Homework 1

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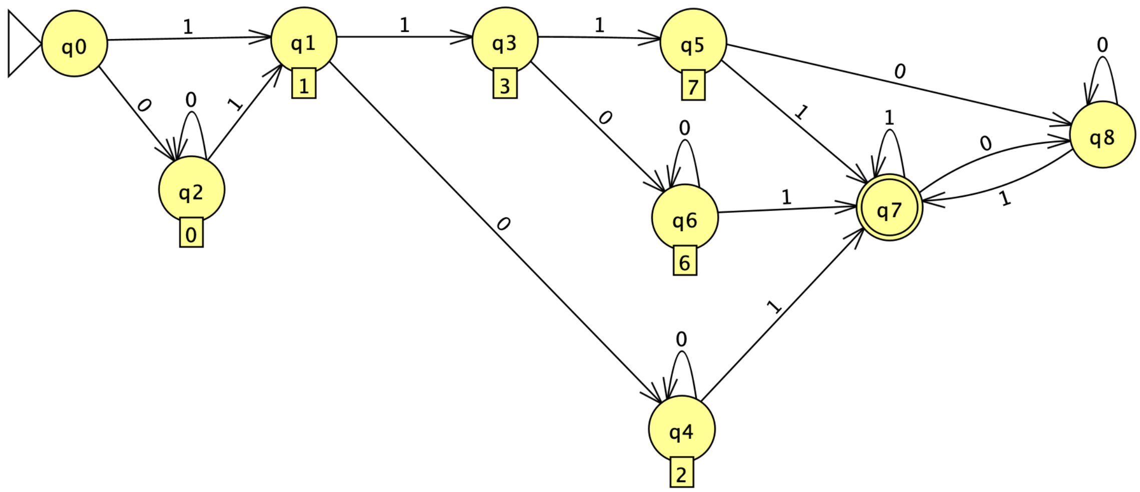
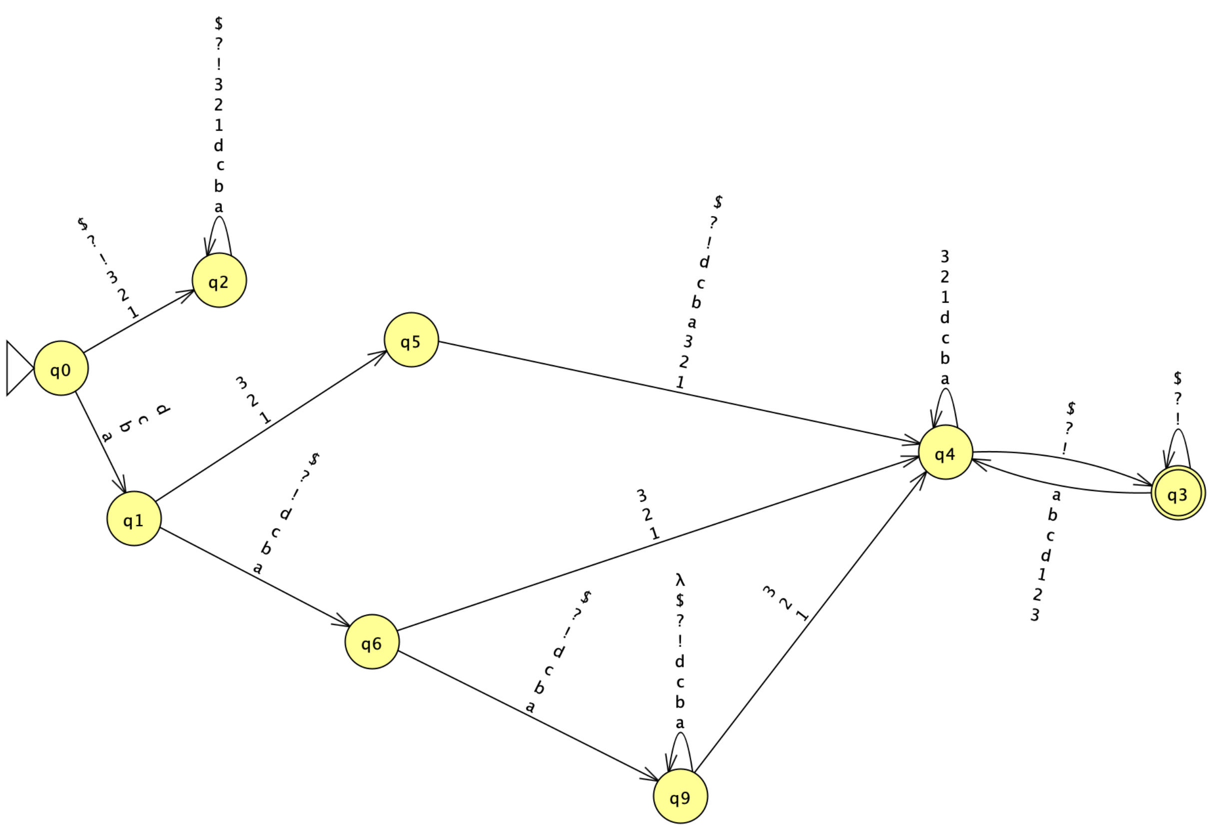
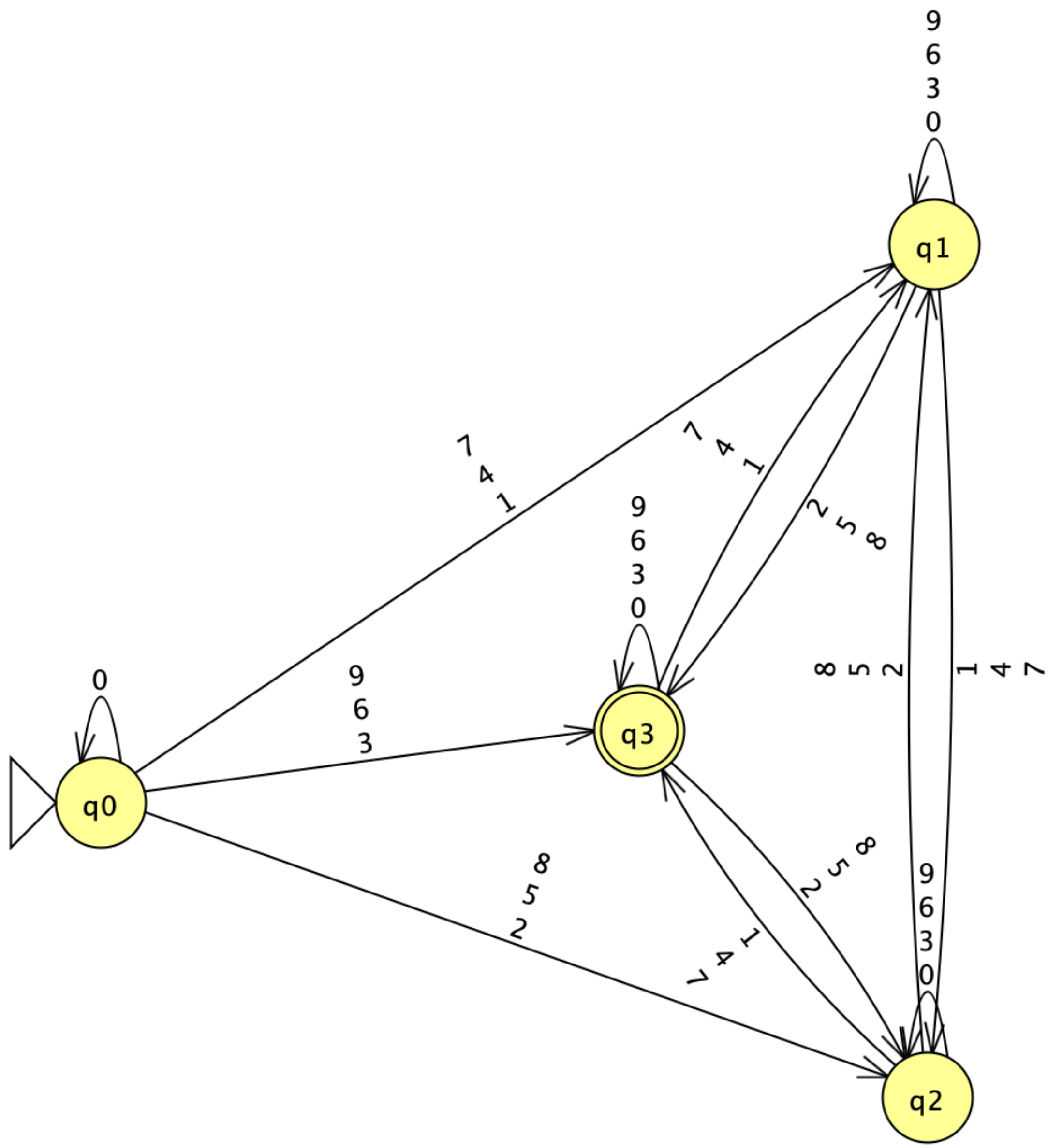
CS 321H



1.



2.

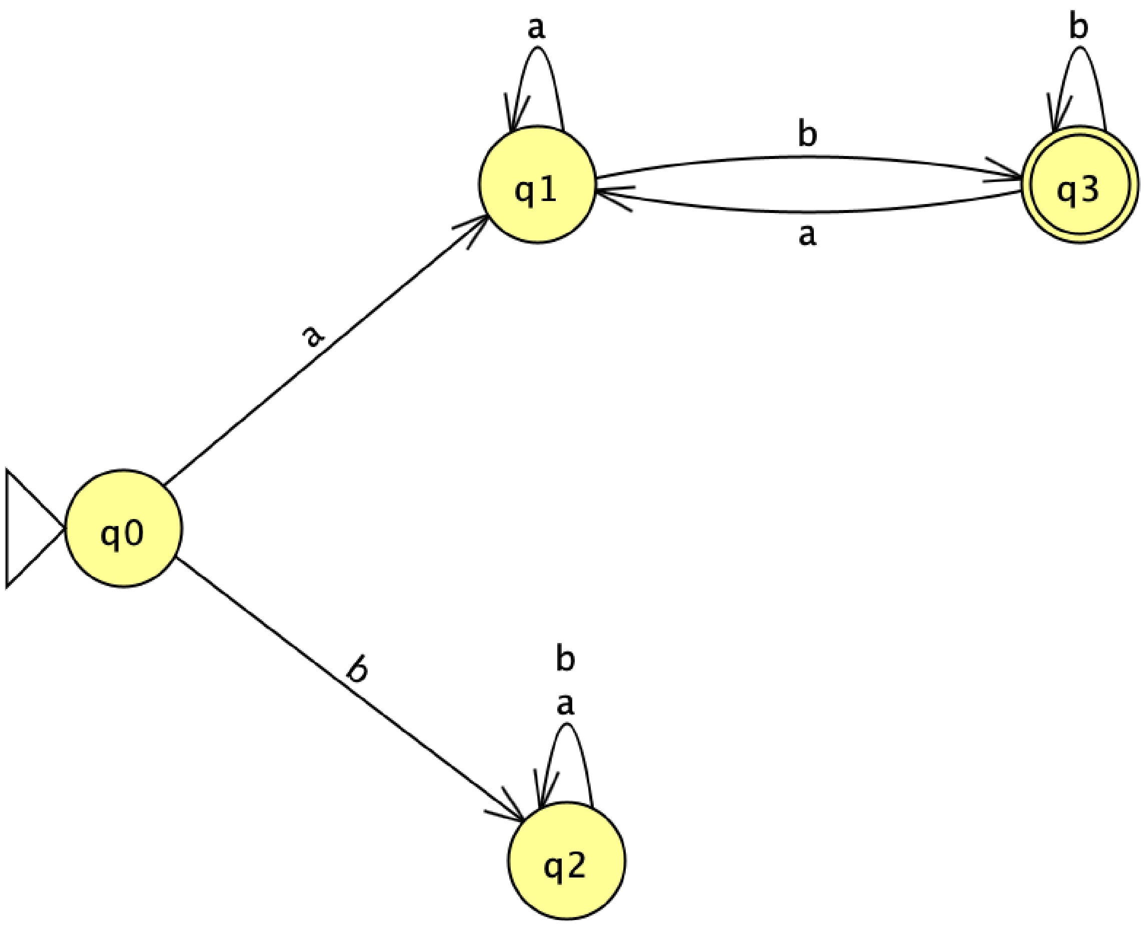


3.

4. This language consists of all strings that are completely comprised of one or more zeros, such as 000 or 000000, as well as at least one one followed by at least one zero, such as 10 or 11100. The quintuple of form $M = (Q, \Sigma, \delta, q_0, F)$ is:
$Q : \{q_0, q_1, q_2, q_3\}$
$\Sigma = \{0, 1\}*$
$\delta : \delta(q_0, 0) = q_1$
$\delta(q_0, 1) = q_3$
$\delta(q_1, 0) = q_1$
$\delta(q_1, 1) = q_2$
$\delta(q_2, 0) = q_2$
$\delta(q_2, 1) = q_2$
$\delta(q_3, 0) = q_1$
$\delta(q_3, 1) = q_3$

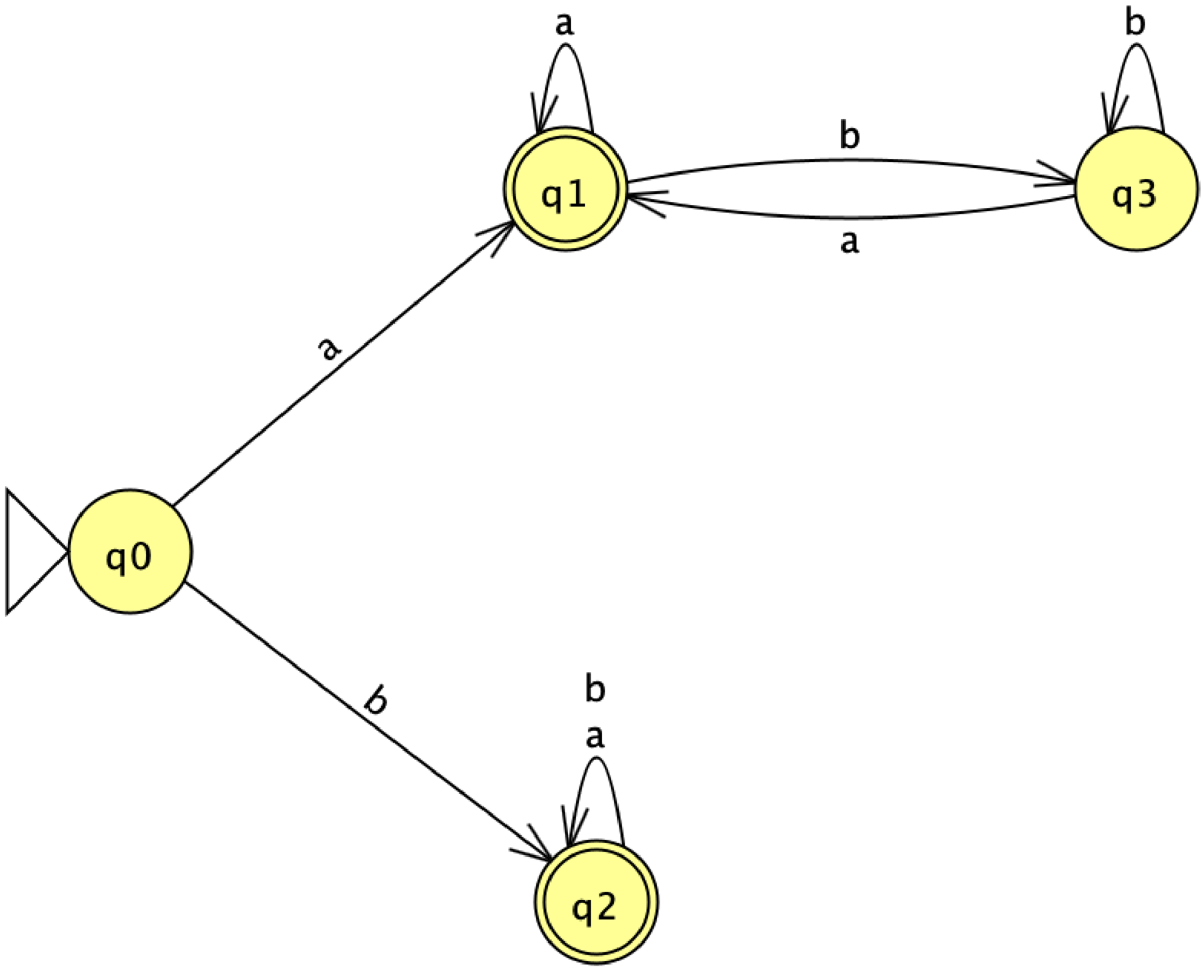
$q_0 = q_0$
$F = q_1, q_3$

5. We know that a regular language has a DFA associated with it, and we know that any NFA can be converted into a DFA. For both 5a and 5b, we can construct an NFA or a DFA showing that the language is regular.



This image depicts a DFA that satisfies the requirements of L. Since any DFA has a regular language associated with it, we know that L is a regular language.

$\bar{L}$ is the complement of L. This means that anything not accepted by L is accepted by $\bar{L}$ and anything accepted by L is not accepted by $\bar{L}$. This can be done in a very simple way: every non-initial state in the DFA that is not a final state is turned into a final state, and every final state is no longer a final state. This produces the following graph:



Since this is also a DFA, we know that $\bar{L}$ is a regular language as well.

6. We know that any regular language can produce a DFA, and any DFA has a set of states, one of which is an initial state and one or more that are final states. The remaining states can be thought of as intermediary states. Consider this process: each final state in the original DFA is turned into an intermediary state, and each intermediary state is turned into a final state. If there were no intermediary states, this is a special case where the language complement is the empty set (still a regular language). This process, without fail, will turn any DFA into another DFA which represents its complement. One example of it is shown above in the two diagrams. Since all DFAs have a number of final states and one initial state, this construction must always be possible. For any regular language, its complement is also a regular language.