28/10/2022

Example 1:

$V_N = \{S\}, T = \{a, b\}, S = \{S\}, P = \{S \rightarrow aSb | \epsilon\}$

$S \rightarrow \epsilon$, $S \rightarrow aSb \rightarrow ab$ $\quad L(G) = \{\epsilon, ab\}$

$L(G) = \{a^n . b^n \mid n >= 0\}$

Example 2:

$P: \{S \rightarrow aCa, C \rightarrow aCa | b\}$

$S \Rightarrow aCa \Rightarrow aCaa \ \ldots \Rightarrow a^n . b^n$

$L(G) = a^n . b^n \quad n > 0$

$- \epsilon \notin L(G)$

Example 3:

$S \rightarrow AbB, A \rightarrow aA | a, B \rightarrow aB | a$

Example 4:

$S \rightarrow aS | bS | \epsilon$

$L(G) = \{a, b\}^*$

Example 5:

$S \rightarrow aSa | bSb | c$ (c is also terminal symbol)

$L(G) = WcW^R$, W is any string from $\{a, b\}^*$

W^R is reverse of W.

Language to Grammar:

Example 1:

$L(G) = a^n, n > 0$

$S \to aS$ or $S \to a$. $S \to aS | a$ $S \to aS | \varepsilon$ $a^0 = \varepsilon$

$S \to \varepsilon$

Grammar:

$G = \{V_N = \{S\}, T = \{a\}, S, P = \{S \to aS | a\}\}$

Example 2:

$L(G) = (ab)^n, n > 0$ ab, abab

abab ab . . . .

$G = \{V_N = S, T = \{ab\}, S, P = \{S \to abS | ab\}\}$

Example 3:

$L(G) = a^n b^n, n > 0$

$S \to aSb | ab$

$G = \{V_N - \{S\}, T = \{a, b\}, S, P = \{S \to aSb | ab\}\}$

Example 4:

$L(G) = a^n c^i b^n, n, i \geq 0$

$S \to aWb$, $W \to cW | \varepsilon$

$P \to \{S \to aSb | A, A \to Ac | \varepsilon$

Context - Sensitive Grammar :

$L(G) = a^n b^n c^n, n >= 1$

$G = \{V_N = \{S, A, B\}, T = \{a, b, c\}, S, P = \{S \rightarrow Abc \mid ABSc, BA \rightarrow AB, Bb \rightarrow bb, A \rightarrow a\}\}$

Example 2:

$L(G) = xx, x \in \{a, b\}^*$

Regular Grammar

→ Uses three operations, Union, Concatenation and kleene star.

→ Description :

Obtained by :

replacing "{ }" by "( )" or leaving it out

replacing "∪" by "+".

replacing concatenation by ".".

Language	Regular Expression
$\{\varepsilon\}$	ε
$\{0\}$	0
$\{0\}\{0\}\{1\}$	$0.0.1$
$\{1, \varepsilon\}\{001\}$	$(1+\varepsilon).001$
$\{110\}^*\{0, 1\}$	$(110)^*(0+1)$

R- Set of Regex over Σ

i) ϕ ~~is~~ $\in R \Rightarrow$ R.E is ϕ -

(ii) $\{\varepsilon\} \in R \Rightarrow$ R.E is ε

(iii) For any $a \in \Sigma$, $\{a\} \in R \Rightarrow$ R.E is a.

(iv) If L_1 & $L_2 \in R$, r_1 and r_2 are the R-E for L_1, L_2

$L_1 \cup L_2 \Rightarrow r_1 + r_2$

$L_1 \cdot L_2 \Rightarrow r_1 \cdot r_2$

$L_1^* \Rightarrow r_1^*$

→ Only those languages obtained from (i) - (iv).
are [~~R~~ REGEX] over Σ.

$L^2 = L \cdot L \Rightarrow r^2 = r \cdot r$

Order of Precision:

Kleene Star - Highest

Concatenation -

Union - least

Example: $(a + ((b)^*) c) = a + b^* c$

$(a+b)^* \neq a + b^*$

$1^* \cdot 1^* = 1^*$

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

$L \subseteq \{0,1\}^*$

(i) string of even length:

~~Is it regular~~

$\{00, 01, 10, 11\}^* \Rightarrow (0.0 + 0\,1 + 1\,0 + 1\,1)^*$

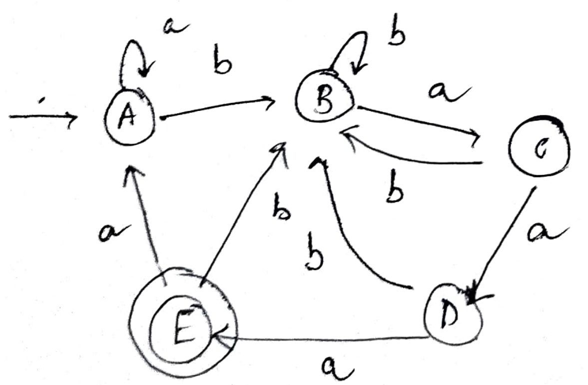
$[(0+1)(0+1)]^*$

(ii) string having odd no. of 1's.

$L = \{x \in \{0,1\}^* : n_1(x) \text{ is odd}\}$

DFA to language expressions.

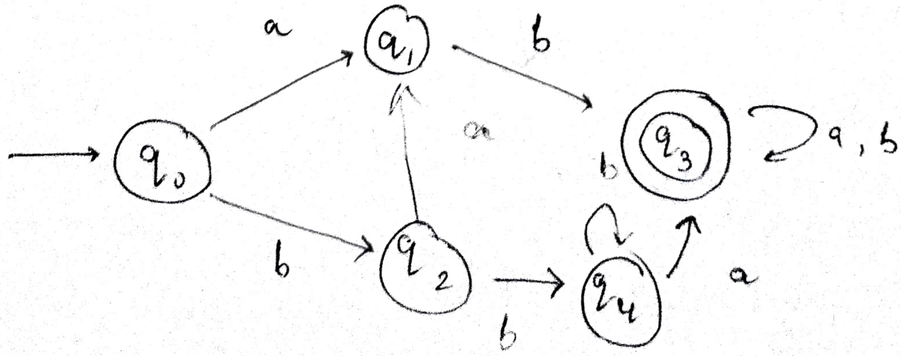
(1)



$\{a, b\}^* \cdot baaa$

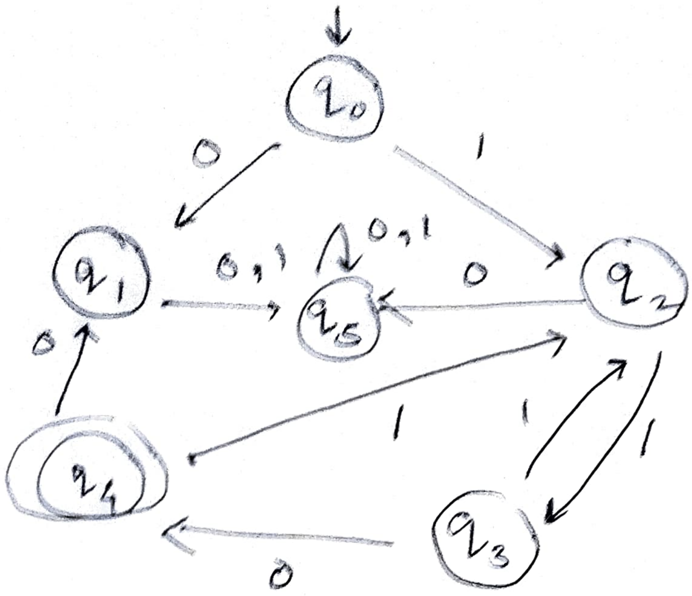
$= (a+b)^* baaa$

(2)



ab + bba

3



$(11+110)^* 0$