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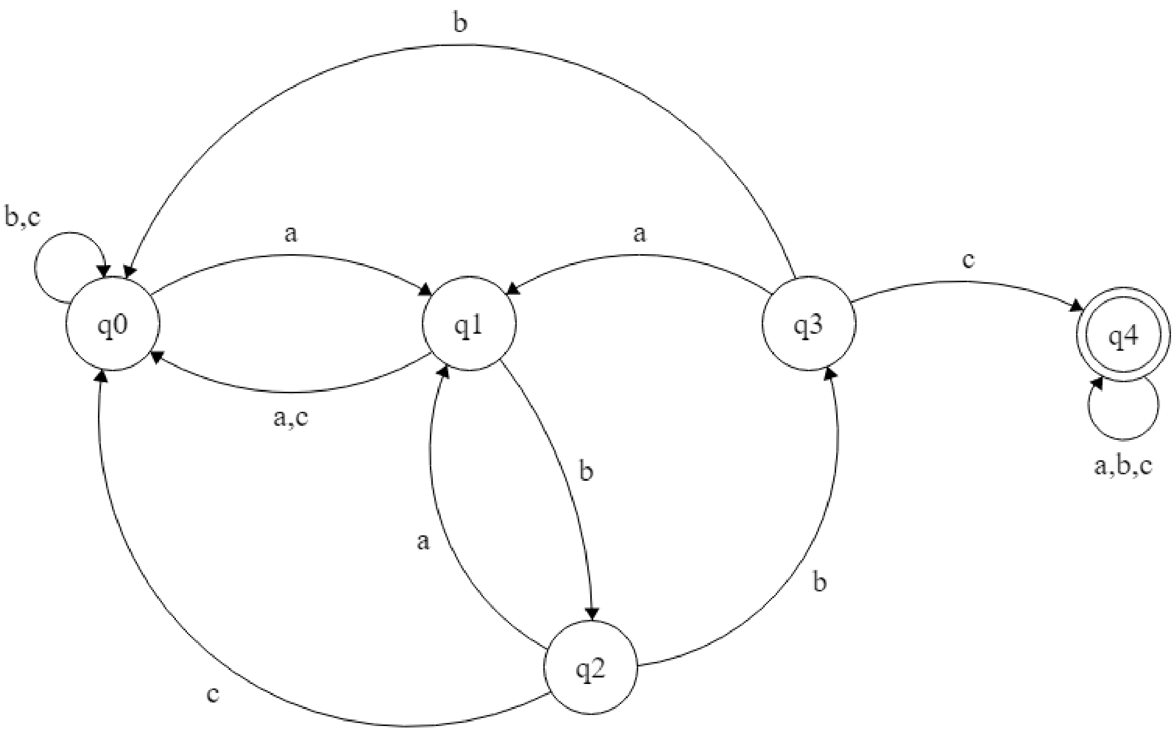
Theory of Computation

Assignment #2

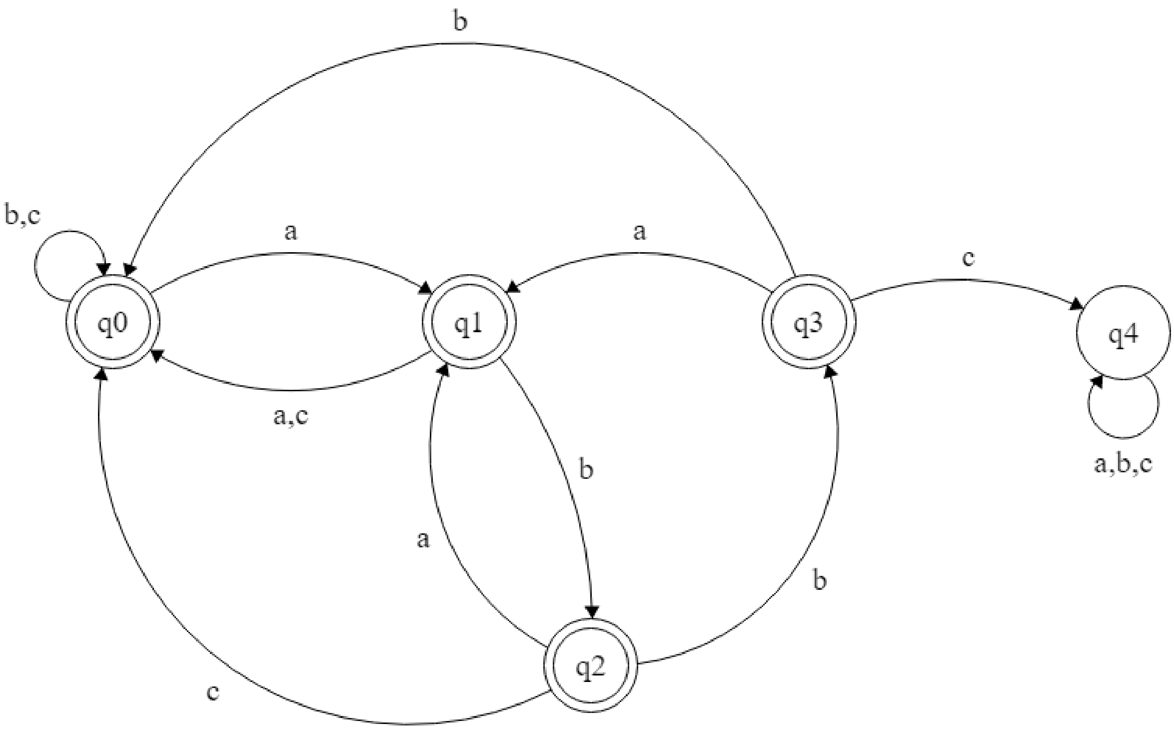
Q1:



The initial state is q0 and the final state(s) are q4

δ(q0, a) = q1	δ(q0, b) = q0	δ(q0, c) = q0
δ(q1, a) = q0	δ(q1, b) = q2	δ(q1, c) = q0
δ(q2, a) = q1	δ(q2, b) = q3	δ(q2, c) = q0
δ(q3, a) = q1	δ(q3, b) = q0	δ(q3, c) = q4
δ(q4, a) = q4	δ(q4, b) = q4	δ(q4, c) = q4

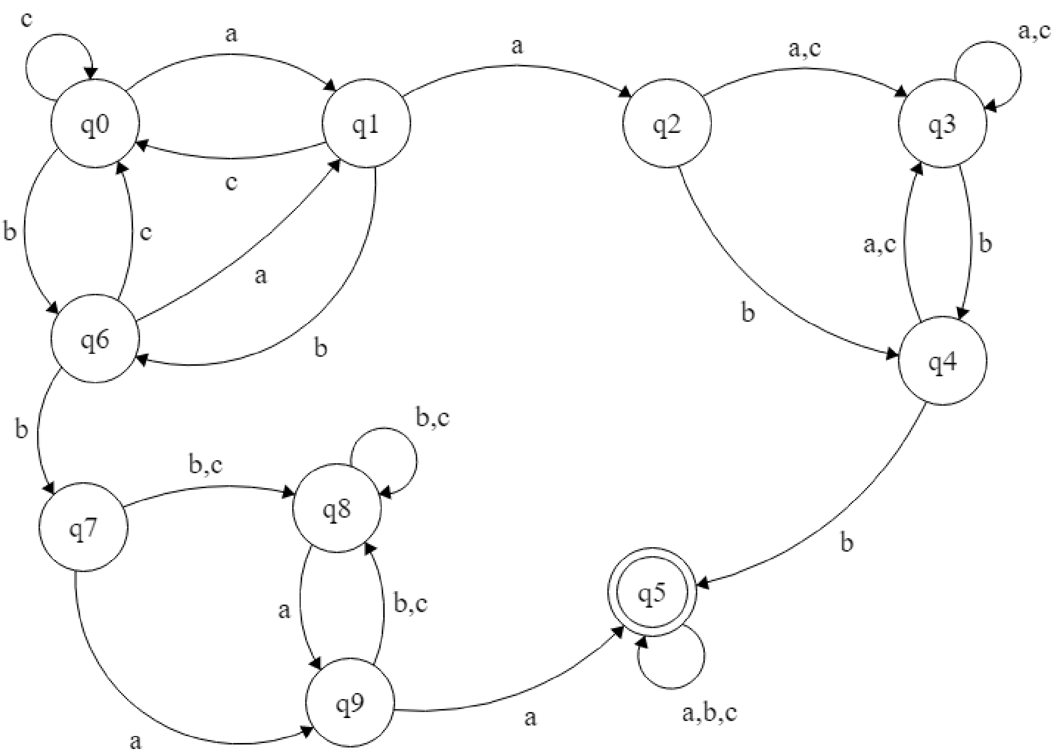
Q2:



The initial state is q0 and the final state(s) are q0, q1, q2, q3

δ(q0, a) = q1	δ(q0, b) = q0	δ(q0, c) = q0
δ(q1, a) = q0	δ(q1, b) = q2	δ(q1, c) = q0
δ(q2, a) = q1	δ(q2, b) = q3	δ(q2, c) = q0
δ(q3, a) = q1	δ(q3, b) = q0	δ(q3, c) = q4
δ(q4, a) = q4	δ(q4, b) = q4	δ(q4, c) = q4

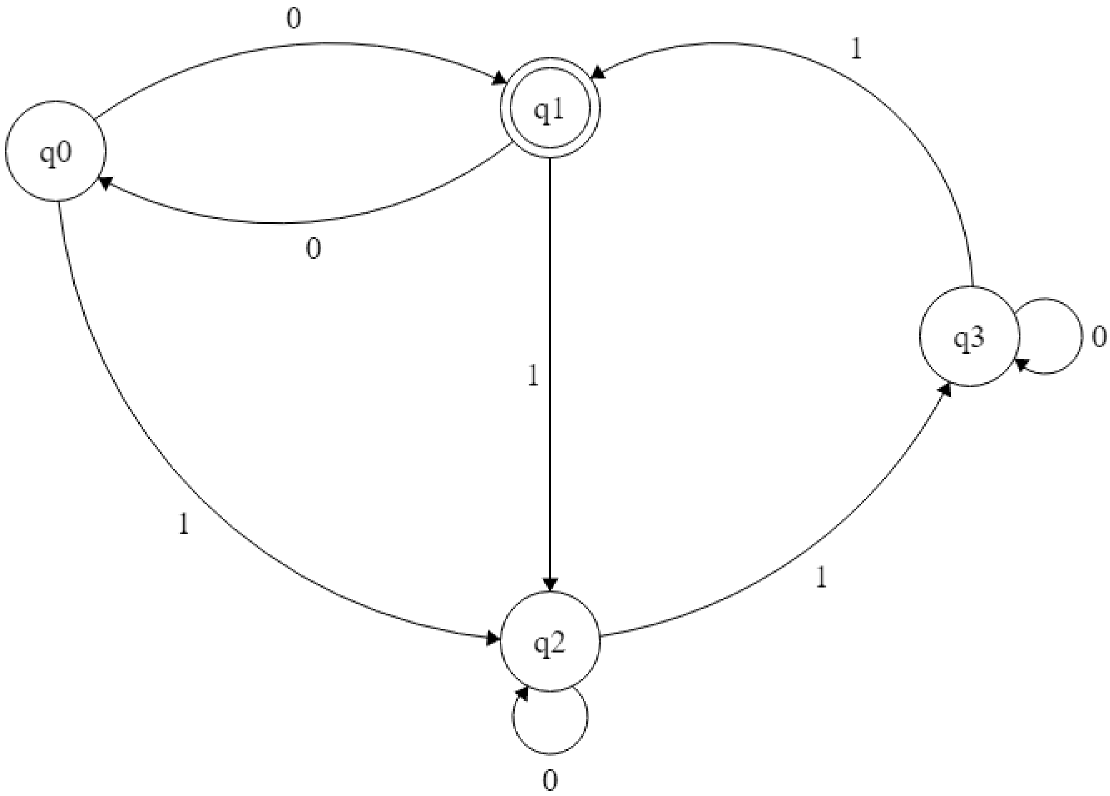
Q3:



The initial state is q0 and the final state is q5

δ(q0, a) = q1	δ(q0, b) = q6	δ(q0, c) = q0
δ(q1, a) = q2	δ(q1, b) = q6	δ(q1, c) = q0
δ(q2, a) = q3	δ(q2, b) = q4	δ(q2, c) = q3
δ(q3, a) = q3	δ(q3, b) = q4	δ(q3, c) = q3
δ(q4, a) = q3	δ(q4, b) = q5	δ(q4, c) = q3
δ(q5, a) = q5	δ(q5, b) = q5	δ(q5, c) = q5
δ(q6, a) = q1	δ(q6, b) = q7	δ(q6, c) = q0
δ(q7, a) = q9	δ(q7, b) = q8	δ(q7, c) = q8
δ(q8, a) = q9	δ(q8, b) = q8	δ(q8, c) = q8
δ(q9, a) = q5	δ(q9, b) = q8	δ(q8, c) = q8

Q4:



The initial state is q0 and the final state is q1

$\delta(q0, 0) = q1$ $\delta(q0, 1) = q2$

$\delta(q1, 0) = q0$ $\delta(q1, 1) = q2$

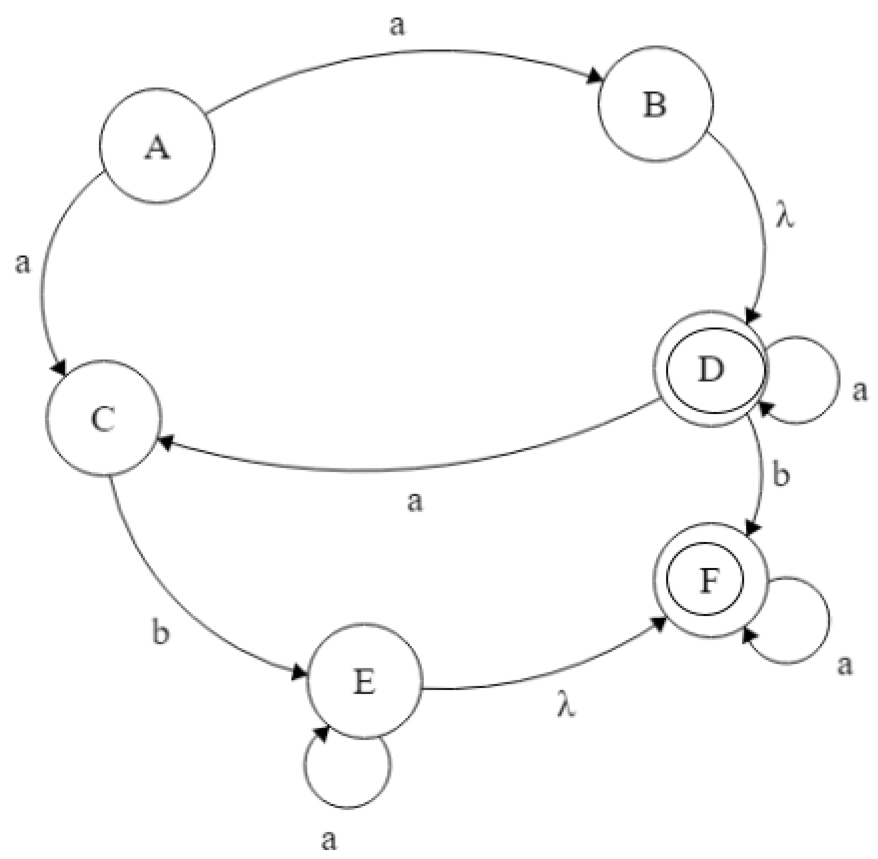
$\delta(q2, 0) = q2$ $\delta(q2, 1) = q3$

$\delta(q3, 0) = q3$ $\delta(q3, 1) = q1$

Q5:

Let A = q0, B = q1, C = q2, D = q3, E = q4, F = q5

λ-NFA graph:



λ-NFA to NFA transition:

For A:

$\delta(A,\lambda) = A$, $\delta(A, a) = \{B,C\}$, $\delta(B, \lambda) = \{B, D\}$ and $\delta(C, \lambda) = C$

$\delta(A,\lambda) = A$, $\delta(A, b) = \Phi$

∴ A's transitions after the λ-NFA to NFA transition:

$\delta(A, a) = \{B,D\} \cup \{C\} = \{B,C,D\}$

$\delta(A, b) = \Phi$

For B:

$\delta(B,\lambda) = \{B,D\}$, $\delta(B, a) = \Phi$, $\delta(D, a) = \{D,C\}$, then $\delta(D, \lambda) = \{D\}$ and $\delta(C, \lambda) = \{C\}$
$\delta(B,\lambda) = \{B,D\}$, $\delta(B, b) = \Phi$, $\delta(D, b) = \{F\}$, then $\delta(F, \lambda) = \{F\}$

∴ B's transitions after the λ-NFA to NFA transition:

$\delta(B, a) = \{D\} \cup \{C\} = \{C,D\}$
$\delta(B, b) = \{F\}$

For C:

$\delta(C, \lambda) = \{C\}$, $\delta(C, a) = \Phi$
$\delta(C, \lambda) = \{C\}$, $\delta(C, b) = \{E\}$, then $\delta(E, \lambda) = \{E,F\}$

∴ C's transitions after the λ-NFA to NFA transition:

$\delta(C, a) = \Phi$
$\delta(C, b) = \{E, F\} = \{E, F\}$

For D:

$\delta(D, \lambda) = \{D\}$, $\delta(D, a) = \{D, C\}$,then $\delta(D, \lambda) = \{D\}$ and $\delta(C, \lambda) = \{C\}$
$\delta(D, \lambda) = \{D\}$, $\delta(D, b) = \{F\}$,then $\delta(F, \lambda) = \{F\}$

∴ D's transitions after the λ-NFA to NFA transition:

$\delta(D, a) = \{C\} \cup \{D\} = \{C,D\}$
$\delta(D, b) = \{F\}$

For E:

$\delta(E, \lambda) = \{E,F\}$, $\delta(E, a) = \{F\}$, $\delta(F, a) = \{F\}$, then $\delta(F, \lambda) = \{F\}$
$\delta(E, \lambda) = \{E,F\}$, $\delta(E, b) = \Phi$, $\delta(F, b) = \Phi$

∴ E's transitions after the λ-NFA to NFA transition:

$\delta(E, a) = \{F\}$
$\delta(E, b) = \Phi$

For F:

$\delta(F, \lambda) = \{F\}$, $\delta(F, a) = \{F\}$, then $\delta(F, \lambda) = \{F\}$
$\delta(F, \lambda) = \{F\}$, $\delta(F, b) = \Phi$

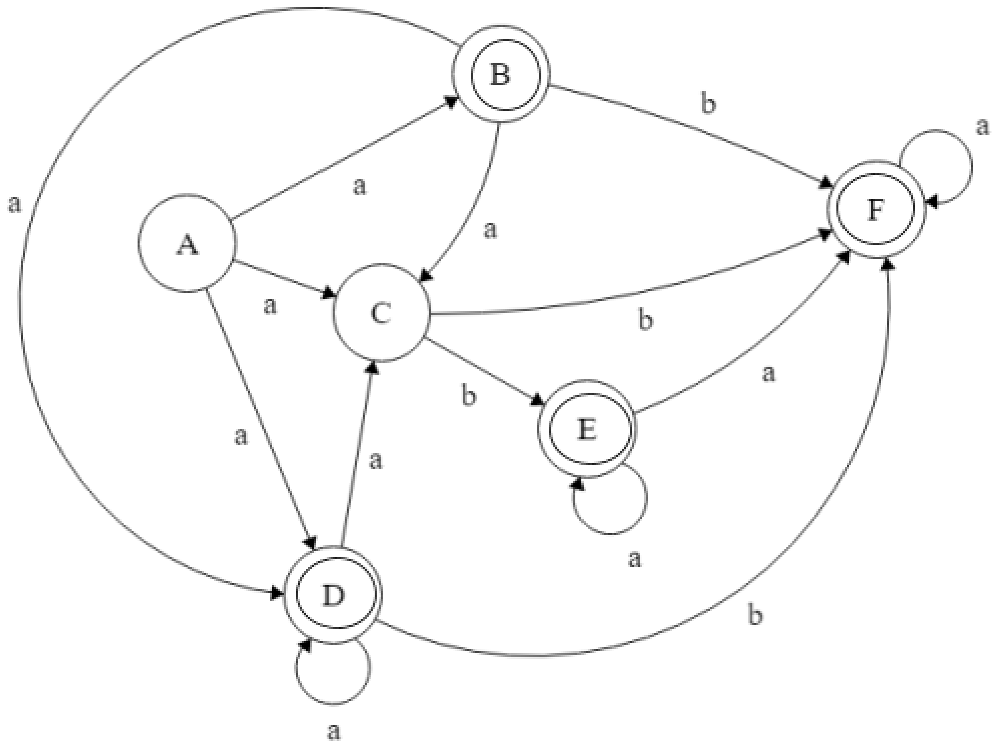
∴ F's transitions after the λ-NFA to NFA transition:

$\delta(F, a) = \{F\}$
$\delta(F, b) = \Phi$

∴ The transition from λ-NFA to NFA is:

$\delta(A, a) = \{B,C,D\}$	$\delta(A, b) = \Phi$	$\delta(B, a) = \{C,D\}$	$\delta(B, b) = \{F\}$
$\delta(C, a) = \Phi$	$\delta(C, b) = \{E,F\}$	$\delta(D, a) = \{C,D\}$	$\delta(D, b) = \{F\}$
$\delta(E, a) = \{F\}$	$\delta(E, b) = \Phi$	$\delta(F, a) = \{F\}$	$\delta(F, b) = \Phi$

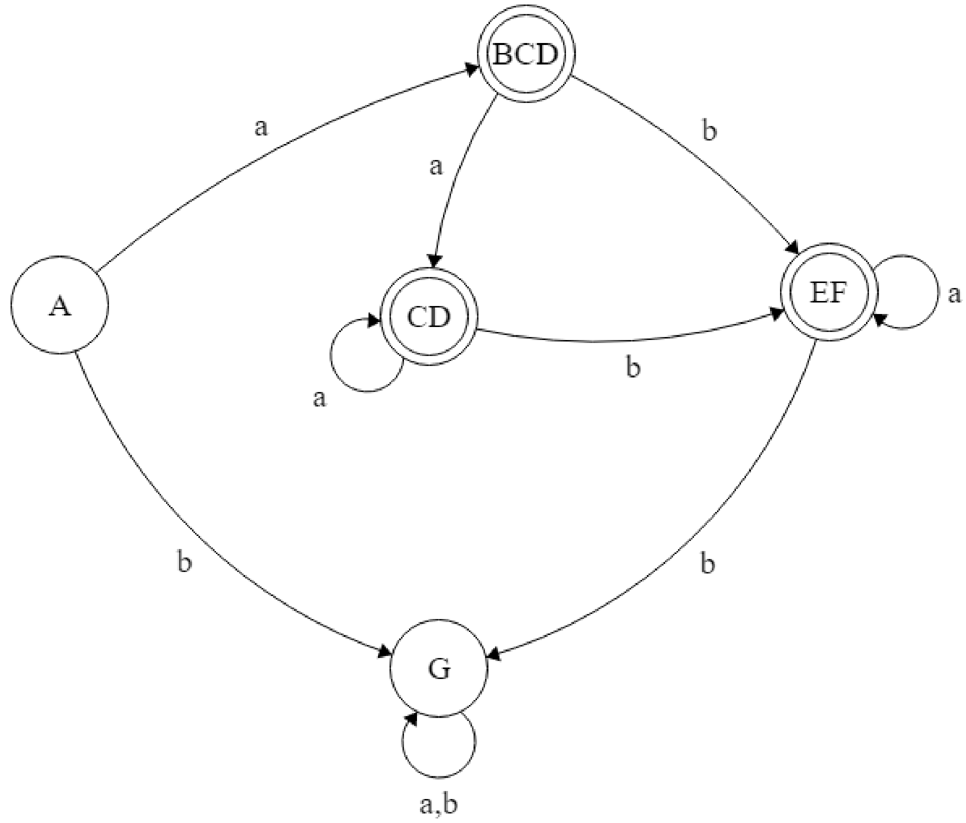
NFA graph:



NFA to DFA transition:

$\delta(A, a) = BCD$	$\delta(A, b) = G$	$\delta(BCD, a) = CD$	$\delta(BCD, b) = EF$
$\delta(CD, a) = CD$	$\delta(CD, b) = EF$	$\delta(EF, a) = EF$	$\delta(EF, b) = \Phi$
$\delta(G, a) = G$	$\delta(G, b) = G$ (G is a trap state)		

DFA graph:



Q6:

Minimization process:

DFA table:

	a	b
q0	q1	q3
q1	q2	q4
q2	q5	q4
q3	q4	q2
q4	q5	q2
q5	q5	q5

n-Equivalnce process is iterated until (n-1)-Equivalnce $\equiv$ n-Equivalnce:

It is done by comparing every state's transitions by seeing if the transitions belong to the same set or a different one. If it is in a different one, then the state goes to another set. Once the comparison is done amongst all states, then a new n-Equivalnce begins.

0-Equivalnce: {{q1, q2, q3, q4}, {q0, q5}}

1-Equivalnce: {{q1, q3}, {q2, q4}, {q0}, {q5}}

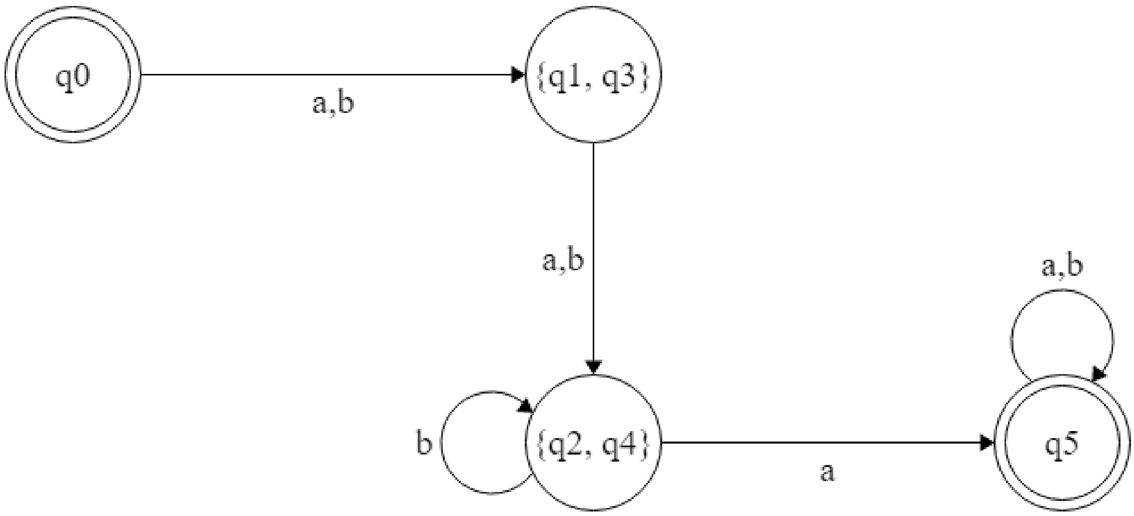
2-Equivalnce: {{q1, q3}, {q2, q4}, {q0}, {q5}}

Since 1-Equivalnce's set $\equiv$ 2-Equivalnce's set, then the minimization process is done.

∴ The minimized DFA table will be:

	a	b
q0	{q1,q3}	{q1,q3}
{q1,q3}	{q2,q4}	{q2,q4}
{q2,q4}	q5	{q2,q4}
q5	q5	q5

Minimied DFA graph:



The initial state is q0, and the final state(s) are q0 and q5

δ(q0, a) = {q1, q3} δ(q0, b) = {q1, q3}

δ({q1, q3}, a) = {q2, q3} δ({q1, q3}, b) = {q2, q4}

δ({q2, q4}, a) = q5 δ({q2, q4}, b) = {q2, q4}

δ(q5, a) = q5 δ(q5, b) = q5