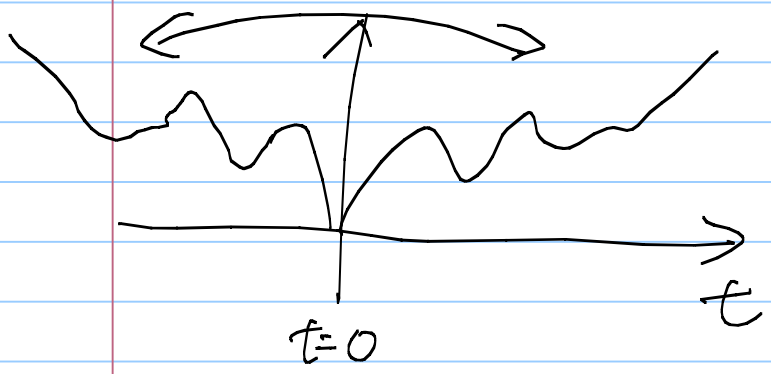
Classification #4: Even & odd signals

Even signals: let $y(t) = x(-t)$

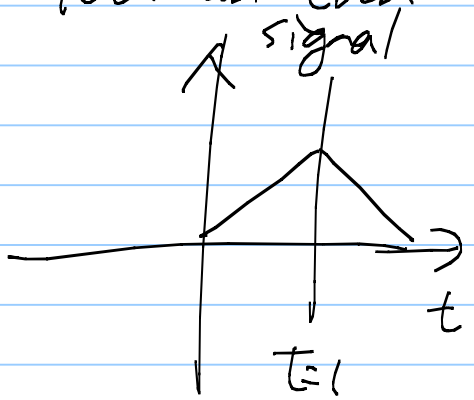
$x(t)$ & $y(t)$ look identical.

That is: signal for $t>0$ and signal for $t<0$ are mirror images of each other with $t=0$ axis serving as the mirror

Even signals:



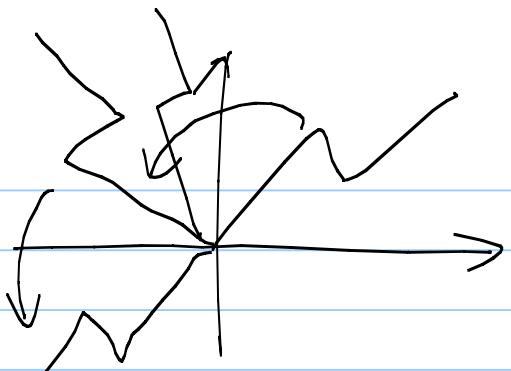
Not an even signal



Odd signals let $y(t) = -x(-t)$.

$x(t)$ & $y(t)$ look identical.

That is: Signal for $t<0$ can be obtained by rotating the signal for $t>0$ by 180 deg around the origin (0,0) point.



Q: Determine whether the following signals are even or odd or neither.

CT:

$\cos(t)$	$\sin(t)$	$\cos(t+\frac{\pi}{4})$	$\sin(t+\frac{\pi}{2}) = \cos(t)$
E	O	N	E

$\lvert t\rvert$	t^2	t^3	e^t	$e^{\lvert t\rvert}\sin(t)$
E	E	O	N	O

DT:

$x[n]$

$\sin(\pi \times n)$	$(-1)^n$	$(-1)^{n+1}$
E or O	E	E

* Any signal can be written as a sum of an even signal & an odd signal

$$x(t) = x_{even}(t) + x_{odd}(t).$$

HW2Q9

Q1

Ans: $x(t) = \underbrace{\frac{x(t)+x(-t)}{2}}_{\hookrightarrow x_1(t)} + \underbrace{\frac{x(t)-x(-t)}{2}}_{\hookrightarrow x_2(t)}$

Q2: Show that $x_1(t)$ is even

$x_2(t)$ is odd.

Ans: $x_1(t) \stackrel{?}{=} x_1(-t)$

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

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

$LHS = RHS \Rightarrow x_1(t)$ is even

$$x_2(t) \stackrel{?}{=} -x_2(-t)$$

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

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

$LHS = RHS \Rightarrow x_2(t)$ is odd.

If we use even & odd signals as our test signal, then any new signal can be expressed as a sum of two test signals (one even, one odd).