CSE 2002 TOC

Digital Assignment - 1

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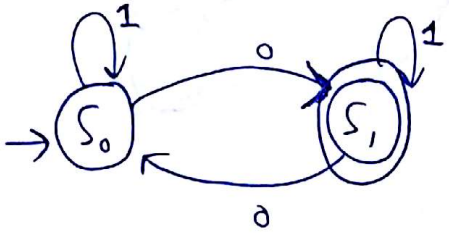
First Part

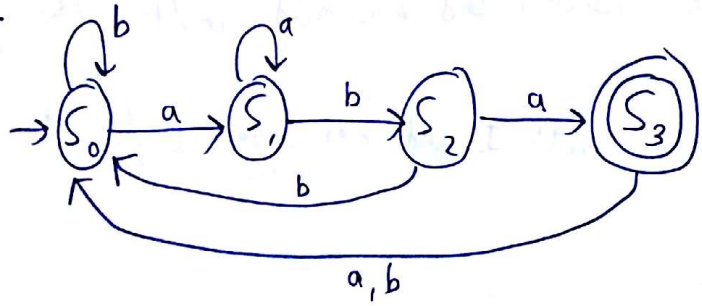
Ans. 1



Present state	Inputs	
	0	1
S_0	S_1	S_0
S_1	S_0	S_1

All strings having odd no. of zeros will be accepted by this automation.

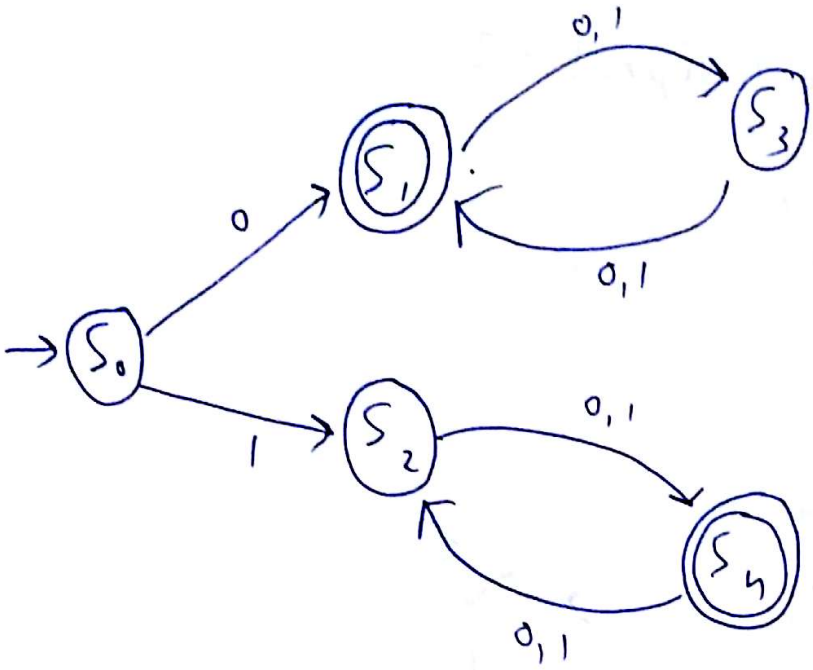
Ans. 2



Present state	Inputs	
	a	b
S_0	S_1	S_0
S_1	S_1	S_2
S_2	S_3	S_0
S_3	S_0	S_0

All strings ending with aba or aaba are accepted by automation.

Ans. 3



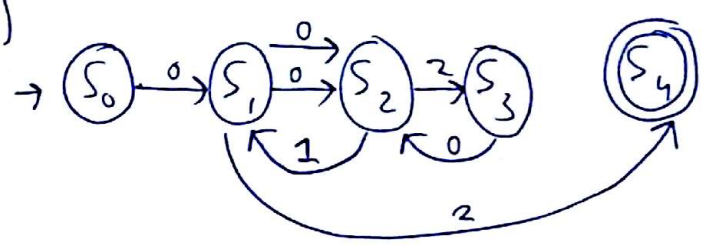
Present State	Inputs	
	0	1
S_0	S_1	S_2
S_1	S_3	S_3
S_2	S_4	S_4
S_3	S_1	S_1
S_4	S_2	S_2

When string starts with 0 and has odd length, the final state is S_1.
When string starts with 1 and has even length, the final state is S_4.

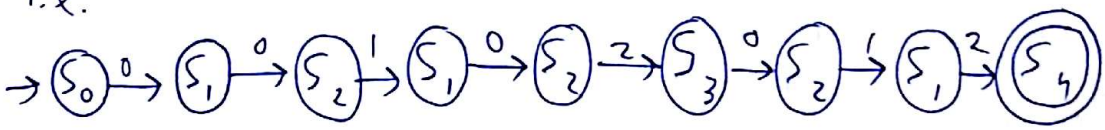
Second Part

Ans. 1 There are 2 transition pathways by which the string 00102012 will be accepted by machine:

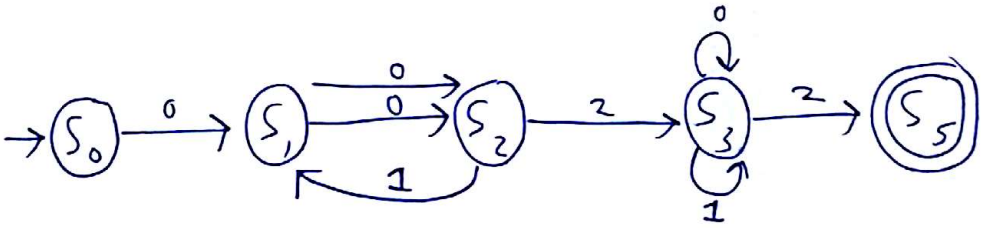
(i)



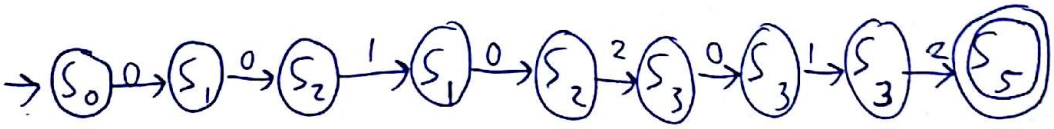
i.e.



(ii)



i.e.



Ans 2

Constructing Equivalent DFA

$$M_1 = (S', \{S_0, S_1, S_2, S_3, S_4, S_5\}, \delta', [S_0], A')$$

$$A' = \{ [S_4], [S_5], [S_0, S_4], [S_0, S_5], [S_1, S_4], [S_1, S_5], [S_2, S_4], [S_2, S_5], [S_3, S_4], [S_3, S_5], [S_4, S_5], [S_0, S_1, S_4], [S_1, S_2, S_4], [S_2, S_3, S_4], [S_3, S_4, S_5], [S_0, S_1, S_5], [S_1, S_2, S_5], [S_2, S_3, S_5], [S_0, S_1, S_2, S_4], [S_1, S_2, S_3, S_4],$$

$$\{[s_0, s_1, s_2, s_5], [s_1, s_2, s_3, s_5], [s_2, s_3, s_4, s_5], [s_0, s_1, s_2, s_3, s_4, s_5]\}$$

$$\delta'([s_0], 0) = [s_1]$$
$$\delta'([s_0], 1) = [s_2]$$
$$\delta'([s_1], 0) = [s_2]$$
$$\delta'([s_1], 1) = [s_1, s_4]$$
$$\delta'([s_1], 2) = [s_4]$$
$$\delta'([s_2], 0) = [s_4]$$
$$\delta'([s_2], 1) = [s_1]$$
$$\delta'([s_2], 2) = [s_3]$$
$$\delta'([s_3], 0) = [s_2, s_3]$$
$$\delta'([s_3], 1) = [s_3]$$
$$\delta'([s_3], 2) = [s_5]$$
$$\delta'([s_4], 2) = [s_5]$$
$$\delta'([s_5], 1) = [s_4]$$
$$\delta'([s_1, s_4], 0) = \delta'([s_1], 0) \cup \delta'([s_4], 0) = [s_2]$$
$$\delta'([s_1, s_4], 1) = \delta'([s_1], 1) \cup \delta'([s_4], 1) = [s_1, s_4]$$
$$\delta'([s_1, s_4], 2) = \delta'([s_1], 2) \cup \delta'([s_4], 2) = [s_4, s_5]$$
$$\delta'([s_2, s_3], 0) = [s_2, s_3, s_4]$$
$$\delta'([s_2, s_3], 1) = [s_1, s_3]$$
$$\delta'([s_2, s_3], 2) = [s_3, s_5]$$

$\delta'([S_4, S_5], 0) = -$

$\delta'([S_4, S_5], 1) = [S_4]$

$\delta'([S_4, S_5], 2) = [S_5]$

$\delta'([S_1, S_3], 0) = [S_2, S_3]$

$\delta'([S_1, S_3], 1) = [S_1, S_3, S_4]$

$\delta'([S_1, S_3], 2) = [S_4, S_5]$

$\delta'([S_3, S_5], 0) = [S_2, S_3]$

$\delta'([S_3, S_5], 1) = [S_3, S_4]$

$\delta'([S_3, S_5], 2) = [S_5]$

$\delta'([S_3, S_4], 0) = [S_2, S_3]$

$\delta'([S_3, S_4], 1) = [S_3]$

$\delta'([S_3, S_4], 2) = [S_5]$

$\delta'([S_1, S_3, S_4], 0) = [S_2, S_3]$

$\delta'([S_1, S_3, S_4], 1) = [S_1, S_3, S_4]$

$\delta'([S_1, S_3, S_4], 2) = [S_4, S_5]$

$\delta'([S_2, S_3, S_4], 0) = [S_2, S_3, S_4]$

$\delta'([S_2, S_3, S_4], 1) = [S_3]$

$\delta'([S_2, S_3, S_4], 2) = [S_3, S_5]$

Present State	Inputs		
	0	1	2
$[S_0]$	$[S_1]$	$[S_2]$	-
$[S_1]$	$[S_2]$	$[S_1, S_4]$	$[S_4]$
$[S_2]$	$[S_4]$	$[S_1]$	$[S_3]$
$[S_3]$	$[S_{62}, S_3]$	$[S_3]$	$[S_5]$
$[S_4]$	-	-	$[S_5]$
$[S_5]$	-	$[S_4]$	-
$[S_1, S_4]$	$[S_2]$	$[S_1, S_4]$	$[S_4, S_5]$
S_2, S_3	$[S_2, S_3, S_4]$	$[S_1, S_3]$	$[S_3, S_5]$
[illegible]		[illegible]	[illegible]
$[S_4, S_5]$	-	$[S_4]$	$[S_5]$
$[S_1, S_3]$	$[S_2, S_3]$	$[S_1, S_3, S_4]$	$[S_4, S_5]$
$[S_3, S_5]$	$[S_2, S_3]$	$[S_3, S_4]$	$[S_5]$
$[S_3, S_4]$	$[S_2, S_3]$	$[S_3]$	$[S_5]$
$[S_1, S_3, S_4]$	$[S_2, S_3]$	$[S_1, S_3, S_4]$	$[S_4, S_5]$
$[S_2, S_3, S_4]$	$[S_2, S_3, S_4]$	$[S_3]$	$[S_3, S_5]$

Ans 3 Testing string on DFA created $w = 00102012$

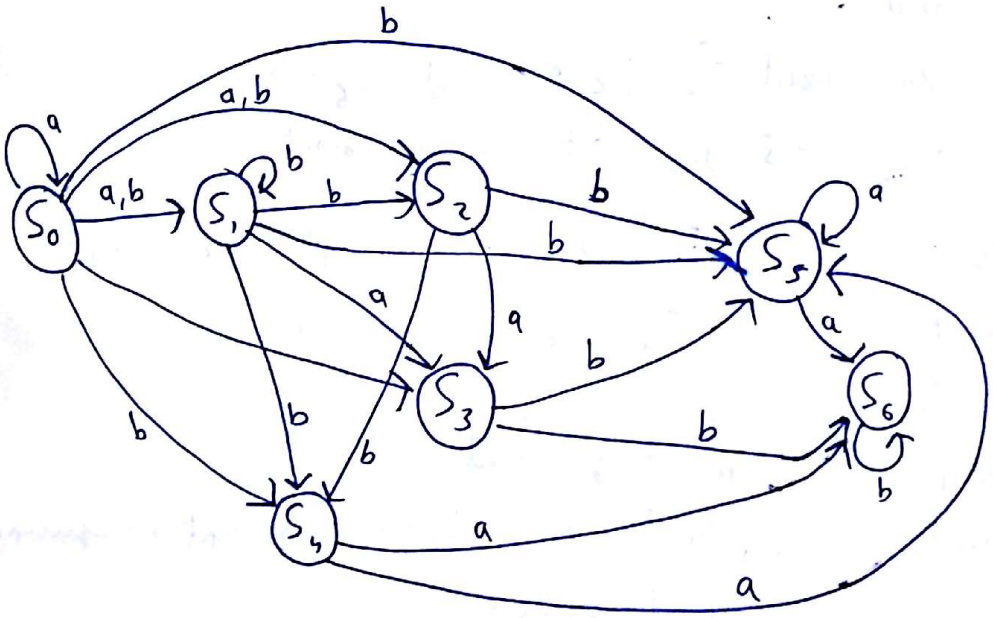
$[S_0] \xrightarrow{0} [S_1] \xrightarrow{0} [S_2] \xrightarrow{1} [S_1] \xrightarrow{0} [S_2] \xrightarrow{2} [S_3] \xrightarrow{0} [S_2, S_3] \xrightarrow{1} [S_1, S_3]$

Both S_4 and S_5 are final states, ∴ the DFA ma
works correctly.

Third Part

Q:

Present State	Inputs	
	a	b
S_0	$\{S_0, S_1, S_2, S_3\}$	$\{S_1, S_2, S_4, S_5\}$
S_1	S_3	$\{S_1, S_2, S_4, S_5\}$
S_2	S_3	$\{S_4, S_5\}$
S_3	$\emptyset$	$\{S_5, S_6\}$
S_4	$\{S_5, S_6\}$	$\emptyset$
S_5	$\{S_5, S_6\}$	S_6
S_6	$\emptyset$	S_6



Fourth Part

Q1:

Present State	Inputs	
	0	1
→ S_0	S_1	S_5
S_1	S_6	S_2
S_2	S_0	S_1
S_3	S_2	S_6
S_4	S_5	S_1
S_5	S_2	S_6
S_6	S_4	S_6
S_7	S_6	S_2

Construction of Π_0:

$$\Pi_0 = \{S_1^0, S_2^0\} = \{\{S_6\}, \{S_0, S_1, S_2, S_3, S_4, S_5, S_7\}\}$$

Construction of Π_1:

For S_0 and S_1:

for input 0, $S_1 \in S_2^0$ and $S_6 \in S_1^0$

$\therefore$ S_0 and S_1 are not 1-equivalent

Similarly S_0-S_3, S_0-S_5 and S_0-S_7 are not 1-equivalent

but S_0-S_2, S_0-S_4 are 1-equivalent

Similarly S_1-S_7 is 1-equivalent

but S_1-S_2, S_1-S_3, S_1-S_4, S_1-S_5 are not 1-equiv

Similarly S_2-S_4 is 1-equivalent

but S_2-S_3, S_2-S_5, S_2-S_7 are not 1-equivalent

Similarly S_3-S_5 is 1-equivalent

but S_3-S_4, S_3-S_7 are not 1-equivalent

Similarly S_4-S_5, S_4-S_7 are not 1-equivalent

Similarly S_5-S_7 is not 1-equivalent

$\therefore \Pi_1 = \{\{S_6\}, \{S_0, S_2, S_4\}, \{S_1, S_7\}, \{S_3, S_5\}\}$

Construction of Π_2:

For S_0 and S_2 of $\{S_0, S_2, S_4\}$ class

for input 0: S_1 and S_0 belong to different classes

$\therefore$ $S_0 - S_2$ are not 2- equivalent

Similarly $S_0 - S_4$ and $S_2 - S_4$ are not 2- equivalent

For $\{S_1, S_7\}$ class

for input 0: S_6 and S_6 belong to same class

for input 1: S_2 and S_2 belong to same class

$\therefore$ $S_1 - S_7$ is 2- equivalent

For $\{S_3 - S_5\}$ class

for input 0: S_2 and S_2 belong to same class

for input 1: S_6 and S_6 belong to same class

$\therefore$ $S_3 - S_5$ is 2- equivalent

$\therefore \Pi_2 = \{\{S_0\}, \{S_0\}, \{S_2\}, \{S_4\}, \{S_1, S_7\}, \{S_3, S_5\}\}$

Construction of Π_3:

$\{S_6\}, \{S_0\}, \{S_2\}, \{S_4\}$ can't be divided further

$S_1 - S_7$ and $S_3 - S_5$ are 3- equivalent

$\therefore \Pi_3 = \{\{S_1, S_7\}, \{S_3, S_5\}, \{S_6\}, \{S_0\}, \{S_2\}, \{S_4\}\} = \Pi_2$

Present State	Inputs 0	Inputs 1
S_0	$\{S_1, S_7\}$	$\{S_3, S_5\}$
$\{S_1, S_7\}$	S_6	S_2
S_2	S_0	$\{S_1, S_7\}$
$\{S_3, S_5\}$	S_2	S_6
S_4	$\{S_3, S_5\}$	$\{S_1, S_7\}$
S_6	S_4	S_6

So, minimized automaton is

State	Input 0	Input 1
$[S_0, S_1, S_2, S_4, S_5, S_6, S_7]$	$[S_0, S_1, S_2, S_4, S_5, S_6, S_7]$	$[S_0, S_1, S_2, S_4, S_5, S_6, S_7]$
$[S_3]$	$[S_0, S_1, S_2, S_4, S_5, S_6, S_7]$	$[S_0, S_1, S_2, S_4, S_5, S_6, S_7]$

Q2 Transition table

Present State.	Input a	Input b
$\rightarrow S_0$	S_1	S_2
S_1	S_2	S_1
S_2	S_2	S_3
S_3	S_3	S_5
S_4	S_3	S_3
S_5	S_4	S_7
S_6	S_5	S_6
S_7	S_6	S_4

Construction of Π_0:

$\Pi_0 = \{S_1^0, S_2^0\} = \{\{S_3, S_6\}, \{S_0, S_1, S_2, S_4, S_5, S_7\}\}$

Construction of Π_1:

Consider S_3, S_6 of S_1^0:

for i/p a: $S_3 - S_5$ belong to different classes

$\therefore S_3 - S_6$ are not equivalent

Consider S_0, S_1 of S_2^0:

for i/p a: $S_1, S_2 \in S_2^0$

for i/p b: $S_2, S_1 \in S_2^0$

$\therefore S_0$ and S_1 are 1- equivalent

Similarly $S_0 - S_5$ is 1- equivalent but

$S_0 - S_2$, $S_0 - S_4$, $S_0 - S_7$ is not 1- equivalent

Consider S_1 and S_2 of S_2^0

for i/p a: $S_2 \in S_2^0$

for i/p b: $S_1, S_3 \notin S_2^0$

$\therefore S_1 - S_2$ is not 1- equivalent

Similarly $S_1 - S_4$, $S_1 - S_7$ is not 1- equivalent

but $S_1 - S_5$ is 1- equivalent

Consider S_2 and S_4 of S_2^0

for i/p a: $S_2 \in S_2^0$ and $S_3 \in S_1^0$

$\therefore S_2 - S_4$ is not 1- equivalent

Similarly $S_2 - S_5$, $S_2 - S_7$ is not 1- equivalent

Consider S_4 and S_5 of S_2^0

for i/p a: $S_3 \in S_1^0$ and $S_4 \in S_2^0$

$\therefore S_4 - S_5$ are not 1- equivalent

Similarly $S_4 - S_7$ is not 1- equivalent

Consider S_5, S_7 of S_2^0

for i/p a: $S_4, S_6 \notin S_1^0$

$\therefore S_5 - S_7$ is not 1- equivalent

$\therefore \Pi_1 = \{\{S_3\}, \{S_6\}, \{S_0, S_1, S_5\}, \{S_2\}, \{S_4\}, \{S_7\}\}$

Constructing π_2:

$\{S_2\}, \{S_3\}, \{S_4\}, \{S_5\}, \{S_7\}$ cannot be divided further

Consider S_0, S_1

for i/p a : S_1, S_2 don't belong to same class

$\therefore S_0 - S_1$ are not 2- equivalent

Consider S_0, S_5

for i/p a: S_1, S_4 dont belong to same class

$\therefore S_0 - S_5$ are not 2- equivalent

Consider S_1, S_5

for i/p a: S_2, S_4 dont belong to same class

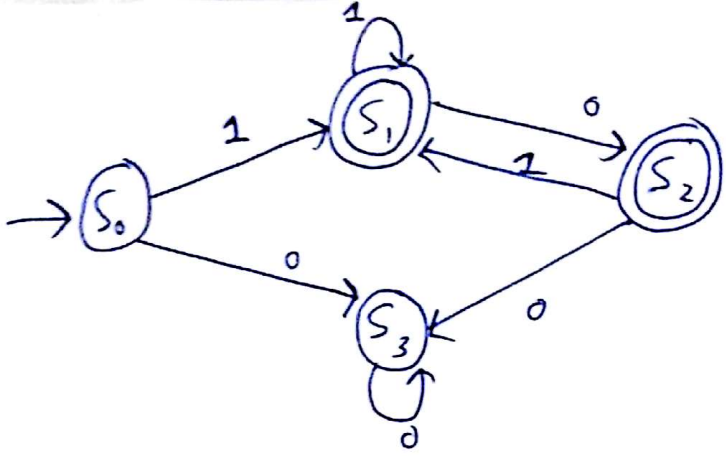
$\therefore S_1 - S_5$ is not 2- equivalent.

$\therefore \pi_2 = \{S_0, S_1, S_2, S_3, S_4, S_5, S_6, S_7\}$ cannot be divided further

$\therefore$ Finite automation is already in its minimized state.

State	Input	
	a	b
S_0	S_1	S_2
S_1	S_2	S_1
S_2	S_2	S_3
S_3	S_3	S_5
S_4	S_3	S_3
S_5	S_4	S_7
S_6	S_5	S_6
S_7	S_6	S_4

Q3:



Transition table

State	Input	
	0	1
S_0	S_3	S_1
S_1	S_2	S_1
S_2	S_2	S_1
S_3	S_3	S_1

: