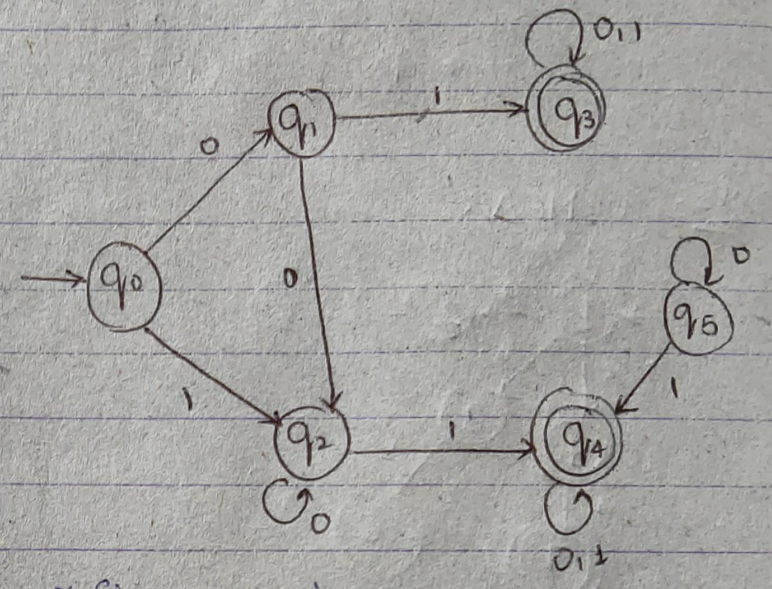
Assignment-4
AUTOMATA THEORY

Mohit Pandey
20194204 CS-B2

Sol 1. a) Equivalence Theorem

Transition Table —

	q	0	1
→	q_0	q_1	q_2
	q_1	q_2	q_3
	q_2	q_2	q_4
*	q_3	q_3	q_3
*	q_4	q_4	q_4
X	q_5	q_5	q_4



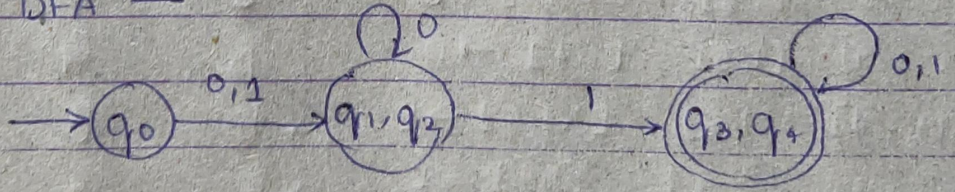
* Since q_5 is an unreachable state, we will not consider it in minimiz

0 Equivalence - $\{q_0, q_1, q_2\}$ $\{q_3, q_4\}$

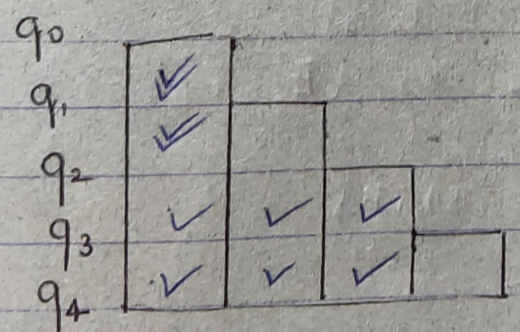
1 Equivalence - $\{q_0\}$ $\{q_1, q_2\}$ $\{q_3, q_4\}$

2 Equivalence - $\{q_0\}$ $\{q_1, q_2\}$ $\{q_3, q_4\}$

Minimized DFA —



b) Myhill-Nerode Theorem



✓(q_0, q_1): $\delta(q_0,0): q_1$ $\delta(q_0,1): q_2$

$\delta(q_1,0): q_2$ $\delta(q_1,1): q_3$

✓(q_0, q_2): $\delta(q_0,0): q_1$ $\delta(q_0,1): q_2$

$\delta(q_2,0): q_2$ $\delta(q_2,1): q_4$

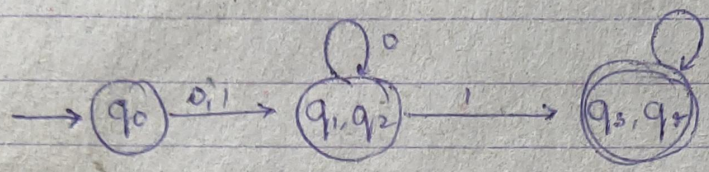
(q_2, q_1): $\delta(q_2,0): q_2$ $\delta(q_2,1): q_4$

$\delta(q_1,0): q_2$ $\delta(q_1,1): q_3$

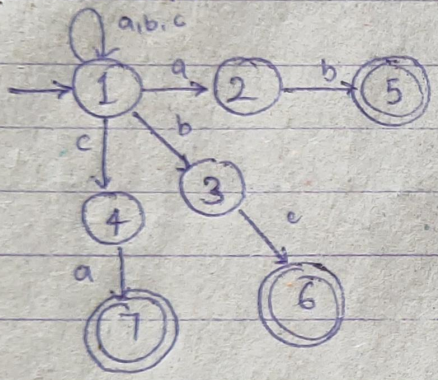
(q_3, q_4): $\delta(q_3,0): q_3$ $\delta(q_3,1): q_3$

$\delta(q_4,0): q_4$ $\delta(q_4,1): q_4$

Combining states : (q_1, q_2) (q_3, q_4)



Sol2. NFA :



q	a	b	c
1	{1,2}	{1,3}	{1,4}
2	ϕ	{5}	ϕ
3	ϕ	ϕ	{6}
4	{7}	ϕ	ϕ
5	ϕ	ϕ	ϕ
6	ϕ	ϕ	ϕ
7	ϕ	ϕ	ϕ

DFA :—

q	a	b	c	
→1	[1,2]	[1,3]	[1,4]	→ A
[1,2]	[1,2]	[1,3,5]	[1,4]	→ B
[1,3]	[1,2]	[1,3]	[1,4,6]	→ C
[1,4]	[1,2,7]	[1,3]	[1,4]	→ D
*[1,3,5]	[1,2]	[1,3]	[1,4,6]	→ E
*[1,4,6]	[1,2,7]	[1,3]	[1,4]	→ F
*[1,2,7]	[1,2]	[1,3,5]	[1,4]	→ G

q	a	b	c
A	B	C	D
B	B	E	D
C	B	C	F
D	G	C	D
* E	B	C	F
* F	G	C	D
* G	B	E	D

a) Equivalence Theorem

0 Equivalence : {A, B, C, D} {E, F, G}

1 Equivalence : {A} {B} {C} {D} {E} {F} {G}

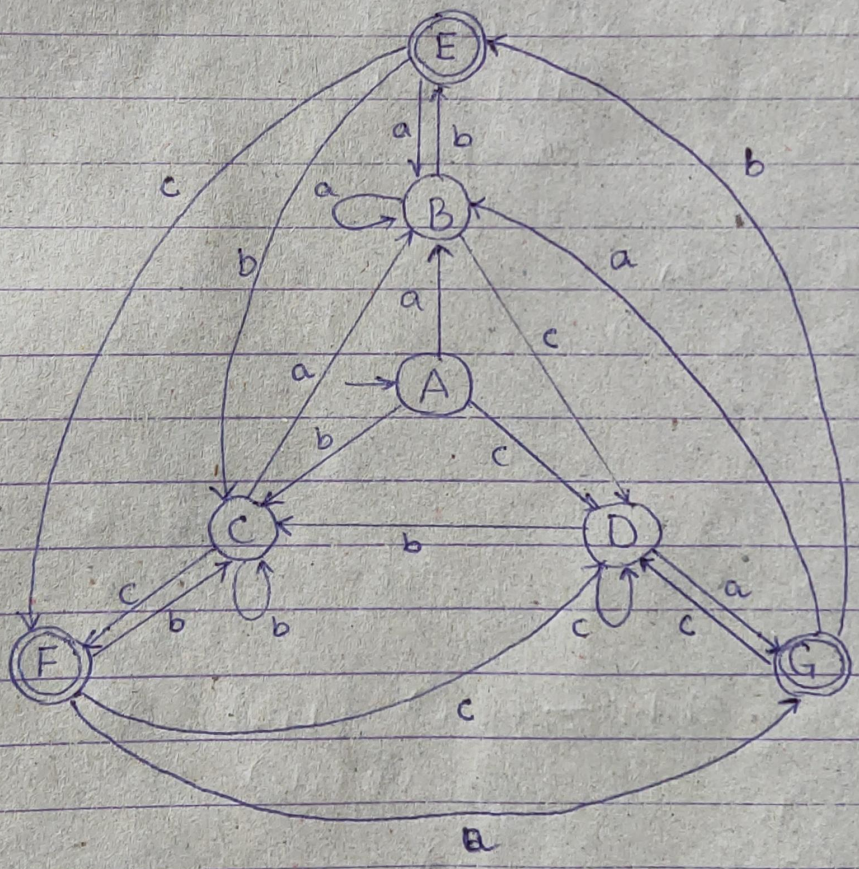
⇒ No combination of states

	A	B	C	D	E	F	G
A							
B	✓						
C	✓	✓					
D	✓	✓	✓				
E	✓	✓	✓	✓			
F	✓	✓	✓	✓	✓		
G	✓	✓	✓	✓	✓	✓	

✓ (A,B) ⇒ δ(A,a) : B , δ(A,b) : C

δ(B,a) : B , δ(B,b) E

NO combined state



Sol3. q - NFA Table —

q	ε	0	1
→1	ϕ	2	1
*2	1	3	2
*3	2	4	3
4	3	1	4

NFA Table —

q	0	1
→1	{1,2}	{1}
*2	{1,2,3}	{1,2}
*3	{1,2,3,4}	{1,2,3}
4	{1,4}	{1,2,3,4}

ε - closure of 1 - {1}

ε - closure of 2 - {1,2}

ε - closure of 3 - {1,2,3}

ε - closure of 4 - {1,2,3,4}

dfa - transition table

q	0	1
→ [1]	[1,2]	[1] → A
* [1,2]	[1,2,3]	[1,2] → B
* [1,2,3]	[1,2,3,4]	[1,2,3] → C
* [1,2,3,4]	[1,2,3,4]	[1,2,3,4] → D

q	0	1
→ A	B	A
* B	C	B
* C	D	C
* D	D	D

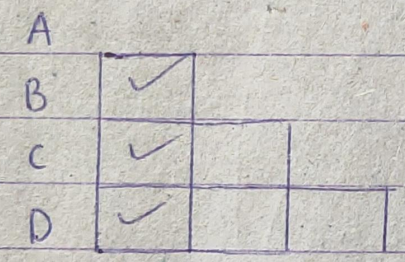
a) Equivalence Theorem

0 Equivalence : {A} {B, C, D}

1 Equivalence : {A} {B, C, D}

⇒ Combine states [B, C, D] into one state

b) Myhill - Nerode Theorem



(B, C) : δ(B, 0) : C δ(B, 1) : B

δ(C, 0) : D δ(C, 1) : C

(B, D) : δ(B, 0) : C δ(B, 1) : B

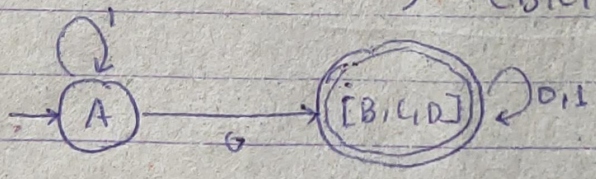
δ(D, 0) : D δ(D, 1) : D

(C, D) : δ(C, 0) : D δ(C, 1) : C

δ(D, 0) : D δ(D, 1) : D

Combining states :— (B, C) (C, D) (B, D)

⇒ (B, C, D)



Sol 4. ε- Transition Table

q	0	1	ε
→ A	E	B	ϕ
B	ϕ	C	D
C	ϕ	D	ϕ
* D	ϕ	ϕ	ϕ
E	F	ϕ	B, C
F	D	ϕ	ϕ

NFA - Table

q	0	1
→ A	{B, C, D, E}	{B, D}
B	ϕ	{C}
C	ϕ	{D}
* D	ϕ	ϕ
E	{F}	{C, D}
F	{ϕ}	ϕ

Dfa Transition Table —

q	0	1
→[A]	[B,C,D,E]	[B,D] → 1
*[B,C,D,E]	[F]	[C,D] → 2
*[B,D]	ϕ	[C] → 3
[F]	[D]	ϕ → 4
*[C,D]	ϕ	[D] → 5
[C]	ϕ	[D] → 6
*[D]	ϕ	ϕ → 7

q	0	1
→ 1	2	3
* 2	4	5
* 3	ϕ	6
4	7	ϕ
* 5	ϕ	7
6	ϕ	7
* 7	ϕ	ϕ

↳ ϕ be a non final dump state

a) Equivalence Theorem

0 Equivalence - {1, 4, 6} {2, 3, 5, 7}

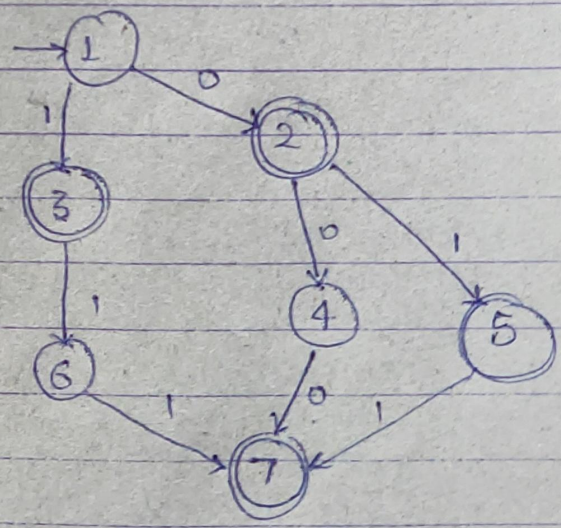
1 Equivalence - {1} {4} {6} {2, 5} {3, 7}

2 Equivalence - {1} {4} {6} {2} {5} {3} {7}

No Combined state

b) Myhill Nerode theorem

q	1	2	3	4	5	6	7	ϕ
1								
2	✓							
3	✓	✓						
4	✓	✓	✓					
5	✓	✓	✓	✓				
6	✓	✓	✓	✓	✓			
7	✓	✓	✓	✓	✓	✓		
ϕ	✓	✓	✓	✓	✓	✓	✓	



NO Combined state