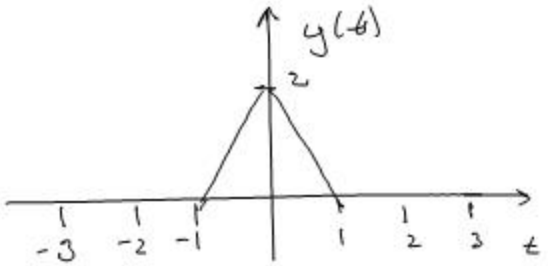
Problem 1-1 a) $y(t) = x(2t)$

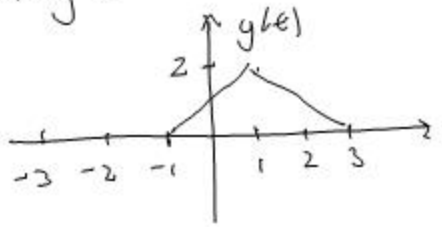
This is called time-scaling. If $a>1$, the signal $y(t)$ is compressed. If $0<a<1$, $y(t)$ is expanded.



b) $y(t) = x(2t-1)$

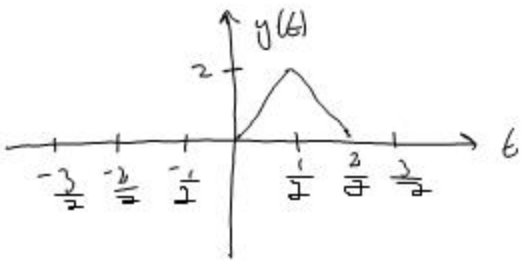
This is time-scaling and time-shifting. It is important to do this time-shifting first, then the time scaling.

step 1 -



$y(t) = x(t-1)$

step 2 -

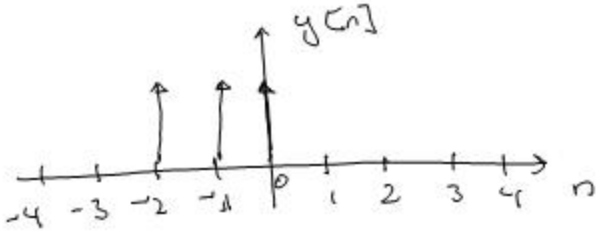


$y(t) = x(2t-1)$

Homework #1 Solutions

Problem 1-2

$y[n] = x[2n+2]$ This is time-shifting and decimation.



Problem 1-3

$x[n] = A\cos(\omega_0 n + \phi)$

a) $x[n+N] = A\cos(\omega_0(n+N) + \phi)$

$= A\cos(\omega_0 n + \omega_0 N + \phi)$

for $x[n] = x[n+N]$

$A\cos(\omega_0 n + \phi) = A\cos(\omega_0 n + \omega_0 N + \phi)$

so, $\omega_0 N = 2\pi K$ where K = any integer

and, $\omega_0 = \frac{2\pi K}{N}$

b) $x[n] = \cos\left(2\pi\frac{13}{52}n\right)$

$2\pi\left(\frac{13}{52}\right) = \omega_0 \Rightarrow \frac{2\pi K}{N} = 2\pi\left(\frac{13}{52}\right)$

$\frac{K}{N} = \frac{13}{52}$

Need smallest value that satisfies (a) $\Rightarrow \frac{K}{N} = \frac{1}{4}$

$N = 4$

c) See plot on matlab page.

Homework #1 Solutions

Problem 1-4 $\quad x[n] = \sin(0.2\pi n)$

a.) $\omega_0 = 0.2\pi$

b.) Use results from problem 1-3a

$$\omega N = 2\pi K$$

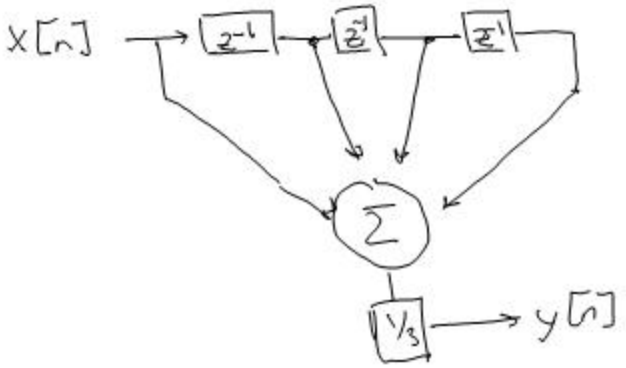
$$N = \frac{2\pi K}{\omega} = \frac{2\pi K}{0.2\pi} = 10K$$

Let $K=1 \Rightarrow \boxed{N=10}$

c.) See attached matlab solutions.

Problem 1-5

a.) $y[n] = \frac{1}{3}\left(x[n] + x[n-1] + x[n-2] + x[n-3]\right)$



b.) $y[n] = \frac{1}{3}\sum_{k=0}^{3} x[n-k]$

c.) See attached matlab