INSTITUT BISNIS DAN INFORMATIKA stikom SURABAYA

HEART & MIND TOWARDS EXCELLENCE

Sinyal Sistem

Oleh : Musayyanah, S.ST, MT

REVIEW

$y(t) = 2 * u(t-5)$ *dimana* sinyal u(t) didefinisikan sebagai berikut

$$u(t) = \begin{cases} 1, t \geq 1 \\ 0, t < 0 \end{cases}$$

a. Cek apakah sistem tersebut sistem kausal berikan alasanya.
b. Lakukan uji time invariant dengan waktu tunda sebesar 2 detik.
c. Lakukan pengujian untuk membuktikan hukum homogenitas dengan factor pengali sebesar 3

REMINDER !
Quiz : 7 April 2016

Sedia Payung Sebelum Hujan
Sedia peluru sebelum Menembak

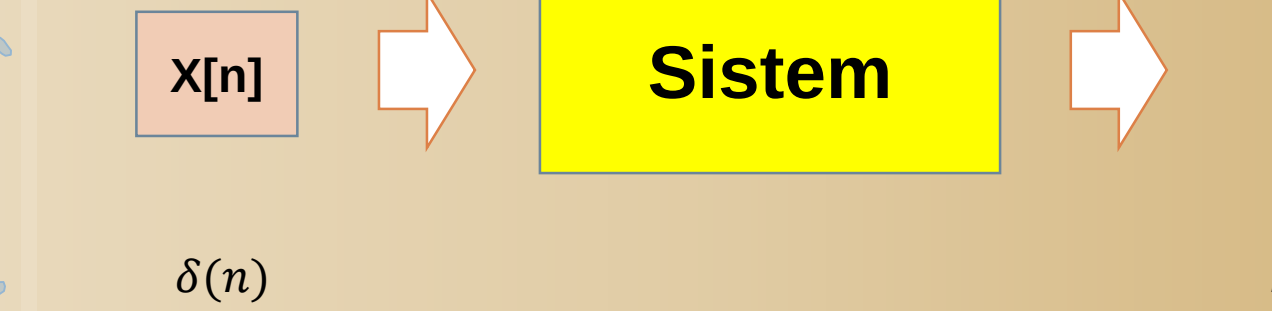
Siapkan diri untuk menempuh UTS Semester Genap
Kunci Keberhasilan UTS adalah

1. Kerja Keras (No Galau, Persiapan penuh)
2. Berdoa
3. Tawakal

Karakteristik Sistem

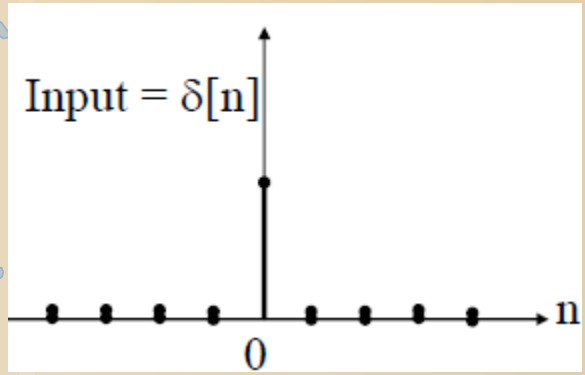
- Hubungan antara masukan dan keluaran itulah yang menyatakan karakteristik suatu sistem yang dapat memberitahu kita bagaimana sistem tersebut akan bekerja.
- Karakteristik sistem tersebut dikenal sebagai *impulse response*.
- *Impulse response* adalah reaksi sebuah sistem saat menerima sinyal impulse sebagai sinyal masukan.

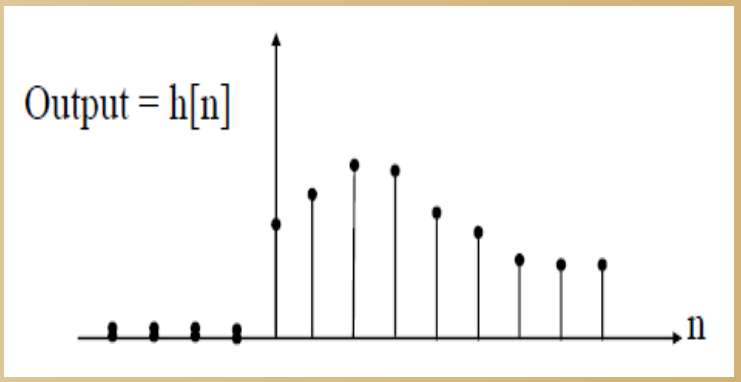
Karakteristik Sistem



$\delta(n)$

$h(n)$





Representasi sinyal

- Representasi sinyal–sinyal waktu diskrit dalam lingkup impuls

$$x[-1]\delta[n+1] = \begin{cases} x[-1], n = -1 \\ 0, n \neq -1 \end{cases}$$

$$x[0]\delta[n] = \begin{cases} x[0], n = 0 \\ 0, n \neq 0 \end{cases}$$

$$x[1]\delta[n-1] = \begin{cases} x[1], n = 1 \\ 0, n \neq 1 \end{cases}$$

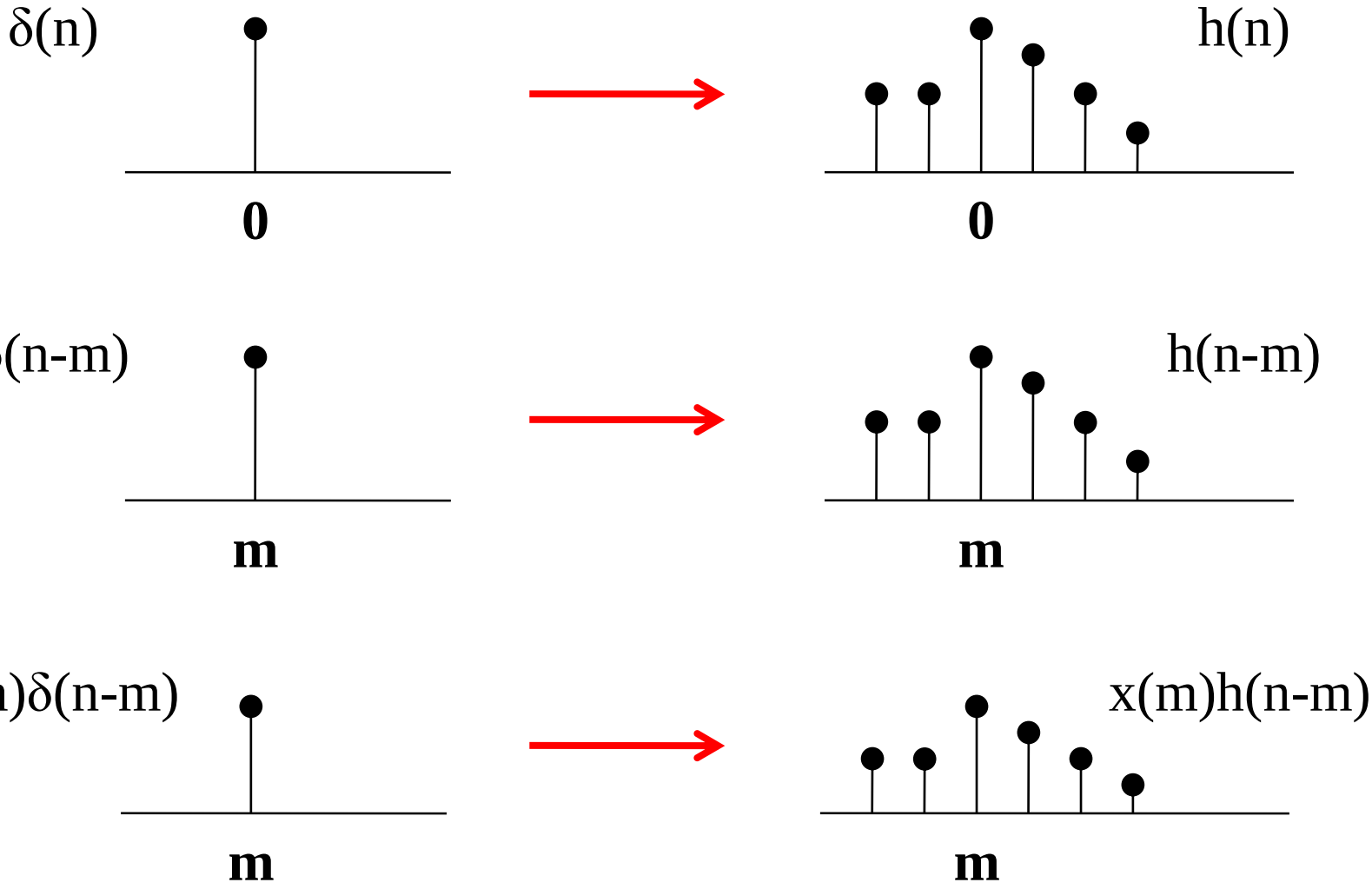
KONVOLUSI

- sebuah proses mendapatkan keluaran berdasarkan masukan yang diterima dan *impulse response* sistem.

$x(n) = \Sigma_k \, x(k) \, \delta(n-k)$

$y(n) = \Sigma_k \, y(k) \, \delta(n-k)$

Konvolusi



Konvolusi

$$y(n) = \sum_{m=-\infty}^{\infty} x(m)h(n-m)$$

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

k = n – m

$$y(n) = \sum_{k=-\infty}^{\infty} x(n-k)h(k)$$

$$y(n) = \sum_{k=-\infty}^{\infty} h(k)x(n-k)$$

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

Contoh Soal

Respon impuls dari suatu sistem LTI adalah

$$\mathbf{h[n]=\{1, 2, 1, -1\}}$$

Tentukan respon sistem terhadap sinyal masukan $\mathbf{x[n]=\{1, 2, 3, 1\}}$

Cara Analitik

k	x
0	1
1	2
2	3
3	1

x(0) = 1

x(1) = 2

x(2) = 3

x(3) = 1

k	h
-1	1
0	2
1	1
2	-1

h(-1) = 1

h(0) = 2

h(1) = 1

h(2) = -1

Batas bawah domain respon sistem = 0 + (-1) = -1

Batas atas domain respon sistem = 3 + 2 = 5

Cara Analitik

$$y(n) = \sum_{k=-\infty}^{\infty} x(k)h(n-k)$$

$$y(-1) = \sum_{k=-\infty}^{\infty} x(k)h(-1-k) = \sum_{k=0}^{3} x(k)h(-1-k)$$

y(-1) = x(0)*h(-1-0) + x(1)*h(-1-1) + x(2)*h(-1-2) + x(3)*h(-1-3)

y(-1) = x(0)*h(-1) + x(1)*h(-2) + x(2)*h(-3) + x(3)*h(-4)

y(-1) = 1*1 + 2*0 + 3*0 + 1*0

y(-1) = 1 + 0 + 0 + 0

y(-1) = 1

Cara Analitik

$y(0) = x(0)*h(0-0) + x(1)*h(0-1) + x(2)*h(0-2) + x(3)*h(0-3)$

$y(0) = x(0)*h(0) + x(1)*h(-1) + x(2)*h(-2) + x(3)*h(-3)$

$y(0) = 1*2 + 2*1 + 3*0 + 1*0$

$y(0) = 4$

$y(1) = x(0)*h(1-0) + x(1)*h(1-1) + x(2)*h(1-2) + x(3)*h(1-3)$

$y(1) = x(0)*h(1) + x(1)*h(0) + x(2)*h(-1) + x(3)*h(-2)$

$y(1) = 1*1 + 2*2 + 3*1 + 1*0$

$y(1) = 8$

Cara Analitik

$y(2) = x(0)*h(2-0) + x(1)*h(2-1) + x(2)*h(2-2) + x(3)*h(2-3)$

$y(2) = x(0)*h(2) + x(1)*h(1) + x(2)*h(0) + x(3)*h(-1)$

$y(2) = 1*-1 + 2*1 + 3*2 + 1*1$

$y(2) = 8$

$y(3) = x(0)*h(3-0) + x(1)*h(3-1) + x(2)*h(3-2) + x(3)*h(3-3)$

$y(3) = x(0)*h(3) + x(1)*h(2) + x(2)*h(1) + x(3)*h(0)$

$y(3) = 1*0 + 2*-1 + 3*1 + 1*2$

$y(3) = 3$

Cara Analitik

$y(4) = x(0)*h(4-0) + x(1)*h(4-1) + x(2)*h(4-2) + x(3)*h(4-3)$

$y(4) = x(0)*h(4) + x(1)*h(3) + x(2)*h(2) + x(3)*h(1)$

$y(4) = 1*0 + 2*0 + 3*-1 + 1*1$

$y(4) = -2$

$y(5) = x(0)*h(5-0) + x(1)*h(5-1) + x(2)*h(5-2) + x(3)*h(5-3)$

$y(5) = x(0)*h(5) + x(1)*h(4) + x(2)*h(3) + x(3)*h(2)$

$y(5) = 1*0 + 2*0 + 3*0 + 1*-1$

$y(5) = -1$

Contoh Soal

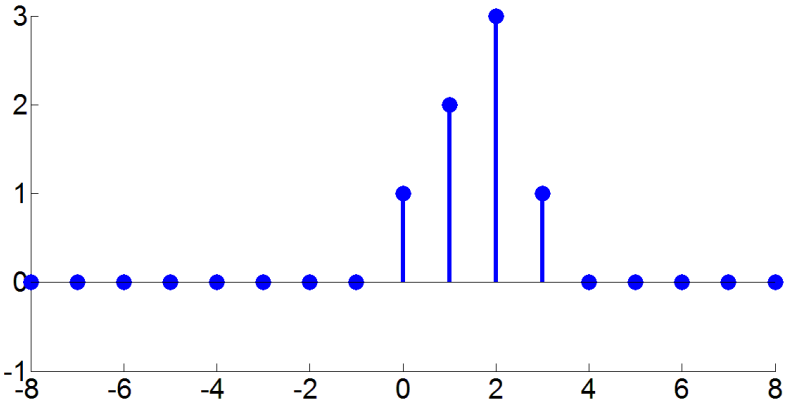
Respon impuls dari suatu sistem LTI adalah

$$\mathbf{h[n]=\{1, 2, 1, -1\}}$$

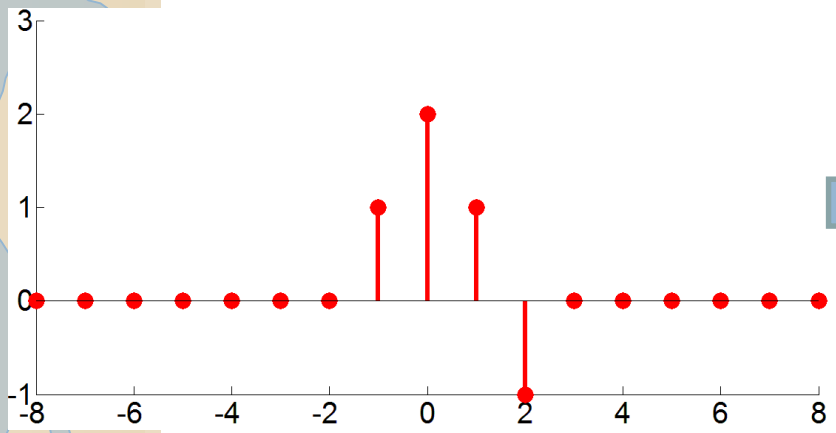
Tentukan respon sistem terhadap sinyal masukan $\mathbf{x[n]=\{1, 2, 3, 1\}}$

Cara Grafik

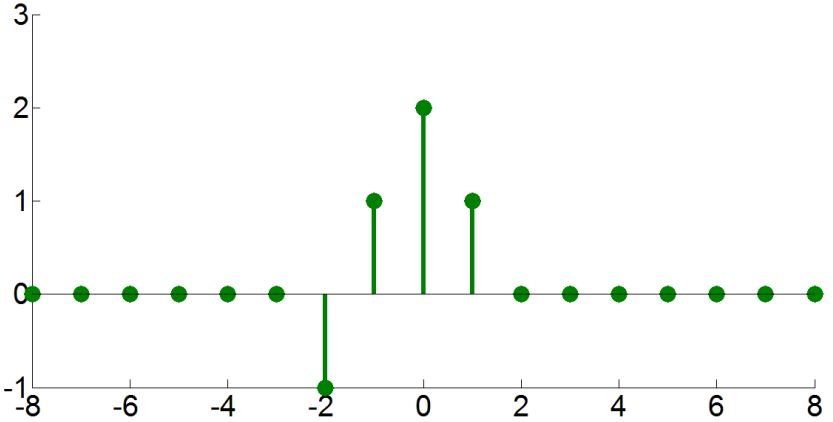
x(k)

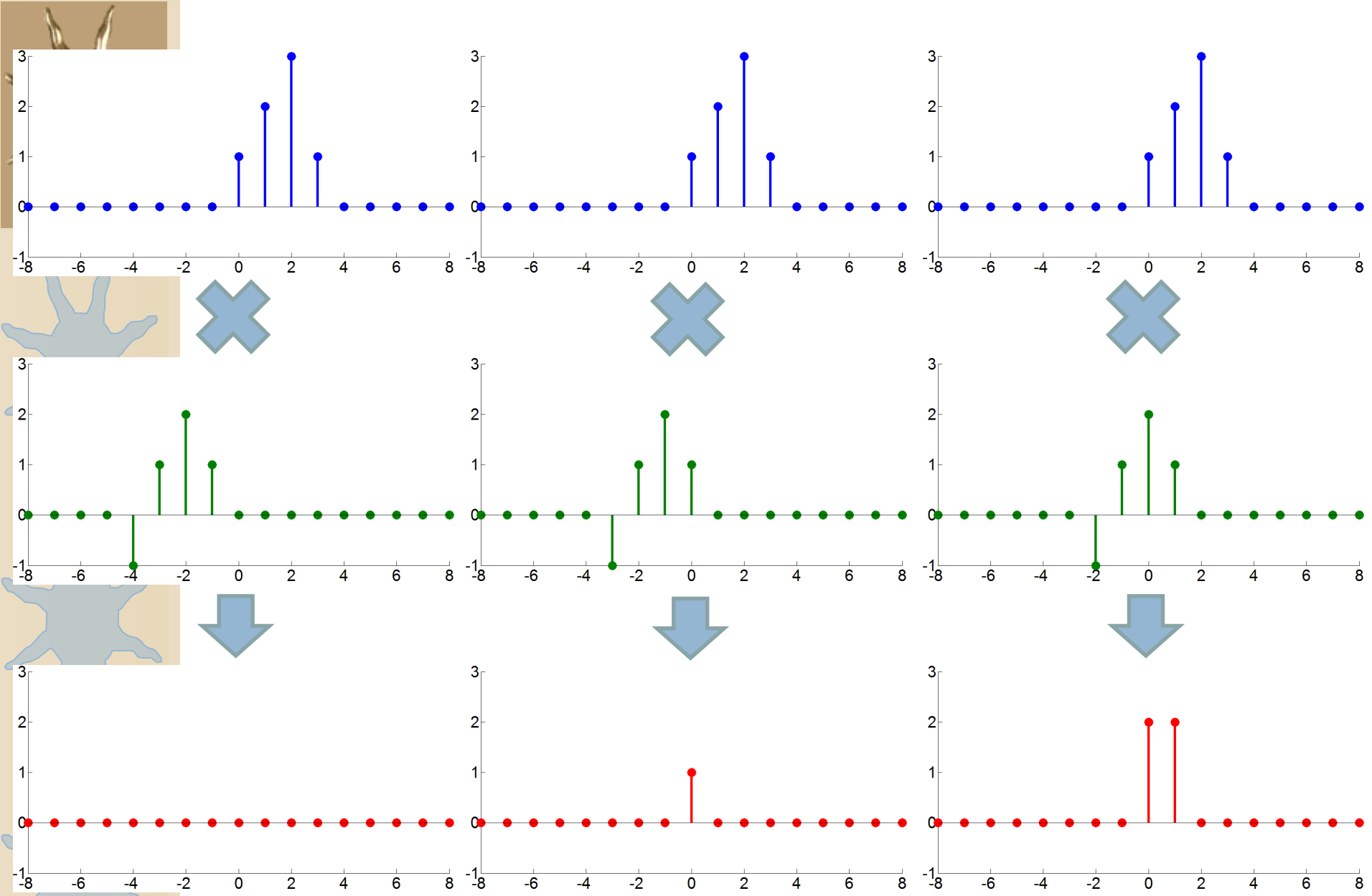


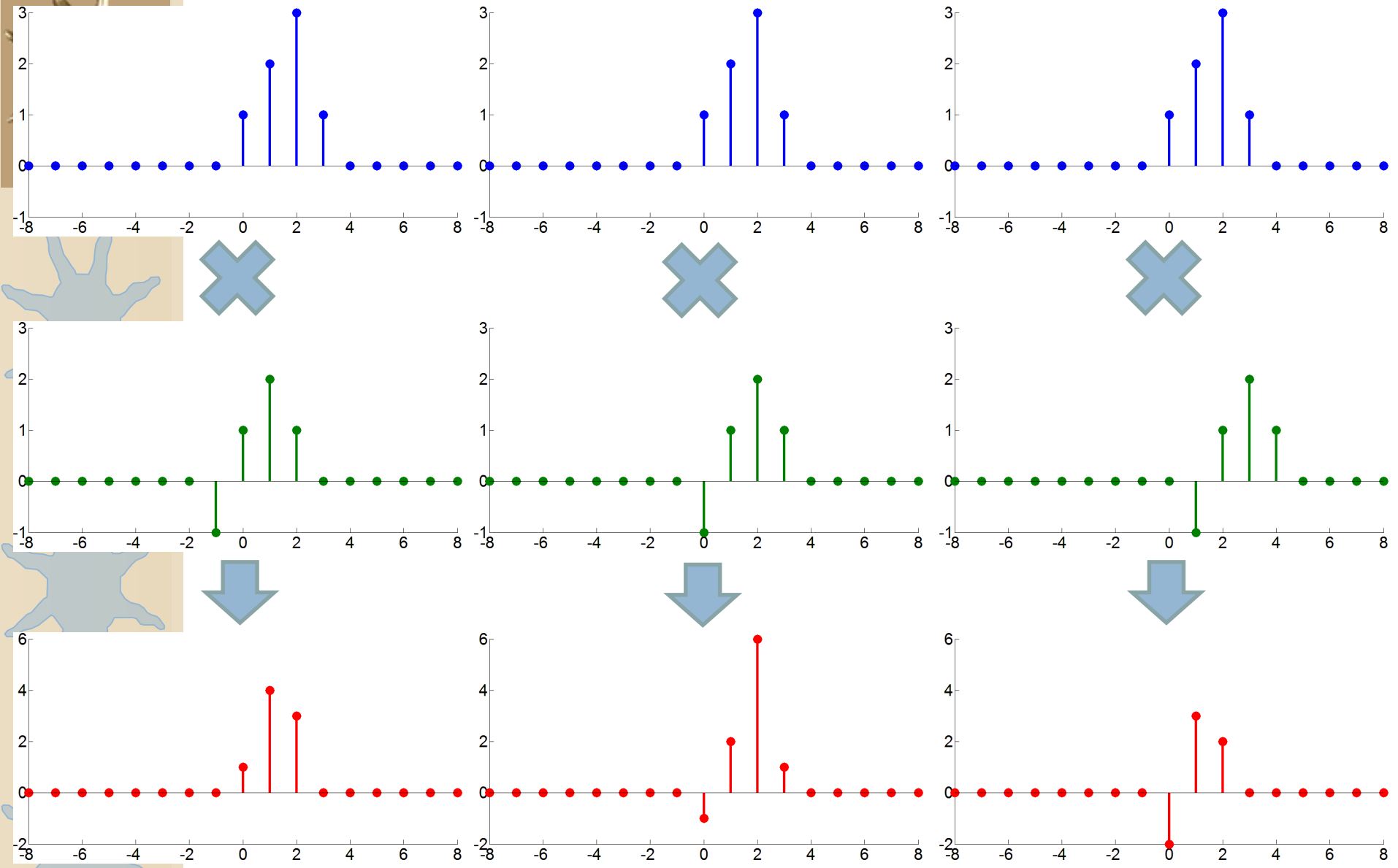
h(k)



h(-k)



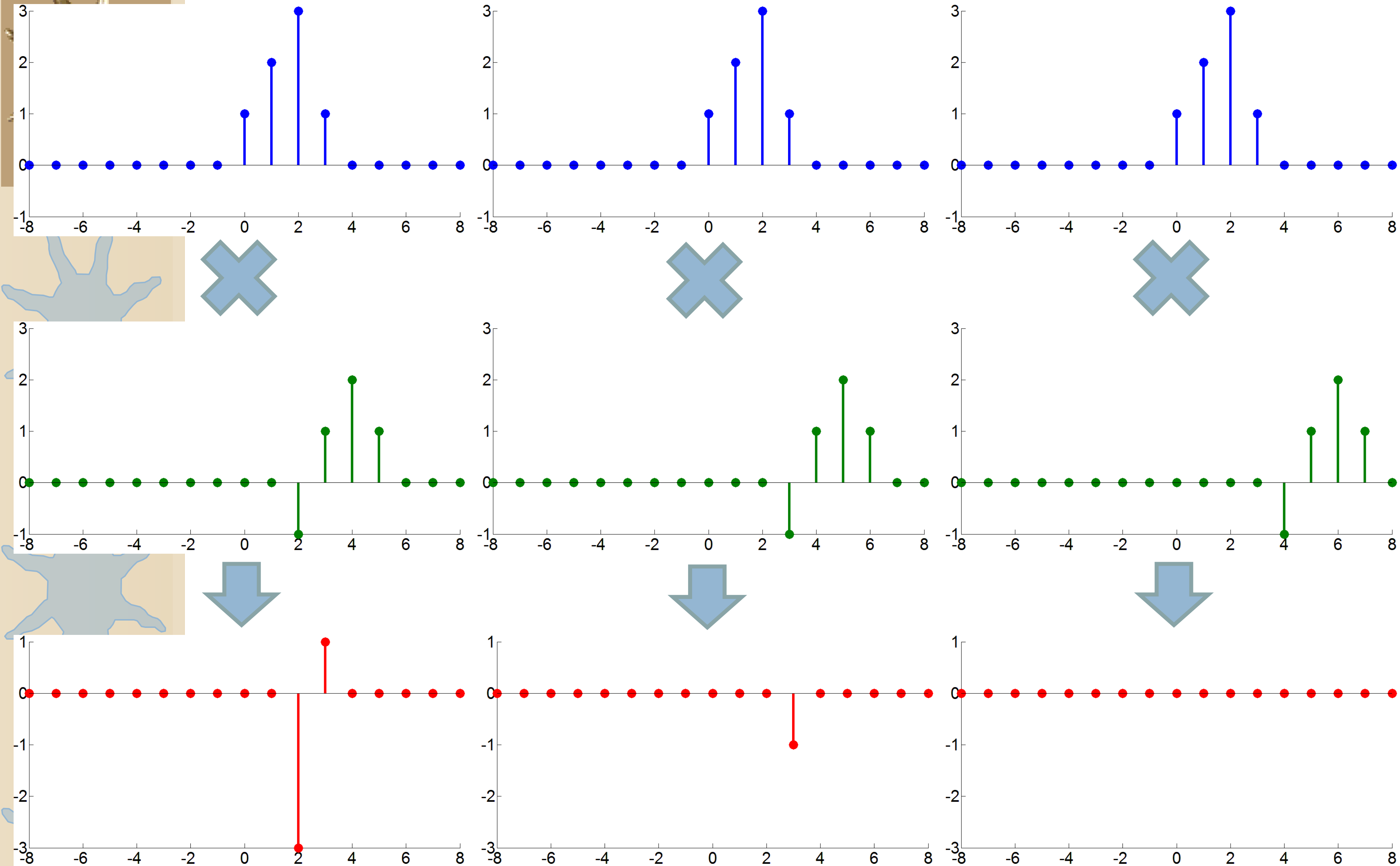

y(-2) = 0
y(-1) = 1
y(0) = 2+2 = 4



y(1) = 1+4+3 = 8

y(2) = -1+2+6+1 = 8

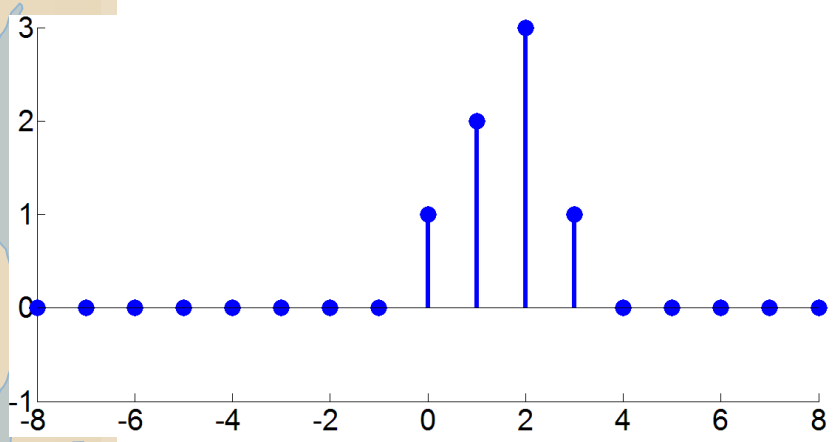
y(3) = -2+3+2 = 3



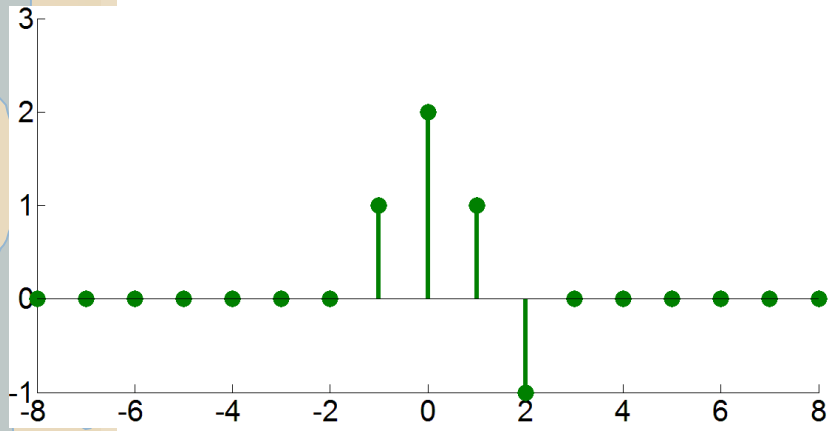
$y(4) = -3+1 = -2$ $y(5) = -1$ $y(6) = 0$

Hasil Konvolusi

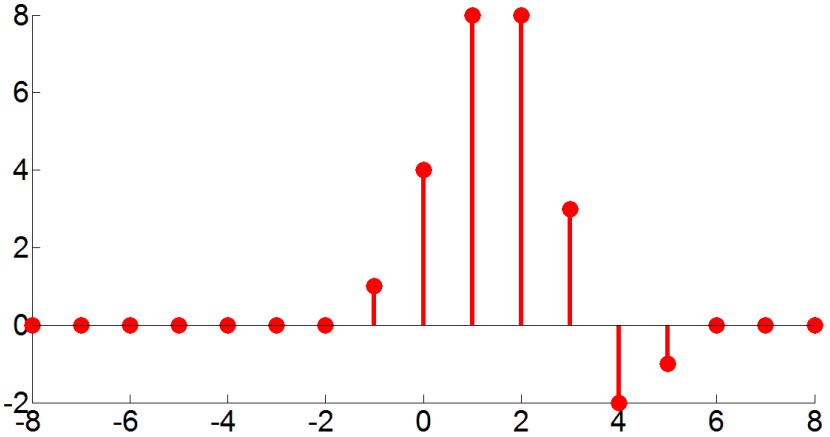
x(n)



h(n)



y(n)



Konvolusi Kontinu

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

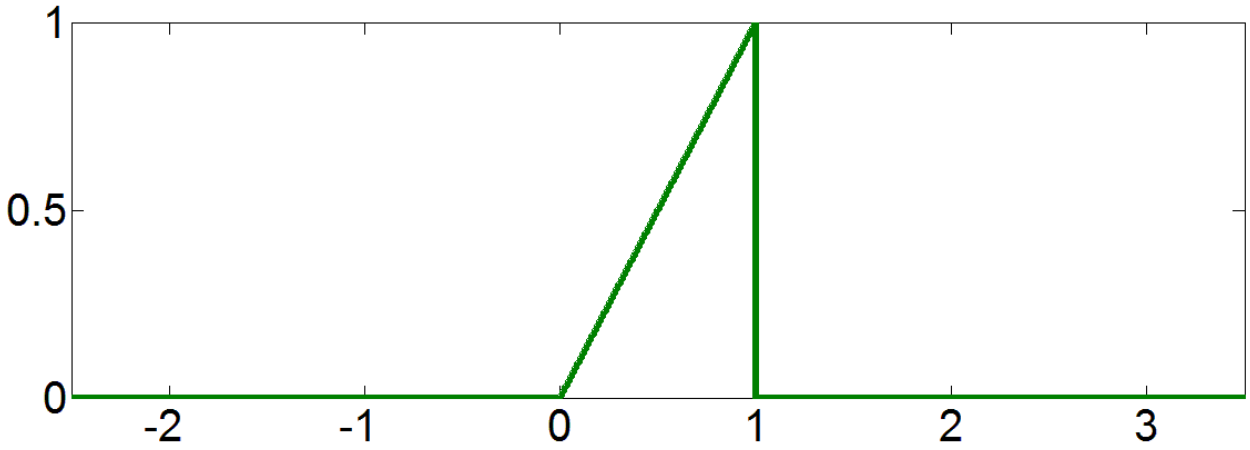
$$y(n) = \sum_{k=-\infty}^{\infty} x(k)h(n-k)$$

y(t) = x(t) * h(t)

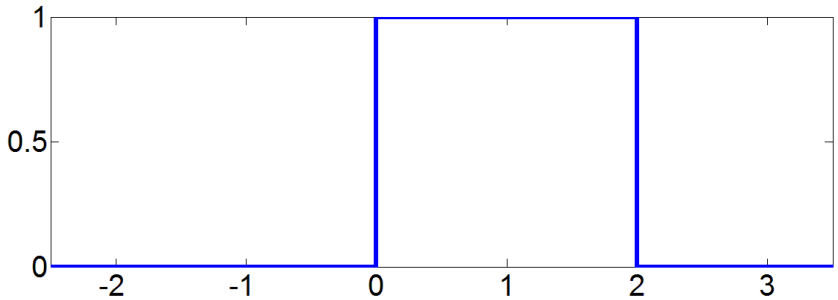
$$y(t) = \int_{-\infty}^{\infty} x(\tau)h(t-\tau)d\tau$$

Konvolusi Kontinu

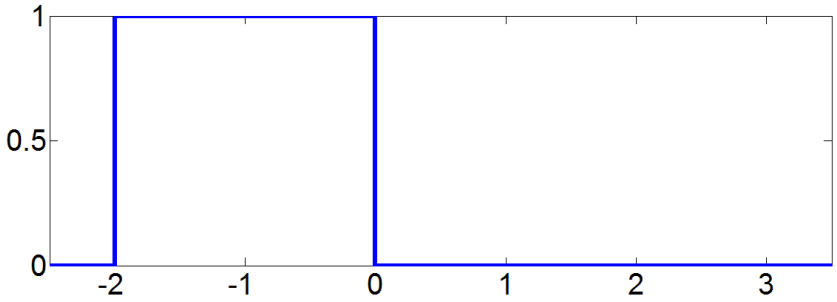
$x(\tau)$



$h(\tau)$

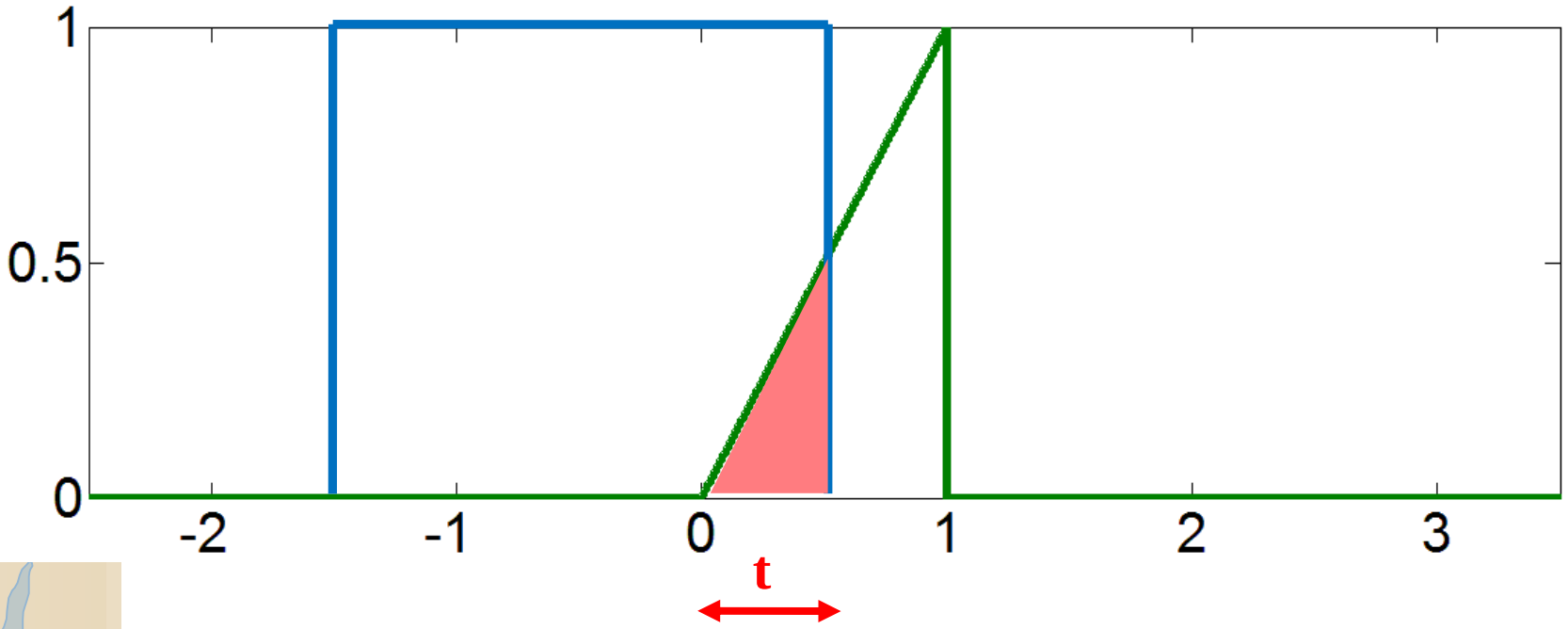


$h(-\tau)$



Konvolusi Kontinu

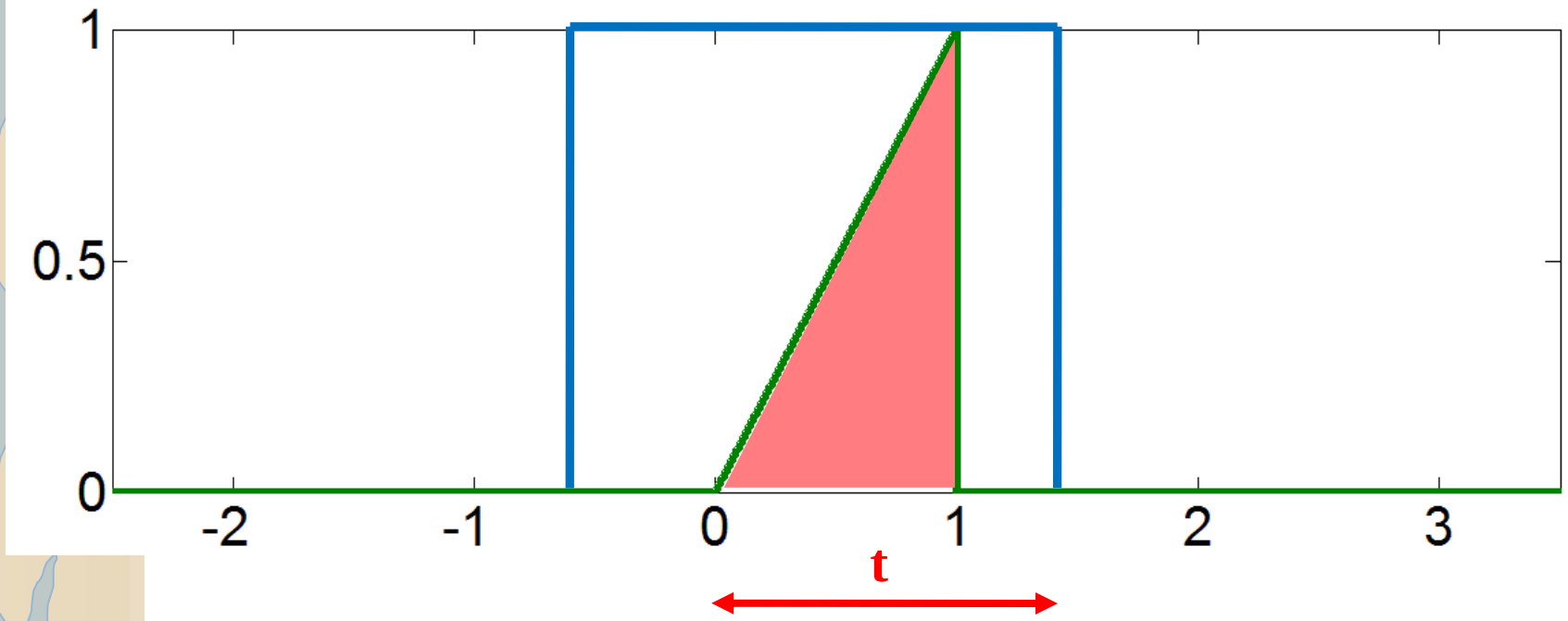
$x(\tau) \cdot h(t-\tau)$ untuk $0 \leq t \leq 1$



$y(t) = 0{,}5\ t^2$

Konvolusi Kontinu

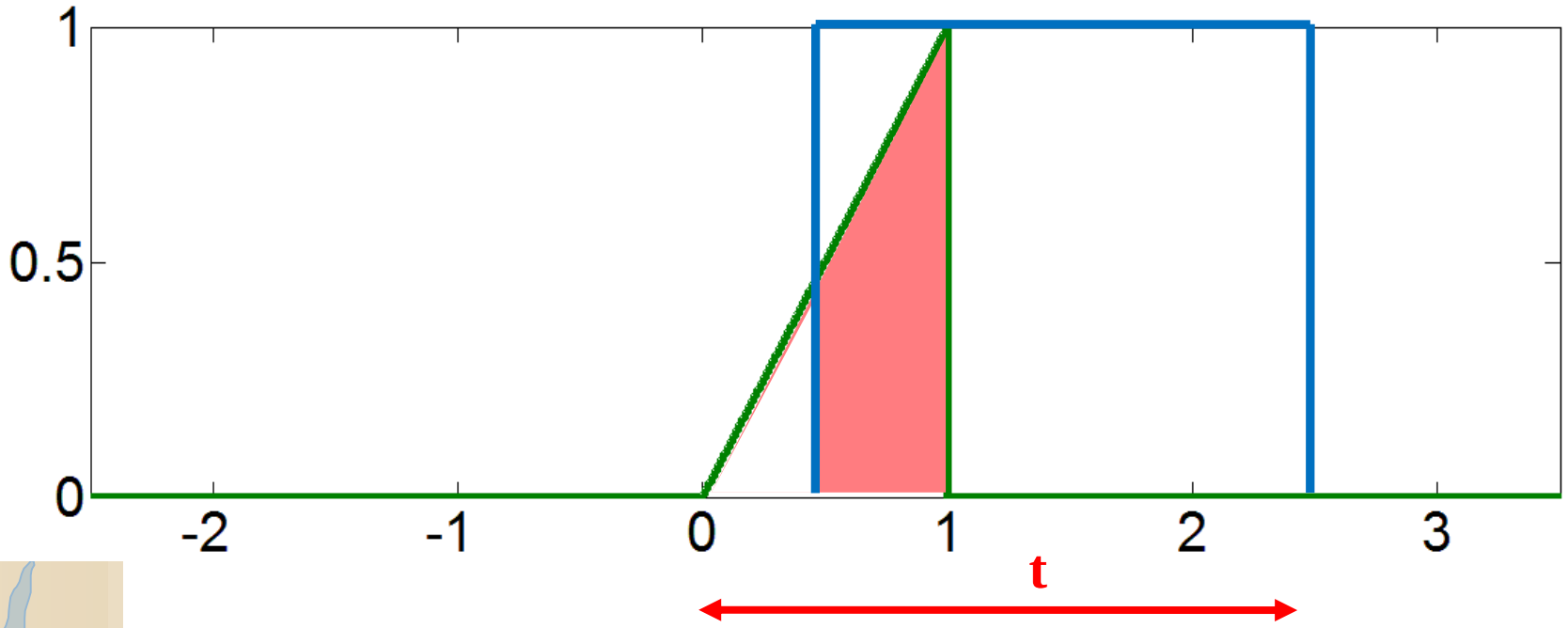
$x(\tau) \cdot h(t-\tau)$ untuk $1 \leq t \leq 2$



$y(t) = 0{,}5$

Konvolusi Kontinu

$x(\tau) \cdot h(t-\tau)$ untuk $2 \leq t \leq 3$



$$y(t) = 0{,}5 - 0{,}5\,(t-2)^{2}$$

Konvolusi Kontinu

$$x(t) = \begin{cases} t & \text{untuk } 0 \le t \le 1 \\ 0 & \text{untuk } t \text{ yang lain} \end{cases}$$

$$h(t) = \begin{cases} 1 & \text{untuk } 0 \le t \le 2 \\ 0 & \text{untuk } t \text{ yang lain} \end{cases}$$

$$y(t) = \begin{cases} 0{,}5\, t^2 & \text{untuk } 0 \le t \le 1 \\ 0{,}5 & \text{untuk } 1 \le t \le 2 \\ 0{,}5 - 0{,}5\,(t-2)^2 & \text{untuk } 2 \le t \le 3 \end{cases}$$