$$M = (\overset{Q}{\{q_0, q_1\}}, \overset{\Sigma}{\{0, 1\}}, \overset{\Gamma}{\{X, z_0\}}, \overset{\delta}{\delta}, \overset{q_0}{q_0}, \overset{z_0}{z_0}, \phi\}$$

where δ is given by

$$\delta(q_0, 0, z_0) = \{(q_0, Xz_0)\}$$

$$\delta(q_0, 0, x) = \{(q_0, XX)\}$$

$$\delta(q_0, 1, X) = \{(q_1, \epsilon)\}$$

$$\delta(q_1, 1, X) = \{(q_1, \epsilon)\}$$

$$\delta(q_1, \epsilon, x) = \{(q_1, \epsilon)\}$$

$$\delta(q_1, \epsilon, z_0) = \{(q_1, \epsilon)\}$$

$[S, A, P]$

S → State
A → Stack symbol
P → State

construct a CFG G generating $N(M)$

<u>Solution:</u>

We find CFG $G = (V, T, P, S)$

$$V = \{S, [q_0, x, q_0], [q_0, x, q_1], [q_1, x, q_0]$$
$$[q_1, x, q_1]\ [q_0, z_0, q_0]\ [q_0, z_0, q_1]$$
$$[q_1, z_0, q_0]\ [q_1, z_0, q_1]\}$$

T = set of inputs (Σ)

$T = \{0, 1\}$

P = set of transition

→ 2 stack

1) $\delta(q_0, 0, z_0) = (q_0, xz_0)$

add

$[q_0, z_0, q_0] \rightarrow 0\,[q_0, x, q_0][q_0, z_0, q_0]$

delete

$[q_0, z_0, q_0] \rightarrow 0\,[q_0, x, q_1][q_1, z_0, q_0]$

$[q_0, z_0, q_1] \rightarrow 0\,[q_0, x, q_0][q_0, z_0, q_1]$

$[q_0, z_0, q_1] \rightarrow 0\,[q_0, x, q_1][q_1, z_0, q_1]$

2) $\delta(q_0, 0, x) = (q_0, xx)$

$[q_0, x, q_0] \rightarrow 0\,[q_0, x, q_0][q_0, x, q_0]$

delete

$[q_0, x, q_0] \rightarrow 0\,[q_0, x, q_1][q_1, x, q_0]$

$[q_0, x, q_1] \rightarrow 0\,[q_0, x, q_0][q_0, x, q_1]$

$[q_0, x, q_1] \rightarrow 0\,[q_0, x, q_1][q_1, x, q_1]$

3) $\delta(q_0, 1, x) = (q_1, \epsilon)$

$[q_0, x, q_1] \rightarrow 1$

4) $\delta(q_1, 1, x) = (q_1, \epsilon)$

$[q_1, x, q_1] \rightarrow 1$

4) $\delta(q_1, \epsilon, x) = (q_1, \epsilon)$

$[q_1, x, q_1] \rightarrow \epsilon$

5) $\delta(q_1, \epsilon, z_0) = (q_1, \epsilon)$

$[q_1, z_0, q_1] \rightarrow \epsilon$

initial state

initial state

$S \rightarrow [q_0, z_0, q_0]$

state

$S \rightarrow [q_0, z_0, q_1]$