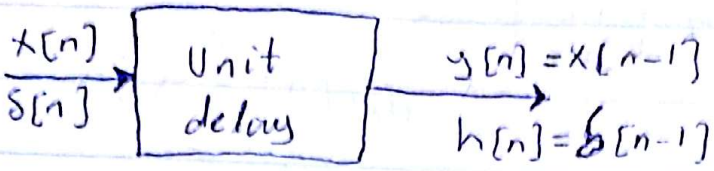

↑ Kronecker Delta

Now we can only observe the system for $n \geq 0$

n	y[n]
0	initial value in the memory location in the unit delay block
1	x[0]
2	x[1]

Homogeneity Property

Input $\alpha x[n]$

n	$y[n] \rightarrow$ scaled $\rightarrow y_{scaled}[n] \stackrel{?}{=} \alpha y[n]$
0	same initial value
1	$\alpha x[0]$
2	$\alpha x[1]$

to pass the all-zero input test for $n \geq 0$ the initial condition has to be zero.

Additivity Property

Input $x_1[n] + x_2[n]$

n	$y_{additive}[n] \stackrel{?}{=} y_1[n] + y_2[n]$
0	same initial value
1	$x_1[0] + x_2[0] = y_1[1] + y_2[1]$ ✓
2	$x_1[1] + x_2[1] = y_1[2] + y_2[2]$

$x[n-n_0]$

$y_{shifted}[n] \stackrel{?}{=} y[n-n_0]$

Finite Impulse Response

$$y_{shifted}[n] = h[n] * x[n-n_0] = \sum_{k=0}^{M} h[k]\,x[n-n_0-k]$$

FIR h[n]

$$y[n] = \sum_{k=0}^{M} h[n]\,x[n-k]$$

$$y[n-n_0] = \sum_{k=0}^{M} h[k]\,x[n-n_0-k]$$

$$y[n] = \sum_{k=0}^{M} h[k]\,x[n-k]$$

$$y[0] = h[0]\,x[0] + h[1]\,x[-1] + \cdots + h[M]\,x[-M]$$

- M # initial conditions: $x[-1], x[-2], \ldots, x[-M]$
- LTI ⟶ initial condition is zero

$$y[0] = h[0]\,x[0]$$

(Deconvolution: solve for h[0]: HW4

$$y[1] = h[0]\,x[1] + h[1]\,x[0]$$

(Deconvolution: solve for h[1])

$$y[n] = \sum_{k=0}^{M} h[k]\,x[n-k] = h[0]x[n] + h[1]x[n-1] + \cdots + h[M]x[n-M]$$

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cascaded system

$$w[n] = x[n] * h_1[n]$$

$$y[n] = w[n] * h_2[n] = (x[n] * h_1[n]) * h_2[n] =$$

$$= x[n] * (h_1[n] * h_2[n]) = x[n] * h_1[n] * h_2[n]$$