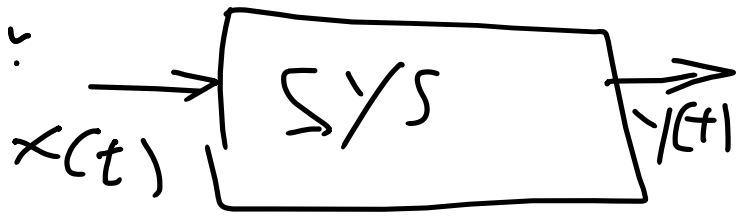
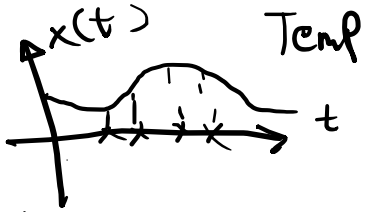
Review:

week (1): → Intro

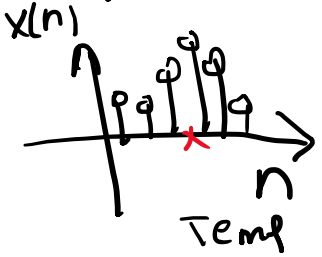
- Signal: Function. → $x(t)$ → ind
  - carry info
    - CTS
    - DTS ↝ Digital Sig
- DC is signal
- System:



CTS: $x(t)$ → time

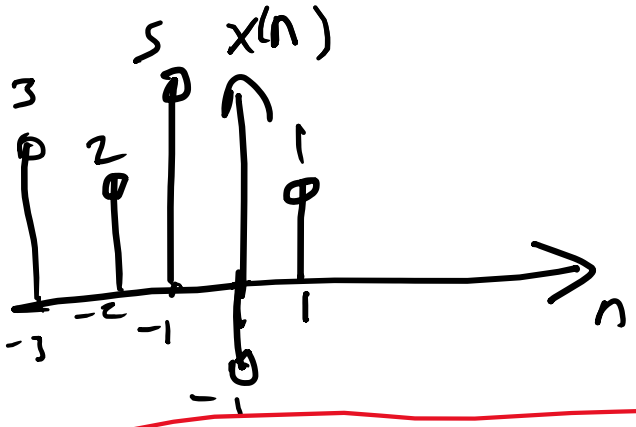


DTS: $x(n)$ → time



$$x(n) = \{3, 2, 5, -1, 1\} \rightarrow$$

-3 -2 -1 0 1



Week (2):

always

Periodic & Non-Periodic Signal

$\downarrow (-\infty, \infty)$

$x(t) = x(t \mp n[T_0])$ → Fundamental time period

Integer

$\sin(\theta) \Rightarrow T_0 = 2\pi$ Sec

$T = 4\pi$ Sec , $f_0 = \frac{1}{T_0}$ Hz

$\omega_0 = 2\pi f_0$ Rad/sec

$\omega_0 = \frac{2\pi}{T_0}$, $T_0 = \frac{2\pi}{\omega_0}$

CTS if

SO ① $y(t) =$ one signal

② $y(t) = x_1(t) + x_2(t)$ → ω_{01}, ω_{02} → T_{01}, T_{02} → $\frac{T_{01}}{T_{02}}$ Rational or not? → $T_0 = LCM(T_{01}, T_{02})$

DTS:

① $y(t) =$ one sig → ω_0, T_0, f_0 → $N = \frac{K}{N_0}$ → Fund time period

② $y(t) = x_1(t) + x_2(t)$ → ω_{01}, ω_{02}, f_{01}, f_{02}, N_{01}, N_{02} → $\frac{N_{01}}{N_{02}}$ Rational → $N = LCM(N_{01}, N_{02})$

CTS	DTS
1) Find ω_0 (coefficient of t)	1) Find ω_0 (coefficient of t)
2) Find f_0, $\omega_0 = 2\pi f_0$	2) Find f_0, $\omega_0 = 2\pi f_0$
3) Find T_0, $T_0 = \frac{1}{f_0}$, $T_0 = \frac{2\pi}{\omega_0}$	3) Find N, $f = \frac{K}{N}$
4) if $x(t) = x(t+T_0) \Rightarrow$ CTS is Periodic	N: The period constant (N must be integer)
$\frac{T_1}{T_2}$ (See if its rational or not, when we have 2 signals rational ratio ⇒ Periodic, irrational ⇒ non Periodic)	K: Just constant number
Review about Rational & irrational numbers	4) if $\frac{K}{N}$ is Rational ⇒ Signal is Periodic
1) Rational: Every number that can be represented by a "ratio" of two integers is a rational number	if $\frac{K}{n}$ is irrational, ⇒ Signal is Not Periodic
e.g: $1 = \frac{1}{1} = \frac{-3}{-3} = \frac{10^6}{10^6}$	
$-6 = \frac{-6}{1} = \frac{6}{-1} = \frac{-12}{2}$	
$4.75 = \frac{475}{100} = \frac{950}{200} = \frac{38}{8} = \frac{-78}{-16}$	
$0.3333 = 0.\overline{3} = \frac{1}{3}$, $0.\overline{6} = \frac{2}{3}$ (the bar means repeating decimal)	

CTS (2 case)

Example: $x(t) = \sin 6\pi t + \cos 5\pi t$

DTS (1) case

Example: Find out if $x[n] = \sin(\frac{\pi}{4} n)$ is Periodic, if yes find N

DTS (2) case

Example: $x[n] = \sin \frac{2\pi}{3} n + \cos \frac{\pi}{2} n$

*LCM for Fraction $(\frac{A}{B})$

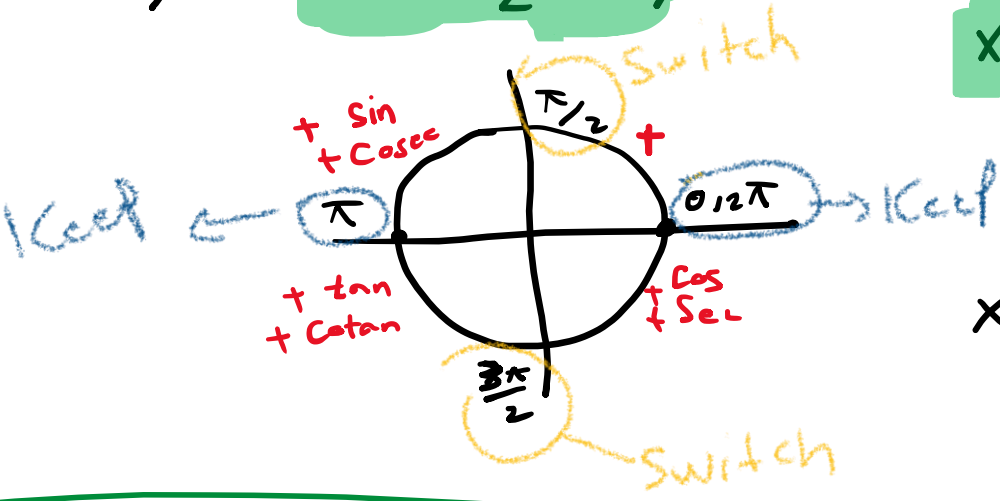
$$LCM\left(\frac{A_1}{B_1}, \frac{A_2}{B_2}\right) = \frac{LCM(A_1, A_2)}{HCF(B_1, B_2)}$$

Be careful!!

Example: $x[n] = \sin^2\left(\frac{\pi}{4}n\right)$, Find N if this signal is Periodic

$$x(t) = \sin\left(\frac{\pi}{2} - t\right) = \cos(t)$$

$$x(t) = \cos\left(\frac{\pi}{2} + t\right) = -\sin(t)$$



$$x(t) = \tan(\pi + t) = +\tan(t)$$

week (3) & (4) : operations over signal

Time scaling → $x(2t)$, $x(\sqrt{t})$, $x(0.5t)$ → expanded

Time Shifting → $x(t+4)$

Time Reversal → $x(-2t)$ → Reversed Shrinked

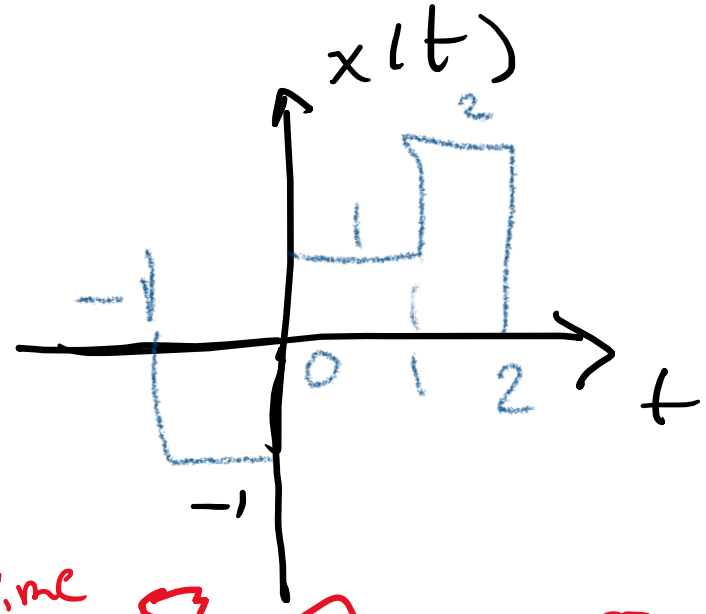
Amp Scaling → $+3x(t)$

// Shifting → $x(t)+2$

$y(t) = x\left(\frac{-1}{2}t - 4\right)$

Plot $y(t) = ?$

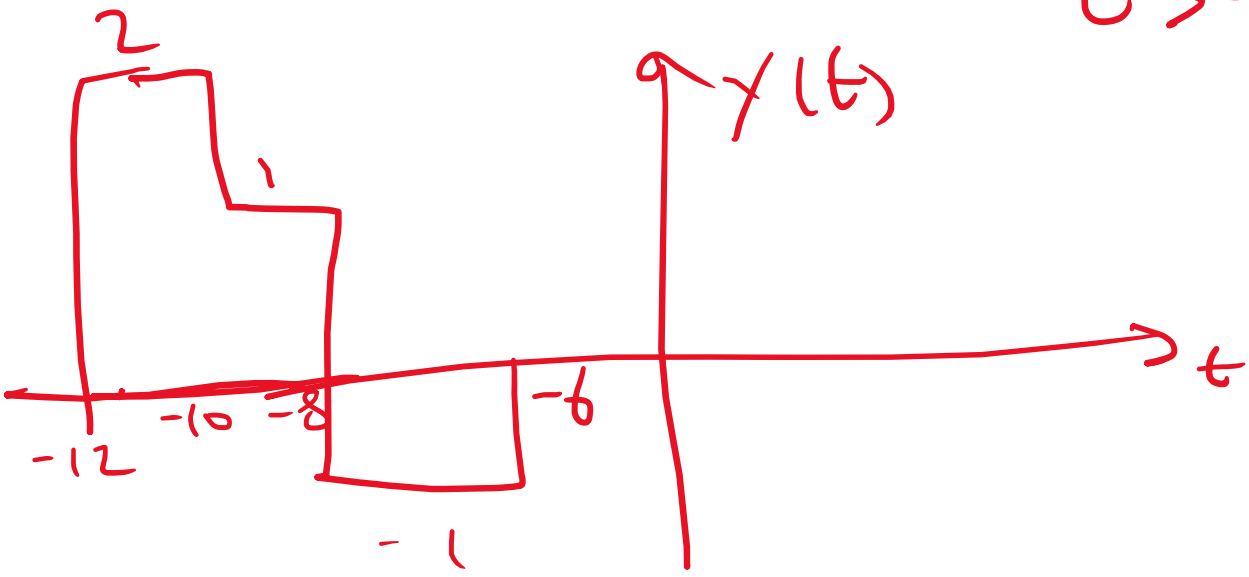
$$x(t) = \begin{cases} 0, & t < -1 \\ -1, & -1 \le t \le 0 \\ 1, & 0 < t \le 1 \\ 2, & 1 < t \le 2 \\ 0, & t > 2 \end{cases}$$



Time Reversal

$x\left(\frac{-1}{2}t - 4\right)$: $0, \quad \frac{-1}{2}t - 4 < -1$

$t > -6$



week (4) & (5)

Even & ODD

$x(t) = x(-t) \rightarrow$ Even — Cosine Function

$x(t) = -x(-t)$
$-x(t) = x(-t)$ $\Big\} \rightarrow$ odd — Sine Function

But Not all Function

are even or odd

$$x_e(t) = \frac{x(t) + x(-t)}{2}$$

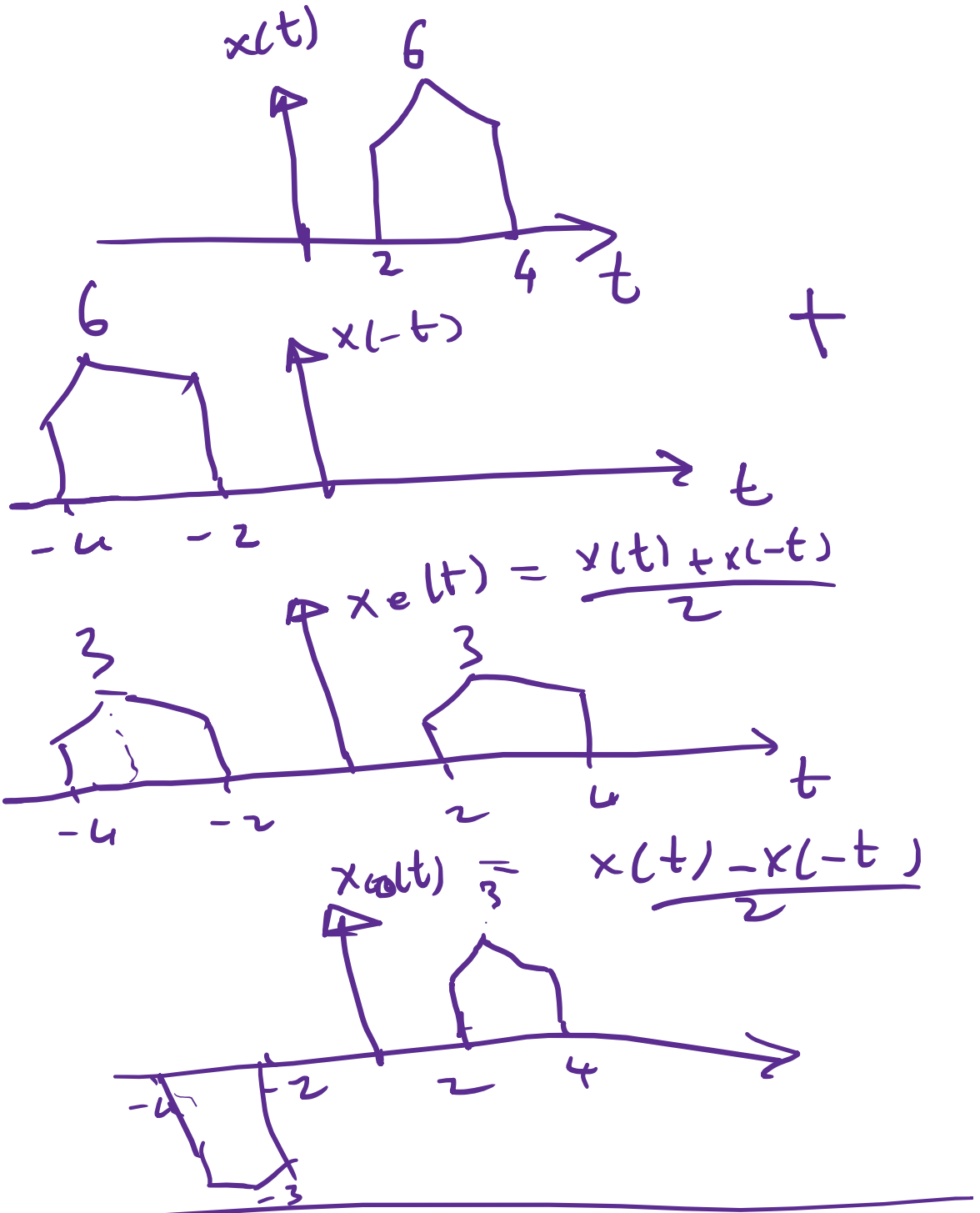
$$x_o(t) = \frac{x(t) - x(-t)}{2}$$

useful for plotting even & odd components

* Finding Even & odd components $\Rightarrow$ use Even & odd properties (14 Pro)
* plotting Even & odd $\Rightarrow$

$$x_e(t) = \frac{x(t) + x(-t)}{2}$$

$$x_o(t) = \frac{x(t) - x(-t)}{2}$$



Systems (week 5 & 6)

Past

Future

Present

① Static & Dynamic

↓ always present (-∞, ∞)

→ at any instant of time

$\int . dt$, $\frac{d}{dt}$ — Dynamic

$y(t+10) = x(t+7)$ D

$y(t+11) = \frac{1}{2} x(t+11)$ S

$y(t^2) = x(t^2)$ S

$y(t) = x(t+1+e^{t-1})$ S

$y(t) = x(\sqrt{t} \cdot \sqrt{t})$ S

② Causal & Non Causal

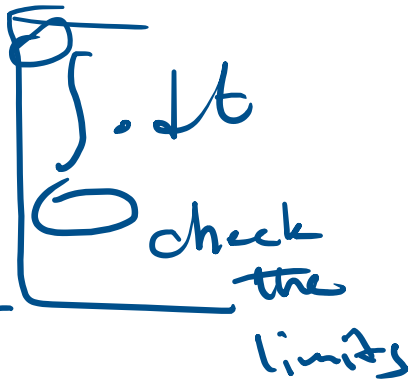
Causal → Past, Present (-∞, ∞)

Non Causal → Future, At any instant of time

Static sys → present ⟷ Causal → Past / Present

check the limits

* Substitute the upper limit & down limit by (t) in the function



3) Time variant & T.I.V

Time Scaling

$x(0.5t)$

$x(\sqrt{t})$

$x(-2t)$

coffficent related to time

$\sin(t) \cdot x(t)$

Time shift alone

* $x(t+1)$
* $5x(t+1)$
* $5x(t+1) + 7$
* Amp $x^2(t+1)$

Polynimal related to time

$x(t) = 4t + x(t)$

Split systems

$$x(t) = \begin{cases} x(t-1), & t<0 \\ x(t+1), & t>0 \end{cases}$$

Linear & Non Linear

- LOA
- LOH
- must achieve

- Shift
  - $y(t) = x(t+3)$
- Amp scaling
  - $x(t) = x^2(t)$

give i/p : 0

o/p : 0

$\rightarrow$

$x(t) = 2x(t)$

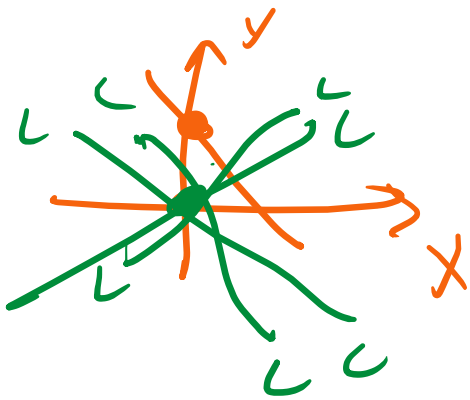
$x(t) = 2x(t) + 2$

Non Linear

$y(t) = x(t+2) + C$

NL

↳ time shift



$$x_e(t) = \frac{x(t) + x(-t)}{2}$$

$$= \frac{1}{2}x(t) + \frac{1}{2}x(-t)$$

DNC TU L

$$x_o(t) = \frac{1}{2}x(t) - \frac{1}{2}x(-t)$$

Non-Linear:

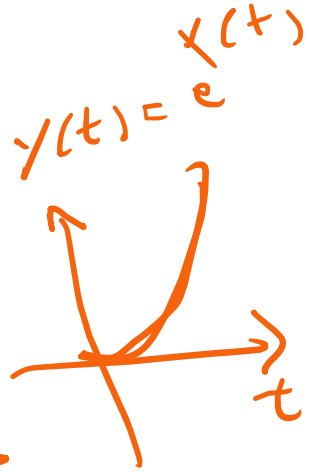
$$y(t) = \cos[x(t)]$$

$$y(t) = \cos^{-1}[x(t)]$$

$$\log y(t) = x(t)$$

$$y(t) = \log[x(t)]$$

$$y(t) = e^{x(t)}$$



$$x(t) = \sqrt[3]{x(t)}$$

$$[y(t)]^3 = x(t)$$

split systems:

$$y(t) = \begin{cases} \underbrace{x(t-1)}_{NL} + 1, & t < 0 \\ \underbrace{x^2(t+1)}_{NL}, & t \geq 0 \end{cases}$$

NL