Quiz $b_{IR} = \{1, -1\}$

$xx = \{0, 1\}$

$yy = ?$ $\Longrightarrow yy = \{0, 1, -1\}$

$y[n] = x[n] - x[n-1]$

$y[0] = x[0] - x[-1] = 0$

$y[1] = x[1] - x[0] = 1$

$y[2] = x[2] - x[1] = -1$

$y[3] = x[3] - x[2] = 0$

$\vdots$

0

5.1 $h[n] = \delta[n-1] - 2\delta[n-4]$

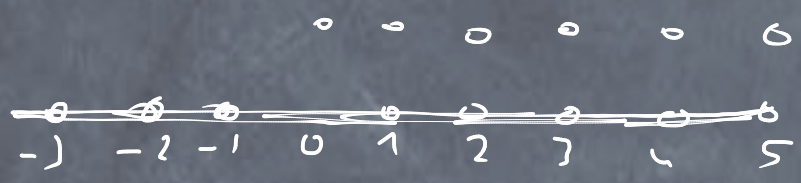
Find diff eqn.

$$y[n] = x[n-1] - 2x[n-4]$$

$$b_k = \{0, 1, 0, 0, -2\}$$

5.2 $y[n] = \frac{1}{L} \sum_{k=0}^{L-1} x[n-k]$ for $x[n] = u[n]$

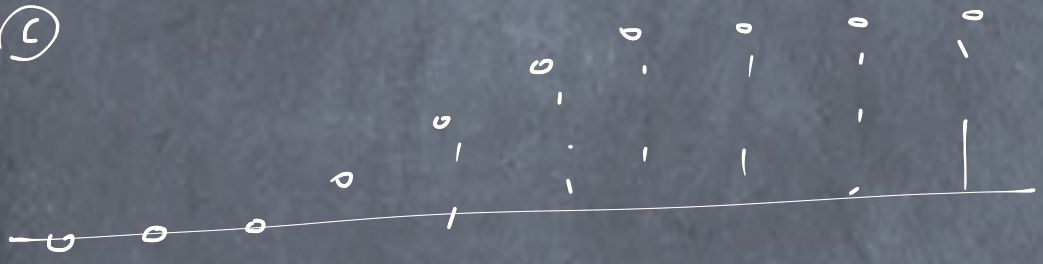
(a) Draw $u[n]$



(b) $L = 5$ $\quad y[n] = ?$

	-3	-2	-1	0	1	2	3	4	5	6	7
$x[n]$	0	0	0	1	1	1	1	1	1	1	1
$y[n]$	0	0	0	$\frac{1}{5}$	$\frac{2}{5}$	$\frac{3}{5}$	$\frac{4}{5}$	1	1	1	1

(c)



5.3 $y[n] = 2x[n] - 3x[n-1] + 2x[n-2]$

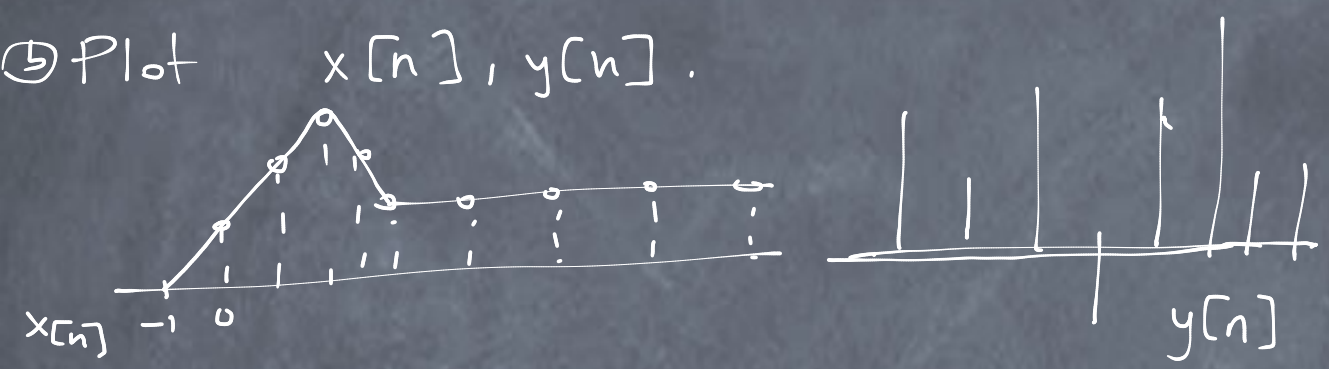
When the input

$$x[n] = \begin{cases} 0 & n<0 \\ n+1 & n=0,1,2 \\ 5-n & n=3,4 \\ 1 & n \geq 5 \end{cases}$$

(a) Compute $y[n]$ $\quad 0 \leq n \leq 10$

	<0	0	1	2	3	4	5	6	7	8	9
x[n]	0	1	2	3	2	1	1	1	1	1	1
y[n]	0	2	1	2	-1	2	3	1	1	1	1

(b) Plot $x[n]$, $y[n]$.



(c) Determine the response of the system to a unit impulse input.

$$h[0] = 2\delta[0] - 3\delta[-1] + 2\delta[-2] = 2$$

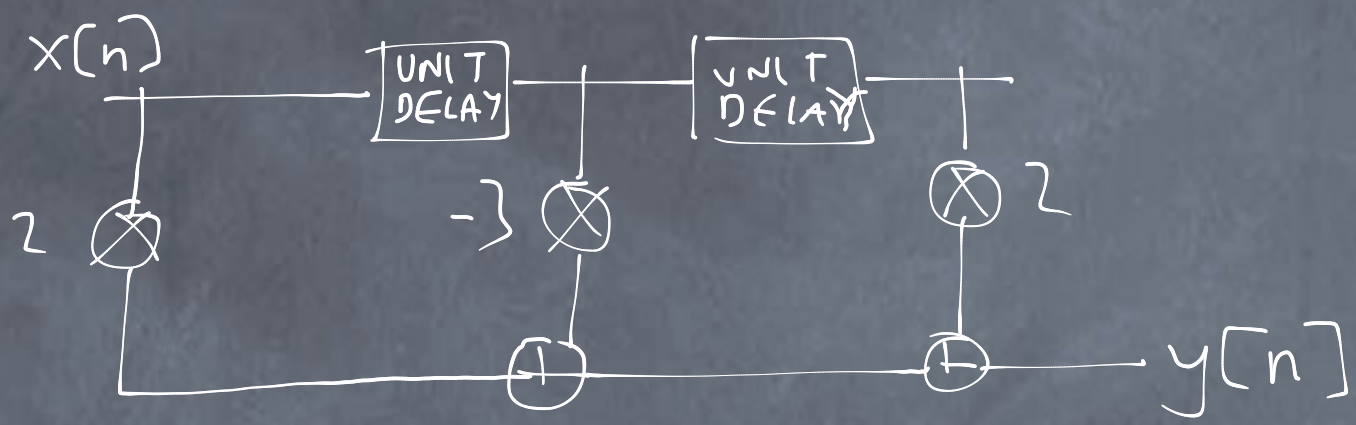
$$h[1] = 2\delta[1] - 3\delta[0] + 2\delta[0] = -3$$

$$h[2] = 2\delta[2] - 3\delta[1] + 2\delta[0] = 2$$

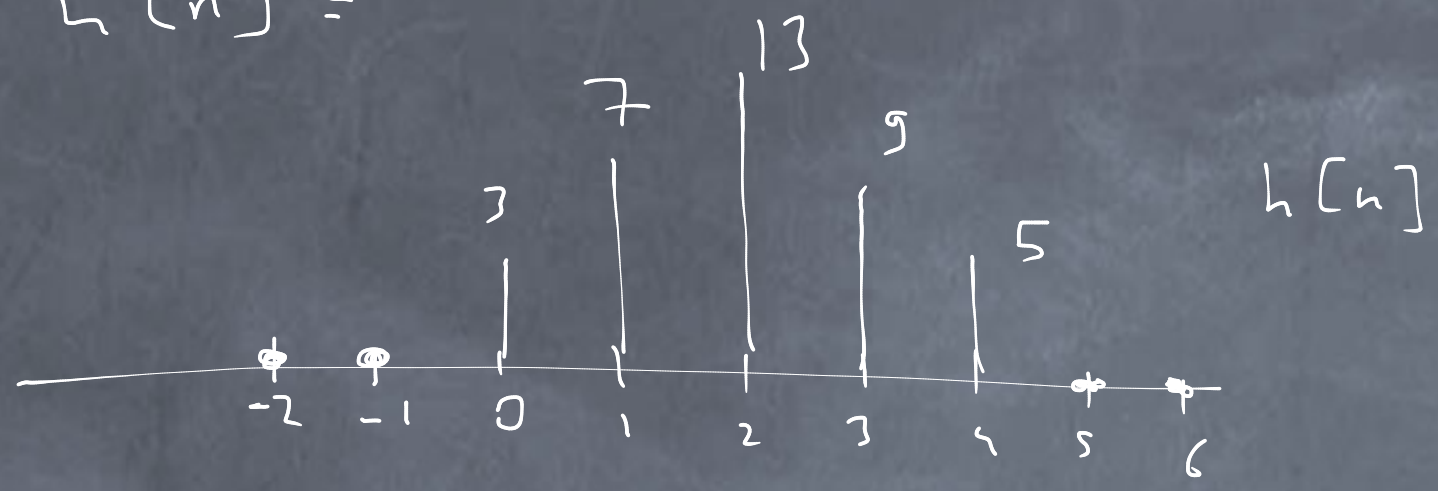
$$h[n] = 2\delta[n] - 3\delta[n-1] + 2\delta[n-2]$$

5.4 $y[n] = 2x[n] - 3x[n-1] + 2x[n-2]$

(a) Draw the block diagram.



5.7 $h[n]$ =



Determine the filter coefficients.

$b_k = \{3, 7, 13, 9, 5\}$

5.9 Linearity

$a_1 x_1[n] + a_2 x_2[n] = x[n]$? $= a_1 y_1 + a_2 y_2$

$y_1 \in x_1[n]$

$y_2 \in x_2[n]$

(a) $x[n]\cos(0.2\pi n) = y[n]$ LINEAR

$y_1 = x_1[n]\cos(0.2\pi n)$

$y_2 = x_2[n]\cos(0.2\pi n)$

$a_1 y_1 + a_2 y_2$ = ?

$x[n]$

$(a_1 x_1[n] + a_2 x_2[n]) \times \cos(0.2\pi n)$

(b) $y[n] = x[n] - x[n-1]$

$y_1 = x_1[n] - x_1[n-1]$

$y_2 = x_2[n] - x_2[n-1]$

$a_1 y_1 + a_2 y_2$ $=$ $a_1 x_1[n] + a_2 x_2[n] - a_1 x_1[n-1] - a_2 x_2[n-1]$

LINEAR

(c) $y[n] = |x[n]|$ NOT LINEAR

$a_1 |x_1[n]| + a_2 |x_2[n]| \neq |a_1 x_1[n] + a_2 x_2[n]|$

a_1, a_2 neg

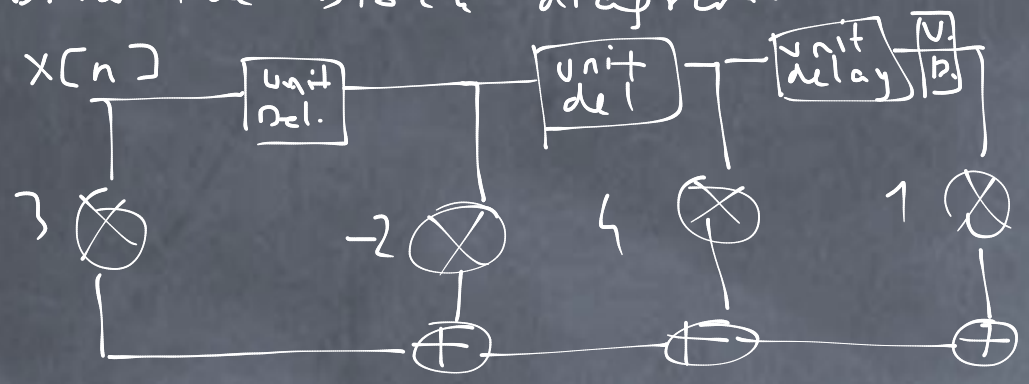
(d) $y[n] = Ax[n] + B$

$A(a_1 x_1[n] + a_2 x_2[n]) + B \stackrel{?}{=} A a_1 x_1(n) + B + A a_2 x_2(n) + B$

$B \neq 0$ ✗

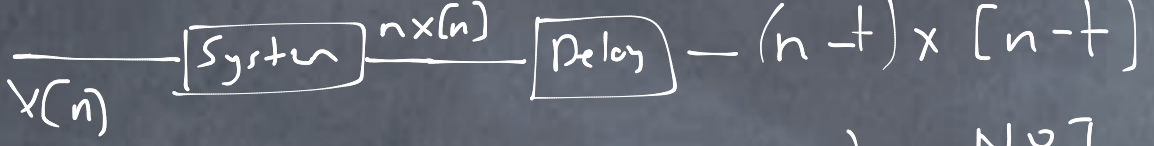
5.11 $h[n] = 3\delta[n] - 2\delta[n-1] + 4\delta[n-3] + \delta[n-4]$

Draw the block diagram.



5.9

Input delayed → output delayed same amount
$y[n] = n\,x[n]$



a) $y[n] = x[n]\cos(0.2\pi n)$ NOT IT

$x[n-1] \rightarrow x[n-1]\cos(0.2\pi n)$

$x[n]\cos(0.2\pi n) \longrightarrow x[n-1]\cos(0.2\pi(n-1))$

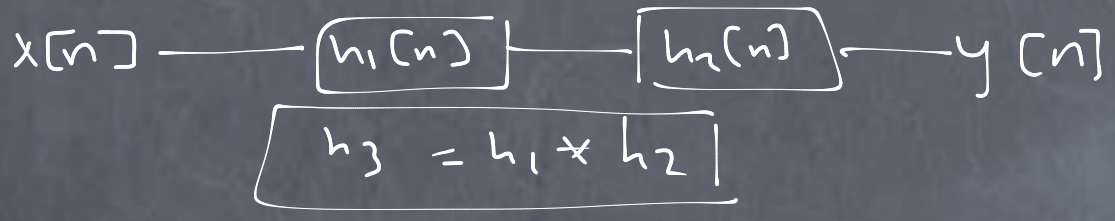
b $y[n] = x[n] - x[n-1]$ ✓

c $y[n] = |x[n]|$ ✓

d $y[n] = Ax[n] + B$ ✓

CAUSAL:

YES



Ex: $\delta[n] * x[n] = x[n]$ (1)

$\delta[n-n_0] * x[n] = x[n-n_0]$ (1)

$h[n] = \delta[n] + 2\delta[n-1] - 3\delta[n-3]$

$x[n] = \delta[n+1] + \delta[n-2]$

$h[n] * x[n] = ?$

		1	2	0	-3		
+				1	2	0	-3
	1	2	0	-2	2	0	-3

MATLAB

```
xx = sin(0.07*pi*(0:50));
hh = ones(11,1)/11;
yy = conv(hh, xx);
```