Unit production elimination

Null Production elimination

- Refer to Questions in Previous Page

2. $S \to AaB \mid aaB$

$A \to \lambda$

$B \to bbA \mid \lambda$

$S \to AaB \mid aaB \mid aB \mid Aa \mid a \mid aa$

A = λ, B = λ, A = B = λ, B = λ in aaB

$A \to \lambda$

$B \to bbA \mid bb$ (A = λ)

$S \to aB \mid aaB \mid \cancel{a} a \mid aa$ (Ans)

$B \to bb$

3. $S \to Aa \mid B$

$B \to A \mid bb$

$A \to a \mid bc \mid B$

$S \to Aa \mid A \mid bb$

$B \to a \mid bc \mid B \mid bb$

$A \to a \mid bc \mid bb$

$S \to Aa \mid a \mid bc \mid bb$

$B \to a \mid bc \mid bb$

$A \to \cancel{b} a \mid bc \mid bb$

- Here B is a ~~so~~ useless symbol.

∴ it can be removed.

$S \to Aa \mid a \mid bc \mid bb$ (Ans)

$A \to a \mid bc \mid bb$

4. $S \to aA$
$A \to BB$
$B \to aBb \mid \lambda$

$S \to aA \mid a$
$A \to BB \mid B$
$B \to aBb \mid ab$

After Removal of $\lambda$

$S \to aA \mid a$
$A \to BB \mid aBb \mid ab$ (Ans)
$B \to aBb \mid ab$

## Chomsky Normal Form (CNF)

$A \to XY \mid a$

$A \in V$

$X, Y \in V$

$a \in \Sigma$

- A grammar is in CNF if every production is of the form of $A \to XY \mid a$.

Example:

1. $S \to aB \mid aaB \mid a \mid aa$
$B \to bb$

Not in CNF

$S \to XB$ $S \to XXB$ $S \to a$ $S \to XX$
$X \to a$ $S \to XY$
$Y \to XB$

$\{S \to XB \mid XY \mid a \mid XX;\ X \to a;\ Y \to XB;\ B \to ZZ;\ Z \to b\}$ (Ans)

2. $S \to aA \mid a$
$A \to BB \mid aBb \mid ab$
$B \to aBb \mid ab$

$S \to XA \quad S \to a \quad A \to BB \qquad A \to XY$

$X \to a \qquad A \to \cancel{aBb}\ X\cancel{BY}Z$

$Y \to b$

$Z \to BY$

$B \to XZ \quad B \to XY$

$\{S \to XA \mid a;\ A \to BB \mid XZ \mid XY;\ X \to a;\ Y \to b;\ Z \to BY;$
$B \to XZ \mid XY\}$

aab

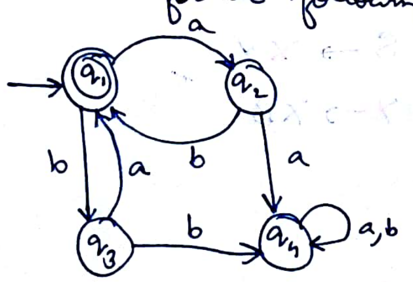
1. Find the languages from the following CFG —
i) $S \to aSbb \mid \lambda \to L = \{a^n b^{2n} \mid n \geq 0\}$ (Ans)
ii) $S \to aSb \mid a \to L = \{a^{n+1} b^n \mid n \geq 0\}$ (Ans)

aSb
aSb

2. Derive grammer for language $L = \{a^i b^{j+i} c^j d^k \mid i, j, k > 0\}$.

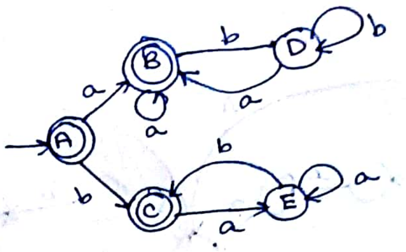
3. Draw NFA for $(aa \mid b)^*(bb \mid a)^*$

4. Derive RES for the following




(Done Before)

5.




2. $\cancel{(a^i b^{j+i})}\cancel{(c^j d^k)}$

$\Downarrow$ $S_1$ $\quad$ $\Downarrow$ $S_2$

$\cancel{S_2 \to \lambda}$

$S_1 \to \lambda \mid \cancel{a S b}$

$$L = \{ \underbrace{a^i b^i}_{L_1} \underbrace{b^j c^j}_{L_2} \underbrace{d^k}_{L_3} \mid i,j,k > 0 \}$$

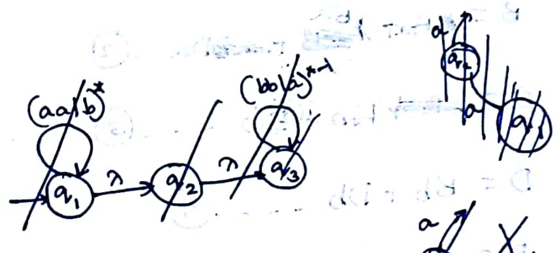
$S \to ABC$

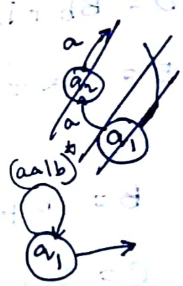
$A \to aAb \mid ab$

$B \to bBc \mid bc$

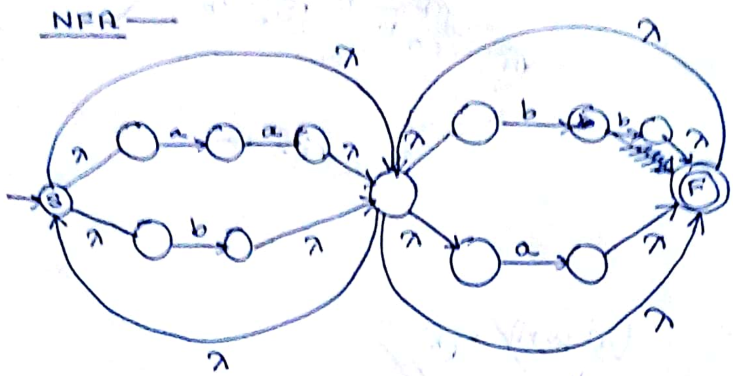
$C \to dC \mid d$

~~3.~~

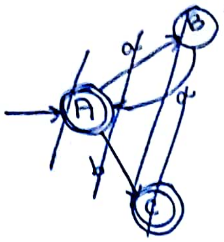


3. NFA—




DFA—




Suppose $(ab)^n$ and $b^n(ab)^n$ are the type of strings which are not acceptable.

∴ Then draw L which contains these.

Then find L'.

5. Result = A + B + C

$A = \lambda$ . . . (1)

$B = Aa + Ba + Da$ . . (2)

$C = \cancel{bA+}\ Ab + Eb$ . . . (3)

$D = Bb + Db$ . . . . (4)

$E = Ca + Ea$ . . . . (5)

∴ $B = a + Ba + Da$ . . . (6)

$C = b + Eb$ . . . (7)

From (4),

$$D = Bb + Db$$

$$= Bbb^*$$

$R = Q + Rp$

$R = Qp^*$

From (5),

$$E = Caa^*$$

$$C = Ab + \underline{C}aa^*b$$

$$\Rightarrow C = Ab(aa^*b)^*$$

$$\Rightarrow \boxed{C = b(aa^*b)^*}$$

$$B = a + Da + Ba$$

$$\Rightarrow B = a + Bbb^*a + Ba$$

$$\Rightarrow B = a + B(bb^*a + a)$$

$$\Rightarrow \boxed{B = a + (bb^*a + a)^*}$$

$$\therefore RE = A + C + B$$

$$= \lambda + b(aa^*b)^* + a + (bb^*a + a)^* \quad \text{(Ans)}$$