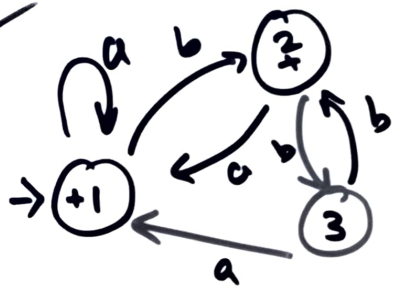
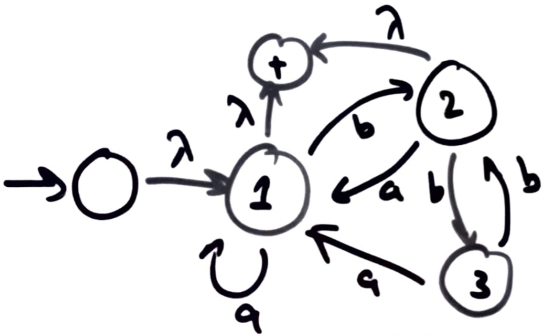
Q1

1.



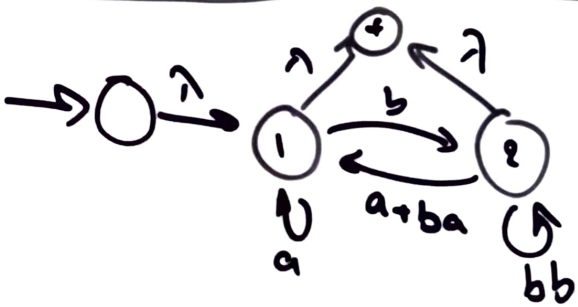
a
b
2
+
a
b
b
+1
3
a

2.



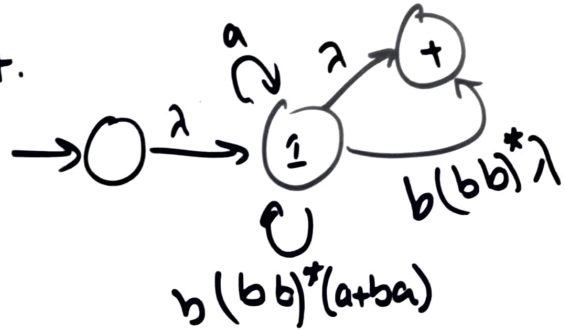
λ
+
λ
2
λ
b
1
a
b
b
a
3
a

3.



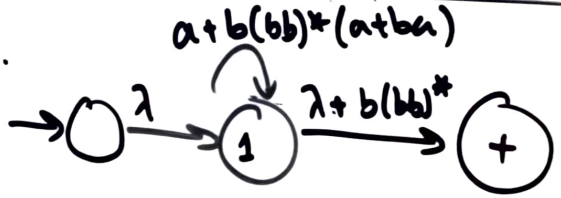
λ
+
λ
λ
b
1
2
a+ba
a
bb

4.



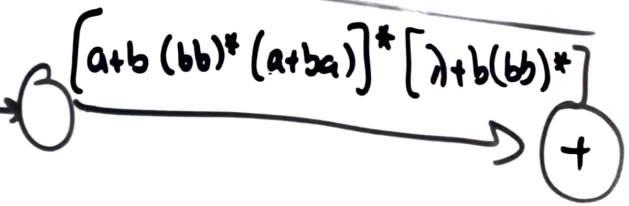
a
λ
+
λ
1
b(bb)*λ
b(bb)*(a+ba)

5.



a+b(bb)*(a+ba)
λ
λ+b(bb)*
1
+

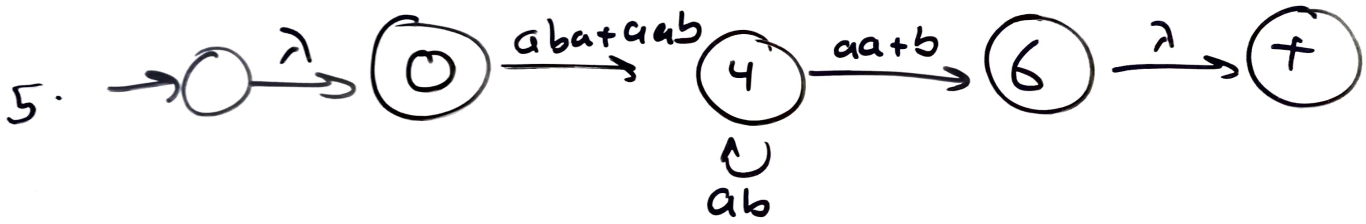
6.

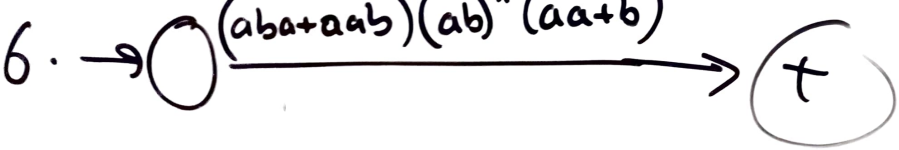


[a+b(bb)*(a+ba)]*[λ+b(bb)*]
+

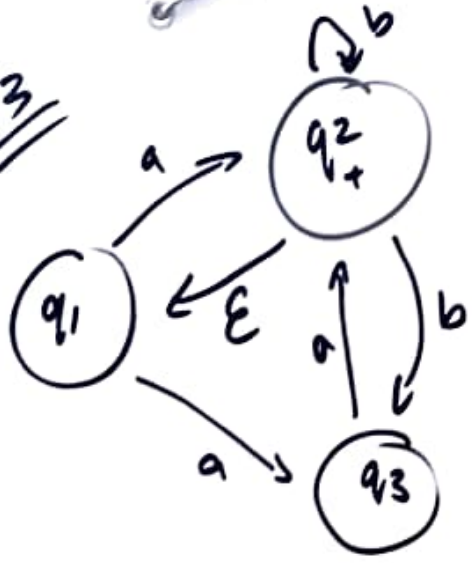
Q2

4.

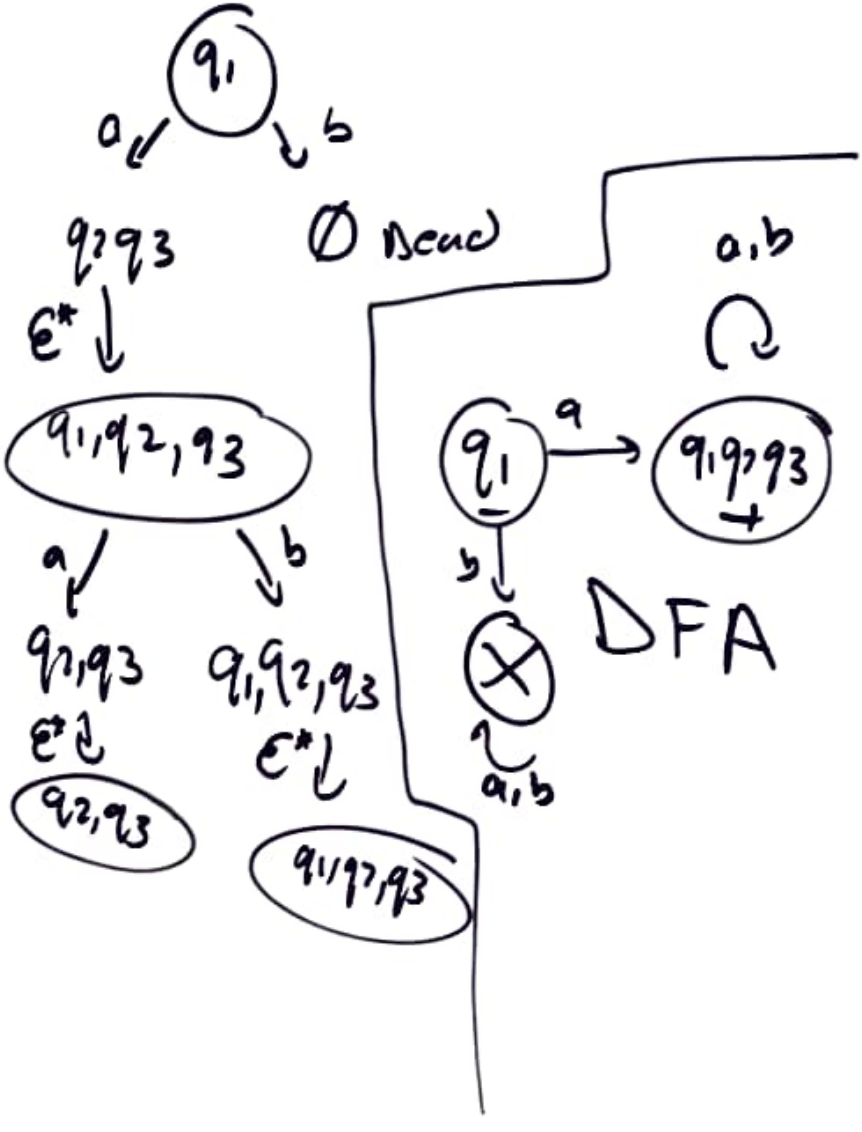
5. 

6. 

Q3



	a	b	ε
→ q_1	q_1,q_2,q_3	∅	q_1
+ q_2	q_2,q_3	q_1,q_2,q_3	q_1,q_2
q_3	q_2	∅	q_3



Q4

	a	b	c	ε
p	p	q	pr	pqr
q	∅	r	qr	q
r	∅	∅	∅	r

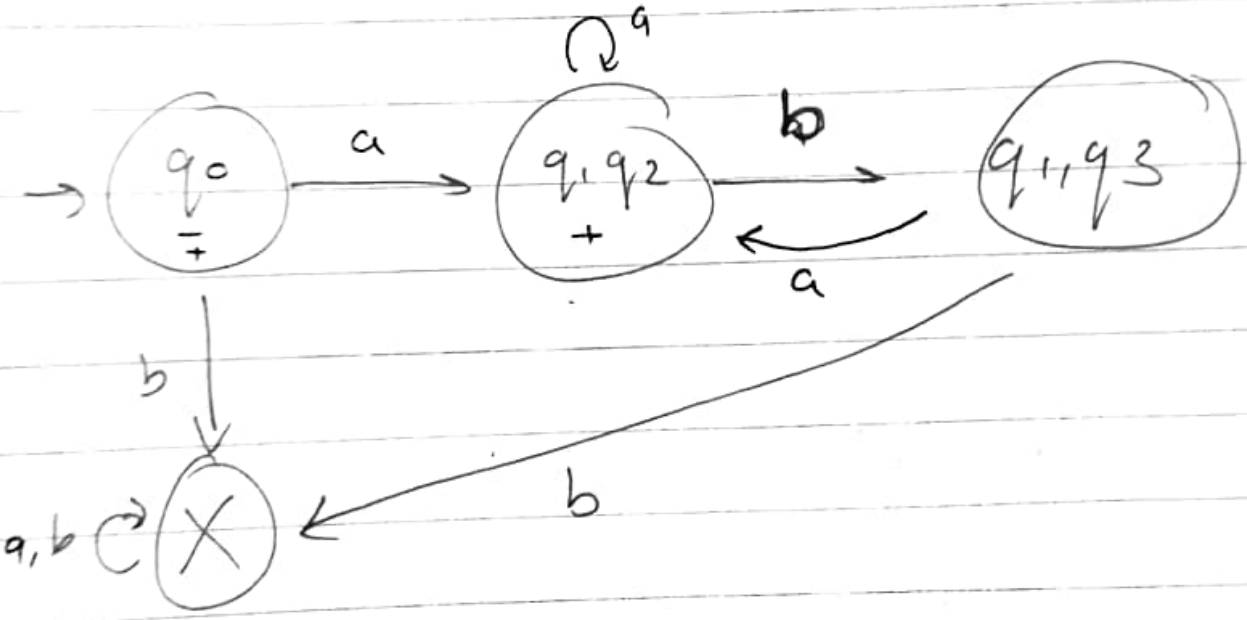
Q5

NFA

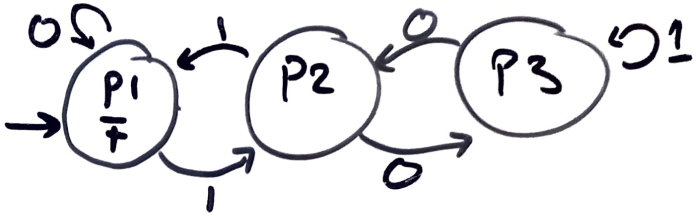
	a	b
→ q_0	q_1, q_2	$\emptyset$
+ q_1	q_1, q_2	$\emptyset$
q_2	$\emptyset$	q_1, q_3
q_3	q_2, q_1	$\emptyset$

DFA

	a	b
→ q_0	q_1, q_2	$\emptyset$
+ $q_1 q_2$	q_1, q_2	q_1, q_3
$\emptyset$	$\emptyset$	$\emptyset$
+ q_1, q_3	q_1, q_2	$\emptyset$



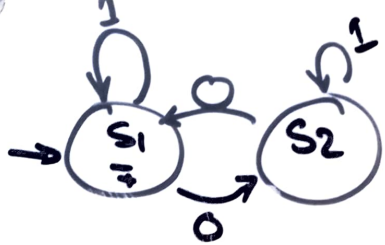
Q6

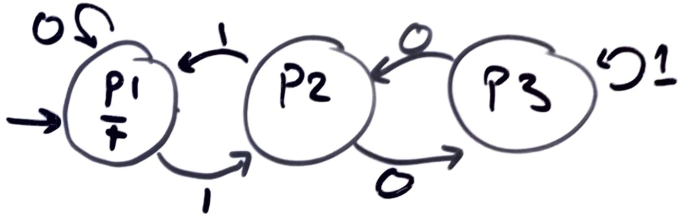


	0	1
$S_1, P_1 (z_1)$	$S_2, P_1 (z_2)$	$S_1, P_1, P_2 (z_3)$
$S_2, P_1 (z_2)$	$S_1, P_1 (z_1)$	$S_2, P_2 (z_4)$
$S_1, P_1, P_2 (z_3)$	$S_2, P_1, P_3 (z_5)$	$S_1, P_1, P_2 (z_3)$
$S_2, P_2 (z_4)$	$S_1, P_1, P_3 (z_6)$	$S_2, P_1 (z_2)$
$S_2, P_1, P_3 (z_5)$	$S_1, P_1, P_2 (z_3)$	$S_2, P_2, P_3 (z_7)$
$S_1, P_1, P_3 (z_6)$	$S_2, P_1, P_2 (z_8)$	$S_1, P_1, P_2, P_3 (z_9)$
$S_2, P_2, P_3 (z_7)$	$S_1, P_1, P_3, P_2 (z_9)$	$S_2, P_1, P_3 (z_5)$
$S_2, P_1, P_2 (z_8)$	$S_1, P_1, P_3 (z_6)$	$S_2, P_2, P_1 (z_8)$
$S_1, P_1, P_2, P_3 (z_9)$	$S_2, P_1, P_3, P_2 (z_{10})$	$S_1, P_1, P_2, P_3 (z_a)$
$S_2, P_1, P_2, P_3 (z_{10})$	$S_1, P_1, P_3, P_2 (z_9)$	$S_2, P_2, P_1, P_3 (z_{10})$

	0	1
S_1	S_2	S_1, P_1
S_2	S_1, P_1	S_2
P_1	P_1	P_2
P_2	P_3	P_1
P_3	P_2	P_3

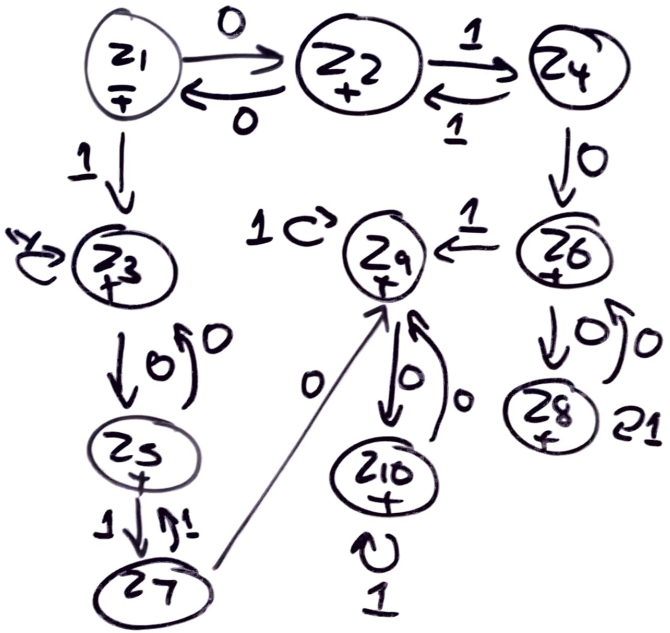
Q6



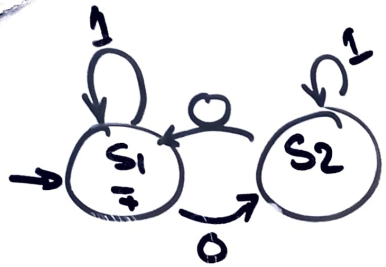


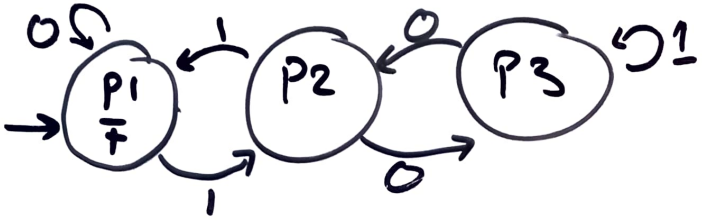
i) CONCAT

	0	1
→ + S_1,P_1 (z_1)	S_2,P_1 (z_2)	S_1,P_1,P_2 (z_3)
+ S_2,P_1 (z_2)	S_1,P_1 (z_1)	S_2,P_2 (z_4)
- S_1,P_1,P_2 (z_3)	S_2,P_1,P_3 (z_5)	S_1,P_1,P_2 (z_3)
S_2,P_2 (z_4)	S_1,P_1,P_3 (z_6)	S_2,P_1 (z_2)
+ S_2,P_1,P_3 (z_5)	S_1,P_1,P_2 (z_3)	S_2,P_2,P_3 (z_7)
+ S_1,P_1,P_3 (z_6)	S_2,P_1,P_2 (z_8)	S_1,P_1,P_2,P_3 (z_9)
S_2,P_2,P_3 (z_7)	S_1,P_1,P_3,P_2 (z_9)	S_2,P_1,P_3 (z_5)
- S_2,P_1,P_2 (z_8)	S_1,P_1,P_3 (z_6)	S_2,P_2,P_1 (z_8)
+ S_1,P_1,P_2,P_3 (z_9)	S_2,P_1,P_3,P_2 (z_9)	S_1,P_1,P_2,P_3 (z_9)
- S_2,P_1,P_2,P_3 (z_{10})	S_1,P_1,P_3,P_2 (z_9)	S_2,P_2,P_1,P_3 (z_{10})


z1
z2
z4
z3
z9
z6
z5
z10
z8
z7
0
1
1
0
1
1
0
0
0
0
0
0
0
1
1
1

Q6

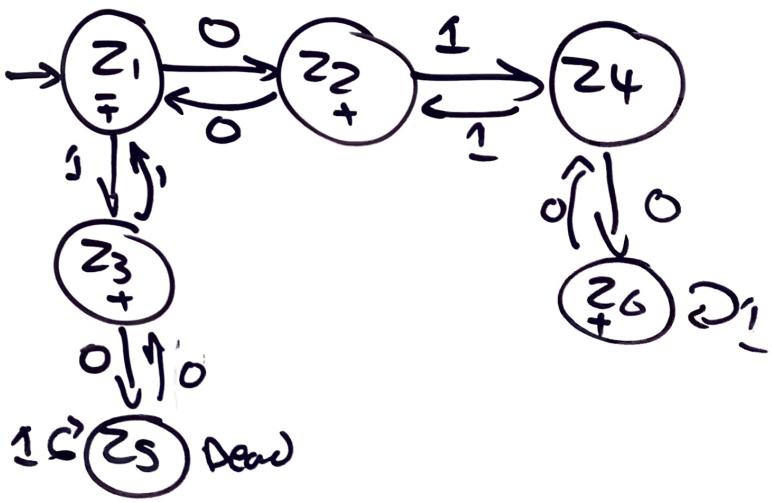




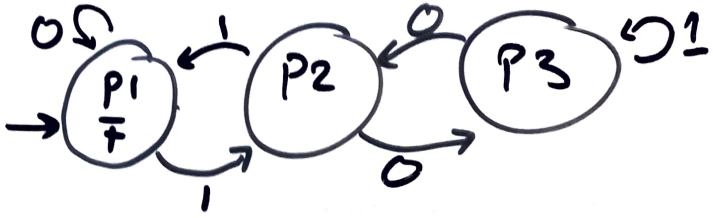
ii) Union :-

	0	1
→ S1, P1 (Z1)	S2, P1 (Z2)	S1, P2 (Z3)
+ S2, P1 (Z2)	S1, P1 (Z1)	S2, P2 (Z4)
+ S1, P2 (Z3)	S2, P3 (Z5)	S1, P1 (Z1)
S2, P2 (Z4)	S1, P3 (Z6)	S2, P1 (Z2)
S2, P3 (Z5)	S1, P2 (Z3)	S2, P3 (Z5)
+ S1, P3 (Z6)	S2, P2 (Z4)	S1, P3 (Z6)

	0	1
S1	S2	S1
S2	S1	S2
P1	P1	P2
P2	P3	P1
P3	P2	P3



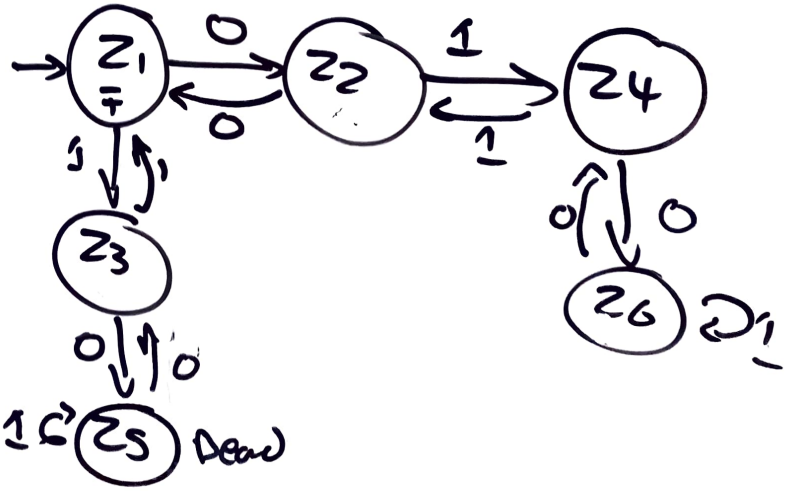
Q6



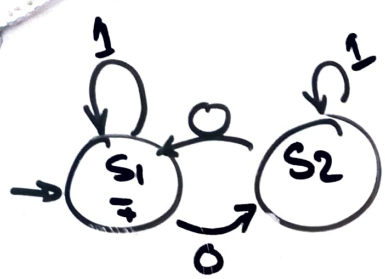
(iii) Intersection:-

	0	1
→ S1,P1(Z1)	S2,P1(Z2)	S1,P2(Z3)
S2,P1(Z2)	S1,P1(Z1)	S2,P2(Z4)
S1,P2(Z3)	S2,P3(Z5)	S1,P1(Z1)
S2,P2(Z4)	S1,P3(Z6)	S2,P1(Z2)
S2,P3(Z5)	S1,P2(Z3)	S2,P3(Z5)
S1,P3(Z6)	S2,P2(Z4)	S1,P3(Z6)

	0	1
S1	S2	S1
S2	S1	S2
P1	P1	P2
P2	P3	P1
P3	P2	P3

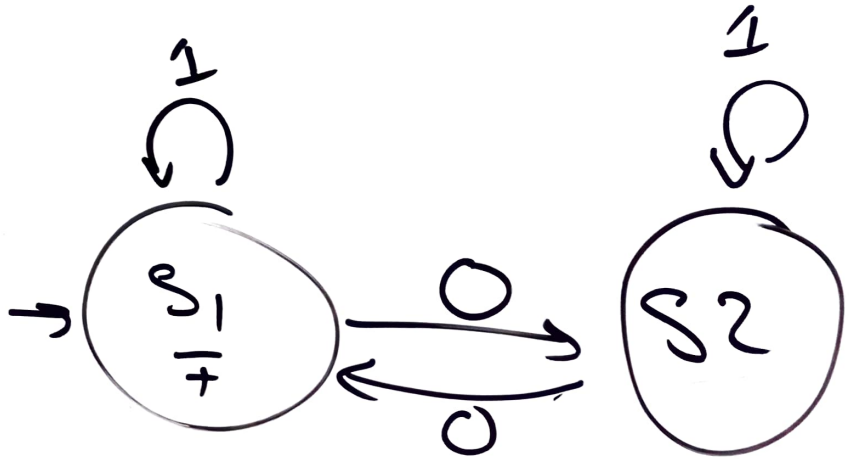


Q6



iv) Closure

	0	1
± S1(z1)	S2(z2)	S1(z1)
S2(z2)	S1(z1)	S2(z2)



Before Closure $(1^*+01^*0)^*$

After Closure: $((1^*+01^*0)^*)^*$

$\equiv (1^*+01^*0)^*$