Homework 02 - Deterministic Finite Automata

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1. The DFA **R1** accepts $\{\omega \mid \omega \text{ has an even number of 1s}\}$:

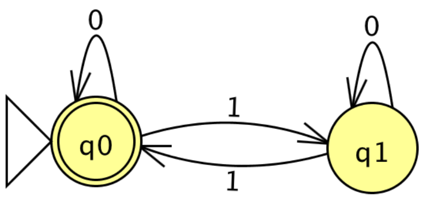

Figure 1: The R1 DFA

For R1:

(a) $Q = \{q_0, q_1\}$

(b) $\Sigma = \{1, 0\}$

(c) $\delta\colon Q \times \Sigma \to Q =$

$\delta(q_0, 0) = q_0$	$\delta(q_0, 1) = q_1$
$\delta(q_1, 0) = q_1$	$\delta(q_1, 1) = q_0$

(d) q_0 (the start state) $= q_0 \in Q$

(e) $F = \{q_0\}$

2. The DFA **R2** accepts

$\{\omega \mid \omega \text{ contains at least one 1 and an even number of 0s follow the last 1}\}$:

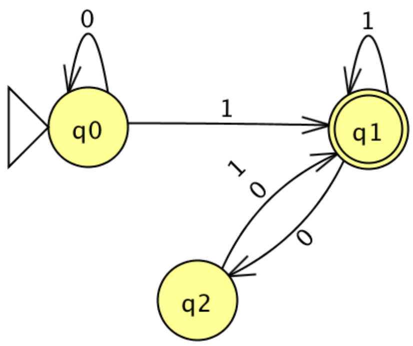

Figure 2: The R2 DFA

For R2:

(a) $Q = \{q_0, q_1, q_2\}$

(b) $\Sigma = \{1, 0\}$

(c) $\delta \colon Q \times \Sigma \to Q =$

$\delta(q_0, 0) = q_0$	$\delta(q_0, 1) = q_1$
$\delta(q_1, 0) = q_2$	$\delta(q_1, 1) = q_1$
$\delta(q_2, 0) = q_1$	$\delta(q_2, 1) = q_1$

(d) q_0 (the start state) $= q_0 \in Q$

(e) $F = \{q_1\}$

3. The DFA **R3** accepts $\{\omega \mid \omega$ is the empty string ϵ or ends in a $0\}$:

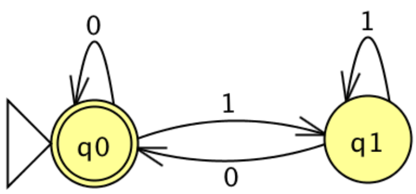

Figure 3: The R3 DFA

For R3:

(a) $Q = \{q_0, q_1\}$

(b) $\Sigma = \{1, 0\}$

(c) $\delta \colon Q \times \Sigma \to Q =$

$\delta(q_0, 0) = q_0$	$\delta(q_0, 1) = q_1$
$\delta(q_1, 0) = q_0$	$\delta(q_1, 1) = q_1$

(d) q_0 (the start state) $= q_0 \in Q$

(e) $F = \{q_0\}$

4. The DFA **R4** accepts $\{\omega \mid \omega$ contains at least one 1 and ends with 1$\}$:

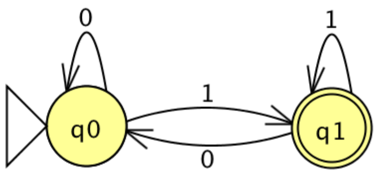

Figure 4: The R4 DFA

For R4:

(a) $Q = \{q_0, q_1\}$

(b) $\Sigma = \{1, 0\}$

(c) $\delta\colon Q \times \Sigma \to Q =$

$\delta(q_0, 0) = q_0$	$\delta(q_0, 1) = q_1$
$\delta(q_1, 0) = q_0$	$\delta(q_1, 1) = q_1$

(d) q_0 (the start state) $= q_0 \in Q$

(e) $F = \{q_1\}$

5. The DFA **R5** accepts $\{\omega \mid \omega$ starts and ends with the same symbol$\}$:

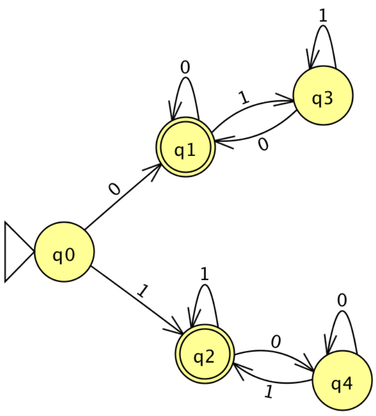

Figure 5: The R5 DFA

For R5:

(a) $Q = \{q_0, q_1, q_2, q_3, q_4\}$

(b) $\Sigma = \{1, 0\}$

(c) $\delta \colon Q \times \Sigma \to Q =$

$\delta(q_1, 0) = q_1$	$\delta(q_0, 1) = q_2$
$\delta(q_4, 0) = q_4$	$\delta(q_2, 1) = q_2$
$\delta(q_3, 1) = q_3$	$\delta(q_0, 0) = q_1$
$\delta(q_3, 0) = q_1$	$\delta(q_1, 1) = q_3$
$\delta(q_4, 1) = q_2$	$\delta(q_2, 0) = q_4$

(d) q_0 (the start state) $= q_0 \in Q$

(e) $F = \{q_1, q_2\}$

6. The DFA **R6** accepts $\{\omega \mid \omega \text{contains a substring } 001\}$:

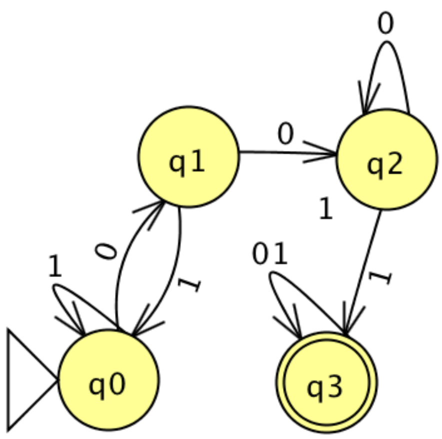

Figure 6: The R6 DFA

For R6:

(a) $Q = \{q_0, q_1, q_2, q_3\}$

(b) $\Sigma = \{1, 0\}$

(c) $\delta \colon Q \times \Sigma \to Q =$

$\delta(q_2, 0) = q_2$	$\delta(q_0, 1) = q_0$
$\delta(q_3, 0) = q_3$	$\delta(q_3, 1) = q_3$
$\delta(q_1, 0) = q_2$	$\delta(q_1, 1) = q_0$
$\delta(q_0, 0) = q_1$	$\delta(q_2, 1) = q_3$

(d) q_0 (the start state) $= q_0 \in Q$

(e) $F = \{q_3\}$

7. The DFA **R7** accepts tuples of the form (front door switch state, rear door switch state):

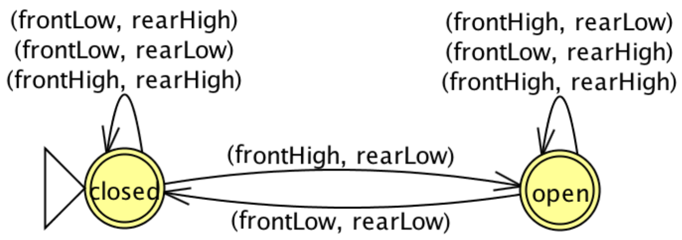

Figure 7: The R6 DFA

For R7:

(a) $Q = \{open, closed\}$

(b) $\Sigma =$

$$\{(frontHigh, rearHigh), (frontHigh, rearLow),$$
$$(frontLow, rearHigh), (frontLow, rearLow)\}$$

(c) $\delta \colon Q \times \Sigma \to Q =$

$\delta(closed, (frontHigh, rearLow)) = open$
$\delta(open, (frontLow, rearLow)) = closed$
$\delta(closed, (frontLow, rearHigh)) = closed$
$\delta(open, (frontLow, rearHigh)) = open$
$\delta(open, (frontHigh, rearLow)) = open$
$\delta(closed, (frontHigh, rearHigh)) = closed$
$\delta(open, (frontHigh, rearHigh)) = open$
$\delta(closed, (frontLow, rearLow)) = closed$

(d) q_0 (the start state) $= closed \in Q$

(e) $F = Q$