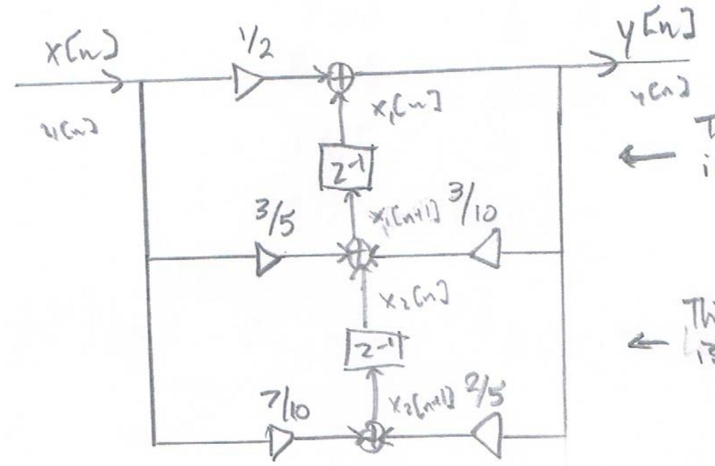
1. $H(z) = \dfrac{5z^2+6z+7}{10z^2-3z-4} = \dfrac{1/2 + 3/5\, z^{-1} + 7/10\, z^{-2}}{1 - 3/10\, z^{-1} - 2/5\, z^{-2}}$

(a)



← This delay element is state variable $x_1[n]$

← This delay element is state variable $x_2[n]$

(b) $A = \begin{bmatrix} -a_1 & 1 \\ -a_2 & 0 \end{bmatrix} = \begin{bmatrix} 3/10 & 1 \\ 2/5 & 0 \end{bmatrix}$ $\quad B = \begin{bmatrix} b_1 - b_0 a_1 \\ b_2 - b_0 a_2 \end{bmatrix} = \begin{bmatrix} 3/5 - (1/2)(-3/10) \\ 7/10 - (1/2)(-2/5) \end{bmatrix} = \begin{bmatrix} \frac{3}{5} + \frac{3}{20} \\ \frac{7}{10} + \frac{1}{5} \end{bmatrix}$

$C = [1 \ \ 0]$ $\quad D = [b_0] = [1/2]$

Alternatively, we know:

$\vec{x}[n+1] = A\vec{x}[n] + B\vec{u}[n]$

$y[n] = C\vec{x}[n] + D\vec{u}[n]$

& From the DFT II Realization in (a):

$y[n] = \frac{1}{2}u[n] + x_1[n] \quad \Rightarrow \quad C = [1 \ \ 0], \quad D = [\frac{1}{2}]$

$x_1[n+1] = \frac{3}{5}u[n] + x_2[n] + \frac{3}{10}y[n] = \left(\frac{3}{5} + \frac{3}{10}\cdot\frac{1}{2}\right)u[n] + \frac{3}{10}x_1[n] + x$

$x_2[n+1] = \frac{7}{10}u[n] + \frac{2}{5}y[n] = \left(\frac{7}{10} + \frac{2}{5}\cdot\frac{1}{2}\right)u(n) + \frac{2}{5}x_1[n]$

$\Rightarrow A = \begin{bmatrix} 3/10 & 1 \\ 2/5 & 0 \end{bmatrix} \quad B = \begin{bmatrix} 3/5 + 3/20 \\ 7/10 + 1/5 \end{bmatrix}$

2. (a) Number of Inputs: 3

Number of Outputs: 2

Number of State Variables: 6

Dimensions of : A : 6x6

B : 6x3

C : 2x6

H(s) : 2x3

(b) $p(t)e^{-3t} + c_1 e^{\frac{1}{2}t} + c_2 e^{-2t}\cos(5t+\theta)$

More specifically: ct^2+bt+c

(c) It is possible for H(s) to be stable if we have +0.5 as a hidden pole.

-3 m=3] LHP

-2 ± j5 m=1

+0.5 m=1] RHP