Assignment #2

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Question 1. Construct the NFA that accepts the language $\{w|w$ contains an odd number of 1's and exactly two 0's$\}$ with exatcly six states.

First let's build a machine that accepts strings with odd number of 1's:

Now we build a machine that accepts strings with exactly 2 zeros:

Notice that we used 6 states already. Then, since we don't need to keep track of strings that go to state r_3, we could simply remove this state, then all the strings with more than 2 zeros would halt on this machine.

Now we can create a new state that goes to both machines without consuming characters of the string:

Question 2. Construct an NFA that accepts the set of binary strings that contain both substrings 010 and 101.

A machine that accepts strings with both substrings 010 and 101 has either the substring 010 or 101 first, then we could build different machines for both cases:

- 010 and then 101

  Notice that the machine consider the case in which 010 and 101 overlaps.

- 101 and then 010

Question 3. Convert the NFA below to a DFA

To solve this question we are going to use the same algorithm used to proove that ϵ-NFAs are equivalent to DFAs. We are going to call this NFA $N = (Q, \Sigma, \delta, q, F)$ and build a DFA $M = (Q', \Sigma, \delta', q', F')$ such that $q' = C_\epsilon(0) = \{0, 1\}$; $\delta' : \mathcal{P}(Q) \times \Sigma$ where $\delta'(R, a) = \bigcup\limits_{r \in R} C_\epsilon(\delta(r, a))$ as it follows:

- Start with the initial state
- Calculate the transitions of $\{0, 1\}$

  $\delta'(\{0, 1\}, a) = C_\epsilon(\{1\}) = \{1\}$
  $\delta'(\{0, 1\}, b) = C_\epsilon(\{2\}) = \{0, 1, 2\}$