

CSI1003 Formal Language and Automata Theory

CAT-2

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Slot 1 C2

1)

$$S \rightarrow xY | \epsilon$$

$$X \rightarrow aXb | \epsilon$$

$$Y \rightarrow cY | \epsilon$$

$S \Rightarrow \text{start}$

$$W \rightarrow aWc | z$$

$$Z \rightarrow bZ | \epsilon$$

Step I: Remove useless symbol

There is no useless symbol

Step II: Remove ϵ production

Indirectly x, y and z tends to ϵ

$$S \rightarrow xY | Y | X | \epsilon$$

$$X \rightarrow aXb | ab$$

$$Y \rightarrow cY | c$$

$$W \rightarrow aWc | z$$

$$Z \rightarrow bZ | b$$

Step III: Remove unit production

$$S \rightarrow xy | cy | c | axb | ab | a^2c | bz | b | z$$

$$S \rightarrow xy | cy | axb | ab | a^2c | bz | b | c$$

$$x \rightarrow axb | ab$$

$$y \rightarrow cy | c$$

$$a^2 \rightarrow a^2c | bz | b$$

$$z \rightarrow bz | b$$

Replace Switch A_1

x with A_2

y with A_3

c with A_4

a^2 with A_5

z with A_6

$$A_1 \rightarrow A_2 A_3 | A_4 A_3 | a A_2 b | a b | a A_5 c | b A_6 | b | c$$

$$A_2 \rightarrow a A_2 b | ab$$

$$A_3 \rightarrow c A_3 | c$$

$$A_5 \rightarrow a A_5 c | b A_6 | b$$

$$A_6 \rightarrow b A_6 | b$$

$$3) L(G) \Rightarrow \{ 0^n w 0^n \mid n \geq 0 \text{ and } w \in \{a, b\}^* \}$$

Valid strings: 0 ab ba 0 and 00 ba ab 00

Invalid strings: 0 abab 0 and 00 ba ba 00

2) "boy like the small cat"

N V A AJ N

Grammar:

$$S \rightarrow \langle NP \rangle \langle VP \rangle$$

$$NP \rightarrow \langle A \rangle \langle N \rangle \mid \langle A \rangle \langle AJ \rangle \langle N \rangle$$

$$AN \rightarrow \langle A \rangle \langle N \rangle$$

$$VP \rightarrow V \mid VNP$$

$$A \rightarrow a \mid the$$

$$N \rightarrow girl \mid boy \mid cat$$

$$AJ \rightarrow big \mid small \mid blue$$

$$V \rightarrow see \mid likes$$

VP				
VP	VP			
VP	VP	ϕ		
VP	VP	ϕ	ϕ	
ϕ	VP	ϕ	ϕ	ϕ
N	V	A	AJ	N

$$x_{1,2} \Rightarrow (x_{1,1} ; x_{2,2}) \Rightarrow (\phi(VP)) \Rightarrow VP$$

$$x_{2,3} \Rightarrow (x_{2,2} ; x_{3,3}) \Rightarrow VP(\phi) \Rightarrow VP$$

$$x_{3,4} \Rightarrow (x_{3,3} ; x_{4,4}) \Rightarrow \phi(\phi)$$

$$x_{4,5} \Rightarrow (x_{4,4} ; x_{5,5}) \Rightarrow \phi(\phi)$$

$$x_{1,3} \Rightarrow (x_{1,1} ; x_{2,3}) \cup (x_{1,2} ; x_{3,3})$$

$$\Rightarrow VP \cup VP$$

$$\Rightarrow VP$$

$$x_{2,4} \Rightarrow (x_{2,2} ; x_{3,4}) \cup (x_{2,3} ; x_{4,4})$$

$$\Rightarrow (VP) \cup (VP) \Rightarrow VP$$

$$\cancel{A_2} \Rightarrow a \cancel{A_2} b \cancel{a} b$$

$$\cancel{A_1} \Rightarrow \cancel{a} b \cancel{A_3} \mid \cancel{c} \cancel{A_3} \mid \cancel{a}$$

$$x_{3,5} \Rightarrow (x_{3,3} ; x_{4,5}) \cup (x_{3,4} ; x_{5,5})$$

$$\Rightarrow \phi \cup \phi$$

$$\Rightarrow \phi$$

$$x_{1,4} \Rightarrow (x_{1,1} ; x_{2,4}) \cup (x_{1,2} ; x_{3,4}) \cup (x_{1,3} ; x_{4,4})$$

$$\Rightarrow VP \cup VP \cup VP$$

$$\Rightarrow VP$$

$$x_{2,5} \Rightarrow (x_{2,2} ; x_{3,5}) \cup (x_{2,3} ; x_{4,4}) \cup (x_{2,4} ; x_{5,5})$$

$$(VP) \cup (VP) \cup \phi$$

$$\Rightarrow VP$$

$$x_{1,5} \Rightarrow (x_{1,1} ; x_{2,5}) \cup (x_{1,2} ; x_{3,5}) \cup (x_{1,3} ; x_{4,5})$$

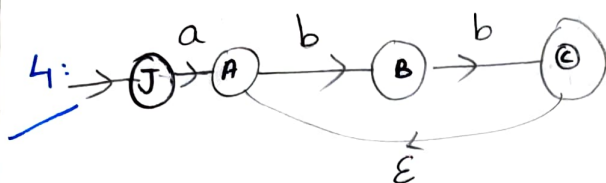
$$\Rightarrow (VP) \cup (VP) \cup (VP) \cup (VP) \cup (x_{1,4} ; x_{5,5})$$

$\Rightarrow VP$. It is so because like the small rat is not valid

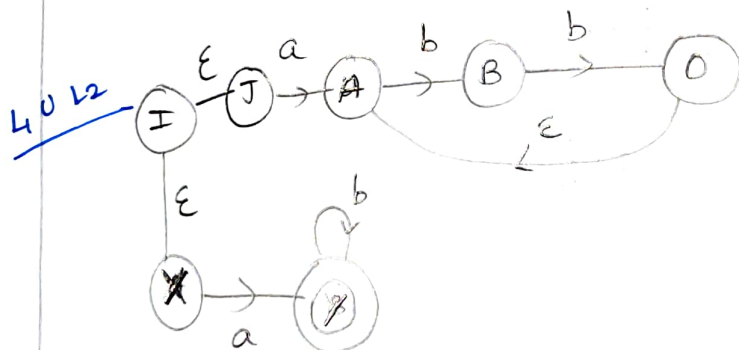
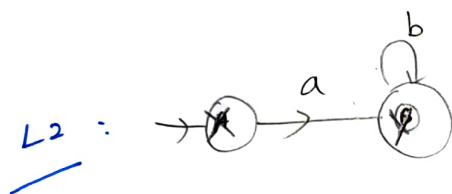
4) $\Sigma \Rightarrow \{a, b\}$

$L_1 \Rightarrow \{ab^{2n} \mid n \geq 0\}$

$L_2 \Rightarrow \{ab^n \mid n \geq 1\}$



b^2, b^4, b^6



If L_1 and L_2 are regular, then $L_1 \cup L_2$ is also regular.