Q 1

$E = \{ w \in \Sigma^* \mid w$ begins with b & ends with $a \}$

let the initial state : q_0

the dead state : q_d

define a DFA $M = (Q, \Sigma, \delta, q_0, F)$

where : $Q = \{ q_0, q_d, q_b, q_{ba} \}$

$\Sigma = \{ a, b \}$

$\delta : Q \times \Sigma \to Q$

State \ Input	a	b
q_0	q_d	q_b
q_d	q_d	q_d
q_b	q_{ba}	q_b
q_{ba}	q_{ba}	q_b

equally : $\delta(q_0, a) = q_d$, $\delta(q_0, b) = q_b$

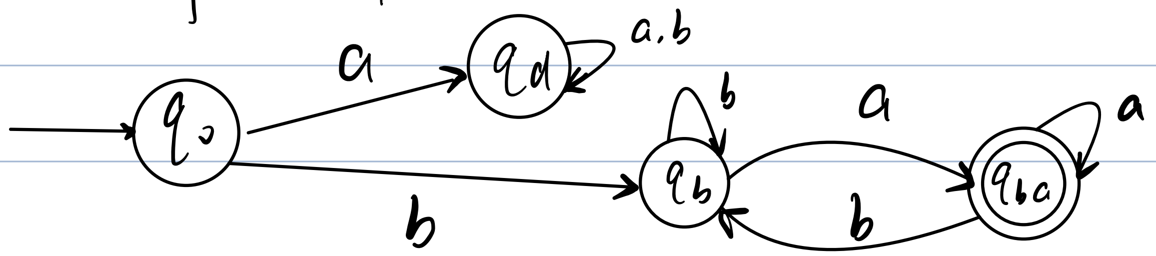
$\delta(q_d, a) = \delta(q_d, b) = q_d$

$\delta(q_b, a) = q_{ba}$, $\delta(q_b, b) = q_b$

$\delta(q_{ba}, a) = q_{ba}$, $\delta(q_{ba}, b) = q_b$

$F = \{ q_{ba} \}$ //

Drawing Description :



Q2

State \ Input	0	1
q_1	$\{q_1\}$	$\{q_2\}$
q_2	$\{q_2, q_3\}$	$\{q_2\}$
q_3	$\{q_3\}$	$\{q_2, q_3\}$

by subset constuction :

State \ Input	0	1
$\{q_1\}$	$\{q_1\}$	$\{q_2\}$
$\{q_2\}$	$\{q_2, q_3\}$	$\{q_2\}$
$\{q_2, q_3\}$	$\{q_2, q_3\}$	$\{q_2, q_3\}$

so the new initial state : $A = \{q_1\}$

$B = \{q_2\}$

the new accept state : $C = \{q_2, q_3\}$

the new DFA : $M = \{Q, \Sigma, \delta, q_0, F\}$

$Q = \{A, B, C\}$

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

$\delta = \delta(A, 0) = A$, $\delta(A, 1) = B$

$\delta(B, 0) = C$ $\quad \delta(B, 1) = B$

$\delta(C, 0) = C$ $\quad \delta(C, 1) = C$

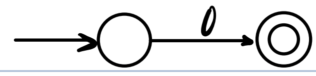
$q_0 = A$

$F = C$

The language accepted by the NFA consists of strings containing 01

Q3

0



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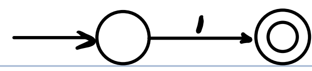

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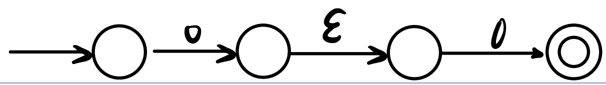

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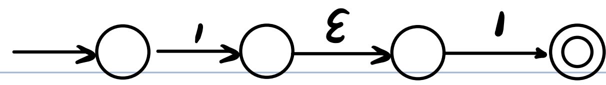
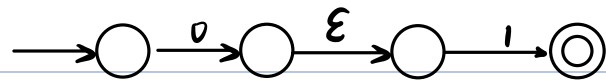


01



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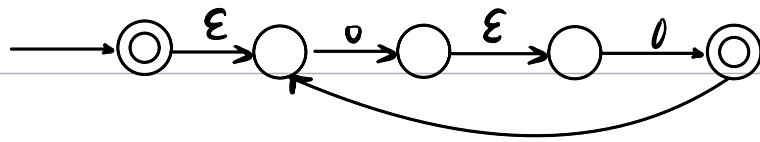

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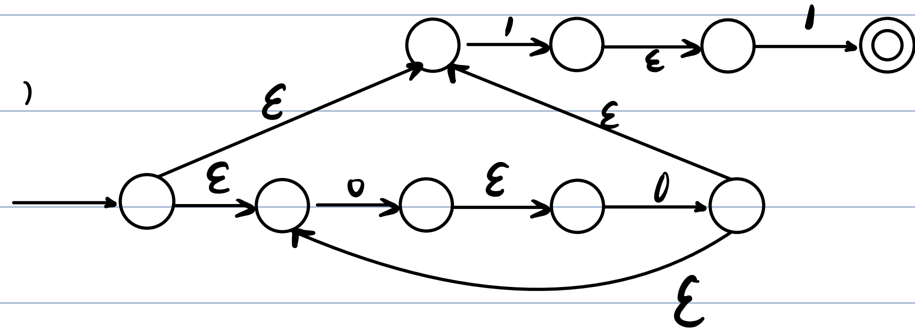

Q4

Assume A_1 is regular

By pumping Lemma:

there's a pumping Length $p \geq 1$ such that every string $s \in A_1$ with $|s| \geq p$ can be writen $s = xyz$

$|xy| \leq p$

$|y| > 0$

for all $i \geq 0$ $xy^iz \in A_1$

Let $w = a^p b^p$

$s = www = (a^p b^p)(a^p b^p)(a^p b^p)$

so $|s| = 6p \geq p$ and $s \in A_1$

$\because$ $s = (a^p b^p)(a^p b^p)(a^p b^p)$

$\therefore$ the first p symbols of s are all "a"

$\because$ $|xy| \leq p$

$\therefore$ x and y are both contained in first a^p

so Let $y = a^t$ $(t > 0)$

$x = a^{p-t}$

according to pumping Lemma:

for all $i \geq 0$ $xy^iz \in A_1$

Let $i = 0$

so $xz = a^{p-t} b^p a^p b^p a^p b^p$

we suppose $xz \in A$

$|xz| = |s| - |y| = 6p - t$

if $xz \in A$

So $|xz|$ should be the multiple of 3

1° t isn't the multiple of 3:

$|xz|$ can't be divided into 3 same parts

So it contradict to for all $i \geq 0$, $xy^iz \in A$

2° t is the multiple of 3

$|xz|$ can be divided into 3 parts

in the first block $a^{p-t}b^t$

the first b appears after $p-t$ "a"

in the second block $a^p b$

the first b appears after p "a"

because $t > 0$

So $p - t \neq p$

they're diffierent strings

Hence! xz can not be uuu

This contradicted with pumping Lemma which predicted $xy^0z \in A_1$, so A_1 is not regular