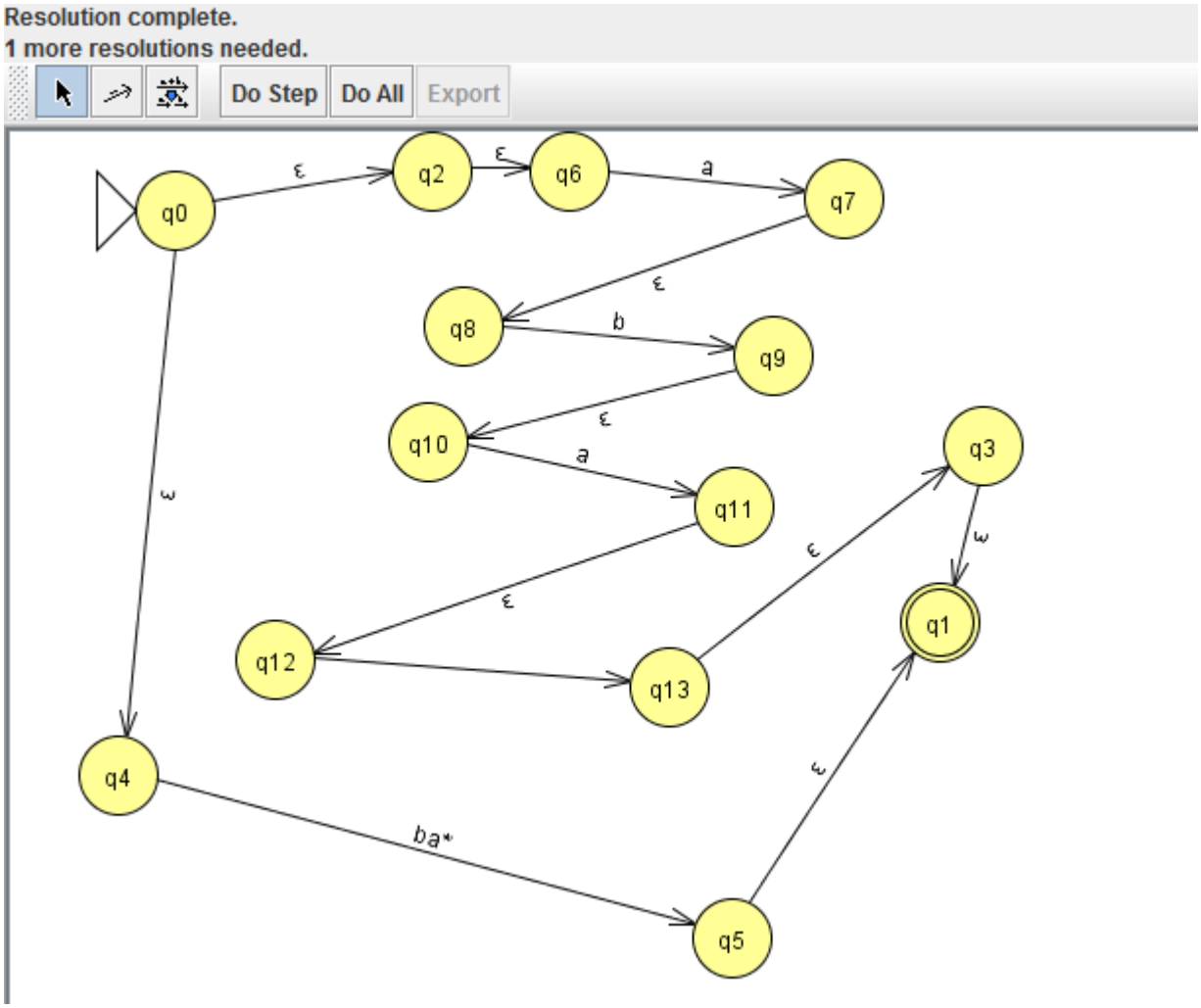
Now to connect up these 'pieces' of the regular expression we will use ϵ transitions.



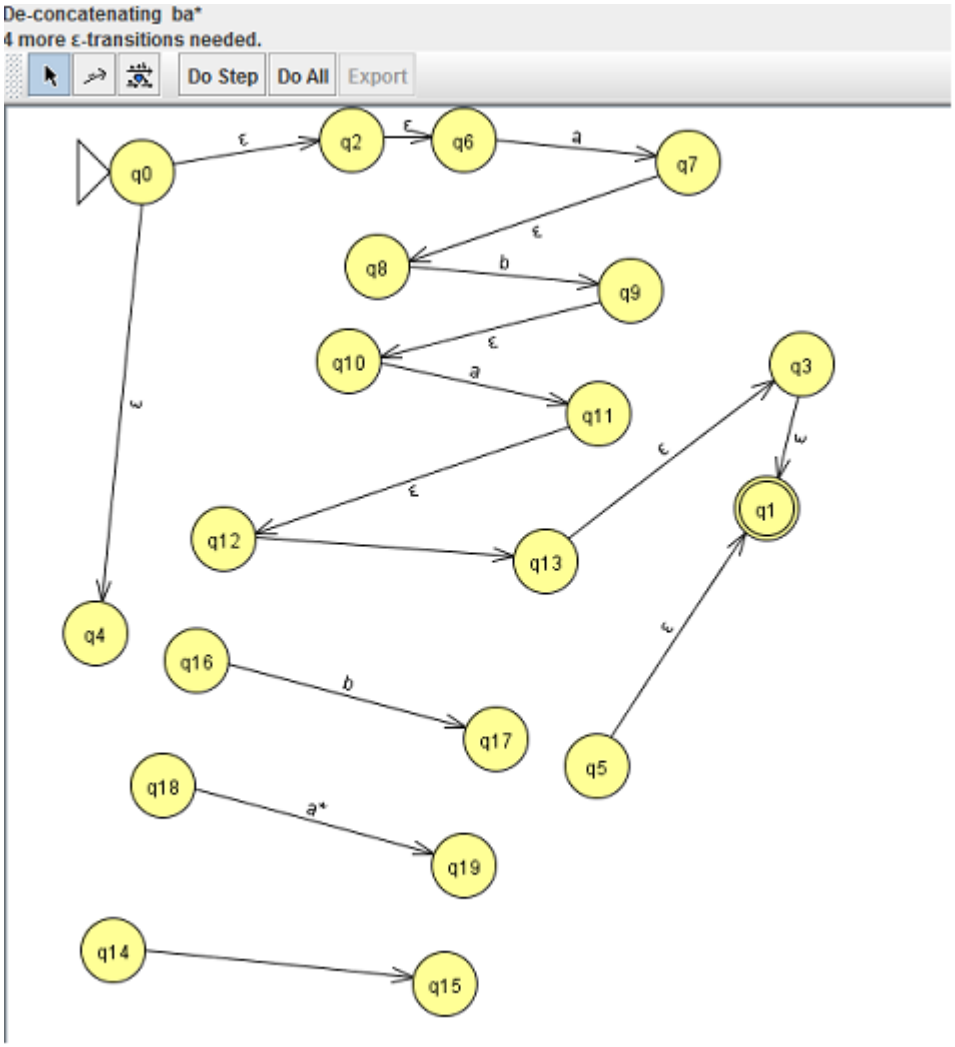
- In the next step we choose to break the expression aba. This is basically an a being concatenated with a b being concatenated with an a. Upon clicking the De-expressionify button you get a picture that looks like



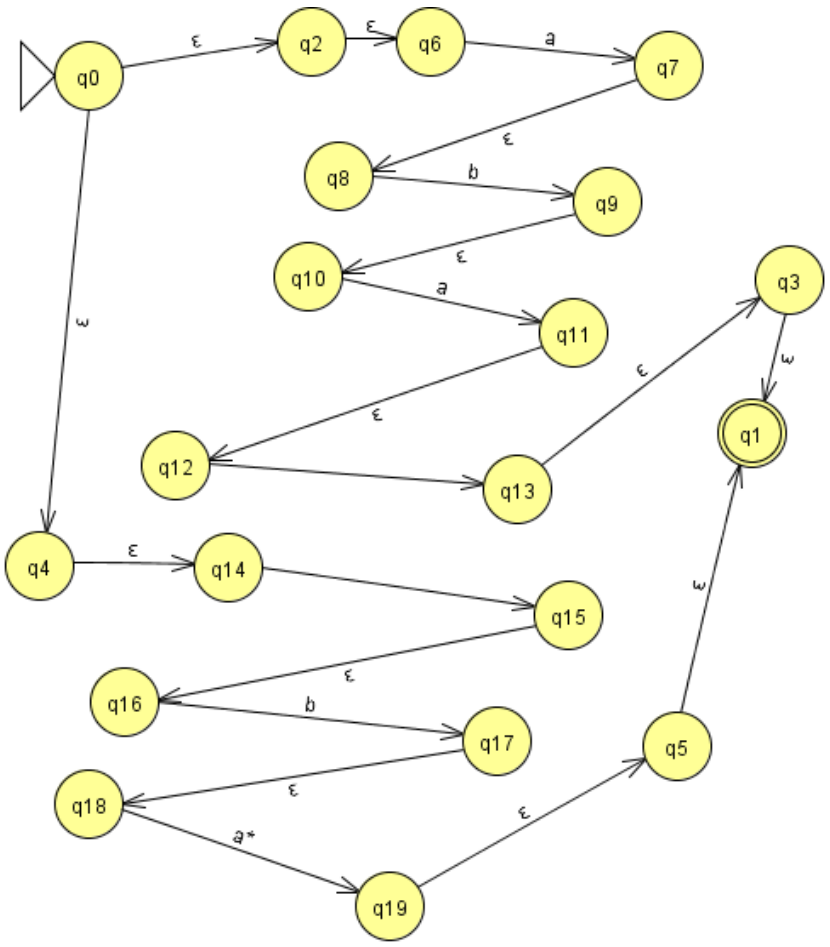
Connect up the states via ϵ transitions. For concatenation you just need to transition from the final state of one to the start state of the next via an ϵ, as can be seen here



- Once *aba* has been broken up into its constituent NFA pieces, we turn our attention to ba^* which upon de-expressionfication first looks like

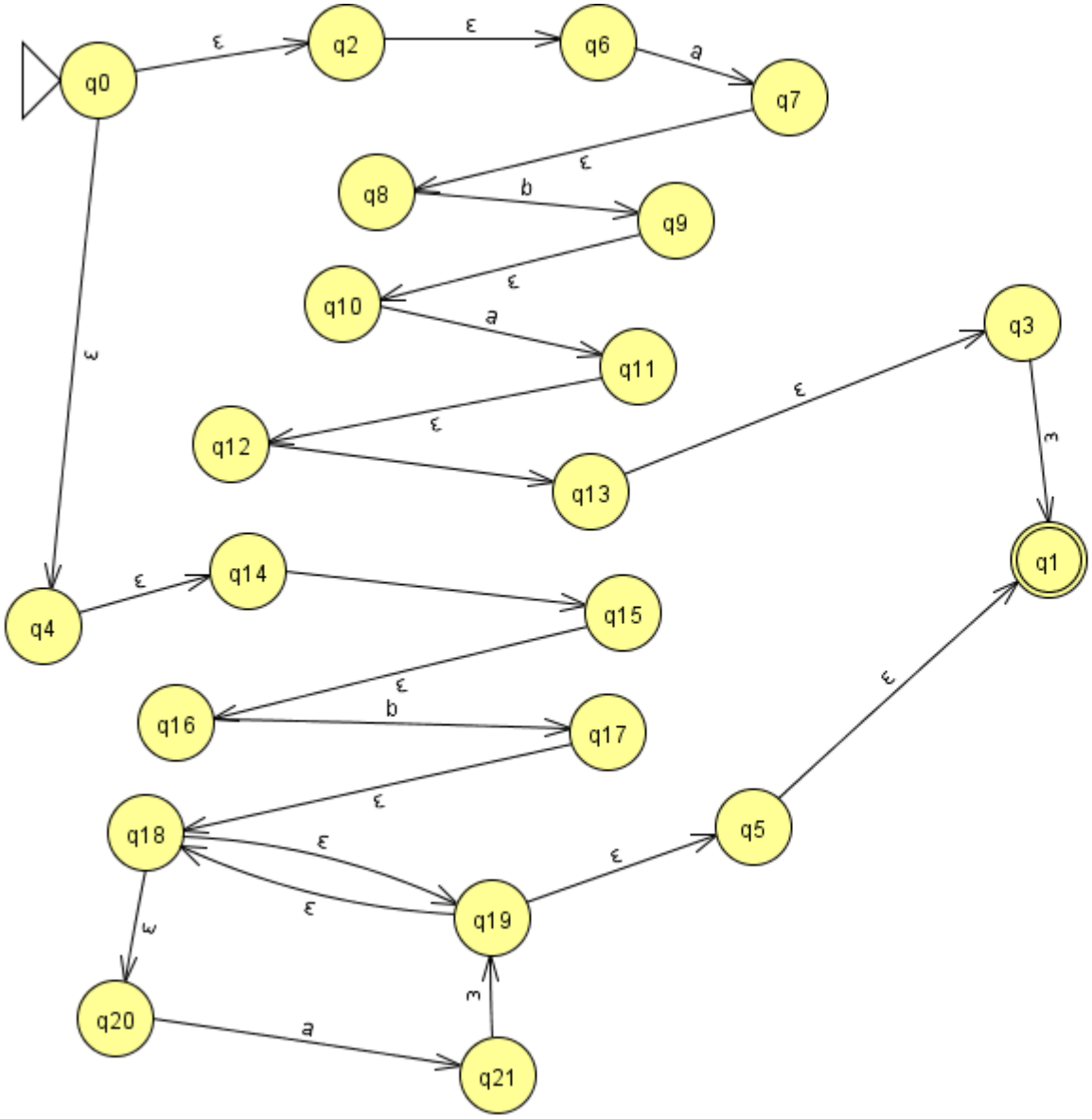


and then upon connecting using ϵ transitions (similar to what we did in the previous step), we get

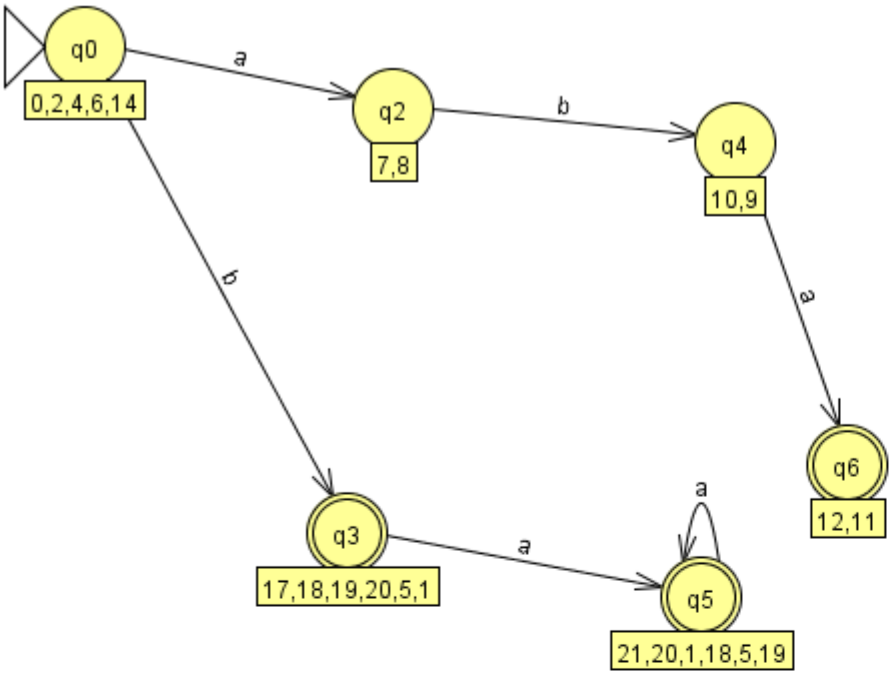


- In the final step we need to break up a^*. Upon clicking the de-expressionify button you get two more states that are connected by an a transition. To create the effect of a $*$ operation, remember that $*$ means 0 or more instances being concatenated with each other. So, create an ϵ transition loop from q_{18} to q_{19}. And then connect up q_{18} to q_{20} and q_{21} to $q_{19}$with ϵ transitions. By doing this, the q_{20} to q_{21} transition can be used multiple times.

- At this stage we are done since every transition is either an a or a b or an ϵ. We use the Export button to save this as an NFA.



- The final step would be to convert this now to a DFA. The convert menu has a convert to DFA option which can be used. Refer to the NFA to DFA conversion help to get more insight into this. In this example we will just use the 'Complete' button to do this in 1 step.


q0
0,2,4,6,14
a
q2
7,8
b
q4
10,9
e
q6
12,11
b
q3
17,18,19,20,5,1
a
a
q5
21,20,1,18,5,19