EE360

Review for Exam 2

Friday, Sept. 24th, 2021

DSP

Controls

$$Q[n+1] = A\,\underline{Q[n]} + B\,\underline{x[n]}$$

$$Y[n] = C\,\underline{Q[n]} + D\,\underline{x[n]}$$

Current States!

Current Inputs!

Quiz #4 EE 360 Fall 2021 Name:____________________________

Attempt and grade yourself with a pen

Show your work for credit and place boxes around your answers.

$\cancel{x}$

1. Define (in written English):

- a transformation

Rule which Assigns to each Element (function) in the set A (function) a unique element (function) in the set B

x y

2. Draw a transposed Direct Form II block diagram for the following system described by:

$$3y[n] - \frac{3}{2}y[n-1] = 6x[n] - 9x[n-2]$$

Determine state equations in the form:

$$\mathbf{q}[n+1] = \mathbf{A}\mathbf{q}[n] + \mathbf{B}\mathbf{x}[n]$$
$$\mathbf{y}[n] = \mathbf{C}\mathbf{q}[n] + \mathbf{D}\mathbf{x}[n]$$

$\div 3$ State Equations!

a_0 $a_1 = -\frac{1}{2}$ $b_0 = 2$ $b_2 = -3$

Represent your answers in matrix form.

$1y[n] - \frac{1}{2}y[n-1] = 2x[n] - 3x[n-2]$

$b_1 = 0$ Gains!

$y[n] + a_1 y[n-1] = b_0 x[n] + b_2 x[n-2]$

$\boxed{y[n] = b_0 x[n] + b_2 x[n-2] - a_1 y[n-1]}$

$\cancel{a_0} = 0$ $a_2 = 0$

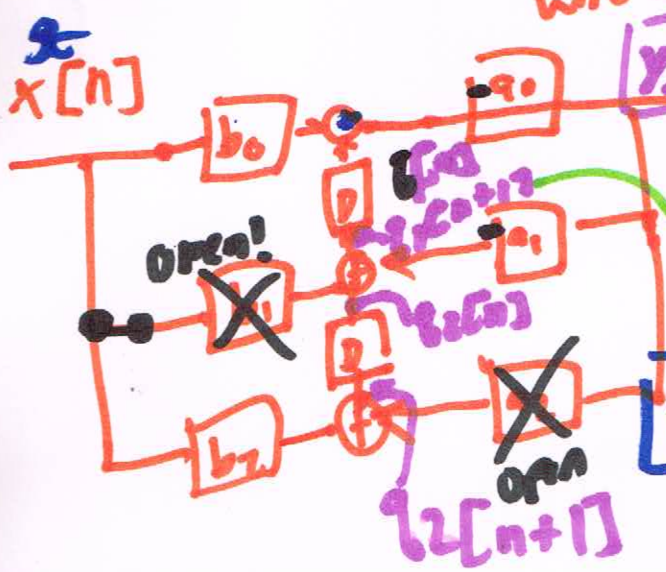
wire! $a_0 = 1$

$\boxed{y[n] = b_0 x[n] + \ell_1[n]}$

$\ell_1[n+1] = \cancel{b_1 x[n]} - a_1 y[n] + \ell_2[n]$

$\ell_1[n+1] = -a_1(b_0 x[n] + \ell_1[n]) + \ell_2[n]$

$\boxed{\ell_1[n+1] = -a_1 b_0 x[n] - a_1 \ell_1[n] + \ell_2[n]}$



$\boxed{q_2[n+1] = b_2 x[n]} - \cancel{a_2 y[n]}$ Implement in MATLAB!

next state!

$b_0 = 2$

$b_1 = 0$

$b_2 = -3$

$a_0 = 1$

$a_1 = -\frac{1}{2}$

$a_2 = 0$

$$q_1[n+1] = -a_1 b_0 x[n] - a_1 q_1[n] + q_2[n]$$

$$q_2[n+1] = +b_2 x[n]$$

$$y[n] = b_0 x[n] + q_1[n]$$

$$\underbrace{\begin{bmatrix} q_1[n+1] \\ q_2[n+1] \end{bmatrix}}_{2\times 1} = \underbrace{\begin{bmatrix} -a_1 = \frac{1}{2} & 1 \\ 0 & 0 \end{bmatrix}}_{\substack{A \\ 2\times 2}} \begin{bmatrix} q_1[n] \\ q_2[n] \end{bmatrix} + \underbrace{\begin{bmatrix} -a_1 b_0 = 1 \\ b_2 = -3 \end{bmatrix}}_{\substack{B \\ 2\times 1}} x[n]$$

$$y[n] = \underbrace{\begin{bmatrix} 1 & 0 \end{bmatrix}}_{C} \begin{bmatrix} q_1[n] \\ q_2[n] \end{bmatrix} + \underbrace{\begin{bmatrix} b_0 = 2 \end{bmatrix}}_{D} x[n]$$

UNLV | ELECTRICAL & COMPUTER ENGINEERING

2)

$$\begin{bmatrix} q_1[n+1] \\ q_2[n+1] \end{bmatrix} = \underbrace{\begin{bmatrix} \frac{1}{2} & 1 \\ 0 & 0 \end{bmatrix}}_{A} \begin{bmatrix} q_1[n] \\ q_2[n] \end{bmatrix} + \underbrace{\begin{bmatrix} 1 \\ -3 \end{bmatrix}}_{B} x[n]$$

$$\underbrace{y[n]}_{1\times 1} = \underbrace{\begin{bmatrix} 1 & 0 \end{bmatrix}}_{C} \begin{bmatrix} q_1[n] \\ q_2[n] \end{bmatrix} + \underbrace{\begin{bmatrix} 2 \end{bmatrix}}_{D} x[n]$$

Prelength + 1

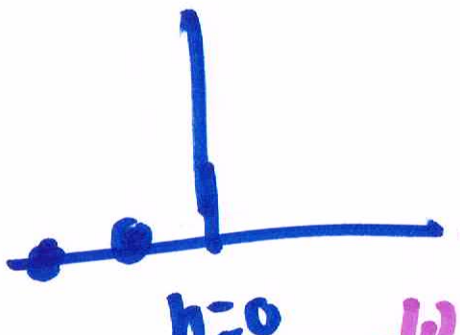
for i = 3 :

~~x[n]~~ $q[n] = \underline{q[n-2]}$

$q(1)$

$n - 2 = 1$

$n = 3$



~~for~~

CS world A(0)

for i=0 A(0)

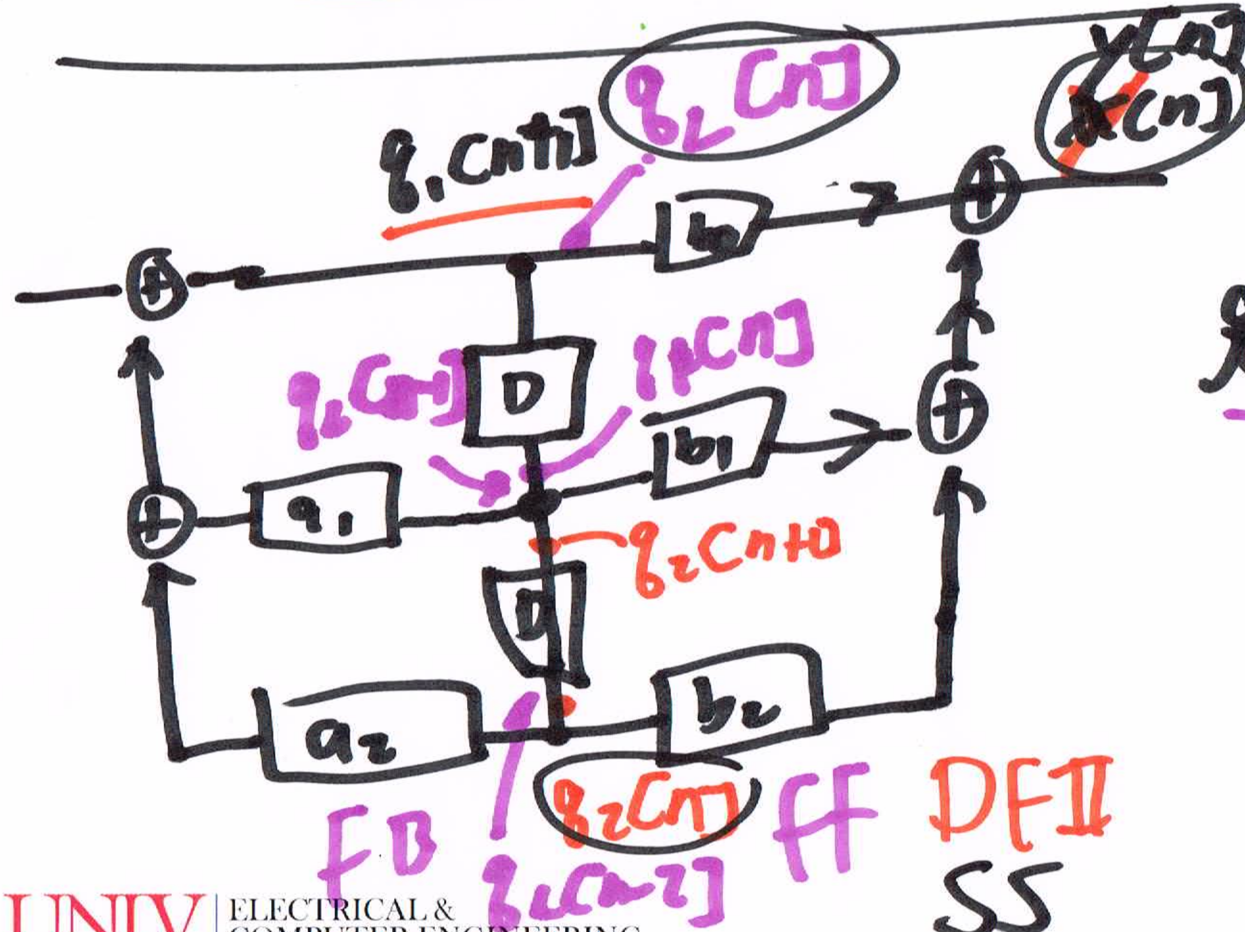
Matlab world A(1)

for i = $\underline{1}$

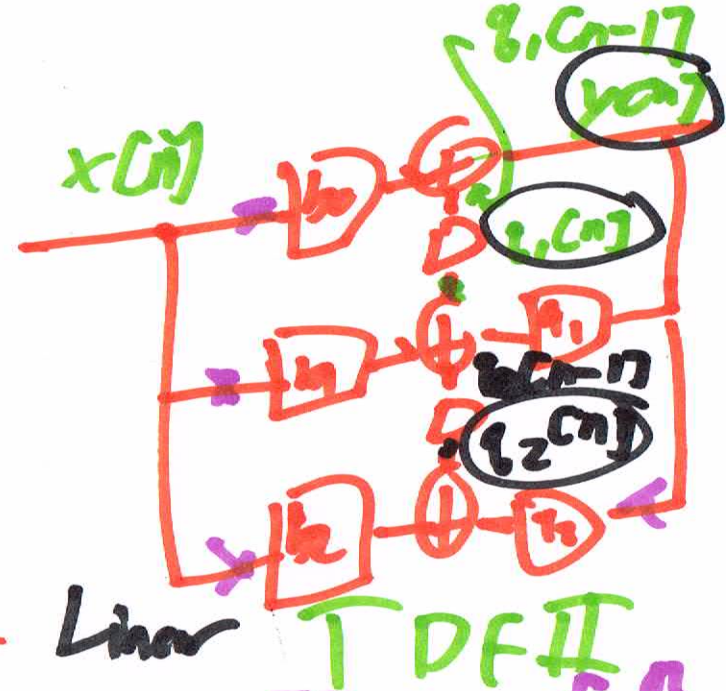
8 positn

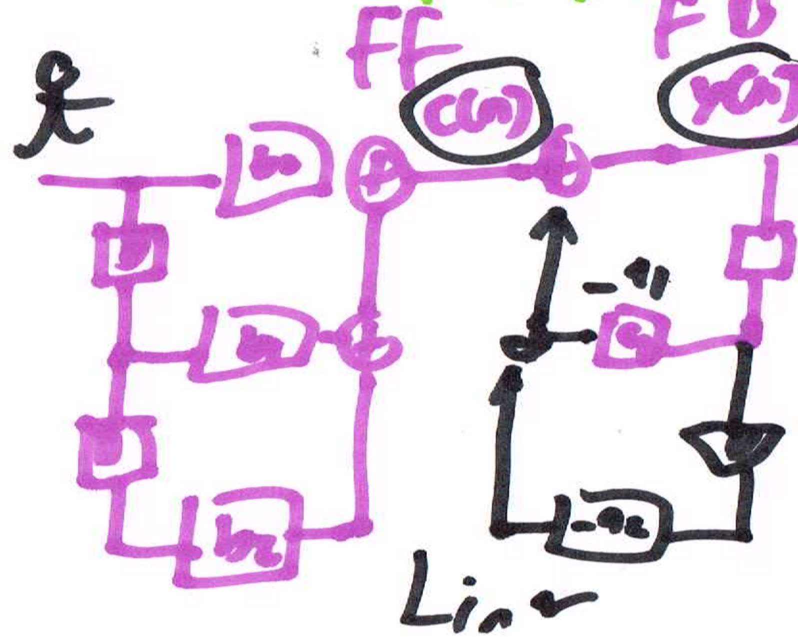
[1 2 3 -- 50 53]

n = -2, -1, 0, 47 50



Linear





9)

$$y[n] = T\big[x[n]\big] = x[n-n_0]$$

i) is it liner?

scaling! ~~α~~, $T[\alpha x_1[n]] = \alpha y[n]$

$\alpha x[n-n_0] = \alpha x[n-n_0]$

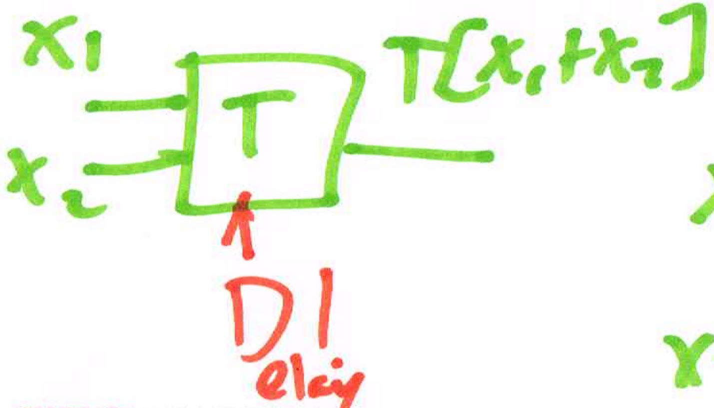
It is Liner!

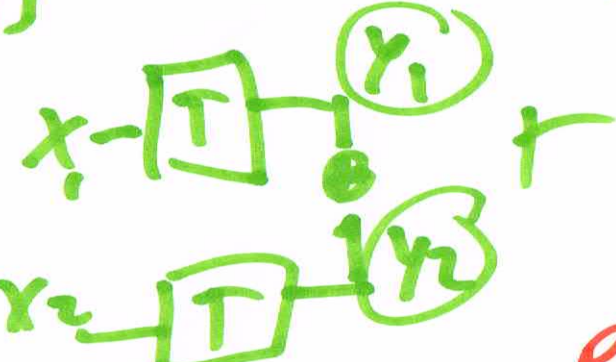
Additive! $T[x_1 + x_2[n]] = T[x_1[n]] + T[x_2[n]]$

$y_1[n]$ $y_2[n]$

$x[n-n_0] + x_2[n-n_0] = x_1[n-n_0] + x_2[n-n_0]$

It is Additive!





It is Liner!

Passes Scaling & Addition! Scaling!

Study:

$y[n] = T[x[n]] = x[n-n_0]$

i) Linearity $[\alpha x_1 + \beta x_2]$

ii) Causuality → Can't see the future! No Pluses!

iii) memoryless

iv) stability → $x[n]$ is bounded $y[n]$

3 Things:

LTI-system

---

i) Definitions

ii) Linear Time-invariant system

iii) Block diagrams

$$\int\left[y + \frac{\partial y}{\partial t} = x + \partial x\right]$$

integrate!

$$\int y + y = \int x + x$$

$$y = \int x + x - \int y$$