CSC 2204 Finite Automata Theory and Formal Languages

Department of Computer Science

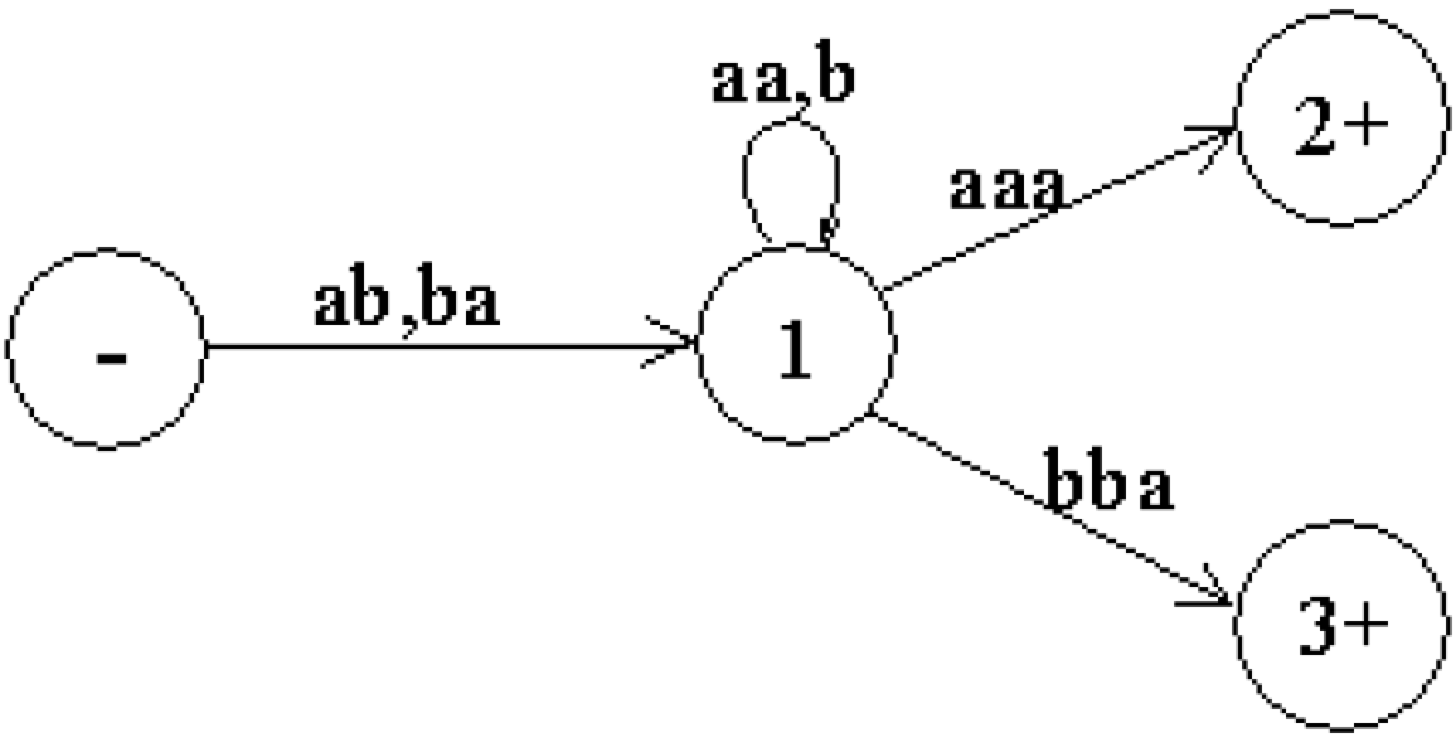
SZABIST (Islamabad Campus)

Week 6 (Lecture 1)

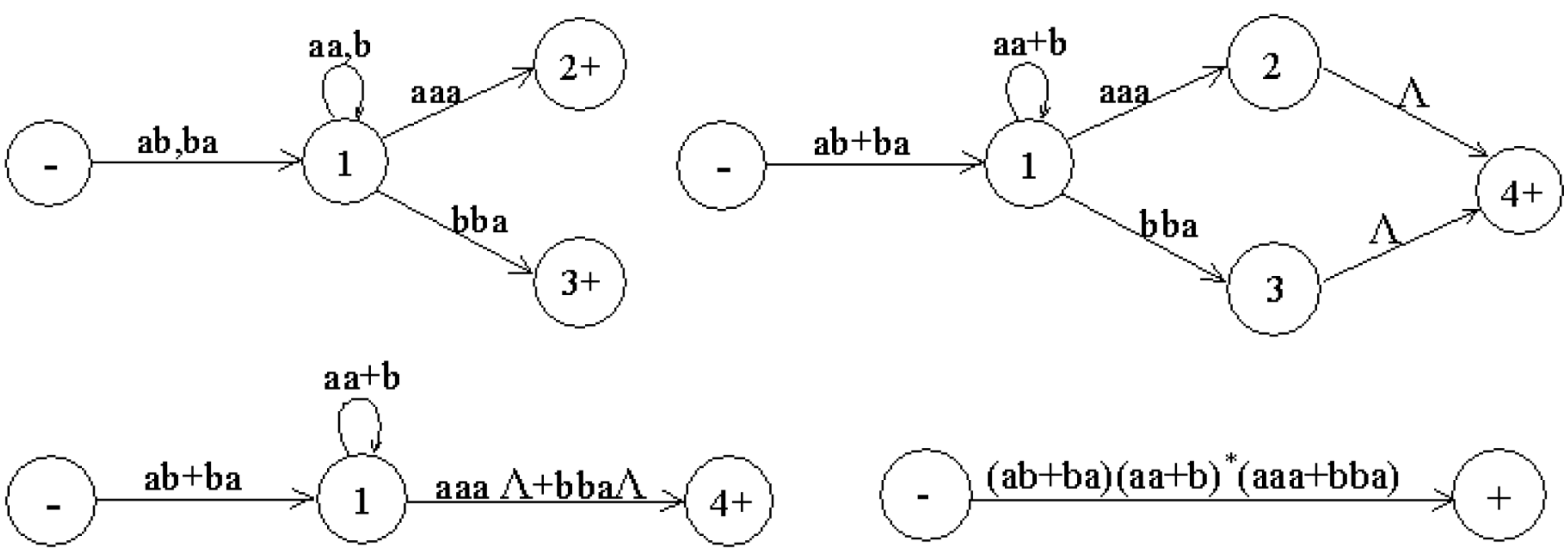
Kleen's Theorem

- Part 1:
  - If a language can be accepted by an FA then it can be accepted by a TG as well.
- Part 2:
  - If a language can be accepted by a TG then it can be expressed by an RE as well.
- Part 3:
  - If a language can be expressed by a RE then it can be accepted by an FA as well.

FA/TG to RE

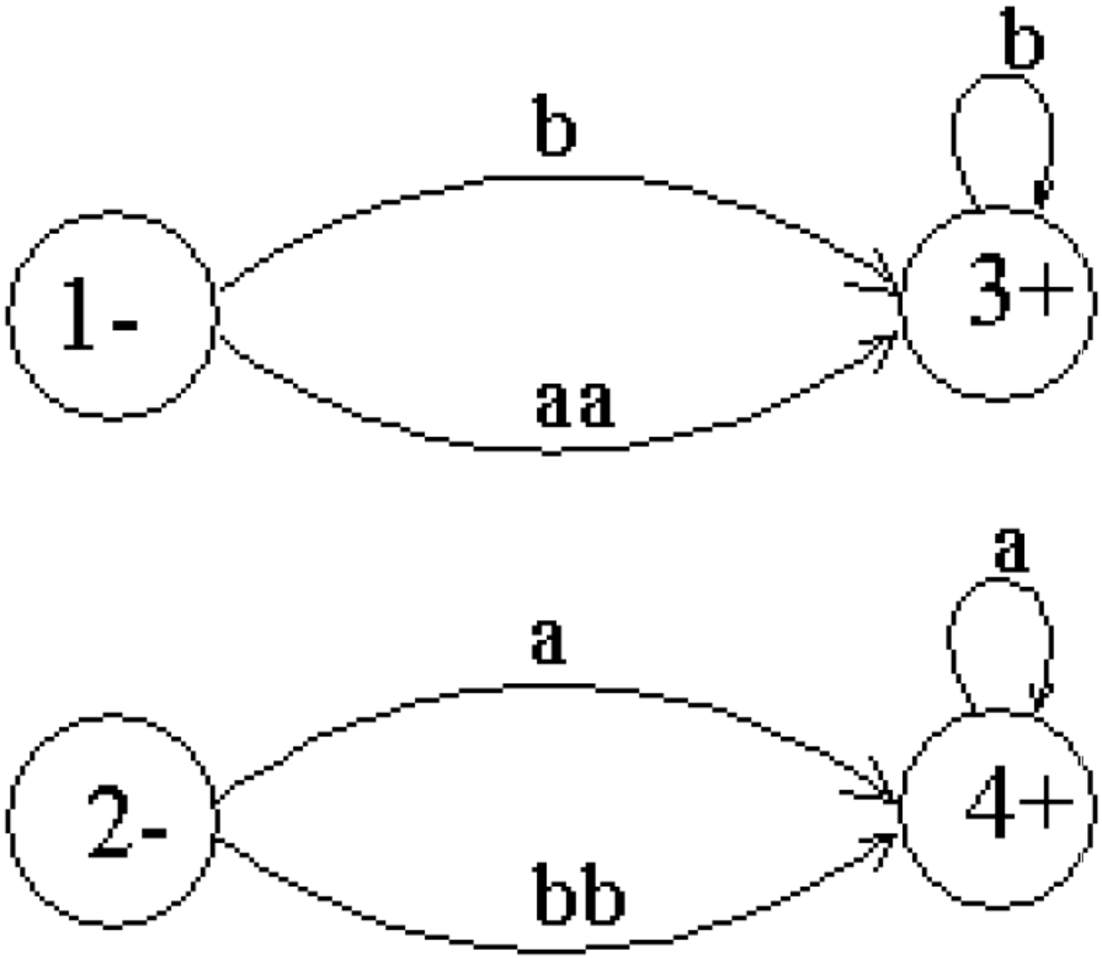


FA/TG to RE

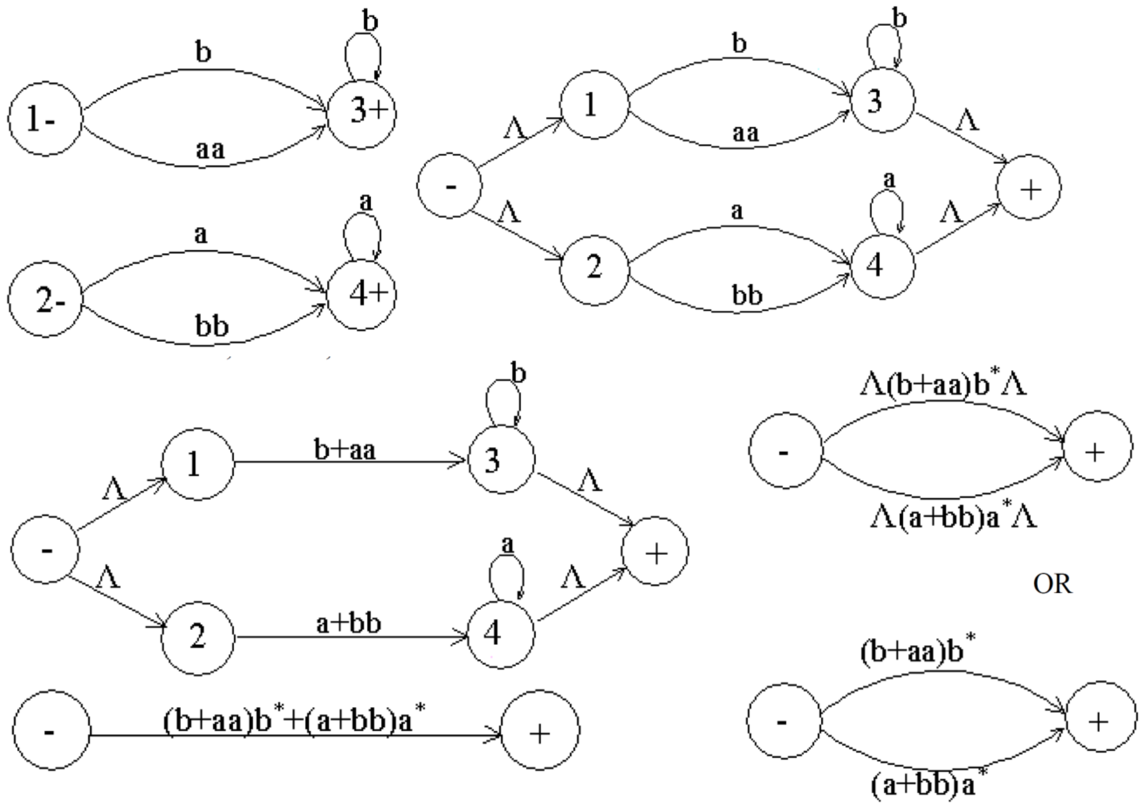


aa,b
aaa
2+
ab,ba
-
1
bba
3+
aa+b
aaa
2
Λ
ab+ba
-
1
4+
bba
Λ
3
aa+b
ab+ba
-
1
aaa Λ+bbaΛ
4+
(ab+ba)(aa+b)*(aaa+bba)
-
+

FA/TG to RE

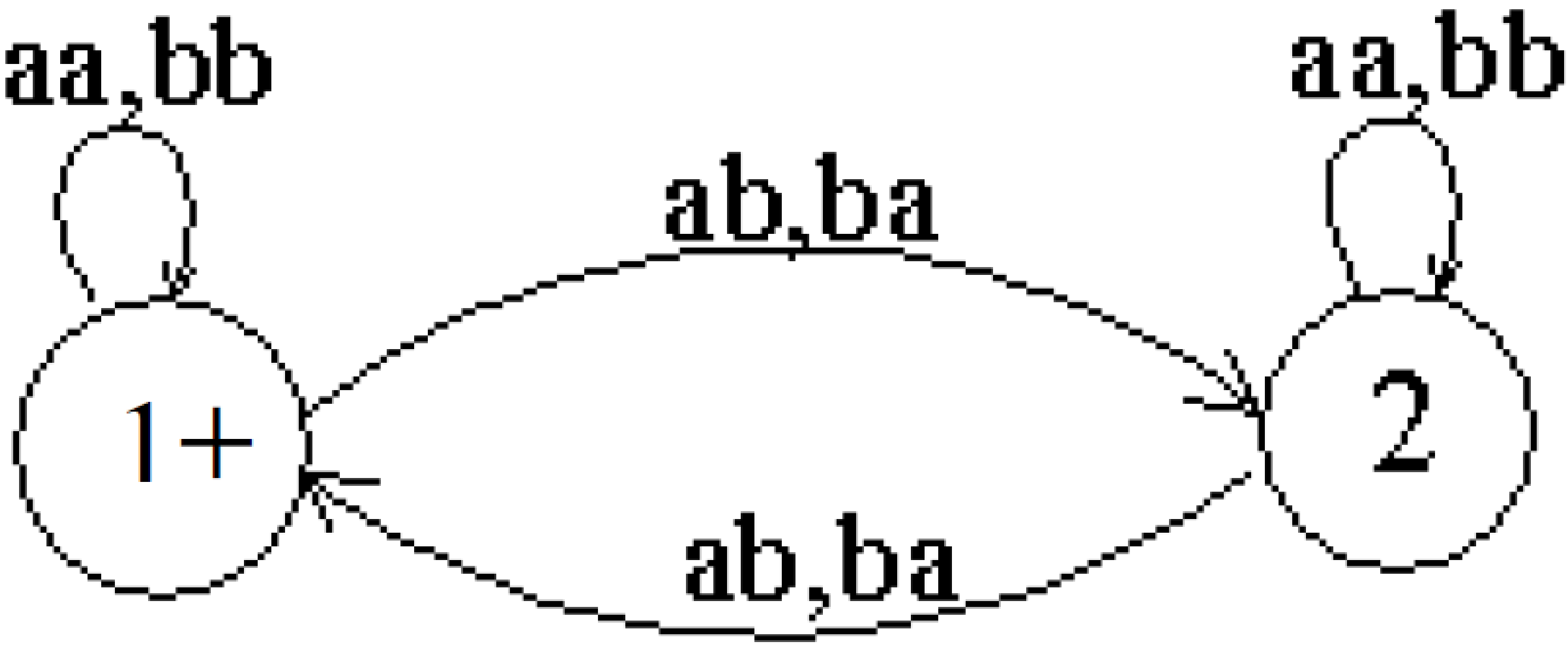


FA/TG to RE

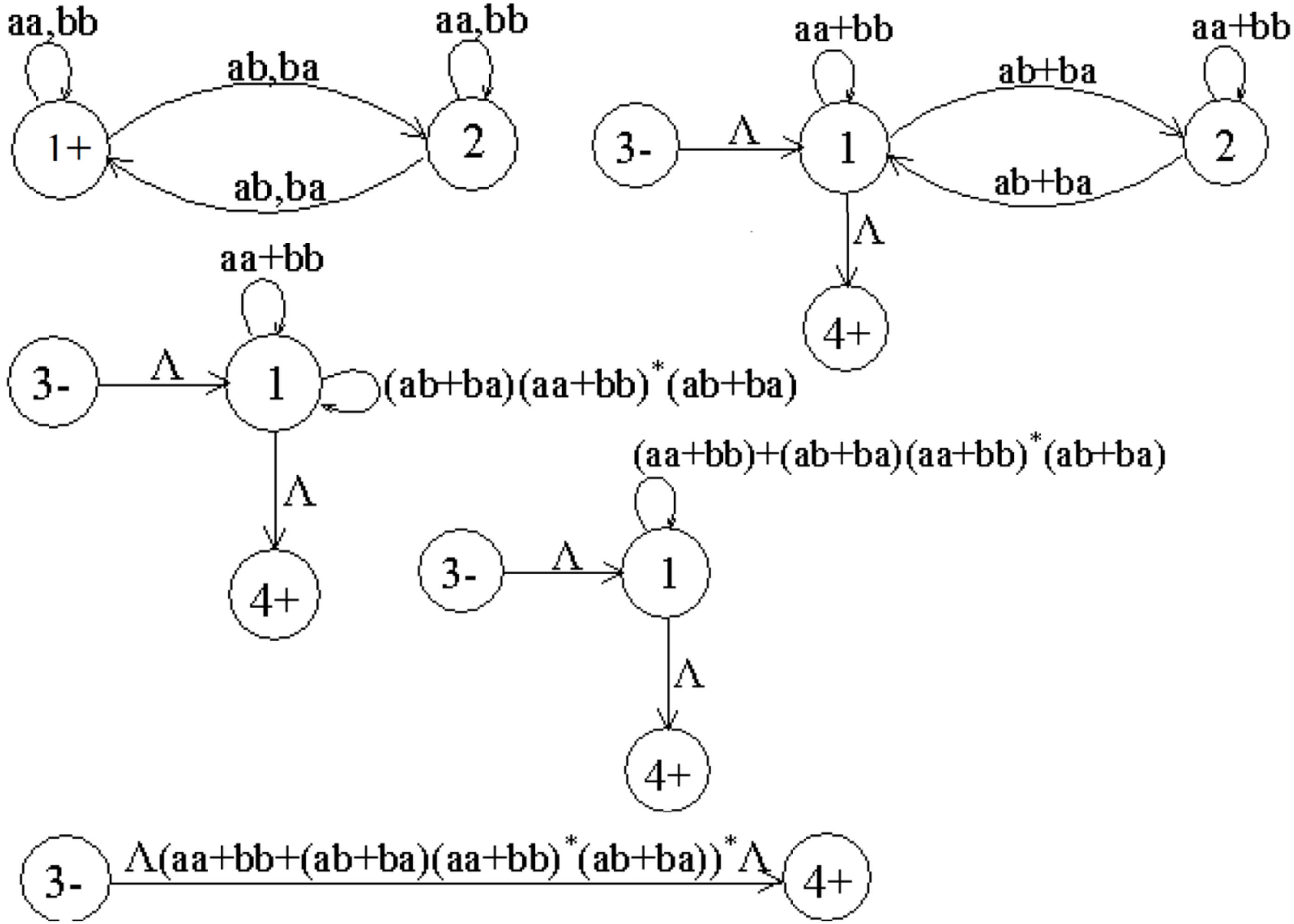


b
b
1-
3+
aa
a
a
2-
4+
bb
b
b
1
3
aa
Λ
Λ
-
+
Λ
Λ
a
a
2
4
bb
b
b+aa
1
3
Λ
Λ
-
+
Λ
Λ
a
2
a+bb
4
-
(b+aa)b*+(a+bb)a*
+
Λ(b+aa)b*Λ
-
+
Λ(a+bb)a*Λ
OR
(b+aa)b*
-
+
(a+bb)a*

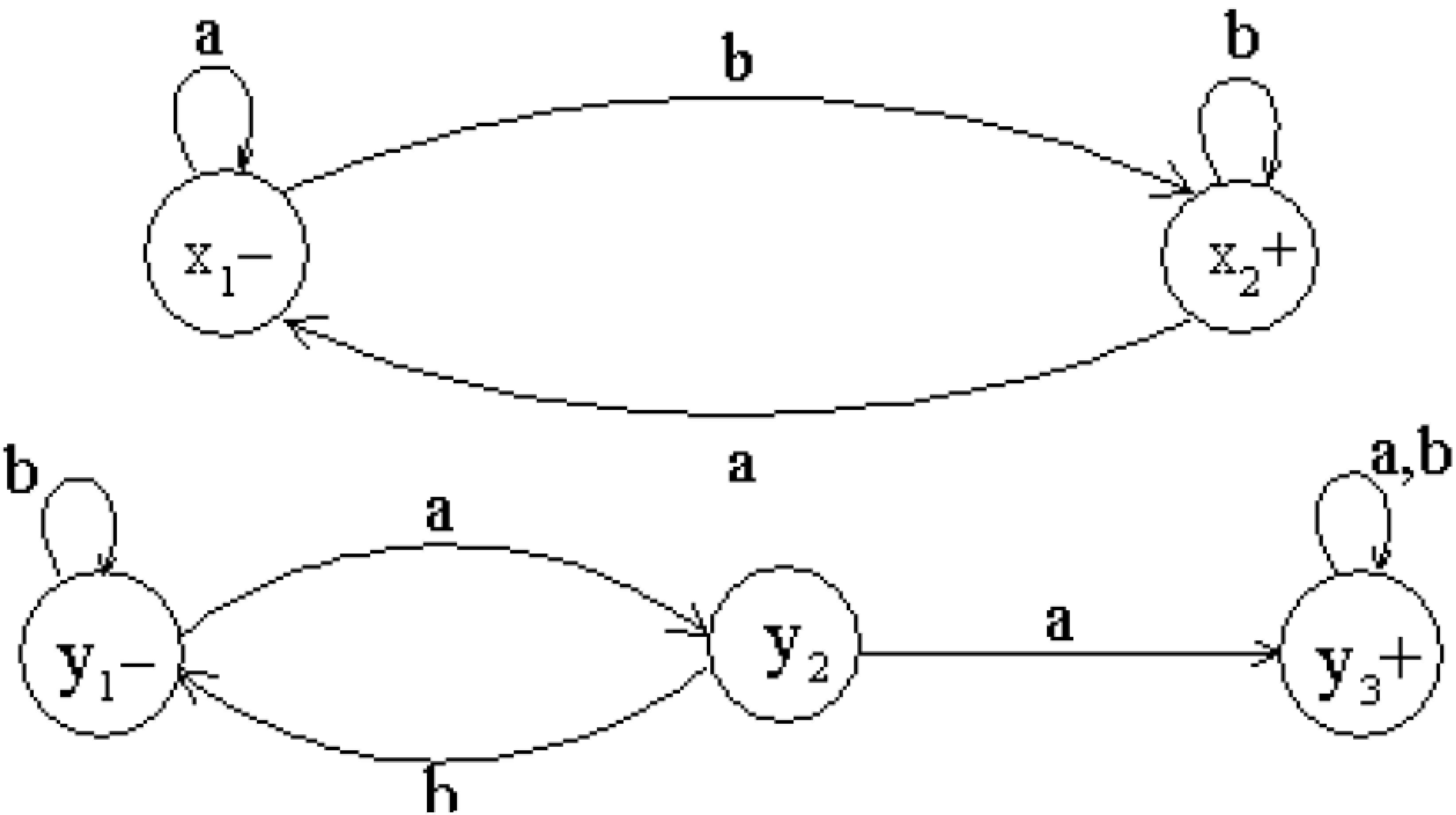
FA/TG to RE



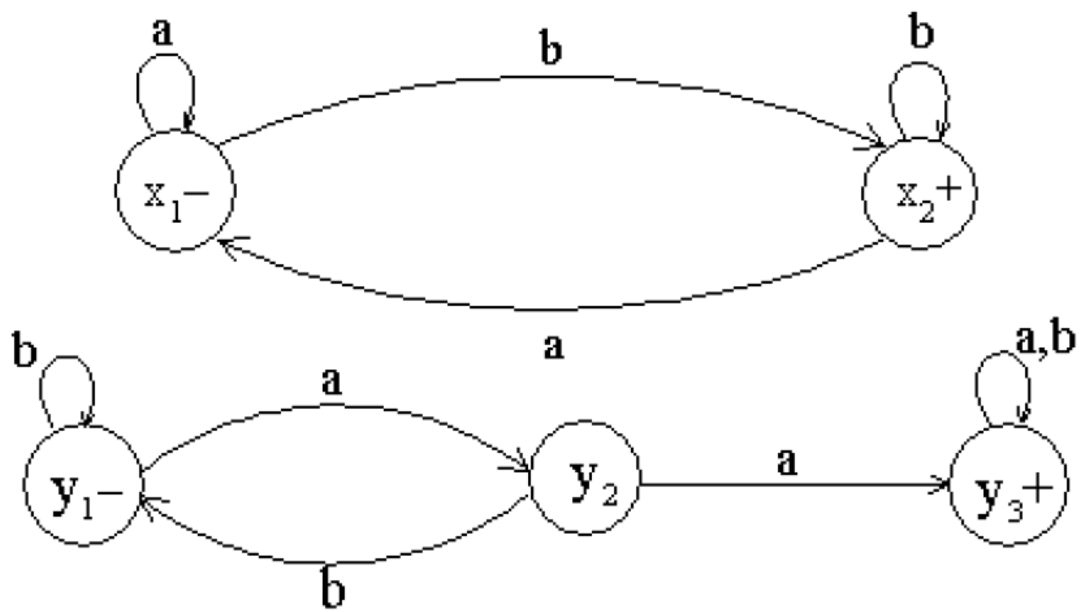
FA/TG to RE


aa,bb
ab,ba
aa,bb
1+
2
ab,ba
aa+bb
ab+ba
aa+bb
3-
Λ
1
2
ab+ba
Λ
4+
aa+bb
3-
Λ
1
(ab+ba)(aa+bb)*(ab+ba)
Λ
4+
(aa+bb)+(ab+ba)(aa+bb)*(ab+ba)
3-
Λ
1
Λ
4+
3-
Λ(aa+bb+(ab+ba)(aa+bb)*(ab+ba))*Λ
4+

Union



Kleen's Theorem

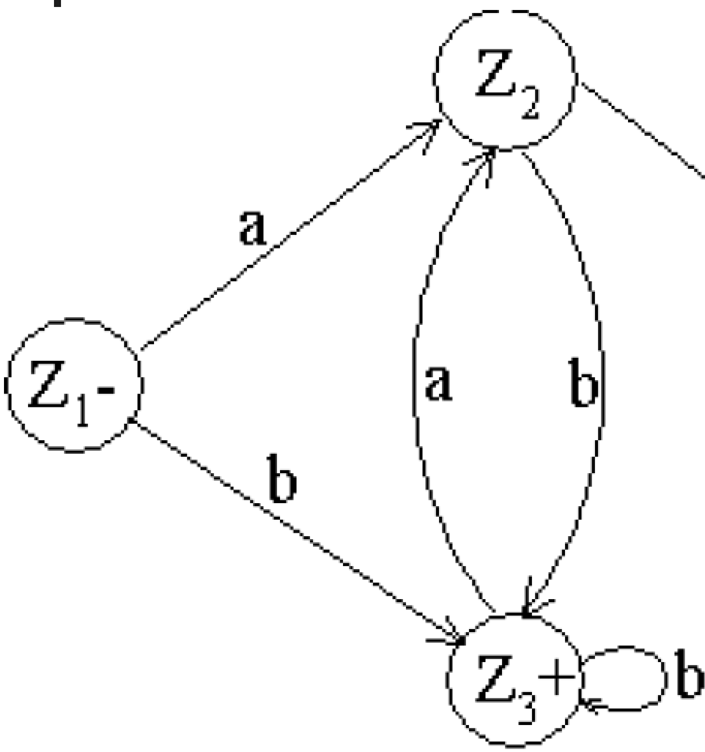


Old States	New States after reading	
	a	b
$z_1 - \equiv (x_1,y_1)$	$(x_1,y_2) \equiv z_2$	$(x_2,y_1) \equiv z_3$

Union

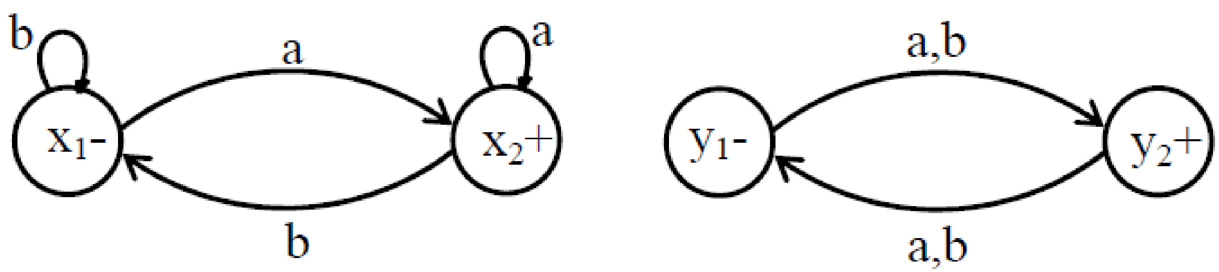
Old States	New States after reading	
	a	b
$z_1- \equiv (x_1,y_1)$	$(x_1,y_2) \equiv z_2$	$(x_2,y_1) \equiv z_3$
$z_2 \equiv (x_1,y_2)$	$(x_1,y_3) \equiv z_4$	$(x_2,y_1) \equiv z_3$
$z_3+ \equiv (x_2,y_1)$	$(x_1,y_2) \equiv z_2$	$(x_2,y_1) \equiv z_3$
$z_4+ \equiv (x_1,y_3)$	$(x_1,y_3) \equiv z_4$	$(x_2,y_3) \equiv z_5$
$z_5+ \equiv (x_2,y_3)$	$(x_1,y_3) \equiv z_4$	$(x_2,y_3) \equiv z_5$

Kleen's Theorem



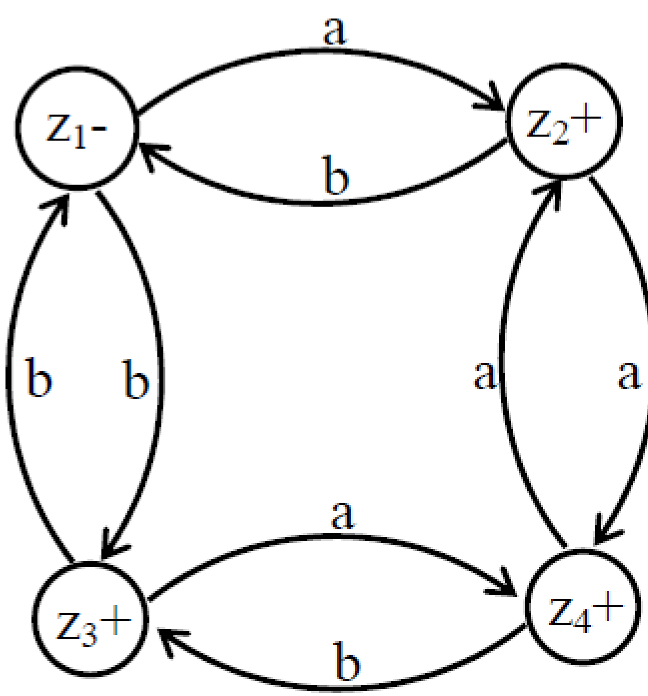
r1 = (a+b)*b
r2 = (a+b)*aa(a+b)*
r1+r2 = (a+b)*b + (a+b)*aa(a+b)*

Union



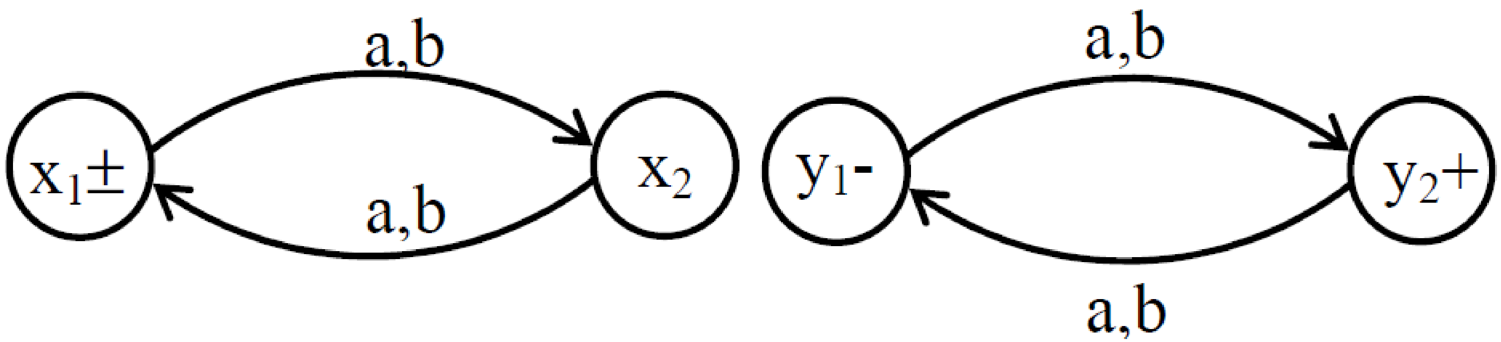
Old States	New States after reading	
	a	b
$z_1- \equiv (x_1,y_1)$	$(x_2,y_2) \equiv z_2$	$(x_1,y_2) \equiv z_3$
$z_2+ \equiv (x_2,y_2)$	$(x_2,y_1) \equiv z_4$	$(x_1,y_1) \equiv z_1$
$z_3+ \equiv (x_1,y_2)$	$(x_2,y_1) \equiv z_4$	$(x_1,y_1) \equiv z_1$
$z_4+ \equiv (x_2,y_1)$	$(x_2,y_2) \equiv z_2$	$(x_1,y_2) \equiv z_3$

Union



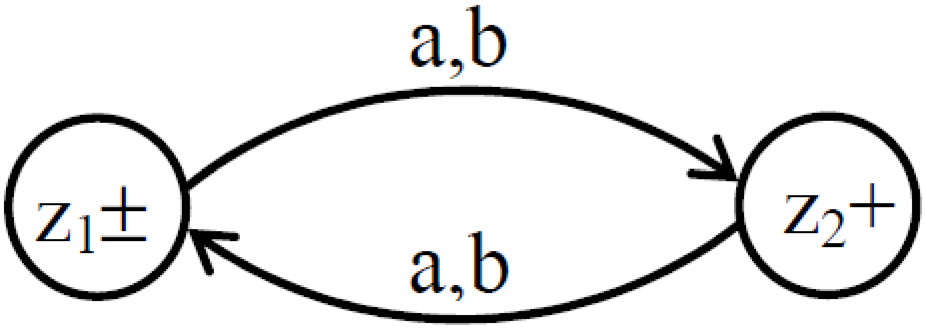
r1 = (a+b)*a
r2 = (a+b)((a+b)(a+b))* or
r2 = ((a+b)(a+b))*(a+b)
r1+r2 = (a+b)*a + (a+b)((a+b)(a+b))*
r1+r2 = (a+b)*a + ((a+b)(a+b))*(a+b)

Union



Old States	New States after reading	
	a	b
$z_1\pm\equiv(x_1,y_1)$	$(x_2,y_2)\equiv z_2$	$(x_2,y_2)\equiv z_2$
$z_2+\equiv(x_2,y_2)$	$(x_1,y_1)\equiv z_1$	$(x_1,y_1)\equiv z_1$

Kleen’s Theorem



r1 = ((a+b)(a+b))*
r2 = (a+b)((a+b)(a+b))*
r2 = ((a+b)(a+b))*(a+b)
r1+r2 = ((a+b)(a+b))* + (a+b)((a+b)(a+b))*
r1+r2 = ((a+b)(a+b))* + ((a+b)(a+b))*(a+b)