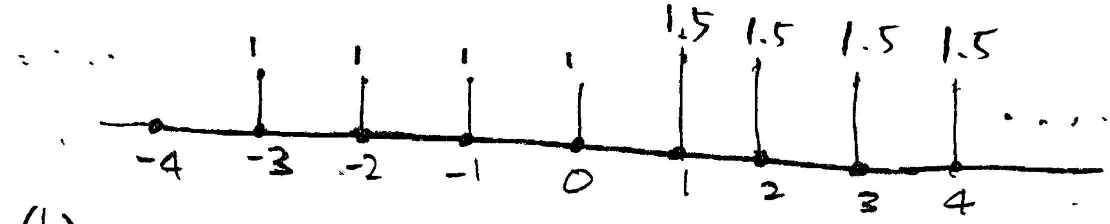
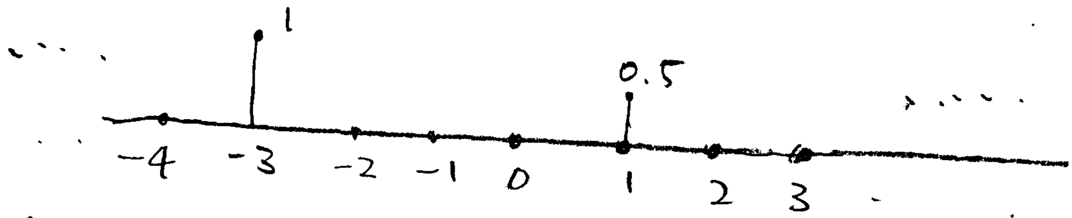
Discrete-Time Signals and System Jaeha Huh

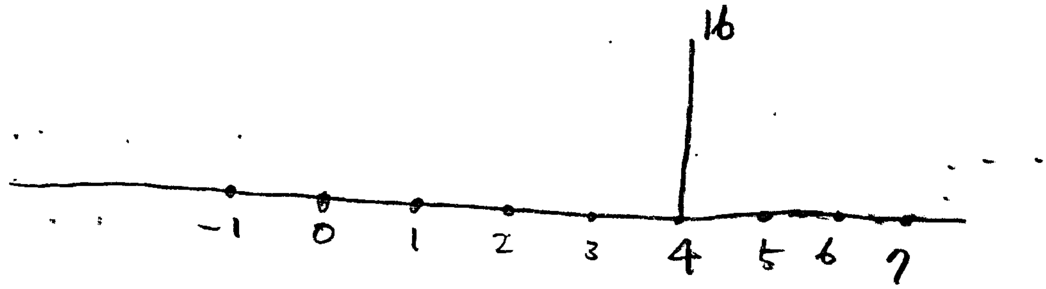
1.1.1 (a) $x(n) = u(n+3) + 0.5\,u(n-1)$



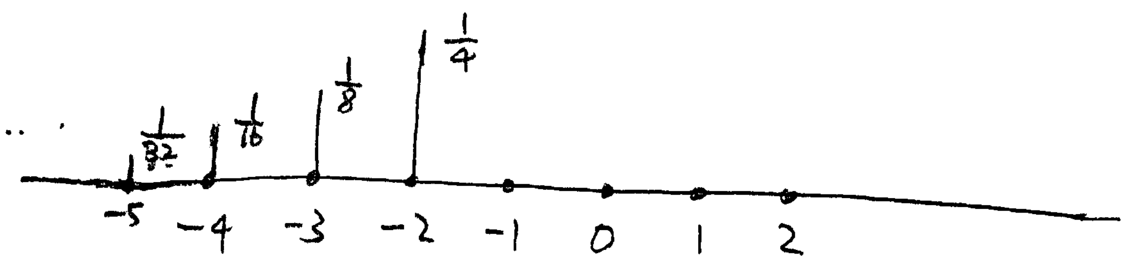
(b) $x(n) = \delta(n+3) + 0.5\,\delta(n-1)$



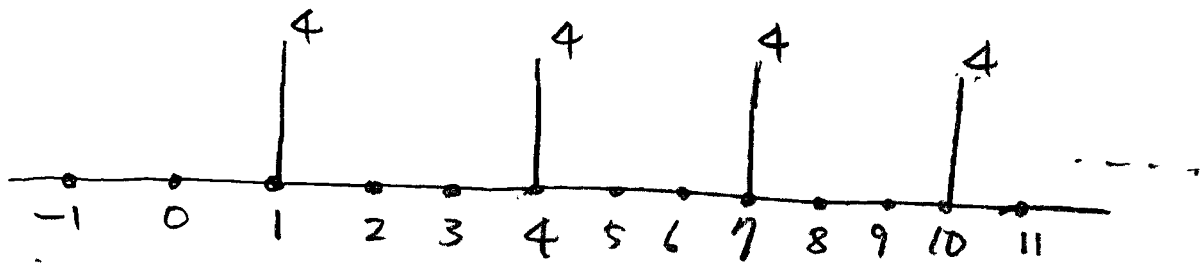
(c) $x(n) = 2^n \cdot \delta(n-4)$



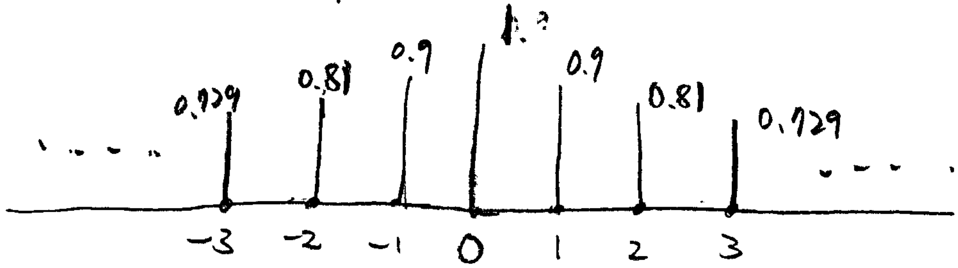
(d) $x(n) = 2^n\, u(-n-2)$



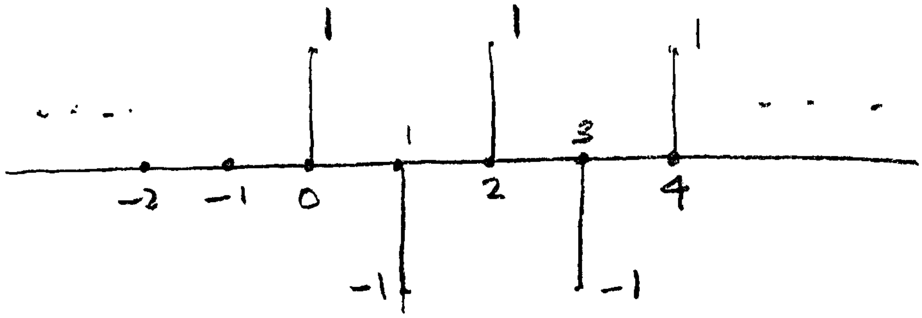
(g) $x(n) = \sum_{k=0}^{\infty} 4\,\delta(n-3k-1)$



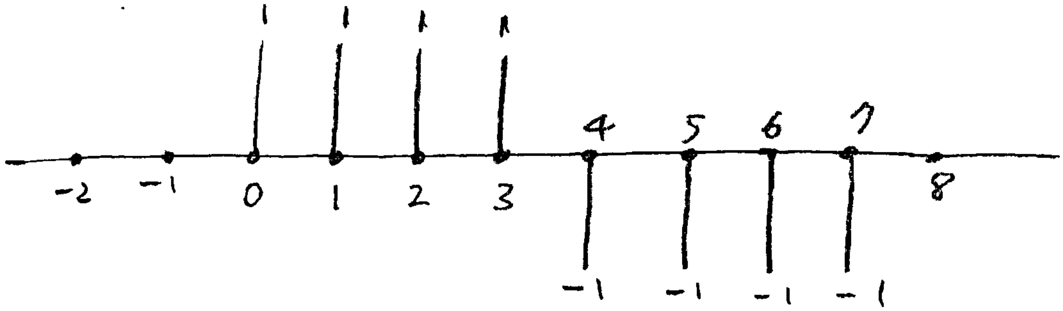
1.1.2 (a) $x(n) = \sum_{k=-\infty}^{\infty} (0.9)^{|k|} \delta(n-k)$



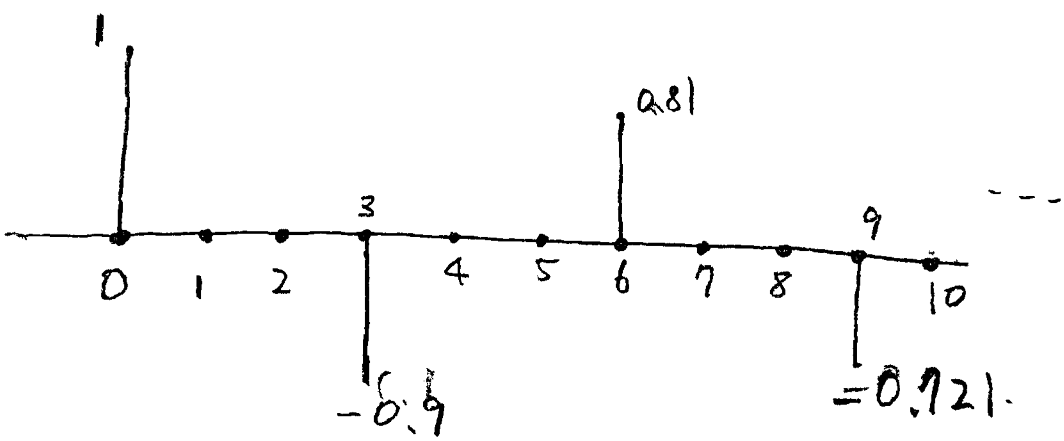
(b) $x(n) = \cos(\pi n)\, u(n)$



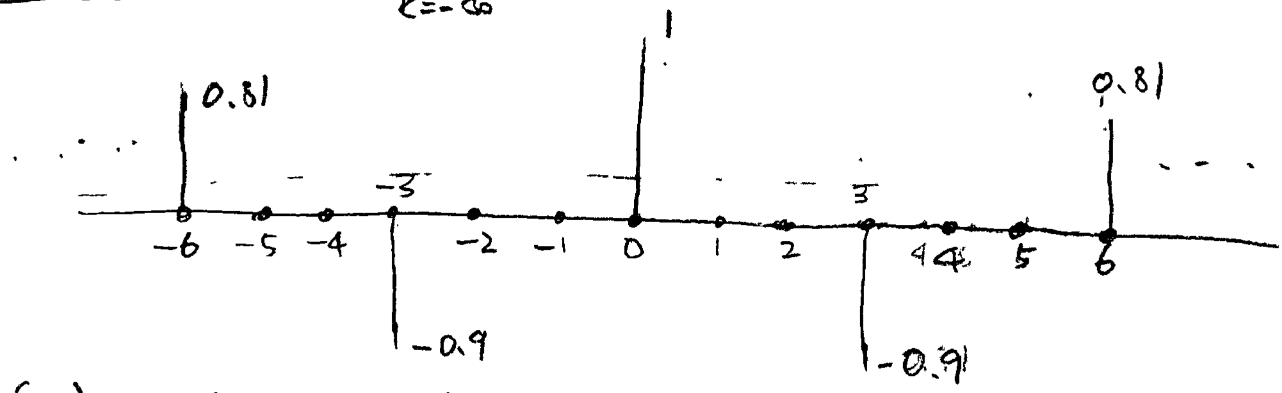
(c) $x(n) = u(n) - 2u(n-4) + u(n-8)$



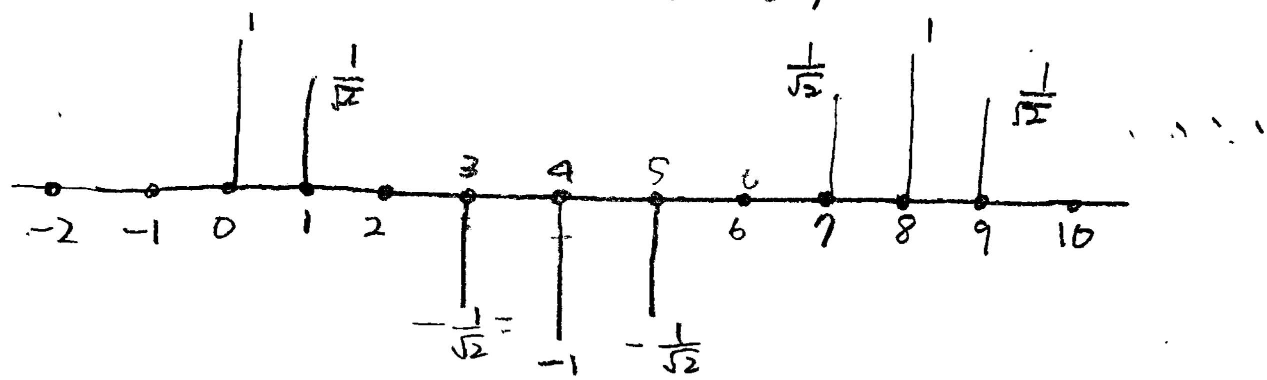
1.1.6. (a) $f(n) = \sum_{k=0}^{\infty} (-0.9)^k \delta(n-3k)$



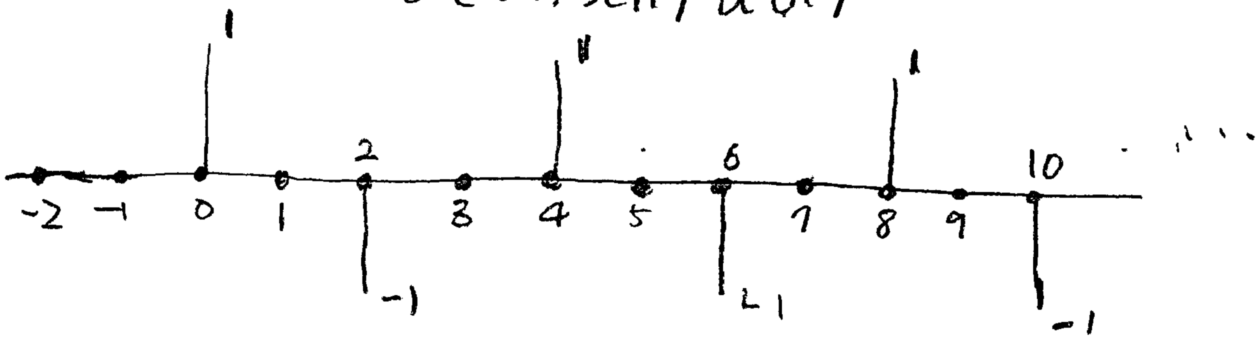
7.1.6 (b) $g(n) = \sum_{k=-\infty}^{\infty} (-0.9)^{|k|} \delta(n-3k)$



(c) $x(n) = \cos(0.25\pi n)\, u(n)$

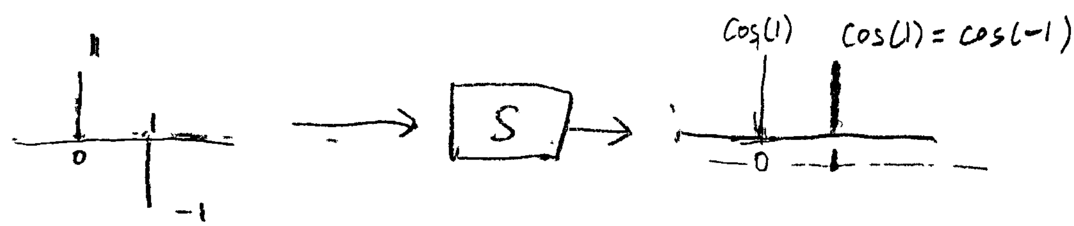


(d). $x(n) = \cos(0.5\pi n)\, u(n)$



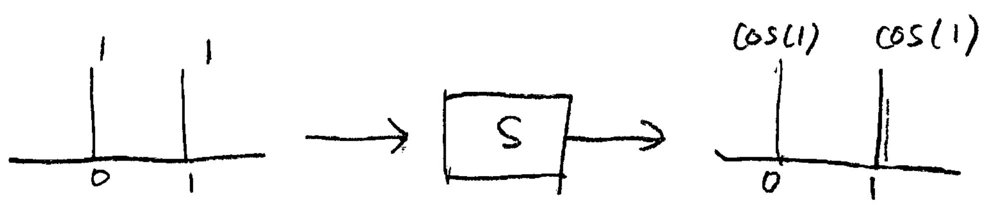
7.2.1 (a) $y = \cos(x(n))$.

$x_1(n)$

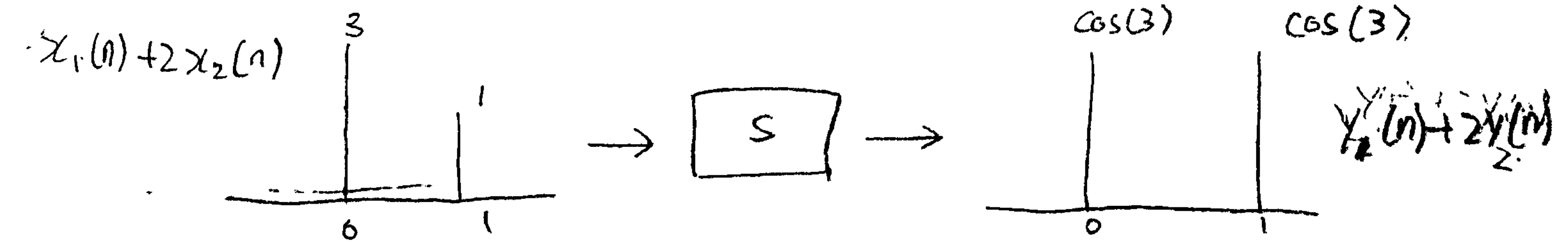


$y_1(n)$

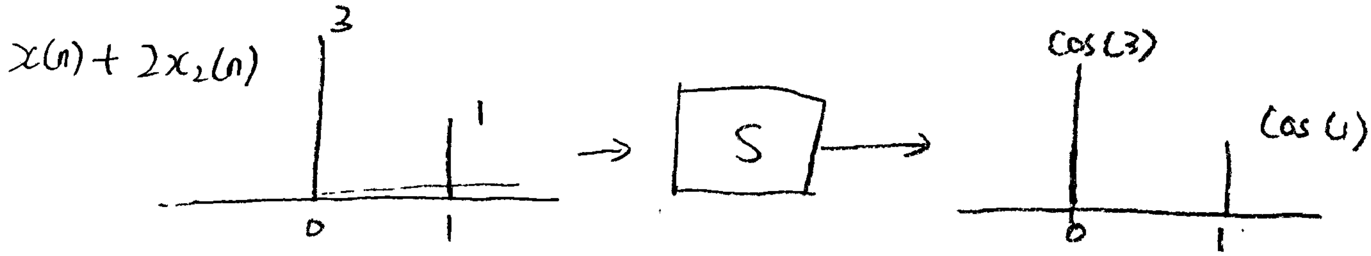
$x_2(n)$



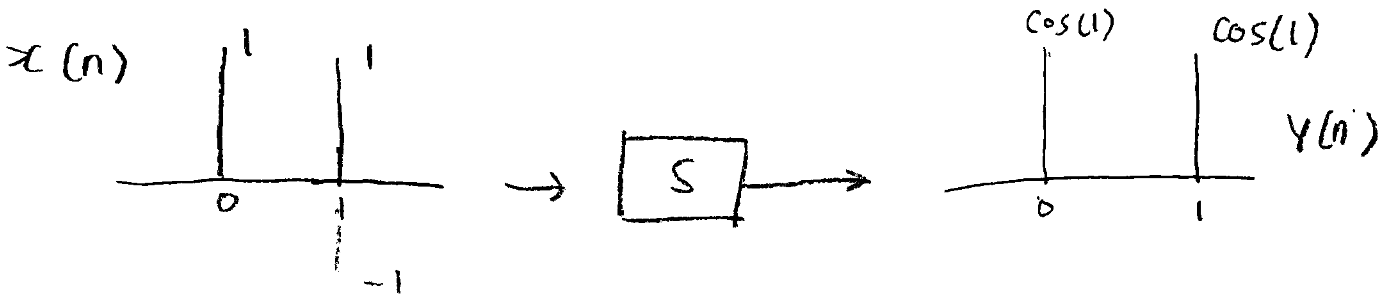
$y_2(n)$

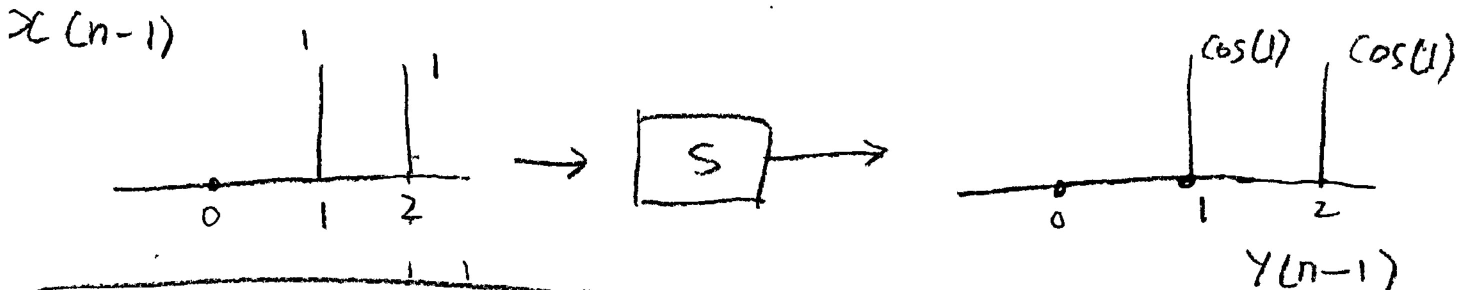


However; according to the system equation $y(n) = \cos(x(n))$,



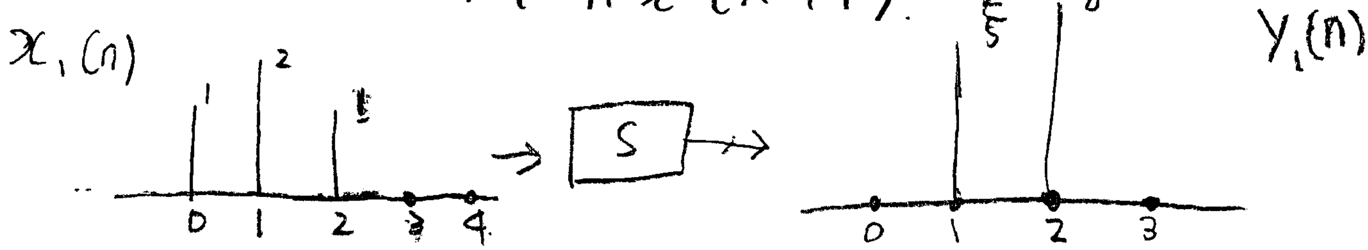
$\boxed{\therefore \text{ System is Not a linear.}}$

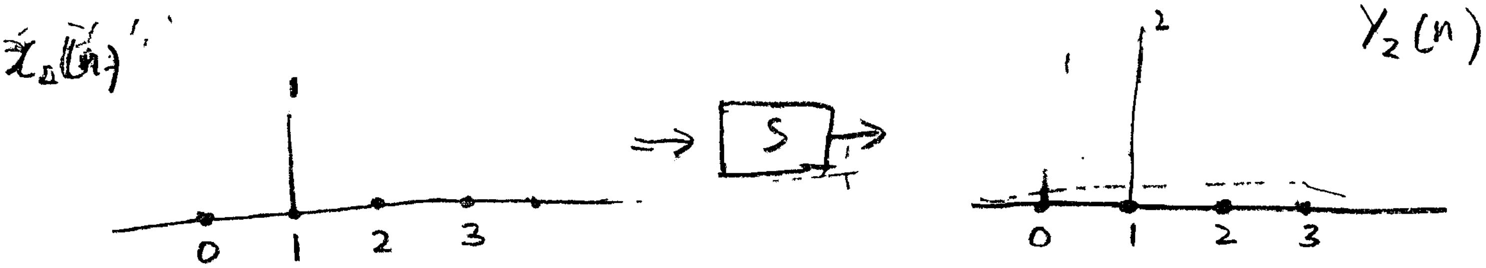


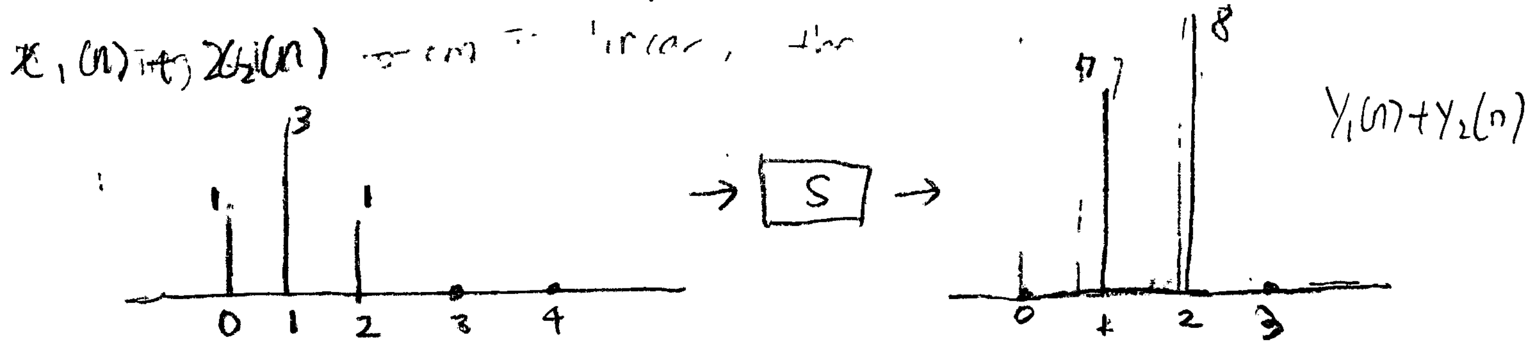


$\boxed{\therefore \text{ Sytem is Time Invariant}}$

(b) $y(n) = 2n^2 x(n) + n\,x(n+1)$.



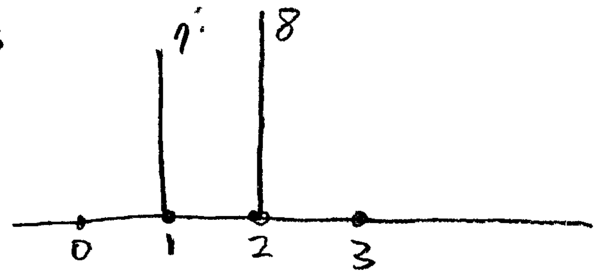




Assuming system is linear, the output signal is $y_1(n) + y_2(n)$

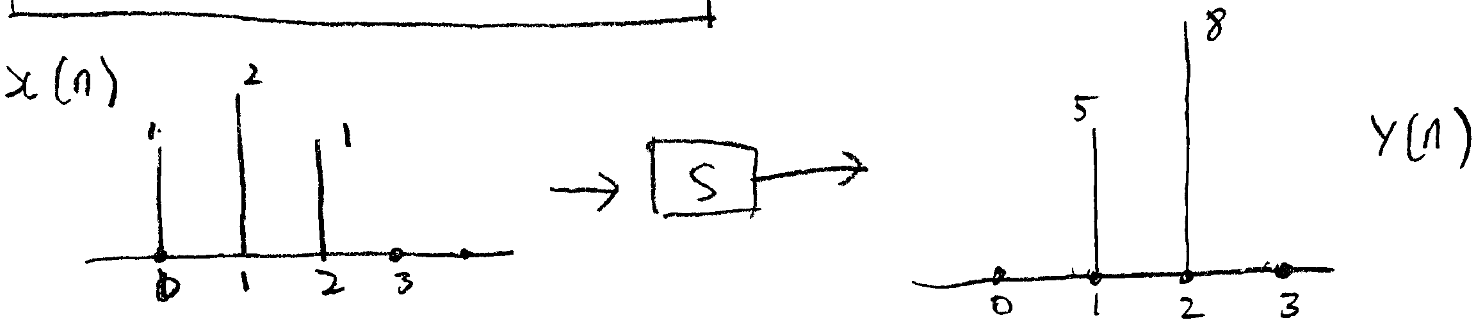
According to the system equation $y(n) = 2n^2 x(n) + n x(n+1)$

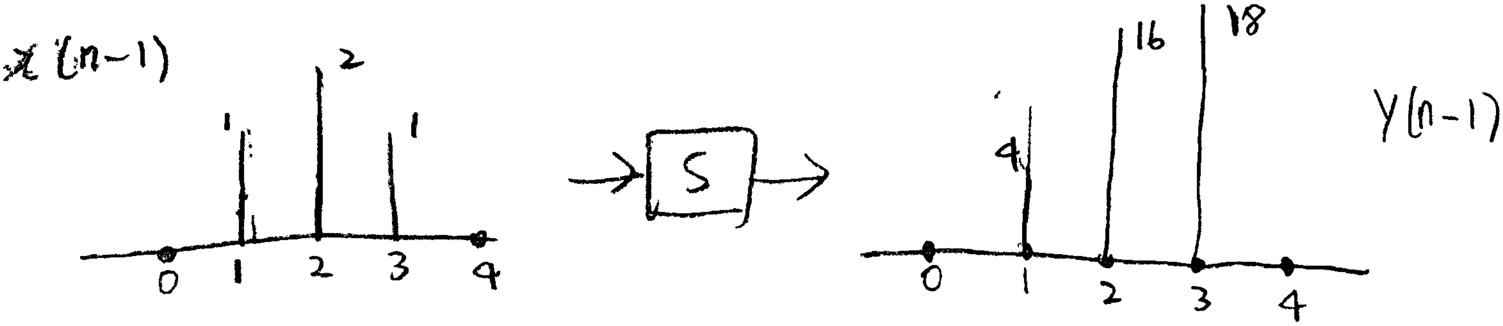
the output is



It is consistent with the assumption.

$\therefore$ The System is linear

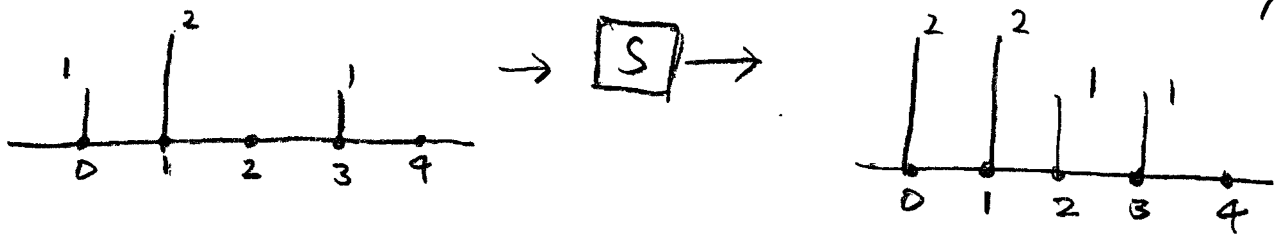




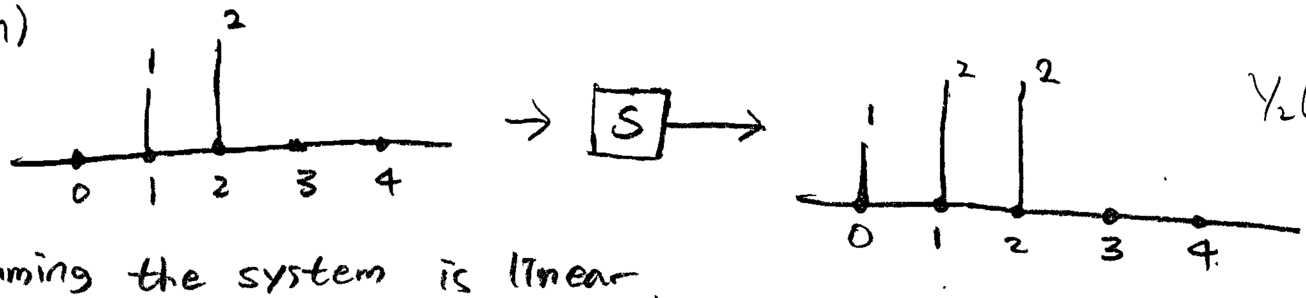
$\therefore$ System is Time-variant

(c) $y(n) = \max\{x(n), x(n+1)\}$

$x_1(n)$ $y_1(n)$

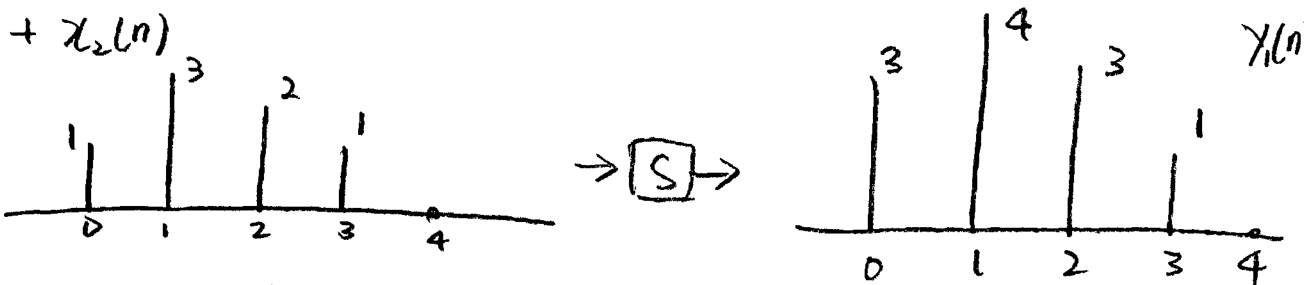


$x_2(n)$ $y_2(n)$

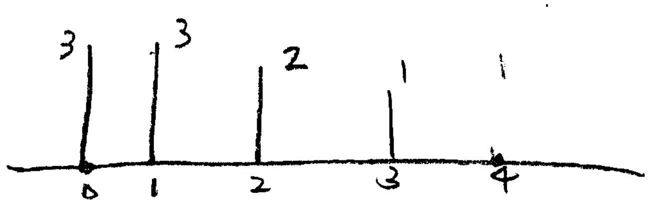


Assuming the system is linear.

$x_1(n) + x_2(n)$ $y_1(n) + y_2(n)$



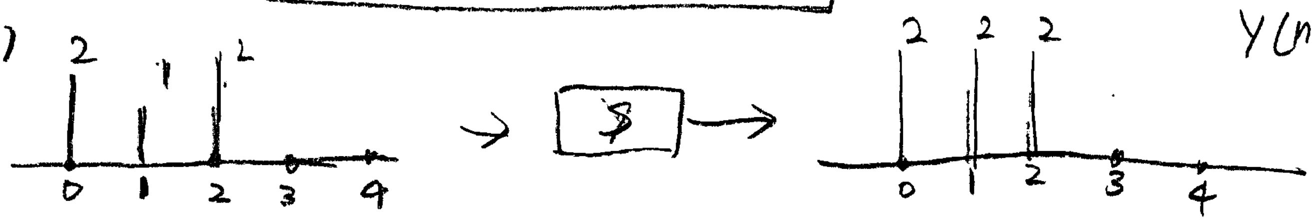
However, according to the system, the output is



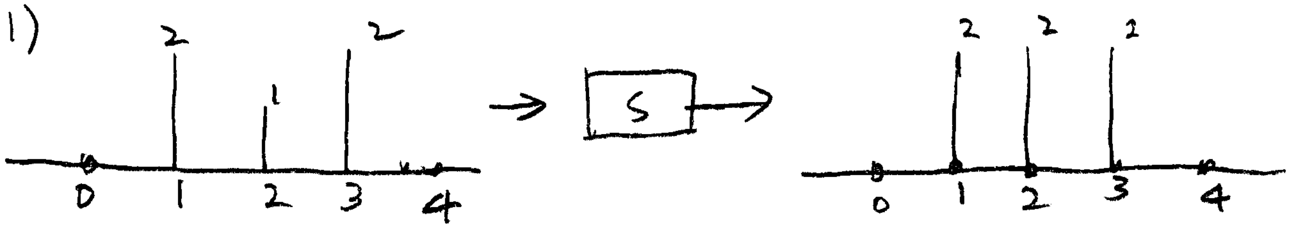
It is not consistent with the assumption.

$\boxed{\therefore \text{ the system is not linear.}}$

$x(n)$ $y(n)$

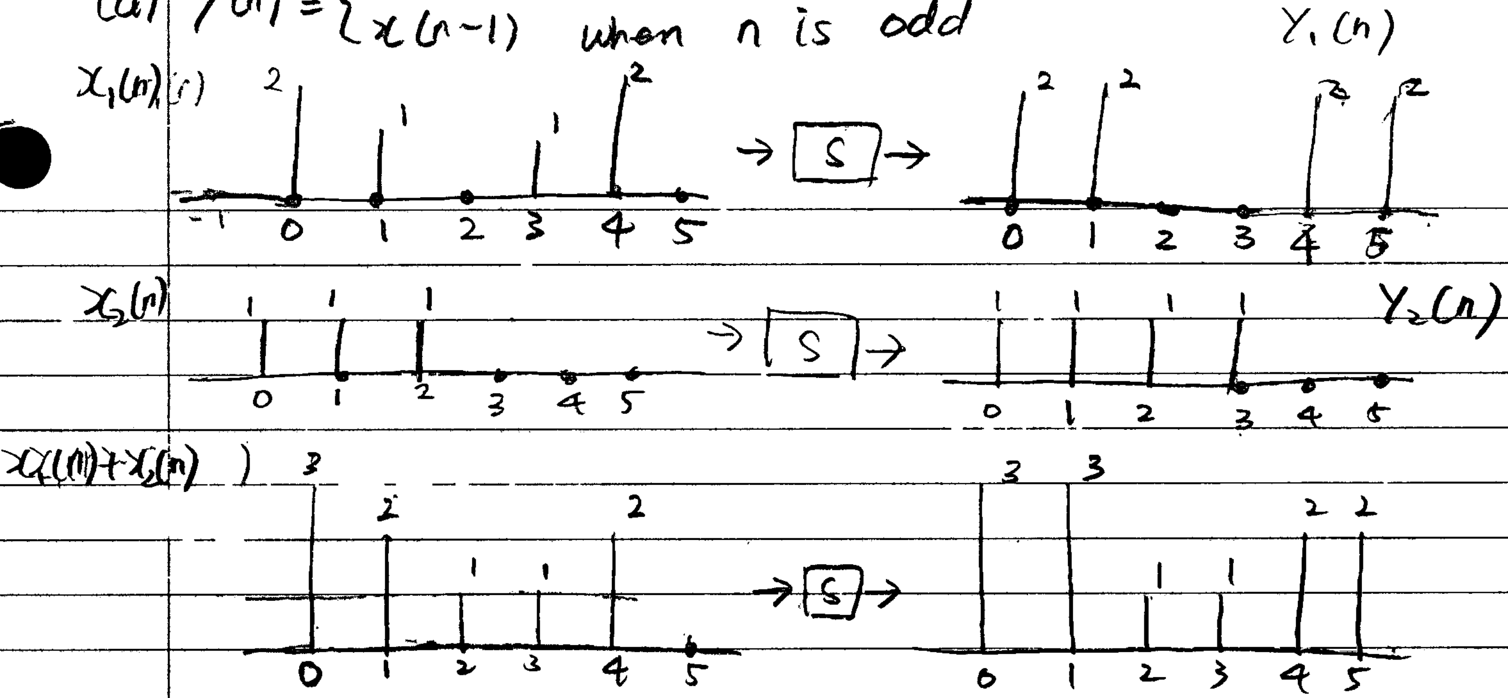


$x(n-1)$



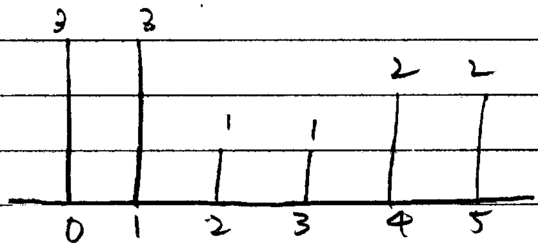
$\boxed{\therefore \text{ the system is time invariant}}$

(d) $y(n) = \begin{cases} x(n) & \text{when } n \text{ is even} \\ x(n-1) & \text{when } n \text{ is odd} \end{cases}$



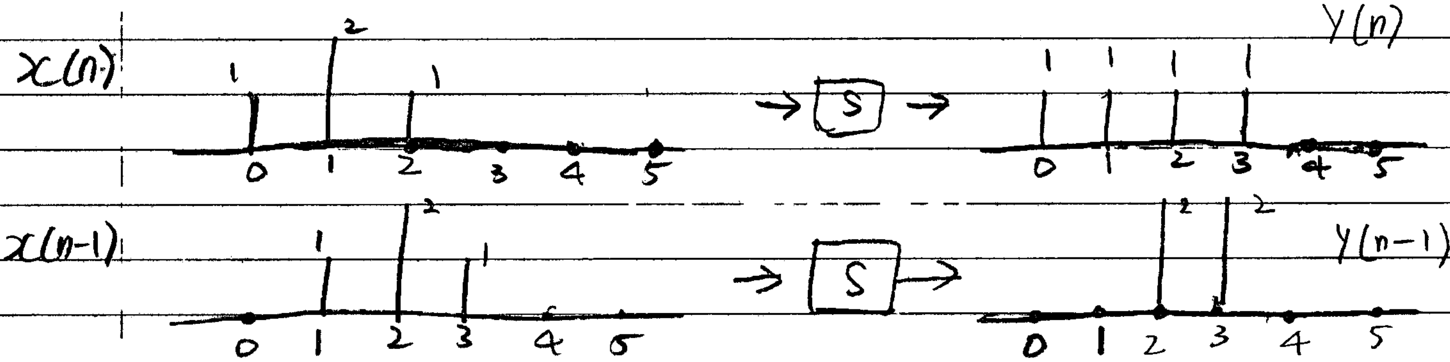
Assuming the system is linear, the output of system is $y_1(n) + y_2(n)$.

According to the system equation, the output is



The result is consistent with my assumption.

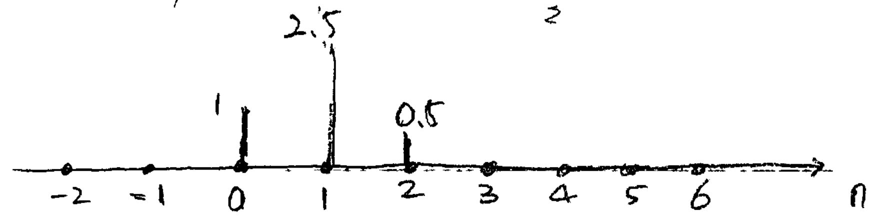
$\boxed{\therefore \text{The system is linear}}$



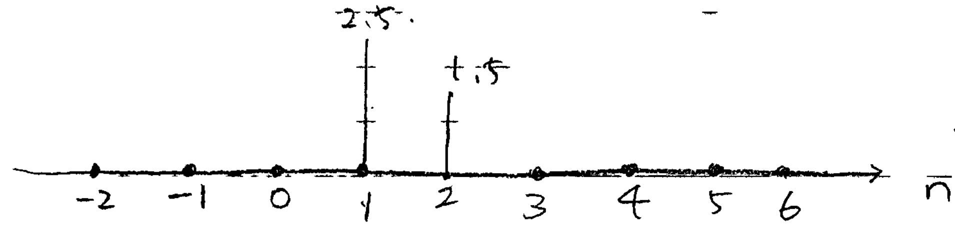
$\boxed{\therefore \text{the System is time-Variant}}$

1.2.2 $y(n) = 0.5\,x(2n) + 0.5\,x(2n-1)$

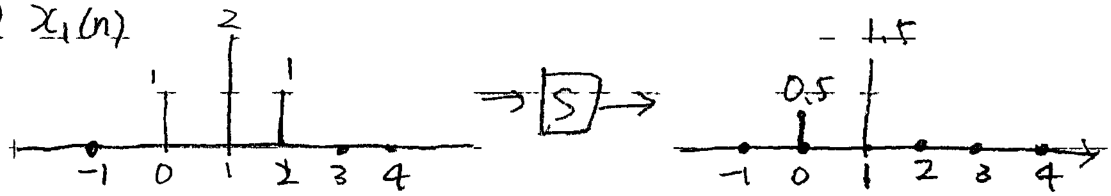
(a) $y(n)$



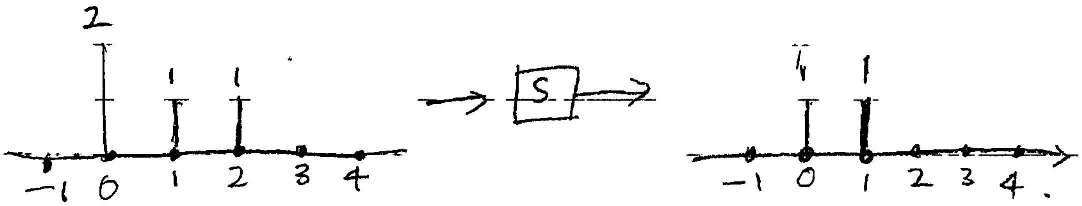
(b) $y(n)$



(c) $x_1(n)$ $y_1(n)$

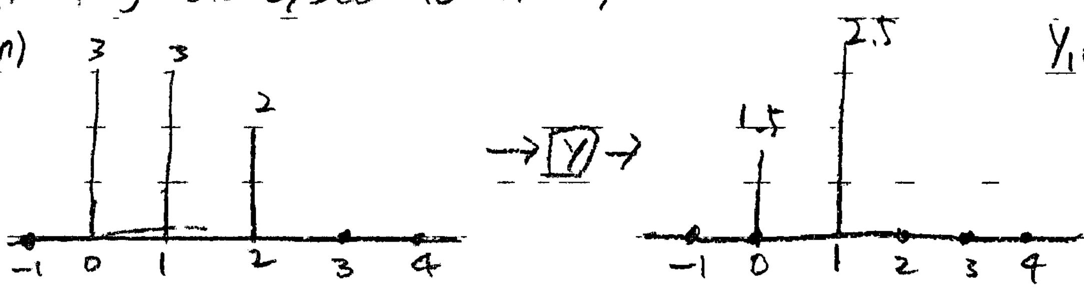


$x_2(n)$ $y_2(n)$

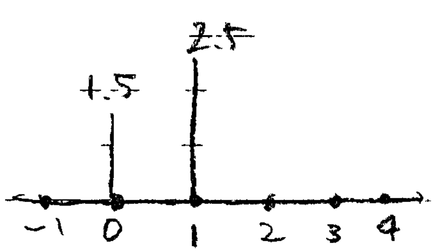


Assuming the system is linear,

$x_1(n)+x_2(n)$ $y_1(n)+y_2(n)$



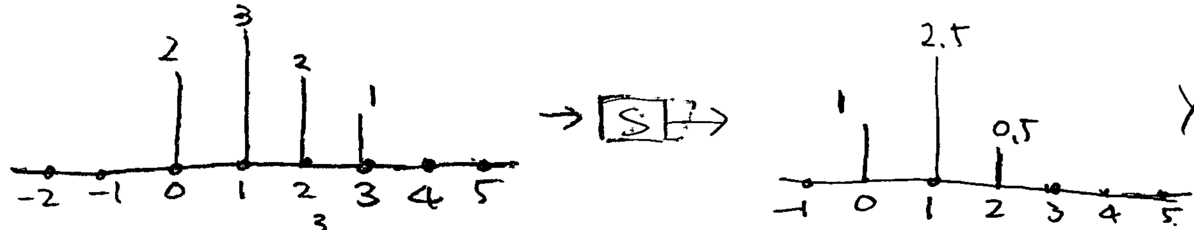
According to the system equation, the output is



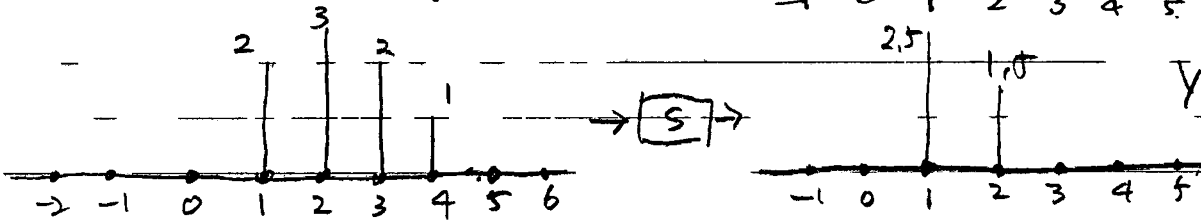
It is consistent with the assumption.

$\boxed{\therefore \text{ the system is linear.}}$

$x(n)$ $\rightarrow$ S $\rightarrow$ $Y(n)$



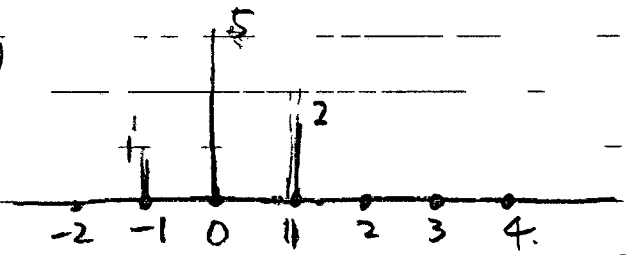
$x(n-1)$ $\rightarrow$ S $\rightarrow$ $Y(n-1)$



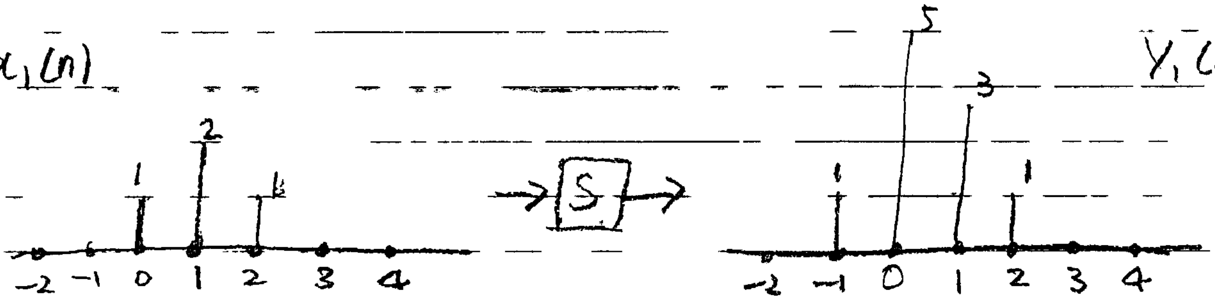
$\boxed{\therefore \text{ the system is time-varing}}$

1.2.4 2) $Y(n) = x(n) + [x(n+1)]^2$

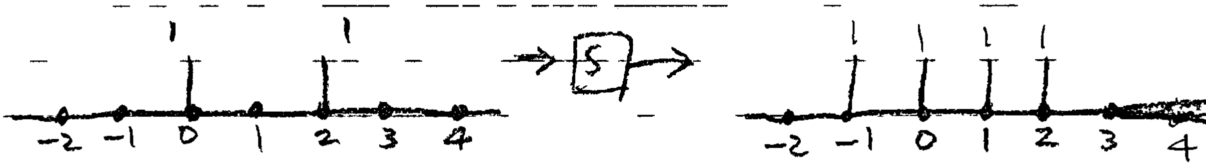
(a) $Y(n)$



(b). $x_1(n)$ $\rightarrow$ S $\rightarrow$ $Y_1(n)$

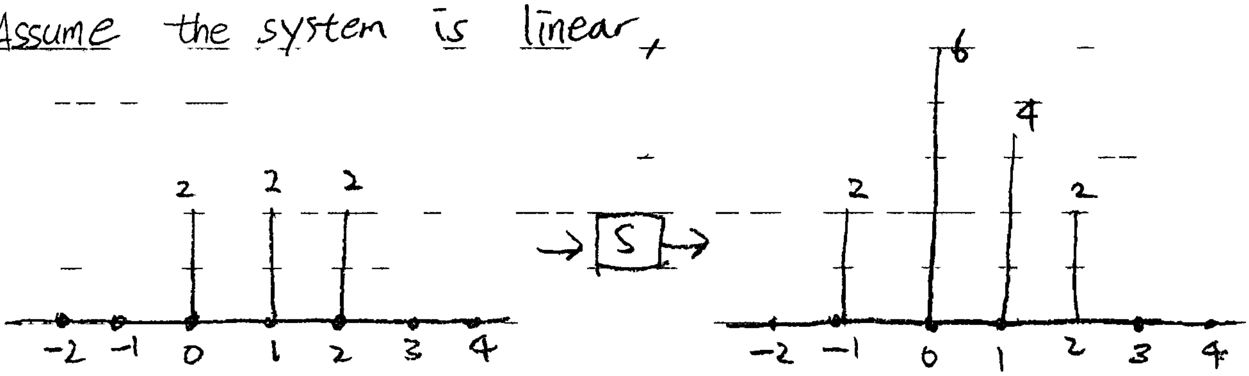


$x_2[n]$

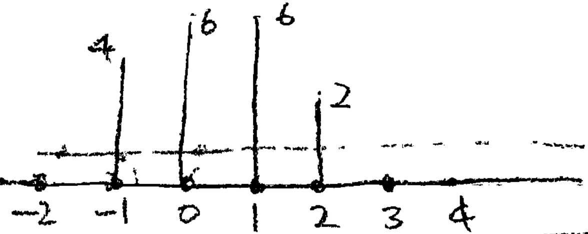


Assume the system is linear,

$x_1(n)+x_2(n)$



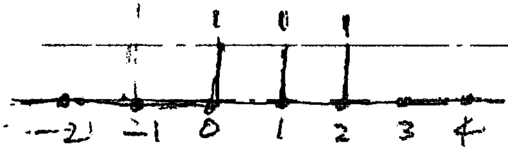
According to the system equation, the output is

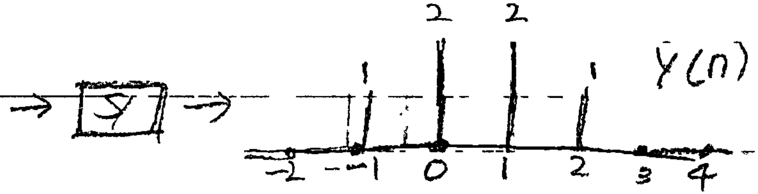


It is not the same as ~~my~~ assumption

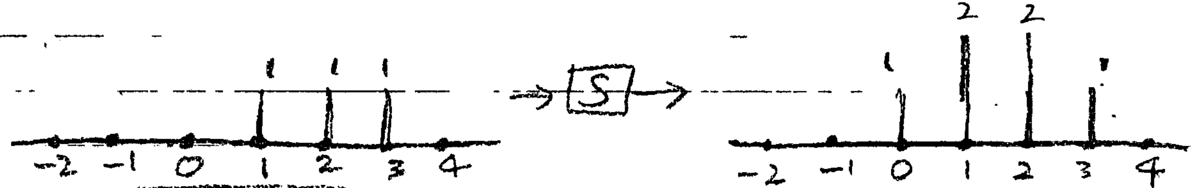
$\therefore$ the system is not linear

(c) $x(n)$



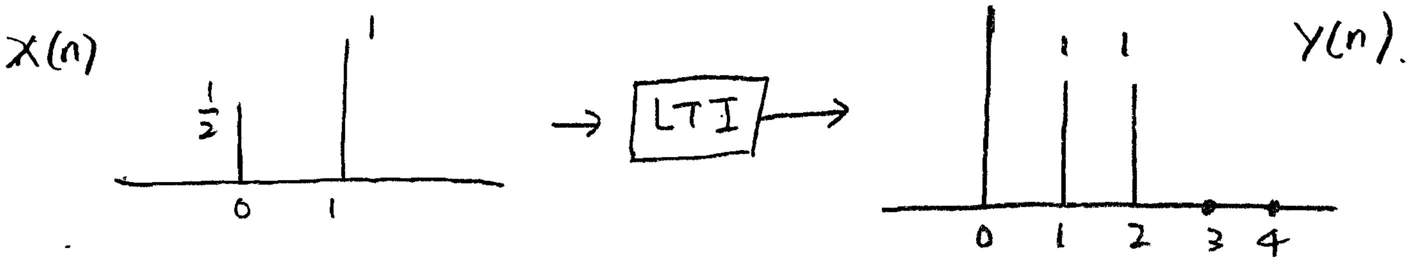


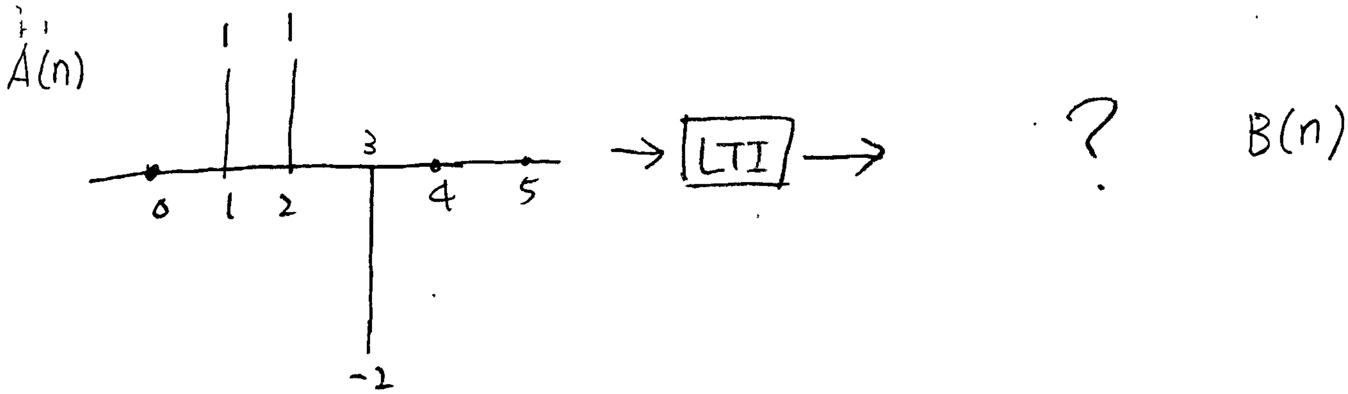
$x(n-1)$

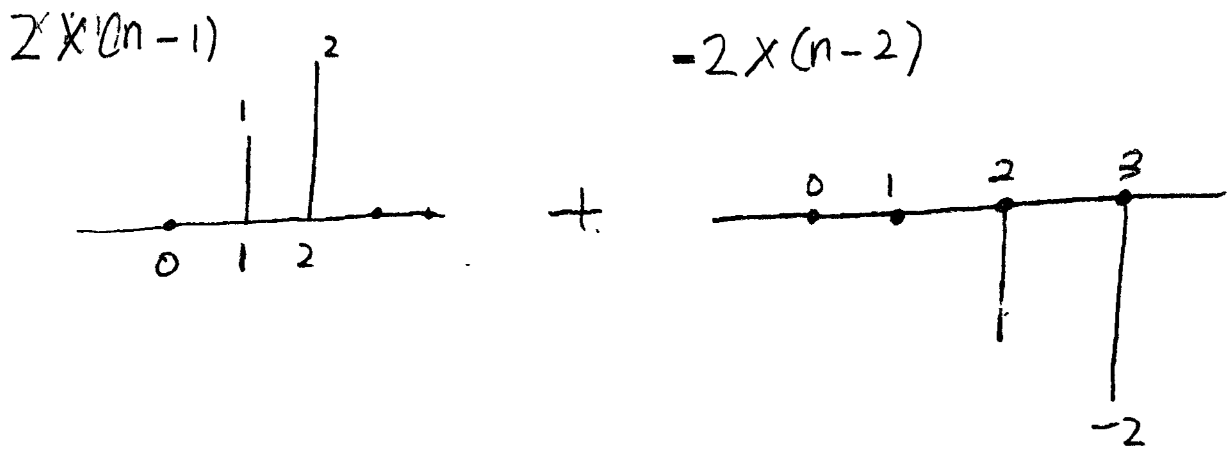


$\therefore$ the system is time-Invariant

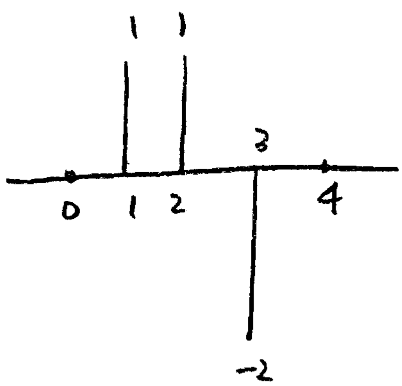
1.2.6. Given







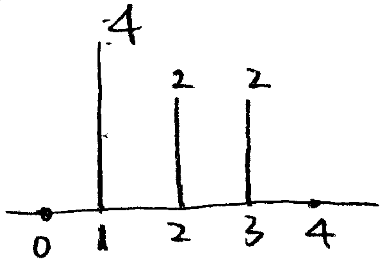
$\therefore A(n) = 2x(n-1) - 2x(n-2)$.



Output signal produced by Linear Time-Invariant system.

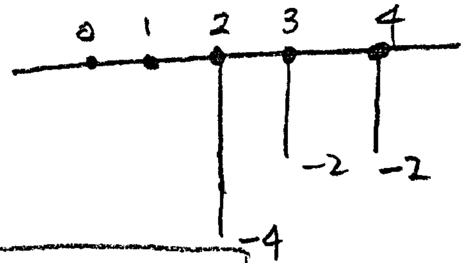
Thus, $B(n) = 2y(n-1) - 2y(n-2)$.

$2y(n-1)$

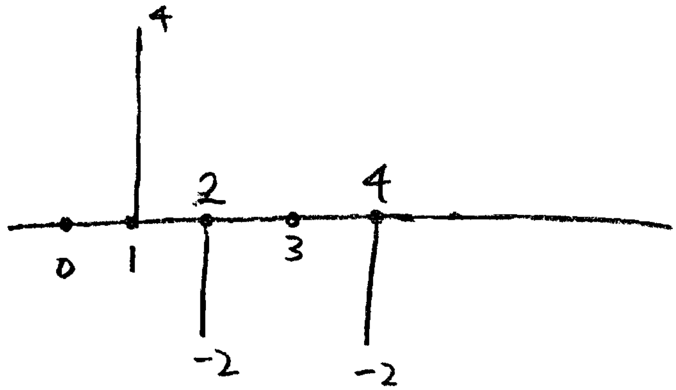


+

$-2y(n-2)$

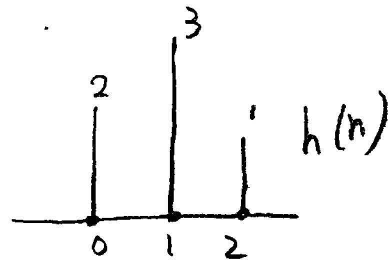


∴ Output signal is



1.2.7

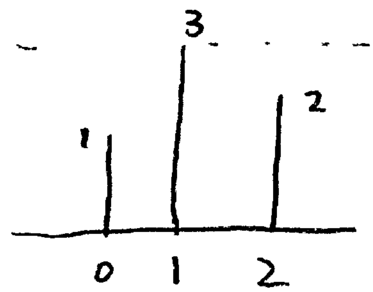
$$h(n) = 2\delta(n) + 3\delta(n-1) + \delta(n-2)$$



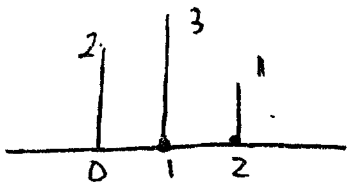
$$x(n) = \delta(n) + 3\delta(n-1) + 2\delta(n-2)$$

$$y(n) = x(n) * h(n)$$

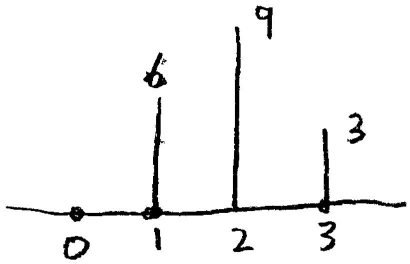
$$y(n) = y_0(n) + y_1(n) + y_2(n)$$



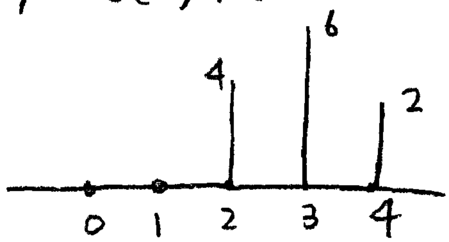
$$y_0(n) = x(0)\,h(n) = (1)\,h(n)$$



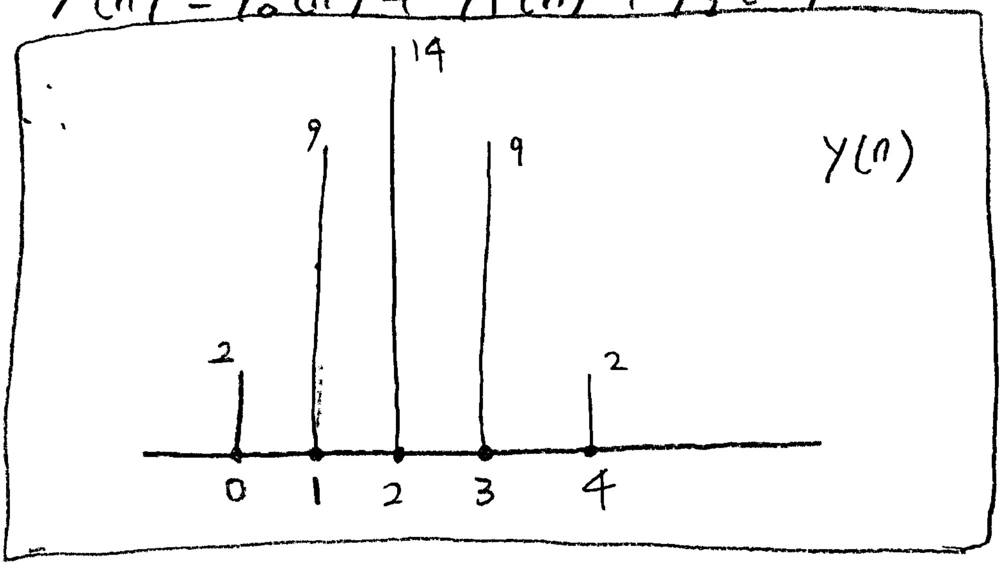
$$y_1(n) = x(1)\,h(n-1) = 3\,h(n-1)$$



$$y_2(n) = x(2)\,h(n-2) = 2\,h(n-2)$$



$$y(n) = y_0(n) + y_1(n) + y_2(n)$$



1.2.8.

$$y(n) = x(n-5) + \frac{1}{2}x(n-7)$$

substitude $x(n) = \delta(n)$

$$\boxed{\therefore h(n) = \delta(n-5) + \frac{1}{2}\delta(n-7)}$$