

EE 360 D

State Space Eqns

DFD
current
output →

$$y[n] = b_0 x[n] + g[n-1]$$

← previous
nodes

Linear
Difference
Eqns

$$g[n] = x[n] + g[n-1]$$

current
node →

STATE
SPACE Eqns

$$y[n] = x[n] + g[n]$$

$$g[n+1] = x[n] + g[n]$$

future
Internal
Signal!

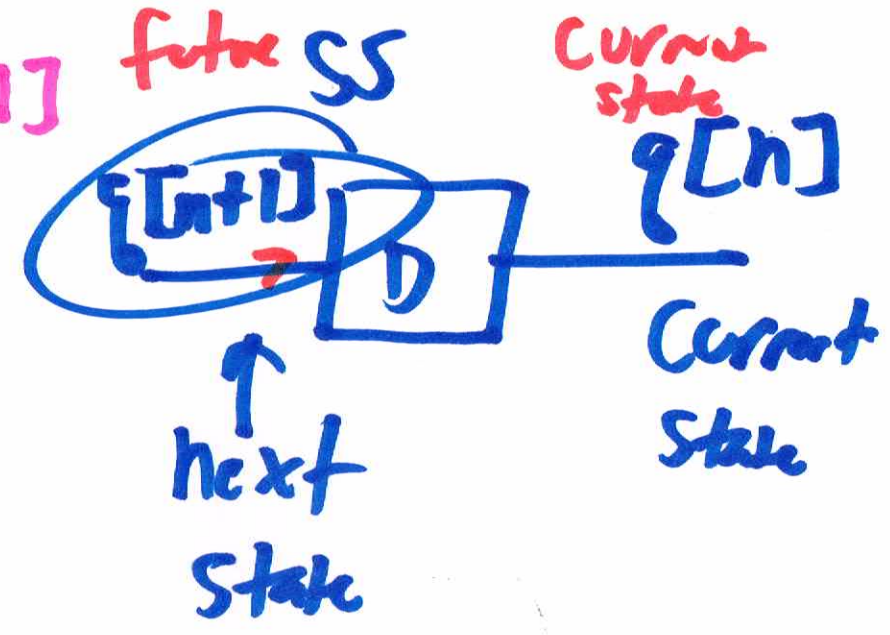
Current
Inputs

Current
nodes/Internal
Signal

Input Signal

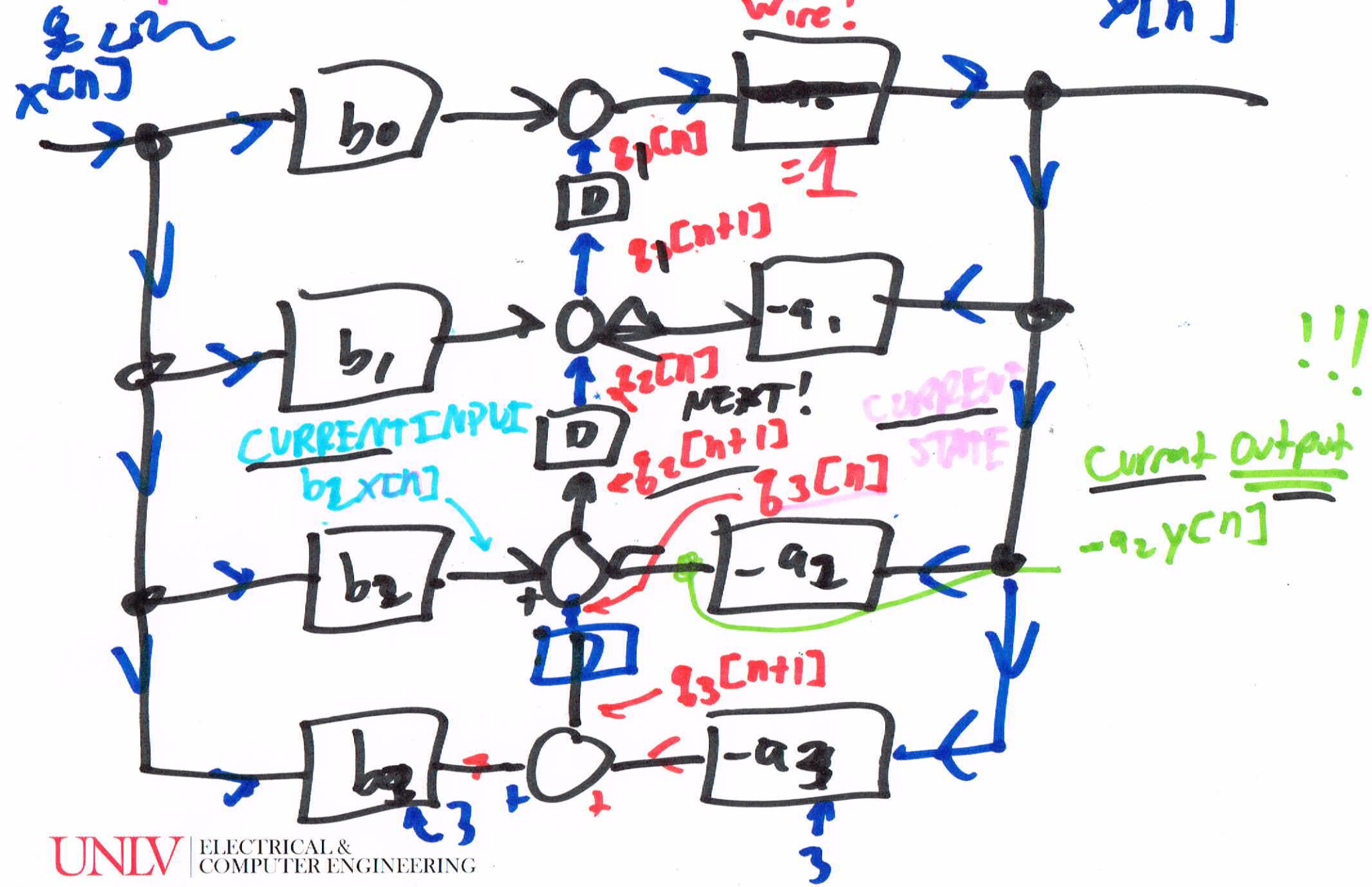


Linear
Diff.
Eq.



2)

Transposed Direct Form II (State Space Eqns)



$$y[n] = b_0 x[n] + z_1[n]$$

Current
Input!

Current
State!

$$z_1[n+1] = \underline{b_1 x[n]} - a_1 \underline{y[n]} + \underline{z_2[n]}$$

$$= b_1 x[n] - a_1 (b_0 x[n] + z_1[n]) + z_2[n]$$

$$z_1[n+1] = x[n] (b_1 - a_1 b_0) - a_1 \underline{z_1[n]} + \underline{z_2[n]}$$

next
state!

Current
Input!

Current
State!

$$q_2[n+1] = b_2 x[n] - a_2 y[n] + q_3[n]$$

$$= b_2 x[n] - a_2 (b_0 x[n] + q_1[n]) + q_3[n]$$

$$q_2[n+1] = x[n] (b_2 - a_2 b_0) - a_2 q_1[n] + q_3[n]$$

↑
Current Input

Current States!

next states!

$$q_3[n+1] = b_3 x[n] - a_3 y[n]$$

$$q_3[n+1] = x[n] (b_3 - a_3 b_0) - a_3 q_1[n]$$

Current Input!

Current State!

next state!

$$Q = \begin{bmatrix} q_1(n+1) \\ q_2(n+1) \\ q_3(n+1) \end{bmatrix} = \begin{bmatrix} -a_1 & 1 & 0 \\ -a_2 & 0 & 1 \\ -a_3 & 0 & 0 \end{bmatrix} \begin{bmatrix} q_1(n) \\ q_2(n) \\ q_3(n) \end{bmatrix} + \begin{bmatrix} b_1 - a_1 b_0 \\ b_2 - a_2 b_0 \\ b_3 - a_3 b_0 \end{bmatrix} x(n)$$

3×1 $A \ 3 \times 3$ $B \ 3 \times 1$

current state! current input!

output

$$y(n) = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} q_1(n) \\ q_2(n) \\ q_3(n) \end{bmatrix} + \begin{bmatrix} b_0 \end{bmatrix} x(n)$$

C D

6)