Chapter 3

1) $L = \{ ab^n w : n \geq 3 , w \in [a,b]^+ \}$

$L = L(r)$

$r = a\,bbb\,b^*(a+b)(a+b)^*$ $\qquad r^+ = rr^*$

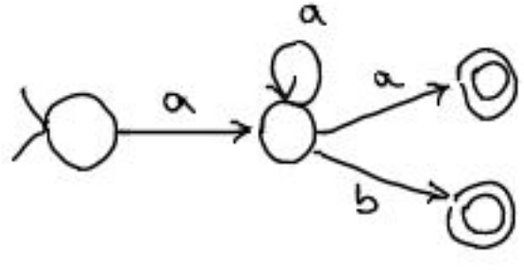
$= a\,bb\,b^+(a+b)^+$

۲)

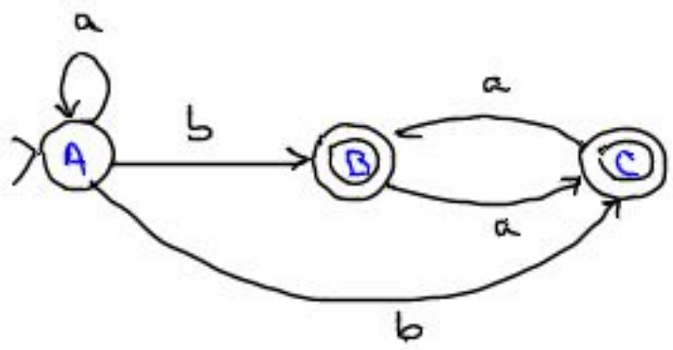
۲ یک عبارت منظم است که حاوی λ و $\emptyset$ نیست.

برای اینکه (۲) ناتناهی باشد، باید حداقل یک زیر عبارت نیز λ و $\emptyset$ وجود باشد که بر روی آن عملگر ستاره (*) قرار گرفته باشد.

۳) $L(aa^*(a+b))$ NFA



f)



$$\begin{cases} A = aA + bB + bC \\ B = aC + \lambda \\ C = aB + \lambda \end{cases}$$

دستگاه معادلات خطی

Arden rule: $x = ax + b \quad \lambda \notin L(a) \Rightarrow x = a^*b$

$$\begin{cases} A = aA + bB + bC \\ B = a(aB + \lambda) + \lambda \end{cases} \Rightarrow$$

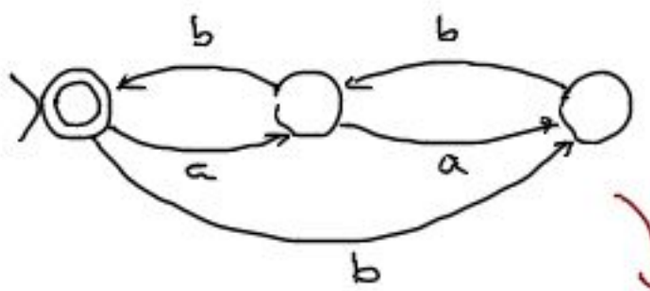
$$= aaB + (a + \lambda)$$

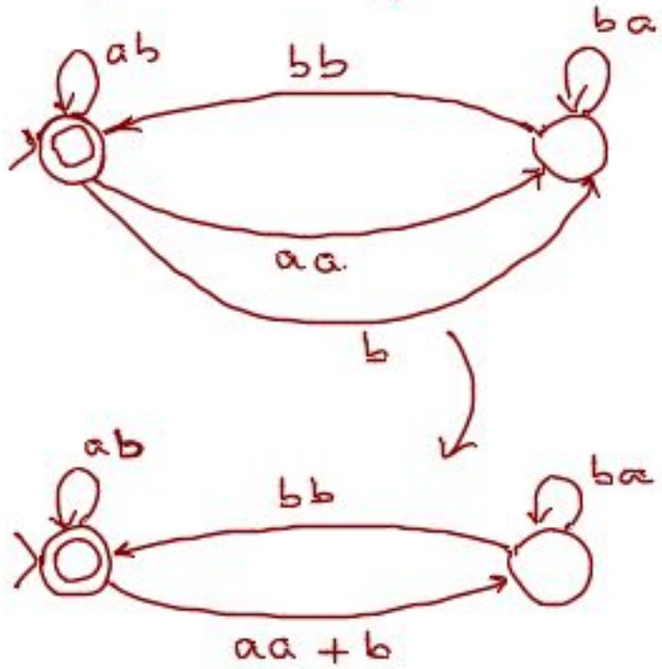
$$\begin{cases} A = aA + bB + bC \\ B = (aa)^*(a + \lambda) \end{cases} \Rightarrow$$

$$A = aA + b(aa)^*(a + \lambda) + b(a(aa)^*(a + \lambda) + \lambda) \Rightarrow$$

$$A = a^*(b(aa)^*(a + \lambda) + b(a(aa)^*(a + \lambda) + \lambda))$$

initial state

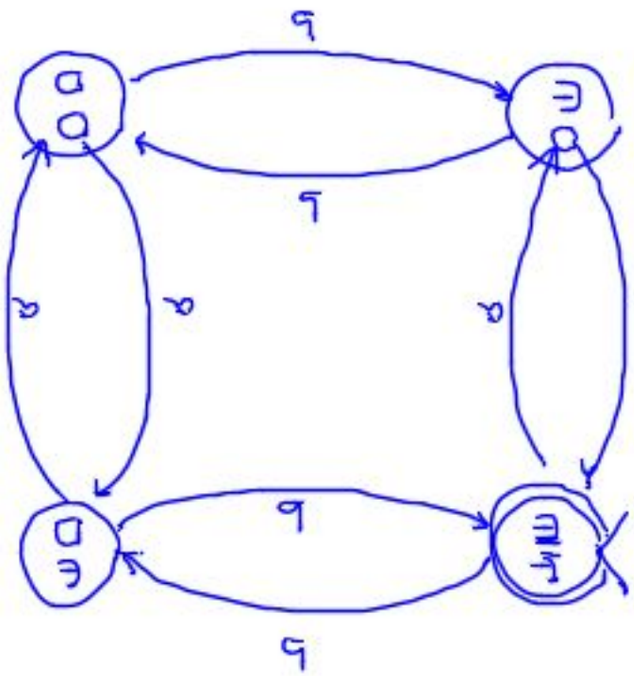




$$(ab)^*((aa + b)(ba)^*bb)^* + \lambda))(ab)^*$$

$$(ab)^*((aa + b)(ba)^*bb)^*(ab)^*$$

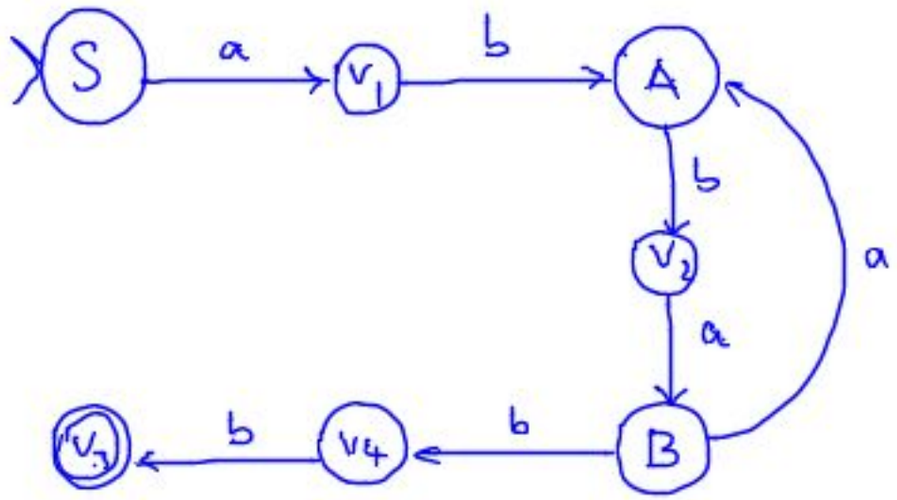
d) $L = \{w \in \{a,b\}^* : n_a(w) \text{ and } n_b(w) \text{ are even}\}$



Q1 $S \rightarrow abA$

$A \rightarrow baB$

$B \rightarrow aA \mid bb$

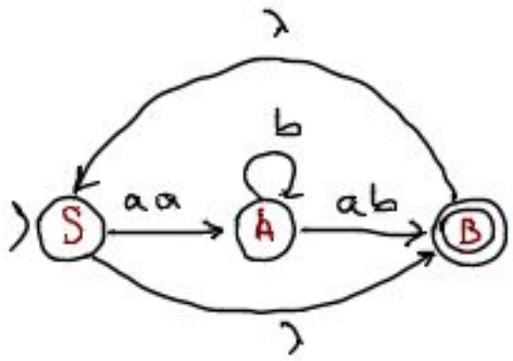


DFA

v) $L((aab^*ab)^*) =$

$(L(aab^*ab))^* =$

$(L(aa)L(b^*)L(ab))^*$



$S \longrightarrow S'S \mid \lambda$

$S' \longrightarrow ABC$

$A \longrightarrow aa$

$B \longrightarrow bB \mid \lambda$

$C \longrightarrow ab$

↓

گرامر منظم نیست.

$S \longrightarrow aaA \mid B$

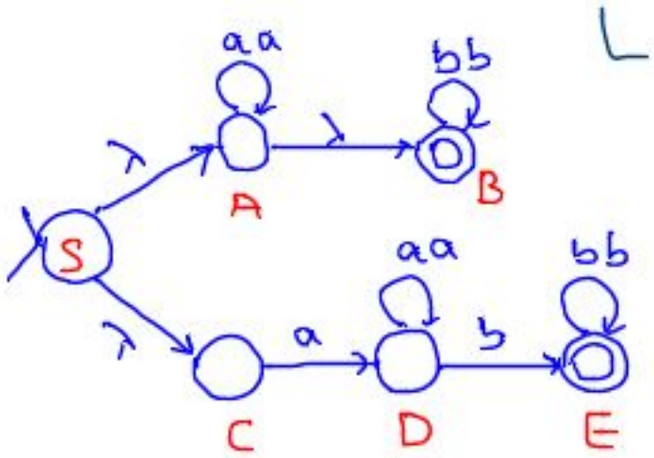
$A \longrightarrow bA \mid abB$

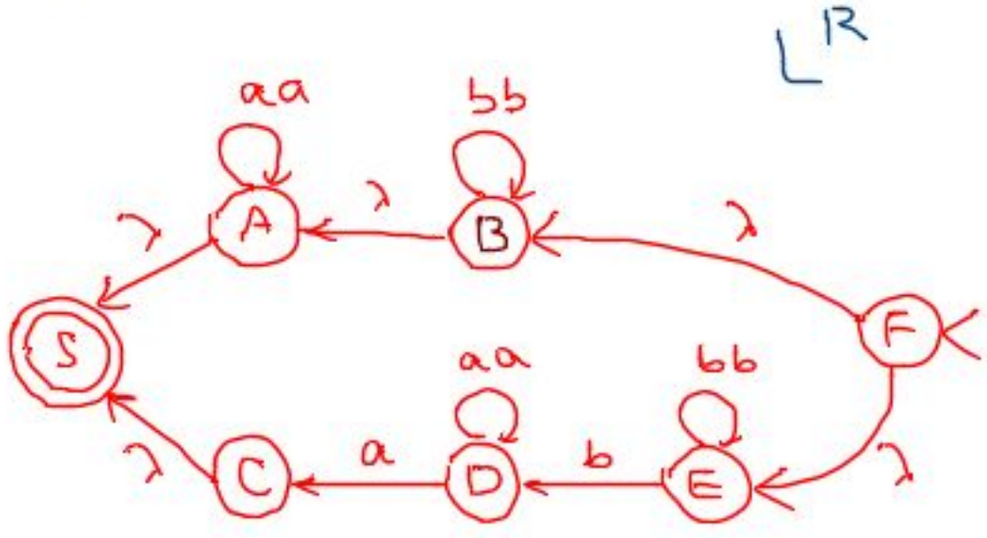
$B \longrightarrow S \mid \lambda$

Right_linear

n) $L = \{a^n b^m : n+m \text{ is even}\}$

$n+m$ is even $\Rightarrow$ (n, m are even) or
(n, m are odd)



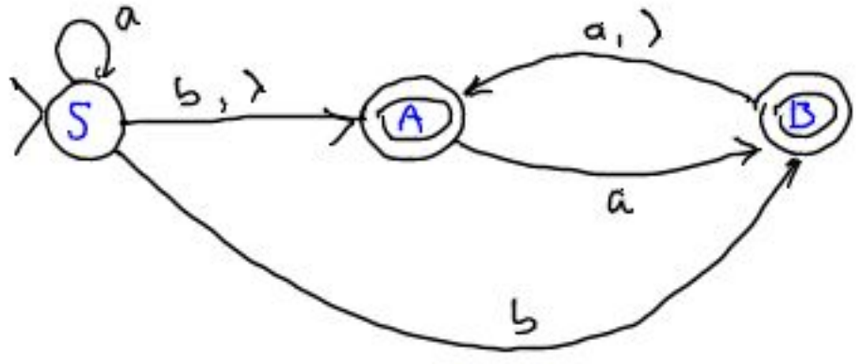


$E \to F$
$B \to F$
$B \to Bbb \quad B \to \lambda$
$A \to B$
$C \to Ebb \quad E \to \lambda$
$D \to Eb$
$A \to Aaa$
$S \to A$
$D \to Daa$
$C \to Da$
$S \to C$

$F \to B \mid E$
$B \to bbB \mid A$
$E \to bbE \mid bD$
$A \to aaA \mid S$
$D \to aaD \mid aC$
$C \to S$
$S \to \lambda$

$B \to Ax^R$ ← $A \to xB$

9)



$S \longrightarrow aS \mid bA \mid A \mid bB$

$A \longrightarrow aB \mid \lambda$

$B \longrightarrow aA \mid A \mid \lambda$

۱۰) $G_1 = (V_1, \Sigma, S_1, P_1)$ RLG

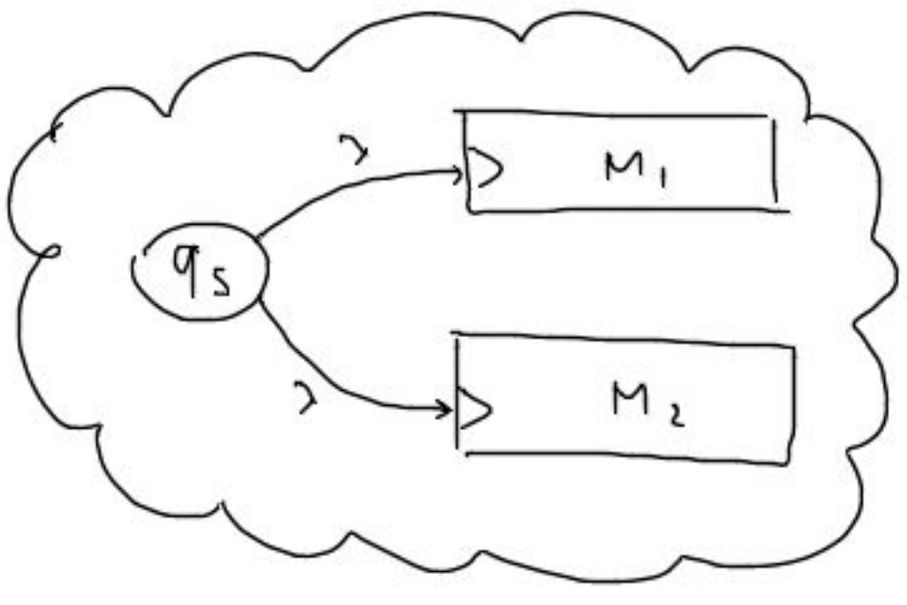
$G_2 = (V_2, \Sigma, S_2, P_2)$ LLG

$V_1 \cap V_2 = \emptyset$

$G = (\{S\} \cup V_1 \cup V_2, \Sigma, S, P)$ $S \notin V_1 \cup V_2$

$P = \{S \rightarrow S_1 \mid S_2\} \cup P_1 \cup P_2$

آیا G منظم است ؟ خیر، زیرا هم قواعد خطی راست و هم خطی از چپ دارد.



اما $L(G)$ منظم است، زیرا برای آن NFA زیر وجود دارد:

$L(M_1) = L(G_1)$

$L(M_2) = L(G_2)$

$L(G) = L(G_1) \cup L(G_2)$