Module – 2

Regular Grammar

A regular grammar G is a Quadruple (V, T, R, S) where

V is the rule alphabet which contains NonTerminals (symbols that are used in the grammar but that do not appear in strings in the language) and terminals (symbols that can appear in strings generated by G)

T is set of terminals

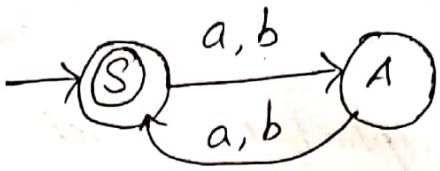
R is set of rules of the form $X \rightarrow Y$

S is start symbol.

In regular grammar all rules in R must be

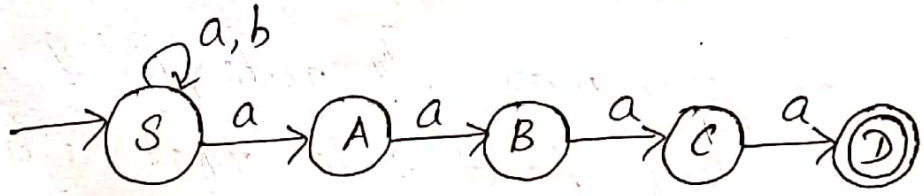
- have a left-hand side that is a single nonterminal
- have a right-hand side that is ε or a single terminal or a single terminal followed by a single non terminal.

Q1) Obtain a regular grammar for $L = \{w \in \{a,b\}^* : |w| \text{ is even}\}$



$S \rightarrow \varepsilon$
$S \rightarrow aA$
$S \rightarrow bA$
$A \rightarrow aS$
$A \rightarrow bS$

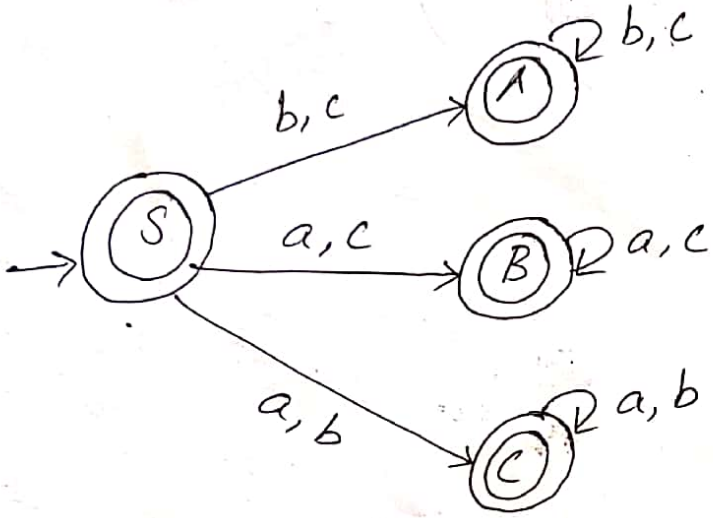
Q2) Obtain a regular grammar for $L = \{w \in \{a,b\}^* : w \text{ ends with the pattern } aaaa\}$.



$S \rightarrow aS$
$S \rightarrow bS$
$S \rightarrow aA$
$A \rightarrow aB$
$B \rightarrow aC$
$C \rightarrow aD$
$D \rightarrow \varepsilon$

Q3) Obtain a regular grammar for

$L_{missing} = \{ w :$ there is a symbol $a_i \in \Sigma$ not appearing in $w \}$



$S \to \varepsilon$

$S \to bA$

$S \to cA$

$S \to aB$

$S \to cB$

$S \to aC$

$S \to bC$

$A \to bA$

$A \to cA$

$B \to aB$

$B \to cB$

$C \to aC$

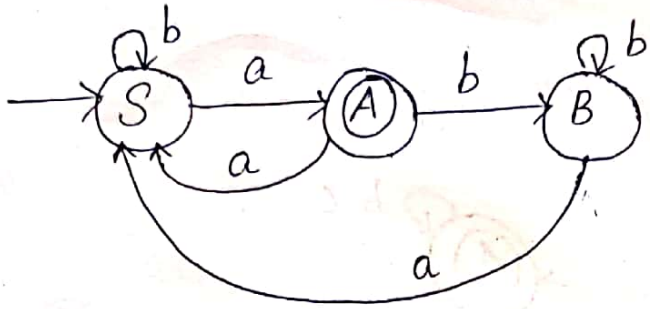
$C \to bC$

$A \to \varepsilon$

$B \to \varepsilon$

$C \to \varepsilon$

Q4) Obtain a regular grammar for $L = \{w \in \{a,b\}^* :$ w contains an odd number of a's and w ends in a



$S \rightarrow bS$
$S \rightarrow aA$
$A \rightarrow aS$
$A \rightarrow bB$
$B \rightarrow bB$
$B \rightarrow aS$
$A \rightarrow \varepsilon$

Regular and Non-regular Languages.

$L_1 = \{w \in \{0-9\}^* : w$ is the social security number of the current US president $\}$

L_1 is finite and thus regular

$L_2 = \{1$ if Santa Claus exists and 0 otherwise$\}$

$L_3 = \{1$ if God exists and 0 otherwise$\}$

L_2 and L_2 are little less clear. Because the meaning of Santa Claus and God are less clear. Pick a defn. for either of them. Then something that satisfies that defn. either does or does not exists.

$L_4 = \{1$ if there were people in North America more than 10000 years ago and 0 otherwise$\}$

L_4 is clear. It is set to 1

$L_5 = \{1$ if there were people in North America more than 15000 years ago and 0 otherwise$\}$

L is finite and thus regular