CS327 · Theory of Computation

Homework 3

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1 Charset

$$\Sigma = \{0, 1\}$$

2 Language

$$L(M) = \{w | w \ has \ even \ number \ of \ 0 \ and \ every \ 0 \ followed \ by \ at \ least \ an \ 1\}$$

3 RE

As requirement, we can construct the regular expression as below.

$$(1^*011^*01)^*1^*$$

4 NFA

NFA can be derived from RE. Here is the step.

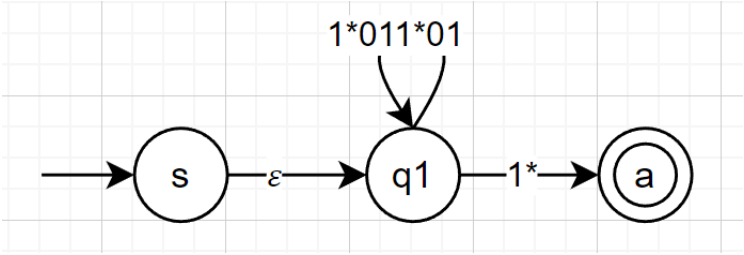

Figure 1: Step 1

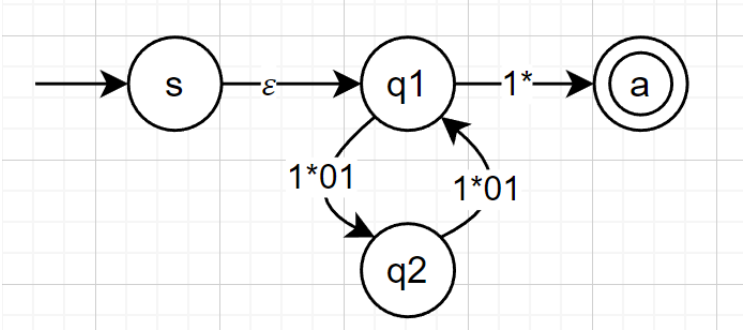

Figure 2: Step 2

The result of step 4 is the NFA.

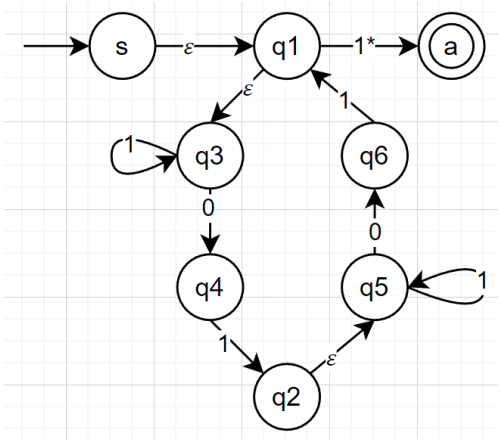

Figure 3: Step 3

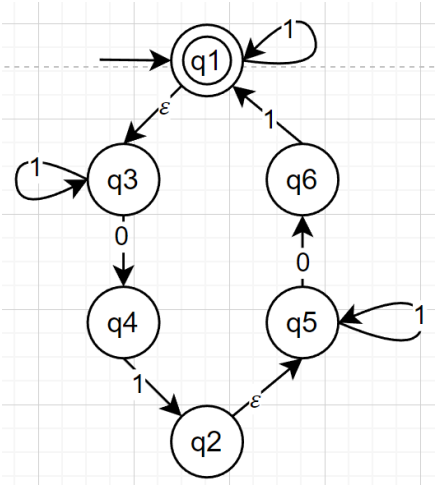

Figure 4: Step 4

5 DFA

To obtain the goal, we can use the lemma of De Morgen's law, i.e., $L_1 \cap L_2 = \overline{\overline{L_1} \cup \overline{L_2}}$.
The DFAs of $\{w|w\ has\ even\ number\ of\ 0\}$ and $\{w|inw, every\ 0\ followed\ by\ at\ least\ an\ 1\}$ are shown as below respectively.

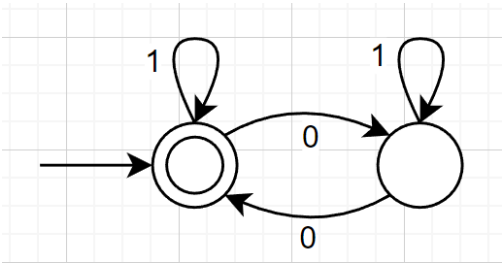

Figure 5: {w | w has even number of 0}

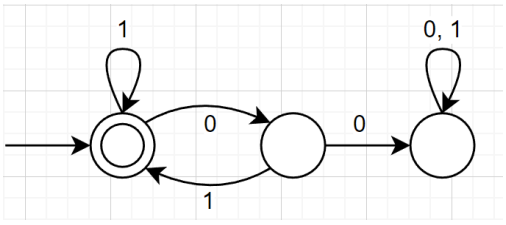

Figure 6: {w | in w, every 0 followed by at least an 1}

Take the complement of them and union them, we have

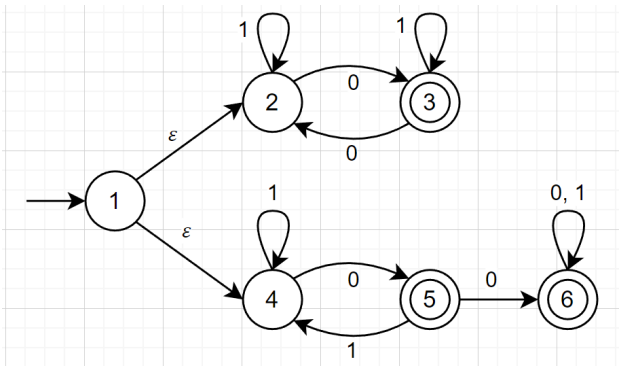

Figure 7: The complement and union of the 2 DFAs, another NFA

Then we can turn the NFA to DFA, where $q_0 = \{1, 2, 4\}$.

$q_0 \xrightarrow{0} \{3,5\}\ (q_1)$	$q_0 \xrightarrow{1} \{2,4\}\ (q_2)$
$q_1 \xrightarrow{0} \{2,6\}\ (q_3)$	$q_1 \xrightarrow{1} \{3,4\}\ (q_4)$
$q_2 \xrightarrow{0} \{3,5\}\ (q_1)$	$q_2 \xrightarrow{1} \{2,4\}\ (q_2)$
$q_3 \xrightarrow{0} \{3,6\}\ (q_5)$	$q_3 \xrightarrow{1} \{2,6\}\ (q_3)$
$q_4 \xrightarrow{0} \{2,5\}\ (q_6)$	$q_4 \xrightarrow{1} \{3,4\}\ (q_4)$
$q_5 \xrightarrow{0} \{2,6\}\ (q_3)$	$q_5 \xrightarrow{1} \{3,6\}\ (q_5)$
$q_6 \xrightarrow{0} \{3,6\}\ (q_5)$	$q_6 \xrightarrow{1} \{2,6\}\ (q_3)$

Table 1: Turn the NFA to DFA

We can draw the corresponding DFA.

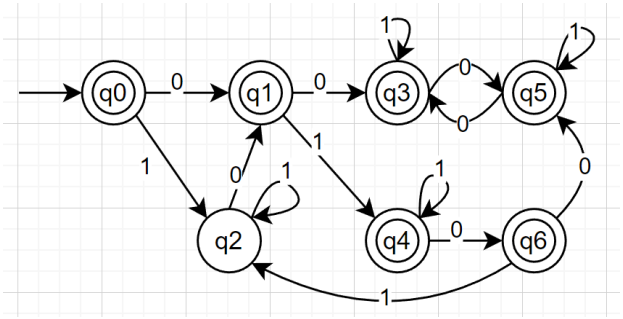

Figure 8: DFA in complement

Then turn to its complement, and obtain the DFA we want.

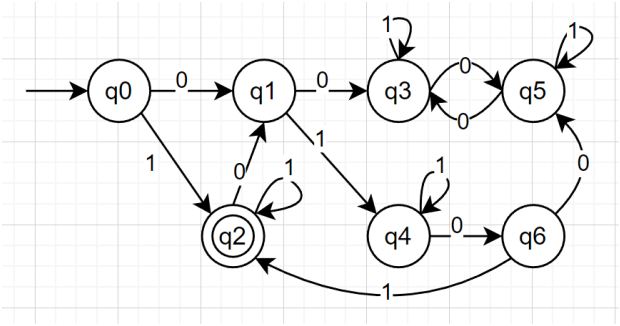

Figure 9: DFA

Or we can simplify it.

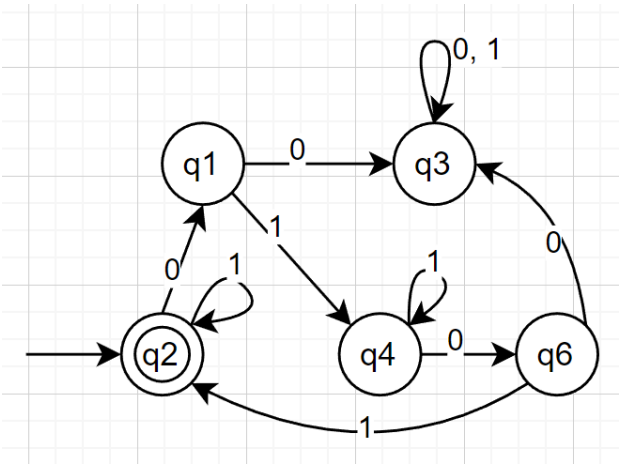

Figure 10: DFA after simplification