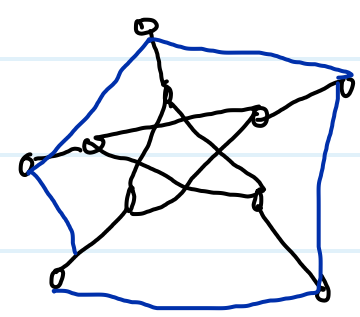


Theory of Computation

- 1) $L = \{x \mid x \text{ contains } 101 \text{ as subst}\}$
- 2) $L = \{x \mid 3^{\text{rd}} \text{ symbol from Rt is } 1\}$
- 3) $L = \{x \mid \#(x) \text{ is div by } 5\}$



FSA $\begin{cases} \text{DFA} \\ \text{NFA} \end{cases}$

Algebraic Expressions

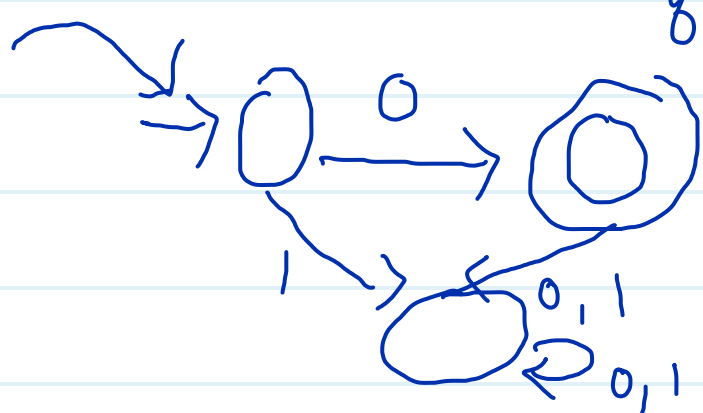
-) Succinct Repn of Lang

$\{0,1\}^*$ $101 \text{ suffix } \{0,1\}^*$

Regular Expression (Algebraic Exp)

\rightarrow Expresses the computing power of FA

$L = \{0\}$ RE = 0
 $L = \{1\}$ = 1



$$L = \left\{ \begin{array}{l} \epsilon, 0, 00, 000, 0000, \\ \epsilon, 1, 11, \end{array} \right\}$$

$$\left. \begin{array}{l} RE = 0^* \\ RE = 1^* \end{array} \right\} \begin{array}{l} \text{Zero or more } 0's \\ \epsilon, 0, 00, 000, \end{array}$$

$$RE_1$$

$$0$$

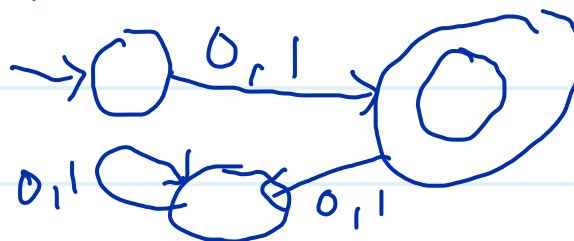
$$RE_2$$

$$1$$

$$RE_3 \quad 0+1$$

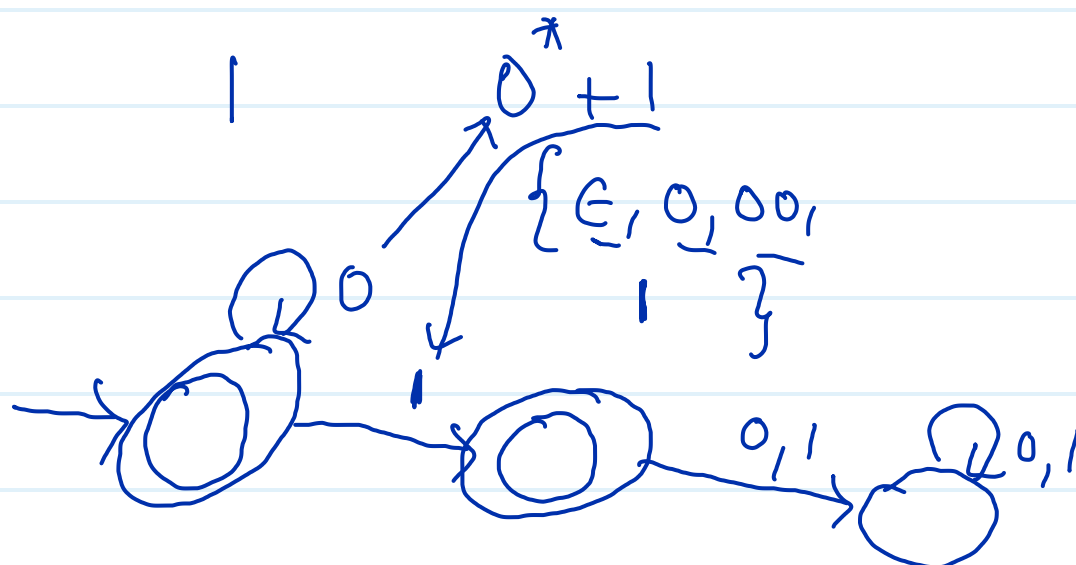
$$\hookrightarrow L(RE_3) = \{0, 1\}$$

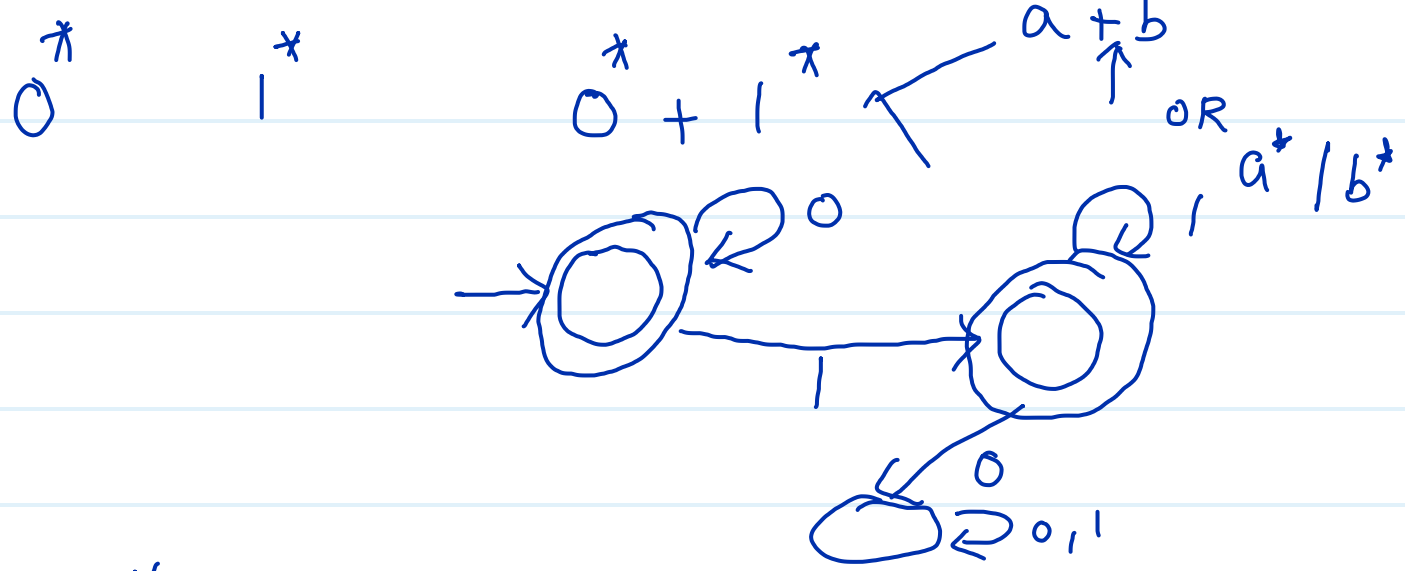
$$\hookrightarrow$$



$$0^*$$

1





$$(0+1)^*$$

$$(0^* + 1^*)^*$$

$$RE_1, RE_2 \quad RE_1 + RE_2$$

$$RL_1^*, RE_2^*$$

$$RE_1^* + RL_2^*$$

$$(RL_1^* + RE_2^*)^*$$

$$RL_1^* + RL_2^*$$

$$(RL_1^* + RL_2^*)^*$$

Lang

$$(0+1) = \{0, 1\}$$

$(0+1)^*$ = Zero or more copies of $(0+1)$

Concatenation

$$L = \{ \epsilon, \underbrace{0}_{\leftarrow}, \underbrace{1}_{\leftarrow}, \underbrace{00, 01, 10, 11}_{\leftarrow}, \underbrace{(0+1)(0+1)}_{\leftarrow}, \dots \}$$

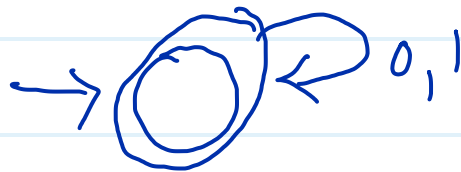
$\begin{matrix} 00 & 01 \\ 10 & 11 \end{matrix}$

$$(0+1)(0+1)(0+1)$$

- 000
- 001
- 010
- 011
- 100
- 101
- 110
- 111

- All strings over $\{0, 1\}$

$$(0+1)^* = \{\epsilon, 0, 1, 00, 01, 10, 11, \dots\}$$



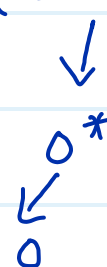
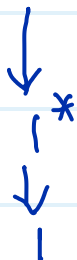
$\epsilon, 0, 1, 0110$

$$(0^* + 1^*)^*$$

0110

4 times

$$(0^* + 1^*)(0^* + 1^*)(0^* + 1^*)(0^* + 1^*)$$



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

$L \sim \text{FA}$

0. 1 01

$(0+1) (0+1)$

$$(0+1)(0+1) = \{00, 01, 10, 11\}$$

$$L_1 = \{x \mid x \text{ contains } 101 \text{ as a substring}\}$$

$$RL \quad (0+1)^* 101 (0+1)^*$$

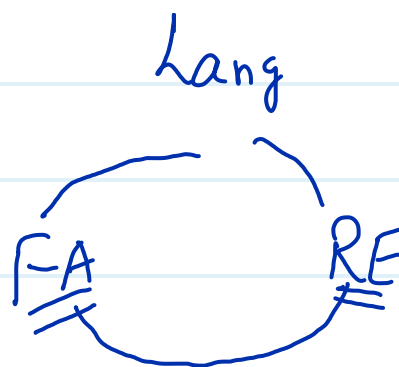
$$L_2 = \{ x \mid 3^{\text{rd}} \text{ symbol from } R^+ \text{ is } 1 \}$$

$(0+1)^*$ | $\underbrace{(0+1)}_{\text{2nd}} \underbrace{(0+1)}_{\text{1st}}$

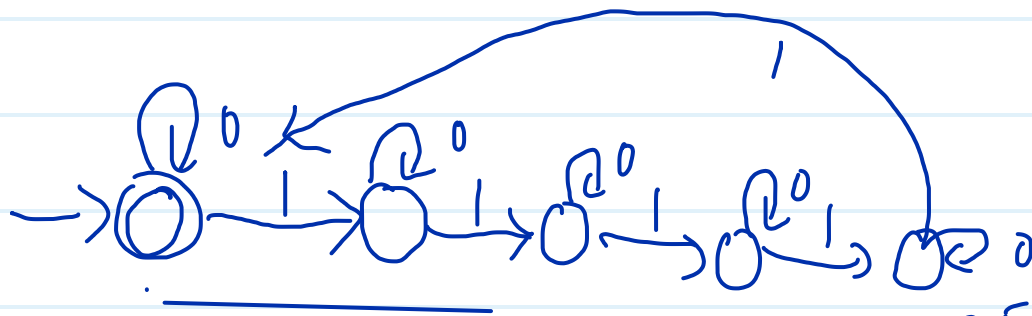
Prefix 3rd

$\underbrace{(0+1)^*}_{\text{Prefix}}$ | $\begin{matrix} & e \\ 0 & 0 \\ & 0 \end{matrix}$

$\begin{matrix} 0 & 1 \\ 1 & 0 \\ 1 & 1 \end{matrix}$



$L_3 = \{ x \mid \#_1(x) \text{ is div by } 5 \}$



$$\begin{aligned}
 1) & \left(0^* 1 0^* 1 0^* 1 0^* 1 0^* \right)^* \\
 & \equiv \left(0^* 1 0^* 1 0^* 1 0^* 1 0^* \right)^* \\
 & \equiv \left(0^* 1 0^* 1 0^* 1 0^* 1 0^* \right)^*
 \end{aligned}$$

CEX
 1111110
 2)