Homework 1

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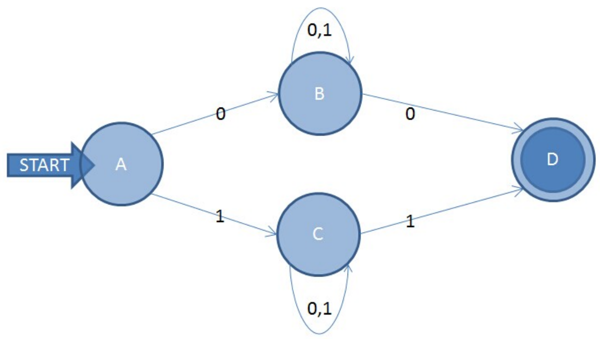
Problem 1

Here is my nfa below.

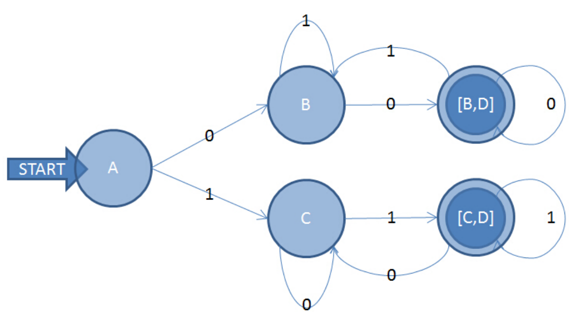


And we try to finish the table of the dfa.

Here is the table.

	0	1
A	B	C
B	[B,D]	B
[B,D]	[B,D]	B
C	C	[C,D]
[C,D]	C	[C,D]

Furthermore, here is my dfa below.



Problem 2

Here is my construction below.

$$(aa^*b + bb^*a)(a + b)^*$$

Problem 3

Here is my steps to construct a regular expression for the complement of the set denoted by R named $\overline{R} = \sum^* - R$.

- Step 1: Construct a DFA $M_1 = (Q, \sum, \delta, q_0, F)$ and satisfied that $R = L(M_1)$.
- Step 2: Show that a DFA $M_2 = (Q, \sum, \delta, q_0, Q - F)$ have satisfied that $\overline{R} = L(M_2)$.
- Step 3: Try to reduce number of final states to 1. And we could describe $\overline{R}$ easily.

Problem 4

First, we suppose that $\{xx^R \mid x \in (0+1)^*\}$ is regular. And because of regular language intersection is closed, So, the intersection below is closed.

$$\{xx^R \mid x \in (0+1)^*\} \bigcap 1^*00^*1^* \;=\; \{1^n0^m1^n \mid n \geq 1, m = 2*k, k \geq 1\}$$

Second, we define a homomorphism $h_0 : \{0,1,2\} \rightarrow \{0,1\}^*$:

$$\begin{cases} h_0(0) = & 0 \\ h_0(1) = & 1 \\ h_0(2) = & 1 \end{cases}$$

And using the anti-homomorphism h_0^{-1} to the set. So, we can get a new set:

$$\{(1+2)^n0^m(1+2)^n \mid n \geq 1, m = 2*k, k \geq 1\}$$

Third, We intersect this set with a regular expression $2^*0^*1^*$, so we have

$$\{(1+2)^n0^m(1+2)^n \mid n \geq 1, m = 2*k, k \geq 1\} \bigcap 2^*0^*1^* \;=\; \{2^n0^m1^n \mid n \geq 1, m = 2*k, k \geq 1\}$$

Fourth, we define an another homomorphism $h_1 : \{0,1,2\} \rightarrow \{0,1\}^*$:

$$\begin{cases} h_1(0) = & \epsilon \\ h_1(1) = & 1 \\ h_1(2) = & 0 \end{cases}$$

So, We have

$$\{2^n0^m1^n \mid n \geq 1, m = 2*k, k \geq 1\} \rightarrow^{h_1} \{0^n1^n \mid n \geq 1\}$$

But the right set should not be regular. Finally, there is a contradiction above. So, $\{xx^R \mid x \in (0+1)^*\}$ should not be regular.