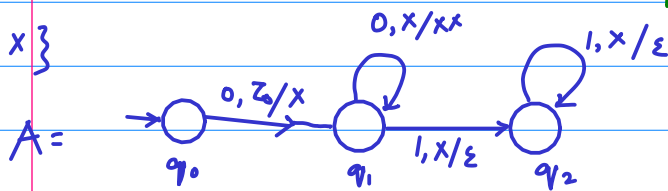


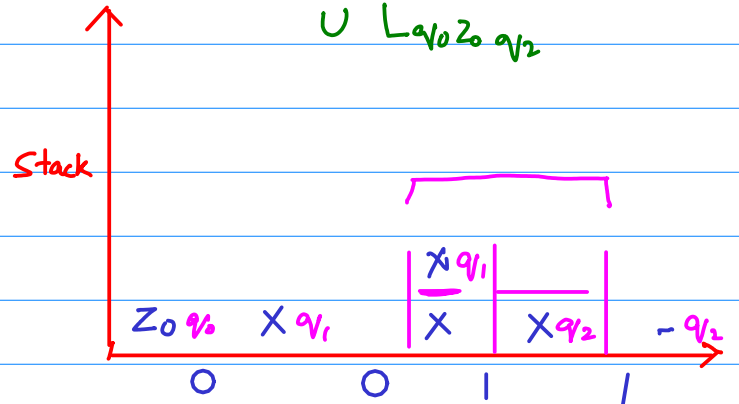
$$\Gamma = \{\underline{z_0}, x\}$$



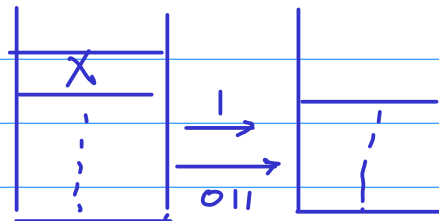
$$N(A) = \{ \underline{0^n 1^n} \mid n \geq 1 \}$$

$$N(A) = L_{q_0 z_0 q_0} \cup L_{q_0 z_0 q_1} \cup L_{q_0 z_0 q_2}$$

$$w = \underline{000111}$$



$$000111 \quad q_1$$



$$q_2 \mid \in L_{q_1 x q_2}$$

$$011 \in L_{q_1 x q_2}$$

$$000111$$

$$z_0 \xrightarrow{0} x \xrightarrow{0} x \xrightarrow{0} x \xrightarrow{1} x q_2 \xrightarrow{1} x q_2 \xrightarrow{1} \underline{q_2}$$

$$1 \in L_{q_2 x q_2}$$

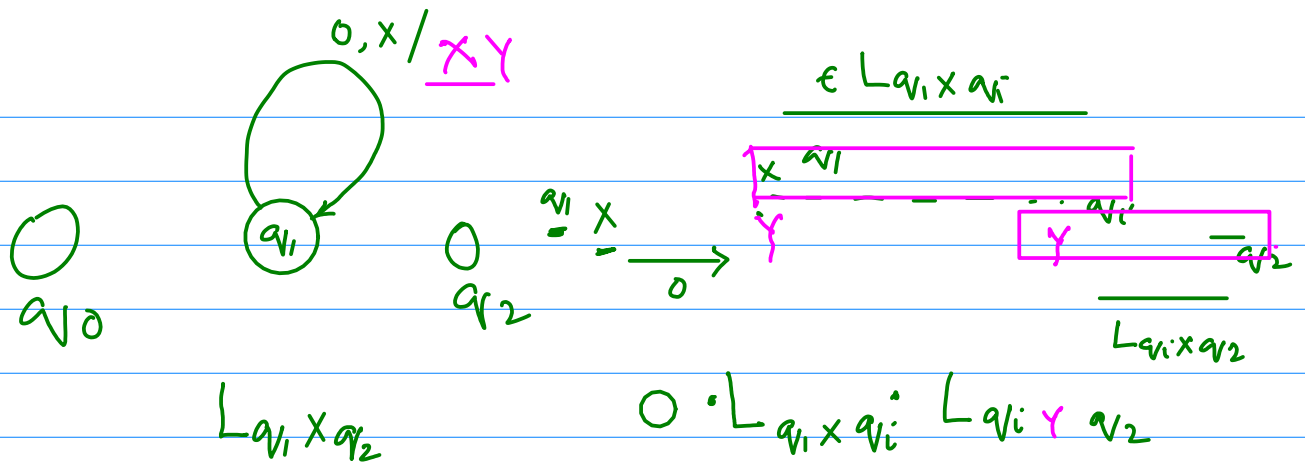
$$L_{q_i z_0 q_j}$$

$$0011 \in L_{q_0 z_0 q_2}$$

$$= \left\{ w \mid q_i \begin{array}{|c|} \hline z_0 \\ \hline \vdots \\ \hline \end{array} \xrightarrow{w} \begin{array}{|c|} \hline \\ \hline \vdots \\ \hline \end{array} q_j \right\}$$

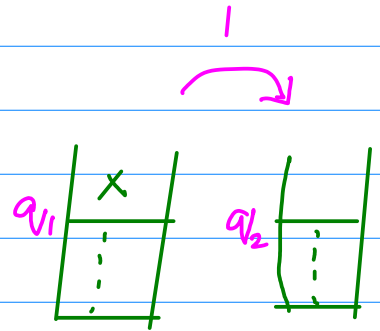
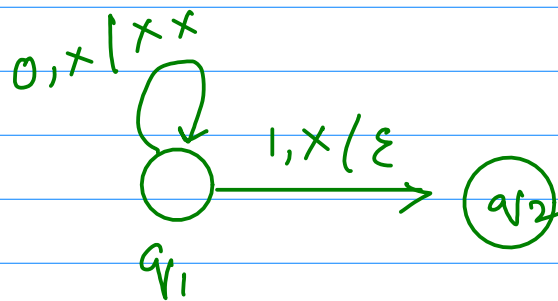
$$L_{q_0 z_0 q_0}$$

$$L_{q_0 z_0 q_1}$$



$$L_{q_1 x q_2} \supseteq \begin{aligned} &0 \cdot L_{q_1 x q_0} \cdot L_{q_0 x q_2} \\ &\cup \\ &0 \cdot L_{q_1 x q_1} \cdot L_{q_1 x q_2} \\ &\cup \\ &0 \cdot L_{q_1 x q_2} \cdot L_{q_2 x q_2} \end{aligned}$$

n states, k stack symbols $n^2 k$



$$L_{q_1 x q_2} \supseteq \{1\}$$

$$L_{q_1 x q_2} \supseteq 0 \cdot L_{q_1 q_1}$$

$$L_1 \supseteq \{1\}$$

$$\supseteq 0.L_2.L_3$$

$$\supseteq 0.L_4.L_1$$

⋮

$$\underline{L_1} \rightarrow 1 \mid 0.L_2.L_3 \mid 0.L_4.\underline{L_1} \mid \dots$$

$$L_2 \rightarrow \dots$$

⋮

⋮

⋮

$$L_{n^2.k} \rightarrow \dots$$

Context-free grammars

$$L_1 \rightarrow 0_1 \mid 0.L_{i,1}$$

$0^n 1^n$
~~~~~

$\Sigma^*$

$\{0,1\}^*$

$$0_1 \in L_1$$

$$L_1 = \Sigma^*$$

$$0.L_{i,1} \subseteq L_1$$

Non-terminals:

 $S, A$ 

$$S \rightarrow A.S \mid \varepsilon$$

$$A \rightarrow A1 \mid 0A1 \mid 01$$

 $00111 \in \text{Lang}$   
corr to  
 $A$ Terminals:  $0, 1, \varepsilon$ 

Context-free grammar CFG

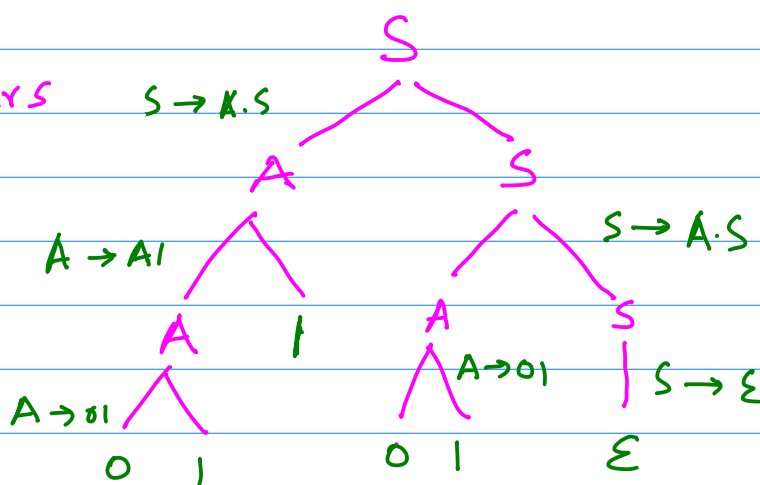
Production rules:

" " languages CFL

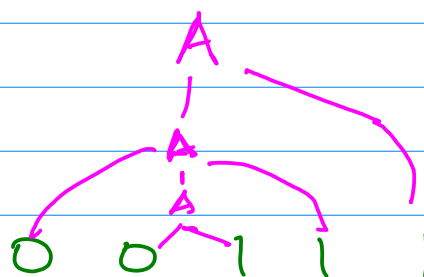
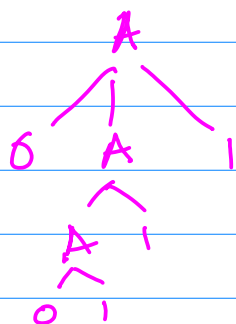
$$S \rightarrow A.S, S \rightarrow \varepsilon, A \rightarrow A.1, \dots$$

Start symbol:  
 $S$  $01, 011, 00111, 0011, \dots \in L \text{ corr. to } A.$   
 $01^k, k \geq 1$  $\varepsilon, 01, 01101, 011, 001101101, \dots \in L \text{ corr to } S$ 

$$G = \left( \overset{\text{NT}}{\downarrow} V, \overset{\text{T}}{\underbrace{\Sigma \cup \{\varepsilon\}}}, P, \underset{\substack{\uparrow \\ V}}{S} \right)$$

Ambiguous  
grammars $00111$   
 $01101$ 

Derivation tree or Parse tree



$$S \rightarrow C.S \mid \varepsilon$$

$$C \rightarrow A.B$$

$$A \rightarrow 0A1 \mid 01$$

$$B \rightarrow 1B \mid \varepsilon$$

$$S \rightarrow A \mid B$$

$$\underline{S} \rightarrow A.S \mid \varepsilon$$

$$A \rightarrow A1 \mid 0A1 \mid 01$$

$$\Sigma = \{0, 1\}$$

$$\Gamma = \{\underline{S}, A, X_0, X_1\}$$

