

**2.5.1****\* Exercise 2.5.1:** Consider the following  $\epsilon$ -NFA.

	$\epsilon$	a	b	c
$\rightarrow p$	$\emptyset$	$\{p\}$	$\{q\}$	$\{r\}$
q	$\{p\}$	$\{q\}$	$\{r\}$	$\emptyset$
*r	$\{q\}$	$\{r\}$	$\emptyset$	$\{p\}$

**a)**a) Compute the  $\epsilon$ -closure of each state.

$$p \rightarrow \{p\}$$

$$q \rightarrow \{p, q\}$$

$$r \rightarrow \{q, r\}$$

**b)**

b) Give all the strings of length three or less accepted by the automaton.

Accepted : c, ac, bc, acc, bcc, aca, acb, bca, bcb

**c)**

c) Convert the automaton to a DFA.

	a	b	c
$\rightarrow \{p\}$	$\{p\}$	$\{p\}$	$\{q, r\}$
$\ast \{q, r\}$	$\{p, q, r\}$	$\{p, q, r\}$	$\{q, r\}$
$\ast \{p, q, r\}$	$\{p, q, r\}$	$\{p, q, r\}$	$\{q, r\}$

**2.5.2****Exercise 2.5.2:** Repeat Exercise 2.5.1 for the following  $\epsilon$ -NFA:

	$\epsilon$	a	b	c
$\rightarrow p$	$\{q, r\}$	$\emptyset$	$\{q\}$	$\{r\}$
q	$\emptyset$	$\{p\}$	$\{r\}$	$\{p, q\}$
*r	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

**a)**a) Compute the  $\epsilon$ -closure of each state.

$$p \rightarrow \{p, q, r\}$$

$$q \rightarrow \{q\}$$

$$r \rightarrow \{r\}$$

**b)**

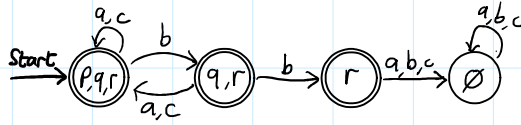
b) Give all the strings of length three or less accepted by the automaton.

Accepted :  $\epsilon$ , a, b, c, ba, bb, bc, ca, cb, cc, aca, acb, ac, aba, abb, bac, bab, bca, bcb, bcc, caa, cab, cac, cba, cbb, cbc, cca, ccb, ccc.

c)

c) Convert the automaton to a DFA.

	a	b	c
$\rightarrow * \{p, q, r\}$	$\{p, q, r\}$	$\{q, r\}$	$\{p, q, r\}$
$* \{q, r\}$	$\{p, q, r\}$	$\{r\}$	$\{p, q, r\}$
$* \{r\}$	$\emptyset$	$\emptyset$	$\emptyset$
$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$



2.5.3

Exercise 2.5.3: Design  $\epsilon$ -NFA's for the following languages. Try to use  $\epsilon$ -transitions to simplify your design.

a)

a) The set of strings consisting of zero or more  $a$ 's followed by zero or more  $b$ 's, followed by zero or more  $c$ 's.

Definisi suatu  $\epsilon$ -NFA,  $N_a = (Q, \Sigma, \delta, q_s, F)$

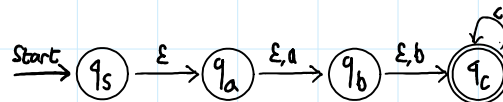
$\rightarrow Q = \{q_s, q_a, q_b, q_c\};$

$\rightarrow \Sigma = \{a, b, c\};$

$\rightarrow F = \{q_c\};$

$\rightarrow \delta$  (tabel)

State	$\epsilon$	a	b	c
$\rightarrow q_s$	$\{q_a\}$	$\emptyset$	$\emptyset$	$\emptyset$
$q_a$	$\{q_b\}$	$\{q_a\}$	$\emptyset$	$\emptyset$
$q_b$	$\{q_c\}$	$\emptyset$	$\{q_b\}$	$\emptyset$
$*q_c$	$\emptyset$	$\emptyset$	$\emptyset$	$\{q_c\}$



b)

b) The set of strings that consist of either 01 repeated one or more times or 010 repeated one or more times.

Definisi suatu  $\epsilon$ -NFA,  $N_b = (Q, \Sigma, \delta, q_s, F)$

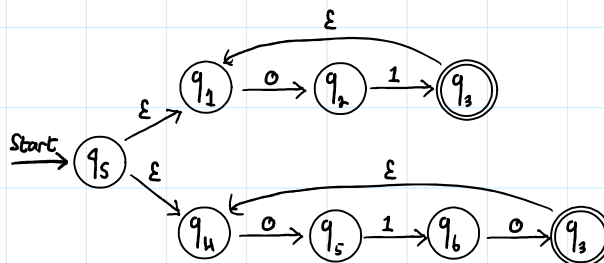
$\rightarrow Q = \{q_s, q_1, q_2, q_3, q_4, q_5, q_6, q_7\};$

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

$\rightarrow F = \{q_3, q_7\};$

$\rightarrow \delta$  (tabel)

State	$\epsilon$	0	1
$\rightarrow q_s$	$\{q_1, q_4\}$	$\emptyset$	$\emptyset$
$q_1$	$\emptyset$	$\{q_2\}$	$\emptyset$
$q_2$	$\emptyset$	$\emptyset$	$\{q_3\}$
$*q_3$	$\{q_1\}$	$\emptyset$	$\emptyset$
$q_4$	$\emptyset$	$\{q_5\}$	$\emptyset$
$q_5$	$\emptyset$	$\emptyset$	$\{q_6\}$
$q_6$	$\emptyset$	$\{q_7\}$	$\emptyset$
$*q_7$	$\{q_4\}$	$\emptyset$	$\emptyset$



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! c) The set of strings of 0's and 1's such that at least one of the last ten positions is a 1.

Definisi suatu  $\epsilon$ -NFA,  $N_b = (Q, \Sigma, \delta, q_s, F)$

$\rightarrow Q = \{q_s, q_1, q_2, q_3, q_4, q_5, q_6, q_7, q_8, q_9, q_{10}\};$

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

$\rightarrow F = \{q_{10}, q_9, q_8, q_7, q_6, q_5, q_4, q_3, q_2, q_1\};$

$\rightarrow \delta$  (tabel)

State	$\epsilon$	0	1
$\rightarrow q_s$	$\emptyset$	$\{q_s\}$	$\{q_s, q_1\}$
*q1	$\{q_2\}$	$\{q_2\}$	$\{q_2\}$
*q2	$\{q_3\}$	$\{q_3\}$	$\{q_3\}$
*q3	$\{q_4\}$	$\{q_4\}$	$\{q_4\}$
*q4	$\{q_5\}$	$\{q_5\}$	$\{q_5\}$
*q5	$\{q_6\}$	$\{q_6\}$	$\{q_6\}$
*q6	$\{q_7\}$	$\{q_7\}$	$\{q_7\}$
*q7	$\{q_8\}$	$\{q_8\}$	$\{q_8\}$
*q8	$\{q_9\}$	$\{q_9\}$	$\{q_9\}$
*q9	$\{q_{10}\}$	$\{q_{10}\}$	$\{q_{10}\}$
*q10	$\emptyset$	$\emptyset$	$\emptyset$

