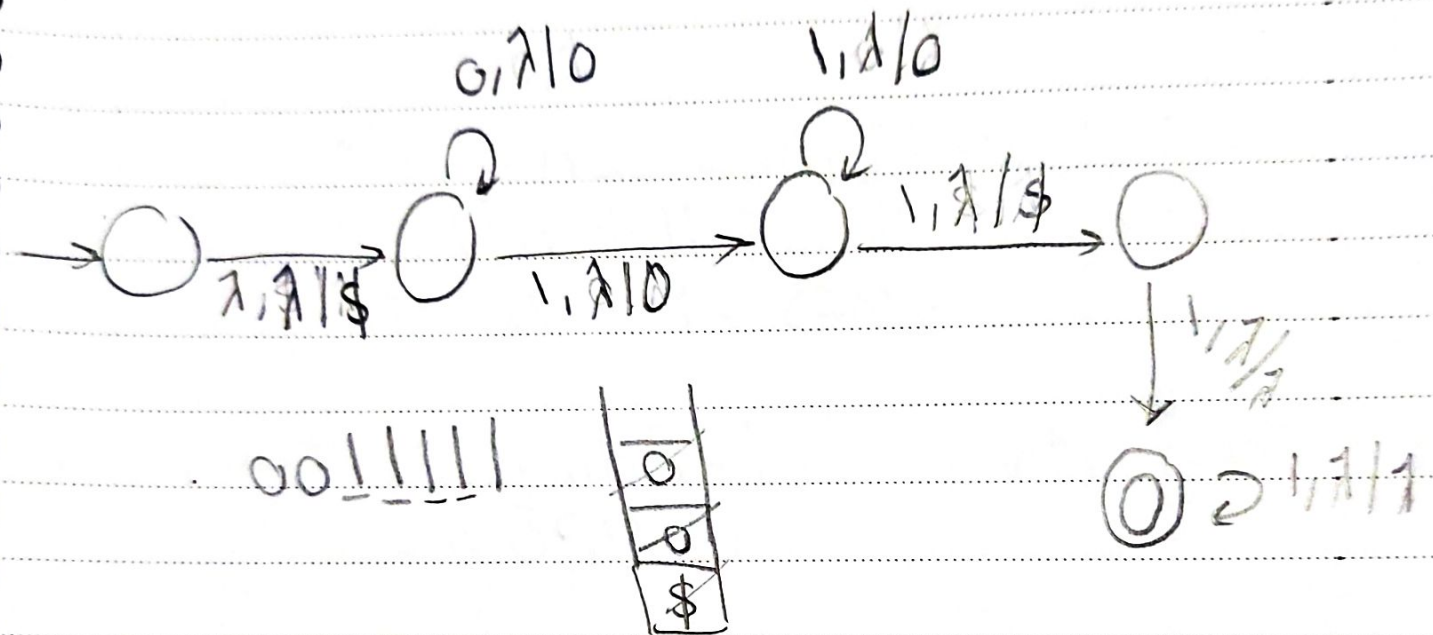


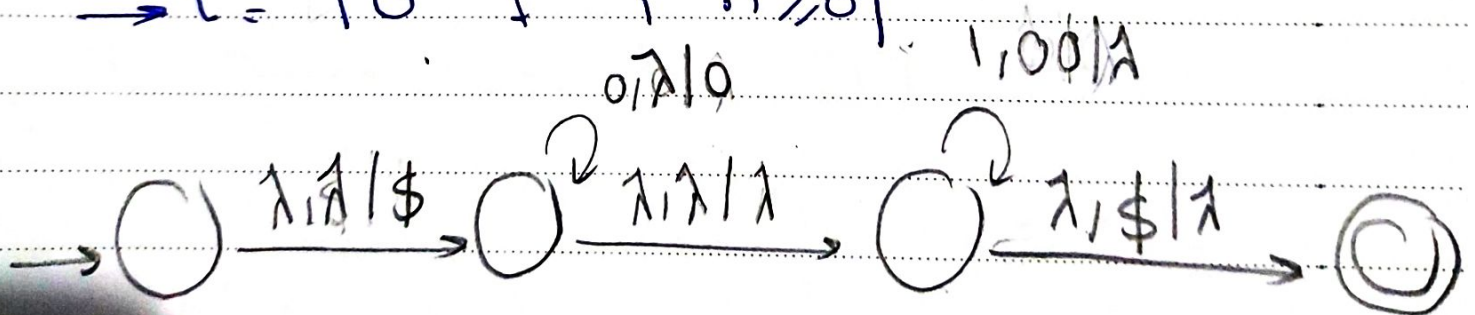
# Theory Sec 7 - General

→ Draw the push down Automata for the following language:

$$\rightarrow L = \{0^n 1^m \mid n \geq 1, m \geq n+2\}$$



$$\rightarrow L = \{0^n 1^{2n} \mid n \geq 0\}$$



→ Greibach Normal Form (GNF):

\* CFG in GNF if all productions are of the form

$$A \rightarrow ax \quad \text{where } a \in T \\ \text{and } x \in N^*$$

$\Rightarrow S \rightarrow AB, A \rightarrow aA|bB|b, B \rightarrow b$  Not GNF

$\Rightarrow S \rightarrow aAB|bBB|bB, A \rightarrow aA|bB|b, B \rightarrow b$  is GNF

\* Convert  $S \rightarrow abSb|aa$  into GNF:

$$S \rightarrow aBSB|aA$$

$$B \rightarrow b$$

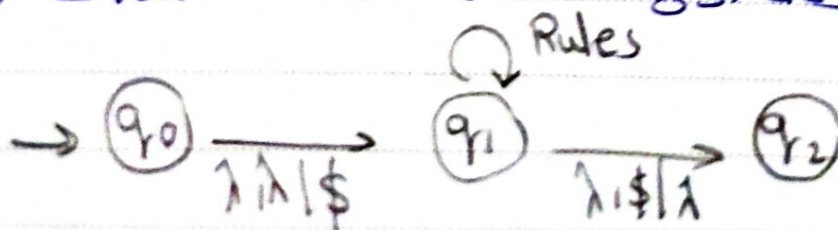
$$A \rightarrow a$$

\* To Convert CFG to PDA:

① Convert CFG to CFG-1 free.

② Convert CFG-1 free to GNF.

③ Draw PDA with 3 states





$$\textcircled{1} L = \{ a^{n+1} b^n b^m a^m : n, m \geq 0 \}$$

CFG:

$$S \rightarrow aXY$$

$$X \rightarrow aXb \mid \lambda$$

$$Y \rightarrow bYa \mid \lambda$$

CFG - 1 free:

$$S \rightarrow aXY$$

$$X \rightarrow aXb \mid ab$$

$$Y \rightarrow bYa \mid ba$$

GNF:

$$S \rightarrow aXY$$

$$X \rightarrow aXB \mid aB$$

$$Y \rightarrow bYA \mid bA$$

$$B \rightarrow b$$

$$A \rightarrow a$$

$$a/A/\lambda$$

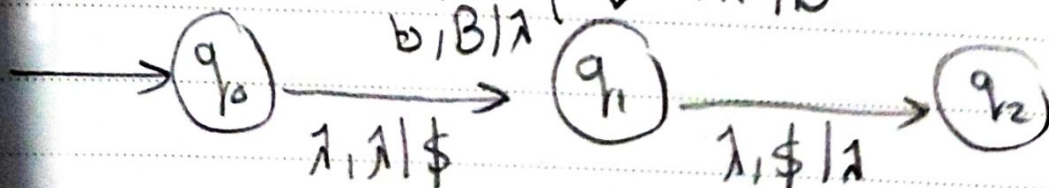
$$a/S/XY$$

$$a/X/XB$$

$$b/Y/A$$

$$b/B/\lambda$$

$$a/X/B$$



$$\begin{aligned} \textcircled{2} \quad S &\rightarrow aTxb \\ T &\rightarrow XTS \mid \lambda \\ X &\rightarrow a \mid b \end{aligned}$$

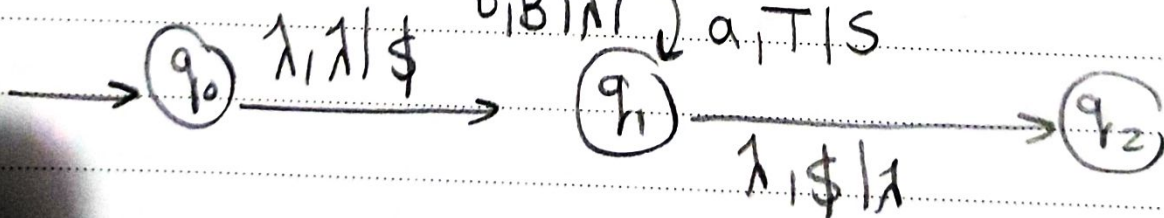
1-free:

$$\begin{aligned} S &\rightarrow aTxb \mid aXb \\ T &\rightarrow XTS \mid XS \\ X &\rightarrow a \mid b \end{aligned}$$

GNF:

$$\begin{aligned} S &\rightarrow aTXB \mid aXB \\ T &\rightarrow aTS \mid bTS \mid aS \mid bS \\ X &\rightarrow a \mid b \\ B &\rightarrow b \end{aligned}$$

$$\begin{aligned} &a, S \mid XB \\ &b, T \mid S \quad a, S \mid TXB \\ &a, X \mid \lambda \quad a, T \mid TS \\ &b, X \mid \lambda \quad b, T \mid TS \\ &b, B \mid \lambda \quad a, T \mid S \end{aligned}$$



$$\textcircled{3} L = \{a^n b^n : n \geq 0\}$$

CFG:

$$S \rightarrow aSb \mid \lambda$$

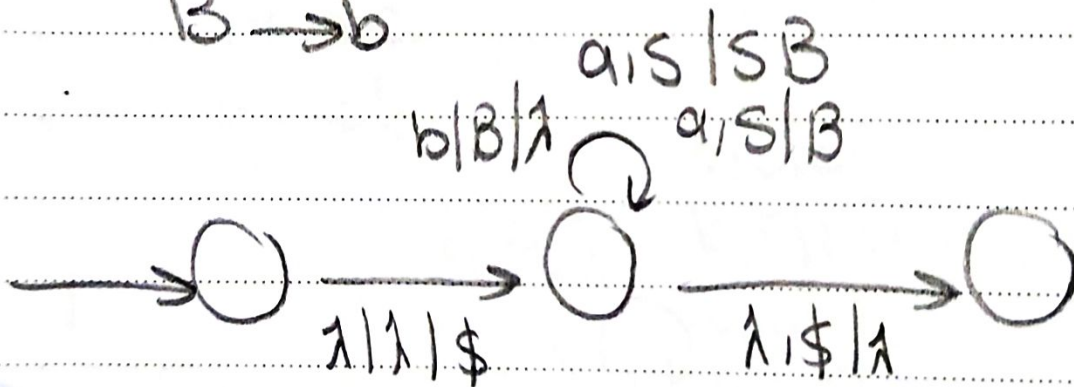
1-free:

$$S \rightarrow aSb \mid ab$$

GNF:

$$S \rightarrow aSB \mid aB$$

$$B \rightarrow b$$





④  $L = \{w w^R : w \in \{a, b\}^+\}$

CFG:

$S \rightarrow aSa \mid bsb \mid \lambda$

$\lambda$ , free:

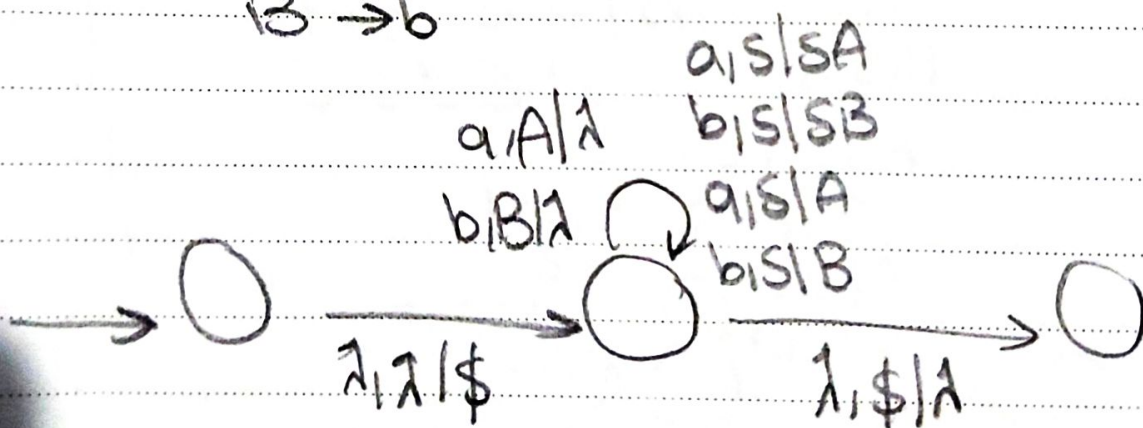
$S \rightarrow aSa \mid bsb \mid aa \mid bb$

GNF:

$S \rightarrow aSA \mid bSB \mid aA \mid bB$

$A \rightarrow a$

$B \rightarrow b$



$$\begin{aligned} \textcircled{5} \quad S &\rightarrow AB \\ A &\rightarrow aA|1 \\ B &\rightarrow bB|1 \end{aligned}$$

$\lambda$ -free:

$$\begin{aligned} S &\rightarrow AB|A|B \\ A &\rightarrow aA|a \\ B &\rightarrow bB|b \end{aligned}$$

GNF:

$$\begin{aligned} S &\rightarrow aAB|aB|aA|a|bB|b \\ A &\rightarrow aA|a \quad \begin{matrix} b, B|1 \\ b, B|B \end{matrix} \\ B &\rightarrow bB|b \end{aligned}$$

