Assignment
3

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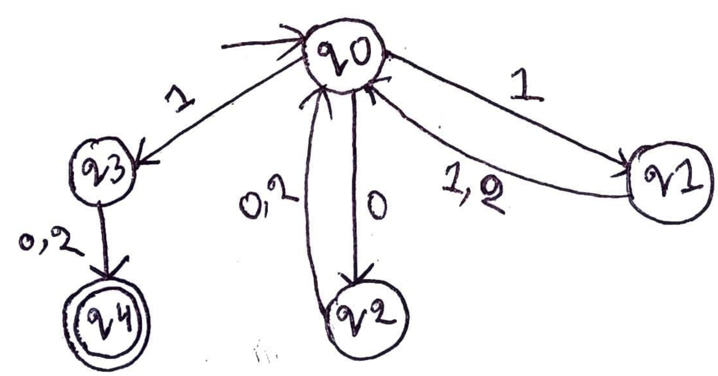
Section: 04

Ans. to the ques. No: 1

Given that,

State/Σ	0	1	2
→ q0	{q2}	{q1, q3}	{ }
q1	{ }	{q0}	{q0}
q2	{q0}	{ }	{q0}
q3	{q4}	{ }	{q4}
q4*	{ }	{ }	{ }

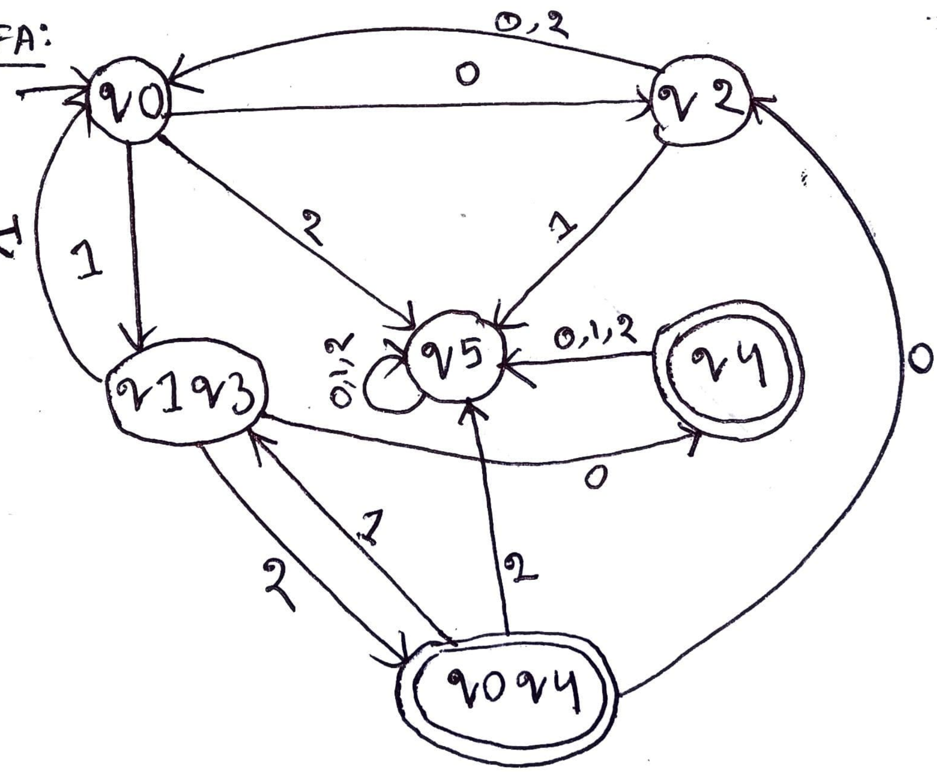
NFA:



Equivalent DFA Transition table:

States	0	1	2
→ q0	{q2}	{q1 q3}	{q5}
q2	{q0}	{q5}	{q0}
q1 q3	{q4}	{q0}	{q0 q4}
q4*	{q5}	{q5}	{q5}
q0 q4*	{q2}	{q1 q3}	{q5}
q5	{q5}	{q5}	{q5}

Equivalent DFA:

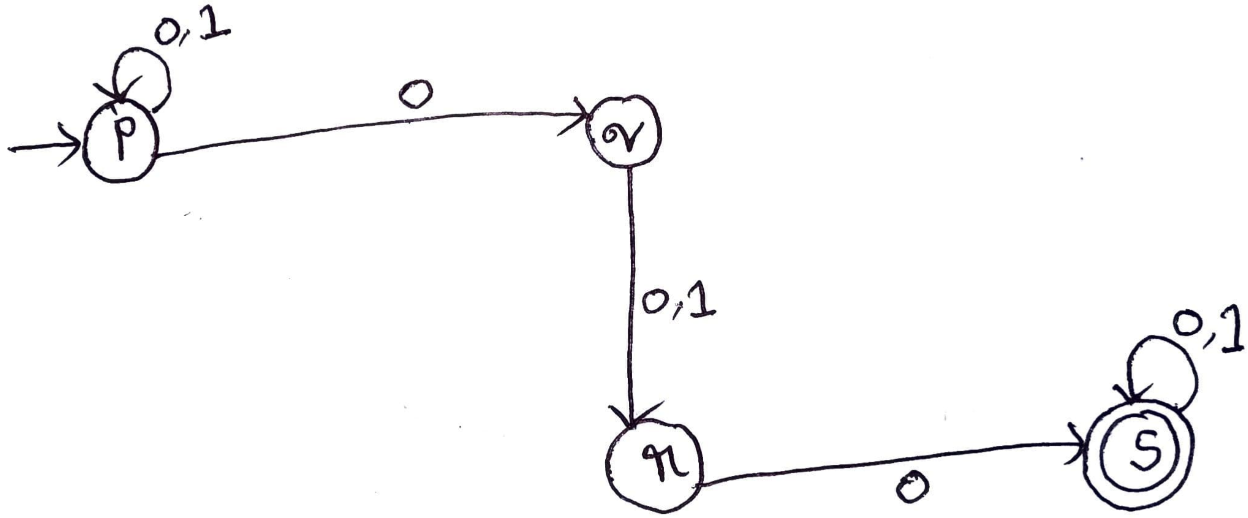


Answer to the ques. No:- 2

Given that,

State	0	1
$\rightarrow p$	$\{p, q\}$	$\{p\}$
q	$\{r\}$	$\{r\}$
r	$\{s\}$	$\{\}$
s^*	$\{s\}$	$\{s\}$

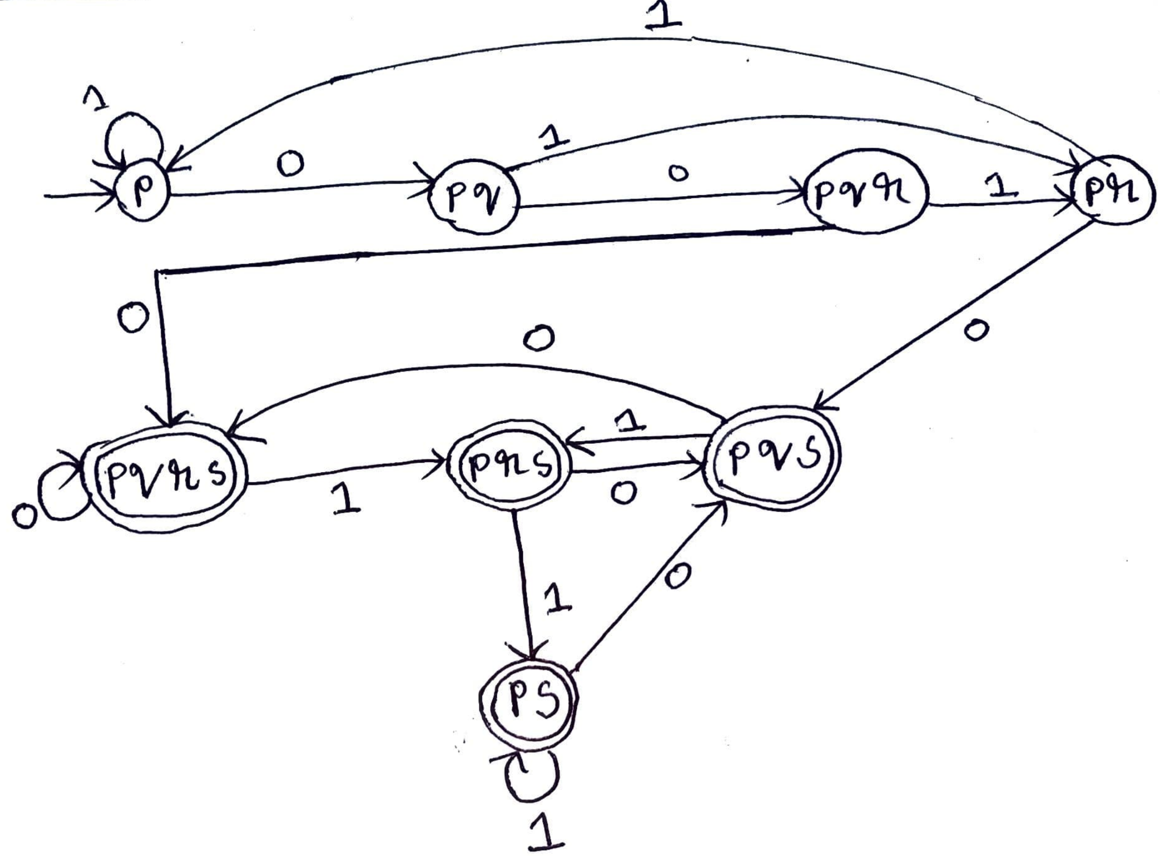
NFA:



Equivalent DFA Transition table:

States	0	1
→ p	{p q}	{p}
p q	{p q r}	{p r}
p q r	{p q r s}	{p r}
p q r s *	{p q r s}	{p r s}
p r s *	{p q s}	{p s}
p r	{p q s}	{p}
p q s *	{p q r s}	{p r s}
p s *	{p q s}	{p s}

Equivalent DFA

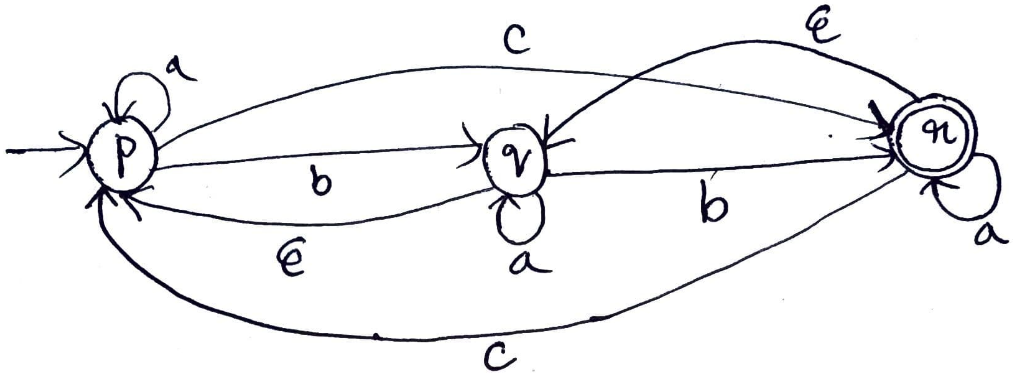


Answer to the ques No:- 3

Given that,

State	ϵ	a	b	c
$\rightarrow p$	{ }	{p}	{q}	{r}
q	{p}	{q}	{r}	{ }
r^*	{q}	{r}	{ }	{p}

NFA from the given transition table:



Start State

$\epsilon\text{-closure}(0)$

$= \{p\}$

$= A$

$\text{Move}_{DFA}(A, a)$

$= \epsilon\text{-closure}(\text{Move}_{NFA}(A, a))$

$= \epsilon\text{-closure}(\{p\})$

$= \{p\}$

$= A$

$\text{Move}_{DFA}(A, b)$

$= \epsilon\text{-closure}(\text{Move}_{NFA}(A, b))$

$= \epsilon\text{-closure}(\{q\})$

$= \{p, q\}$

$= B$

$\text{Move}_{DFA}(A, c)$

$= \epsilon\text{-closure}(\text{Move}_{NFA}(A, c))$

$= \epsilon\text{-closure}(\{r\})$

$= \{p, q, r\} = C$

$Move_{DFA}(B, a)$
$= \epsilon\text{-closure}(Move_{NFA}(B, a))$
$= \epsilon\text{-closure}(\{p, q\})$
$= \{p, q\} = B$

$Move_{DFA}(B, b)$
$= \epsilon\text{-closure}(Move_{NFA}(B, b))$
$= \epsilon\text{-closure}(\{q, r\})$
$= \{p, q, r\}$
$= C$

$Move_{DFA}(B, c)$
$= \epsilon\text{-closure}(Move_{NFA}(B, c))$
$= \epsilon\text{-closure}(\{r\})$
$= \{p, q, r\} = C$

$Move_{DFA}(C, a)$
$= \epsilon\text{-closure}(Move_{NFA}(C, a))$
$= \epsilon\text{-closure}(\{p, q, r\})$
$= \{p, q, r\} = C$

$Move_{DFA}(C, b)$
$= \epsilon\text{-closure}(Move_{NFA}(C, b))$
$= \epsilon\text{-closure}(\{q, r\})$
$= \{p, q, r\} = C$

$Move_{DFA}(C, c)$
$= \epsilon\text{-closure}(Move_{NFA}(C, c)$
$= \epsilon\text{-closure}(\{r, p\})$
$= \{p, q, r\} = C$

From the transition table we can see that, the final state is 'r'.

And, 'r' only appear in set 'C'

$C = \{p, q, r\}$

So, 'C' will be the final state of equivalent DFA.

Equivalent DFA:

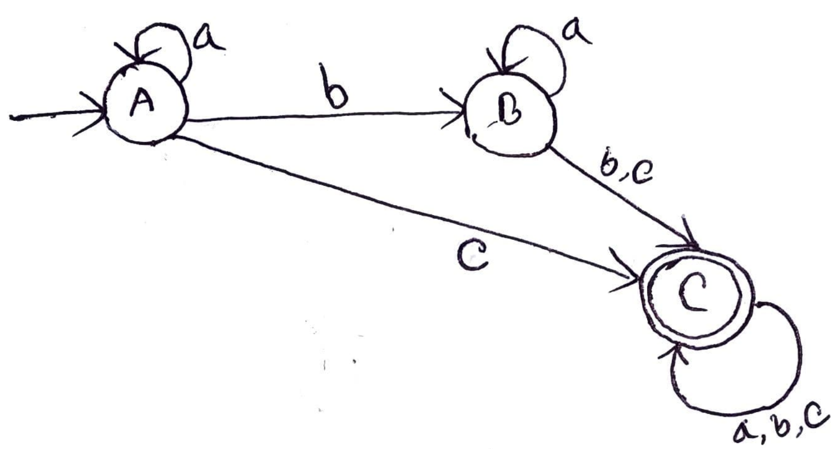


Table:

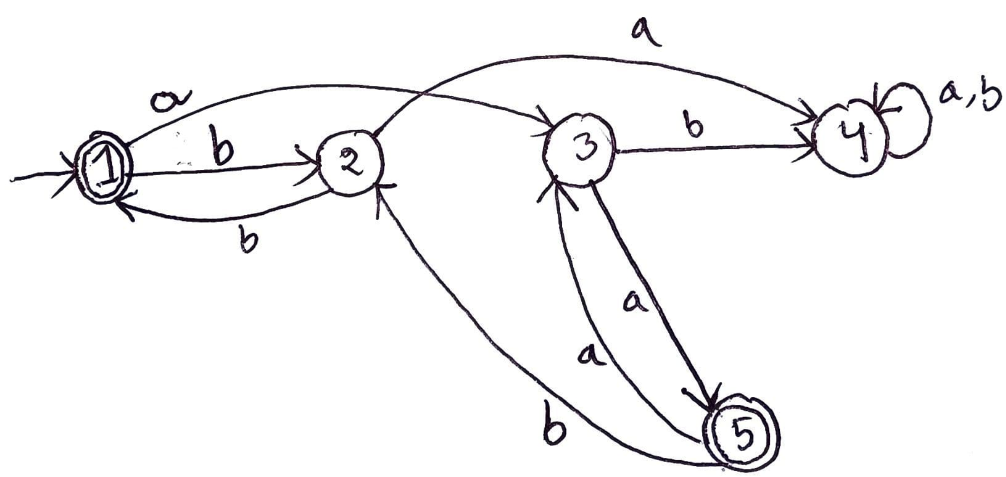
	a	b	c
→ A	A	B	C
B	B	C	C
C*	C	C	C

Answer to the question No:-4

Given that,

State/Σ	a	b
→1*	3	2
2	4	1
3	5	4
4	4	4
5*	3	2

DFA:



DFA minimization using hopcroft's algorithm:

~~set of accepting , $G_1 = \{1, 5\}$~~

~~set of rejecting states, $G_2 = \{2, 3, 4\}$~~

set of all states, $S = \{1, 2, 3, 4, 5\}$

set of all rejected states, $G_1 = \{2, 3, 4\}$

set of all accepted states, $G_2 = \{1, 5\}$

So, Initial partitioning:

$$\Pi_1 = \underbrace{(2\ 3\ 4)}_{G_1}\ \underbrace{(1\ 5)}_{G_2}$$

	a	b
2	G_1	G_2
3	G_2	G_1
4	G_1	G_1

Considering $G_1 = (2.3\ 4)$

Here, we can see that neither of the states combination matches.

So, G_1 will break apart.

$\Rightarrow$ (2) (3) (4)

Considering $G_2 = (1 \ 5)$

	a	b
1	G_1	G_1
5	G_1	G_1

So, G_2 will not break apart.

Here, New ~~parti~~ partitioning,

$$\pi_2 = \underbrace{(2)}_{G_1} \ \underbrace{(3)}_{G_2} \ \underbrace{(4)}_{G_3} \quad \underbrace{(1 \ 5)}_{G_4}$$

Considering,
G_1, G_2, G_3. These groups can not break apart as these groups only contain single states.

Considering $G_4 = (1 \ 5)$

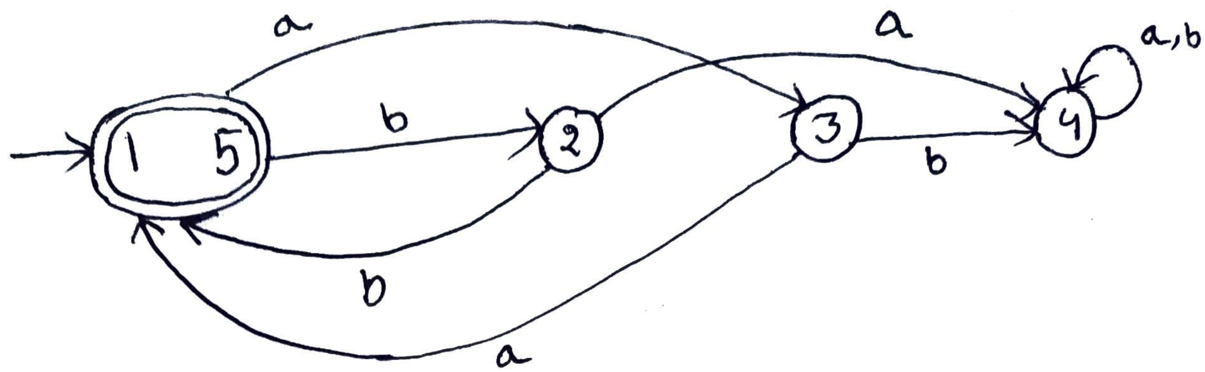
	a	b
1	G_2	G_1
5	G_2	G_1

So, G_2 will not break apart. So, partitioning is over.

So, Final partitioning,

$\pi_f = (2) \ (3) \ (4) \ (1 \ 5)$

Minimized DFA:



Answer to ques. No: 5

Given that,

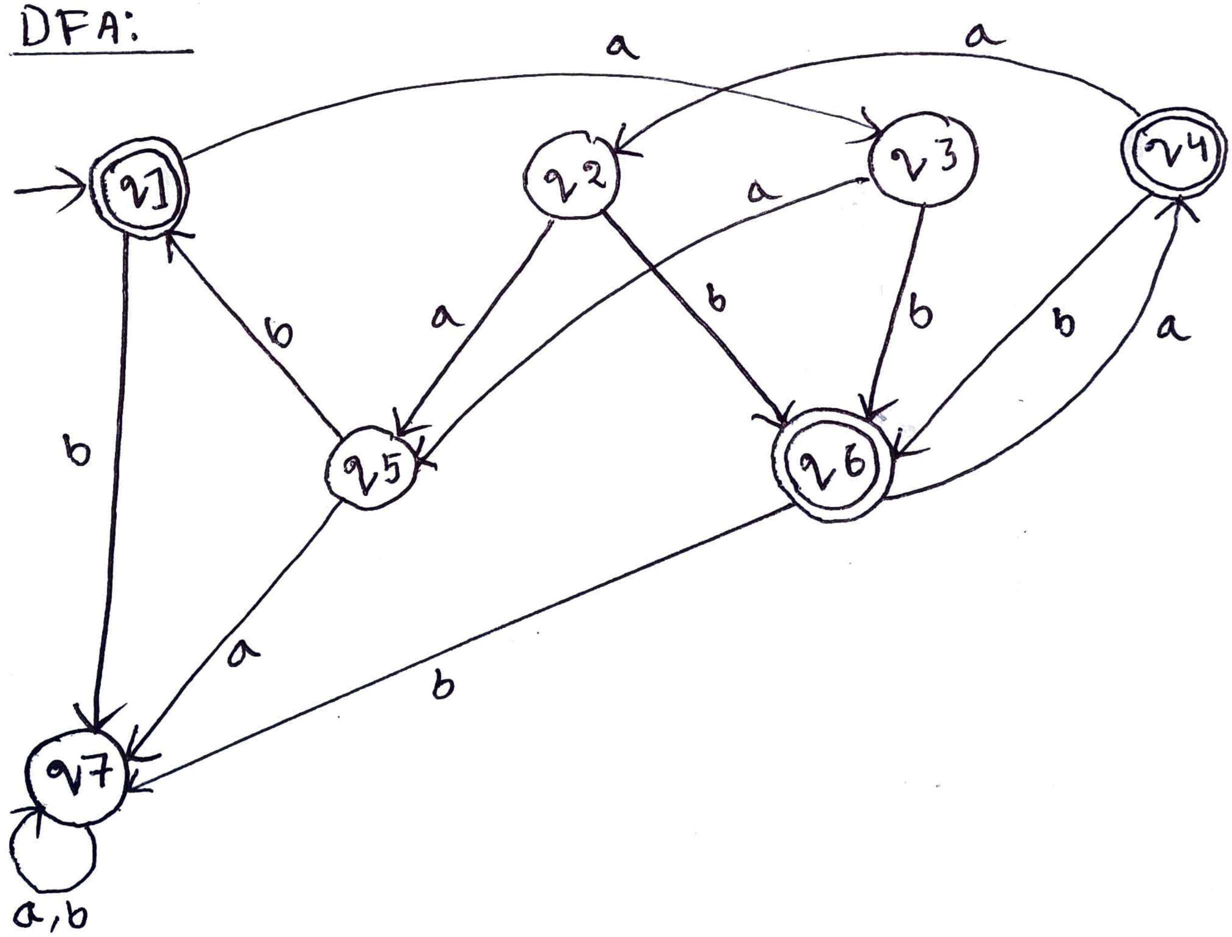
State	a	b
→q1*	q3	{ }
q2	q5	q6
q3	q5	q6
q4*	q2	q6
q5	{ }	q1
q6*	q4	{ }

As, DFA can not have empty transitions, we have to fill the empty transition with a trap state.

DFA transition table with trap state:

State	a	b
→ q1*	q3	q7
q2	q5	q6
q3	q5	q6
q4*	q2	q6
q5	q7	q1
q6*	q4	q7
q7	q7	q7

DFA:



DFA minimization using Hopcroft's algorithm:

Set of all states, $S = \{q1, q2, q3, q4, q5, q6, q7\}$

Set of all rejected states, $G_1 = \{q2, q3, q5, q7\}$

Set of all accepted states, $G_2 = \{q1, q4, q6\}$

So, initial ~~parti~~ Partitioning:

$$\Pi_1 = \underbrace{(q2\ q3\ q5\ q7)}_{G_1}\ \underbrace{(q1\ q4\ q6)}_{G_2}$$

Considering $G1 = (q2\ q3\ q5\ q7)$

	a	b
q2	G1	G2
q3	G1	G2
q5	G1	G2
q7	G1	G1

'q7' is breaking apart group G1.

So, (q2 q3 q5) (q7)

Considering $G_2 = (q1 \quad q4 \quad q6)$

	a	b
q1	G_1	G_1
q4	G_1	G_2
q6	G_2	G_1

Here we can see that, neither of the state's combination matches.

So, (q1) (q4) (q6)

So, the new ~~partioning~~ partitioning,

$$\Pi_2 = \underbrace{(q1)}_{G_1} \underbrace{(q2 \quad q3 \quad q5)}_{G_2} \underbrace{(q4)}_{G_3} \underbrace{(q6)}_{G_4} \underbrace{(q7)}_{G_5}$$

Considering G_1, G_3, G_4, G_5. These groups can not break apart as these groups only contain single states.

Considering $G_2 = (q2\ q3\ q5)$

	a	b
q_2	G_2	G_4
q_3	G_2	G_4
q_5	G_5	G_1

'q_5' is breaking apart group G_2

So, $(q2\ q3)\ (q5)$

So, the new ~~~~ partitioning,

$$\Pi_3 = \underbrace{(q_1)}_{G_1}\ \underbrace{(q_2\ q3)}_{G_2}\ \underbrace{(q4)}_{G_3}\ \underbrace{(q5)}_{G_4}\ \underbrace{(q6)}_{G_5}\ \underbrace{(q7)}_{G_6}$$

Considering Groups G_1, G_3, G_4, G_5, G_6. These groups only contain single states. So, breaking these groups apart will not be possible.

Considering $G_2 = (q2\ q3)$

	a	b
q2	G_4	G_5
q3	G_4	G_5

Here, G_2 will not break apart. So, partitioning is over.

Final partitioning,

$\pi_f = (q1) \quad (q2 \ q3) \quad (q4) \ (q5) \ (q6) \ (q7)$

Minimized DFA: