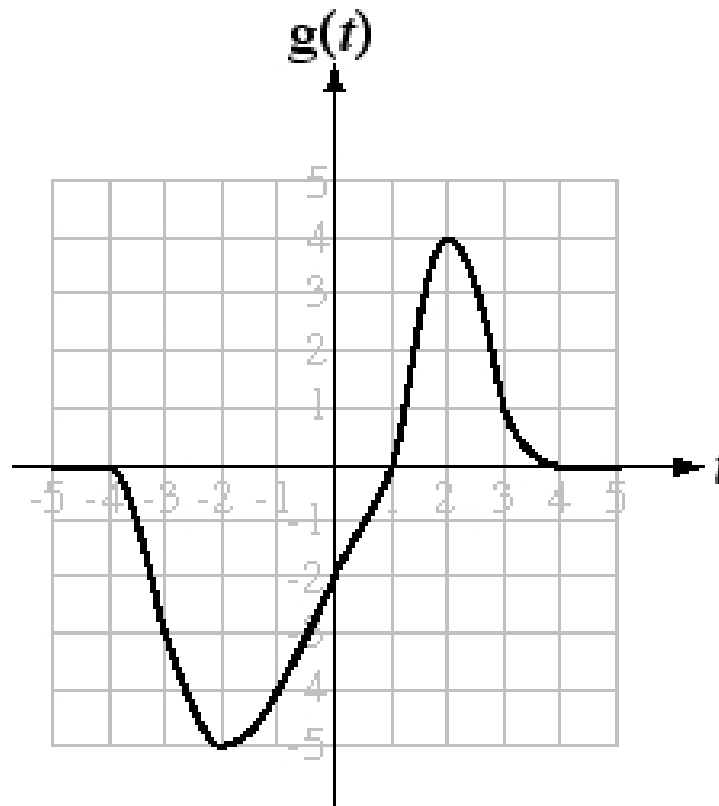


The background is a large yellow diamond shape. In the top-left corner, there is a red crayon with a yellow body and a black outline, pointing towards the center. A short red wavy line extends from the tip of the crayon. In the bottom-right corner, there is a blue wavy line that starts from the left and ends at a small blue crayon with a yellow body and a black outline. The text "Signals And Systems" is centered within the yellow diamond.

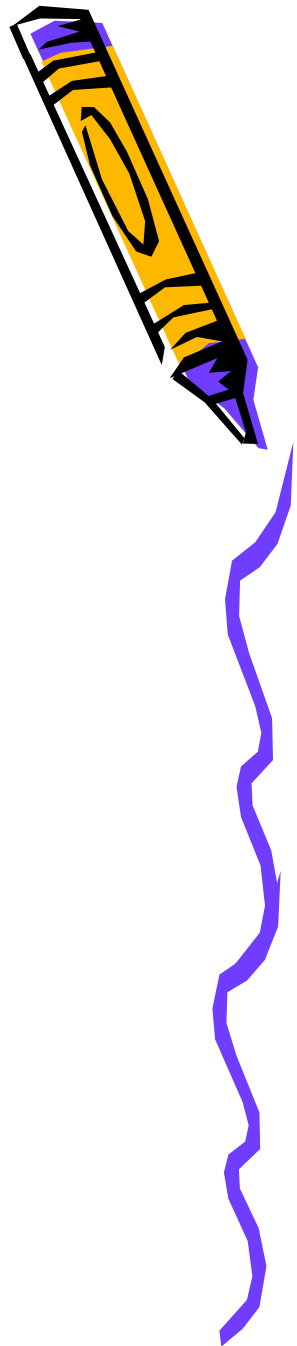
Signals And Systems

Transformations of CT Functions

Let a CT function be defined by

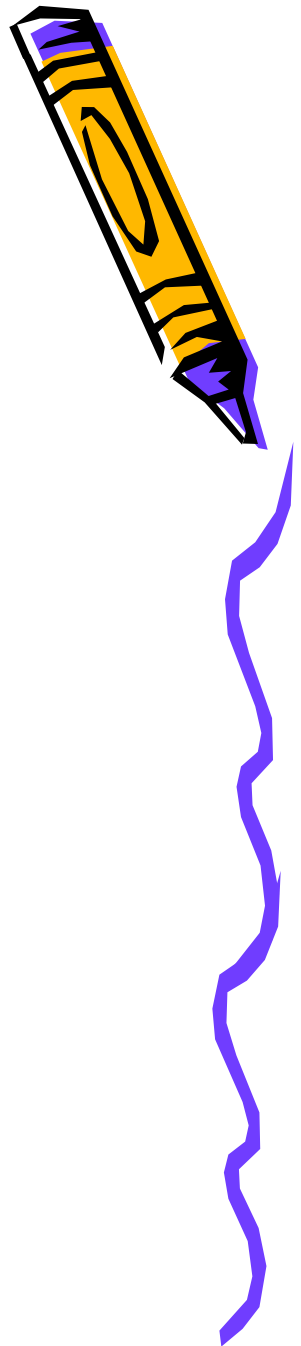
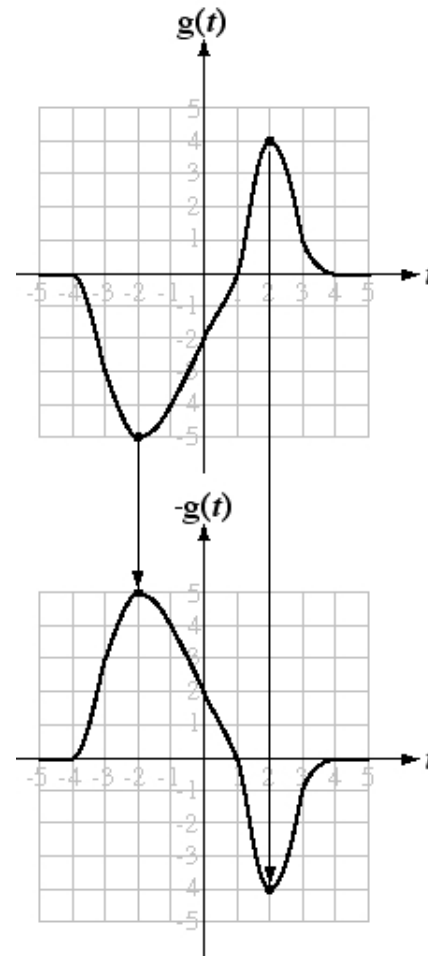
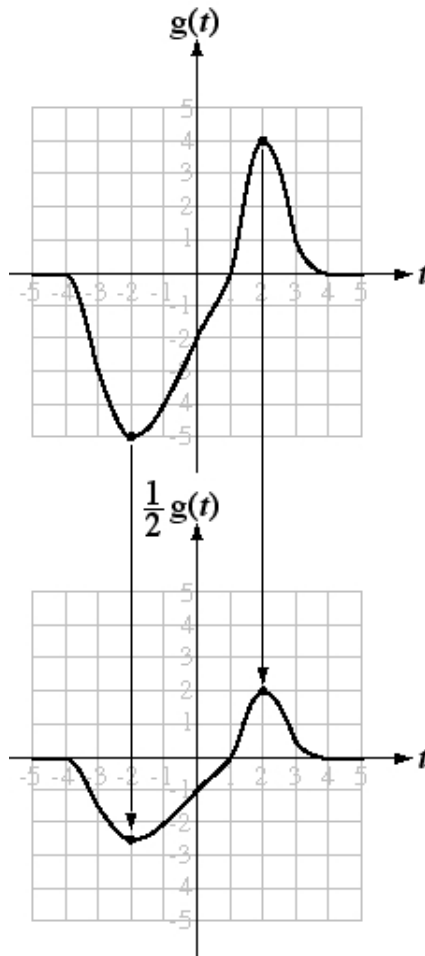


$$g(t) = 0, \quad |t| > 5$$



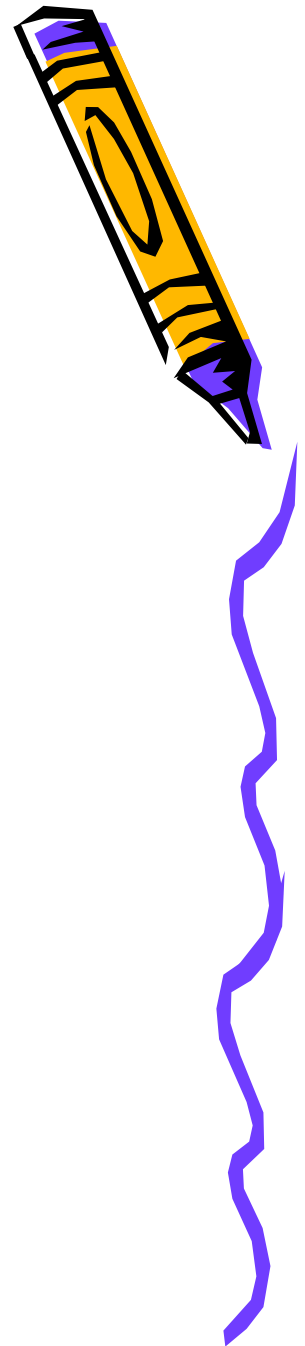
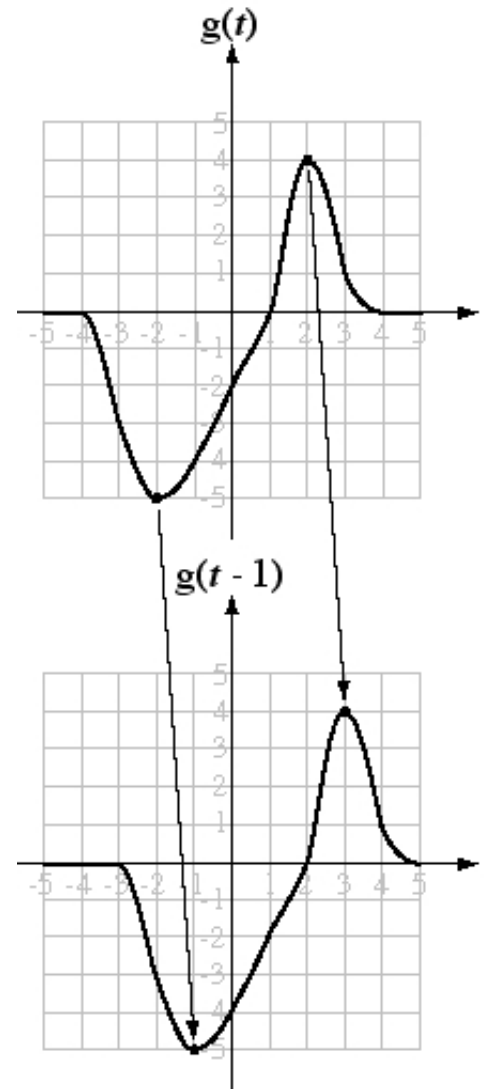
Transformations of CT Functions

Amplitude Scaling, $g(t) \rightarrow A g(t)$



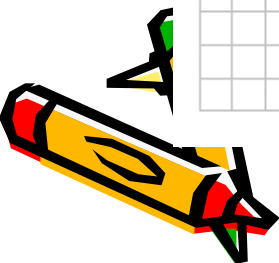
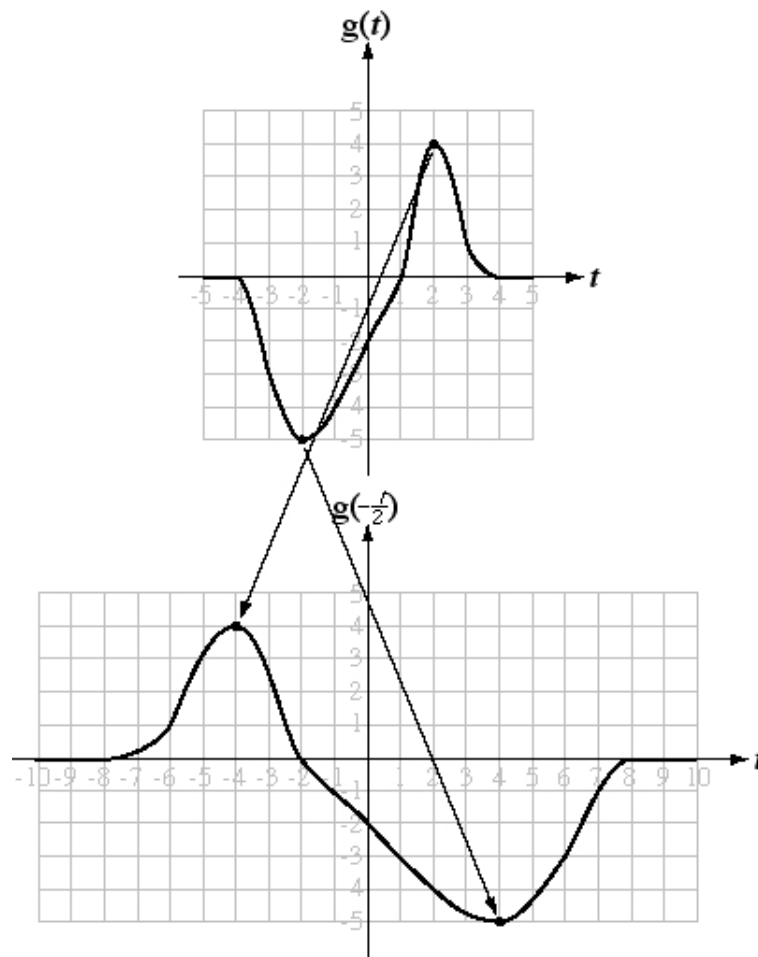
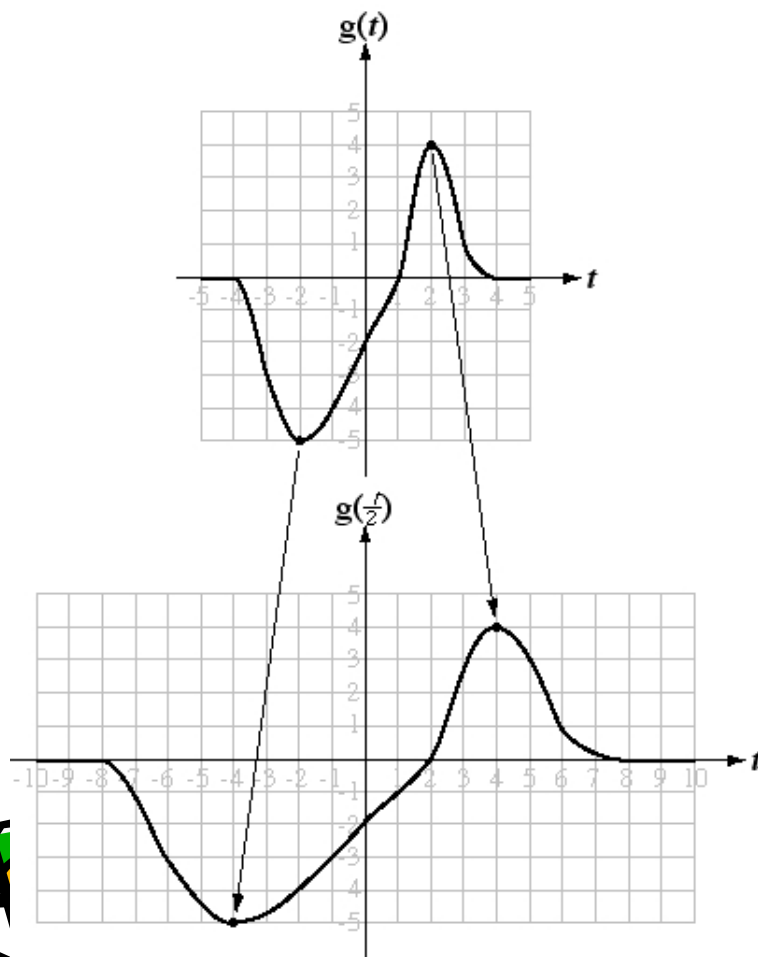
Transformations of CT Functions

Time shifting, $t \rightarrow t - t_0$



Transformations of CT Functions

Time scaling, $t \rightarrow \frac{t}{a}$



Transformations of CT Functions



Multiple transformations, $g(t) \rightarrow A g\left(\frac{t-t_0}{a}\right)$

A multiple transformation can be done in steps

$$g(t) \xrightarrow{\text{amplitude scaling, } A} A g(t) \xrightarrow{t \rightarrow \frac{t}{a}} A g\left(\frac{t}{a}\right) \xrightarrow{t \rightarrow t-t_0} A g\left(\frac{t-t_0}{a}\right)$$

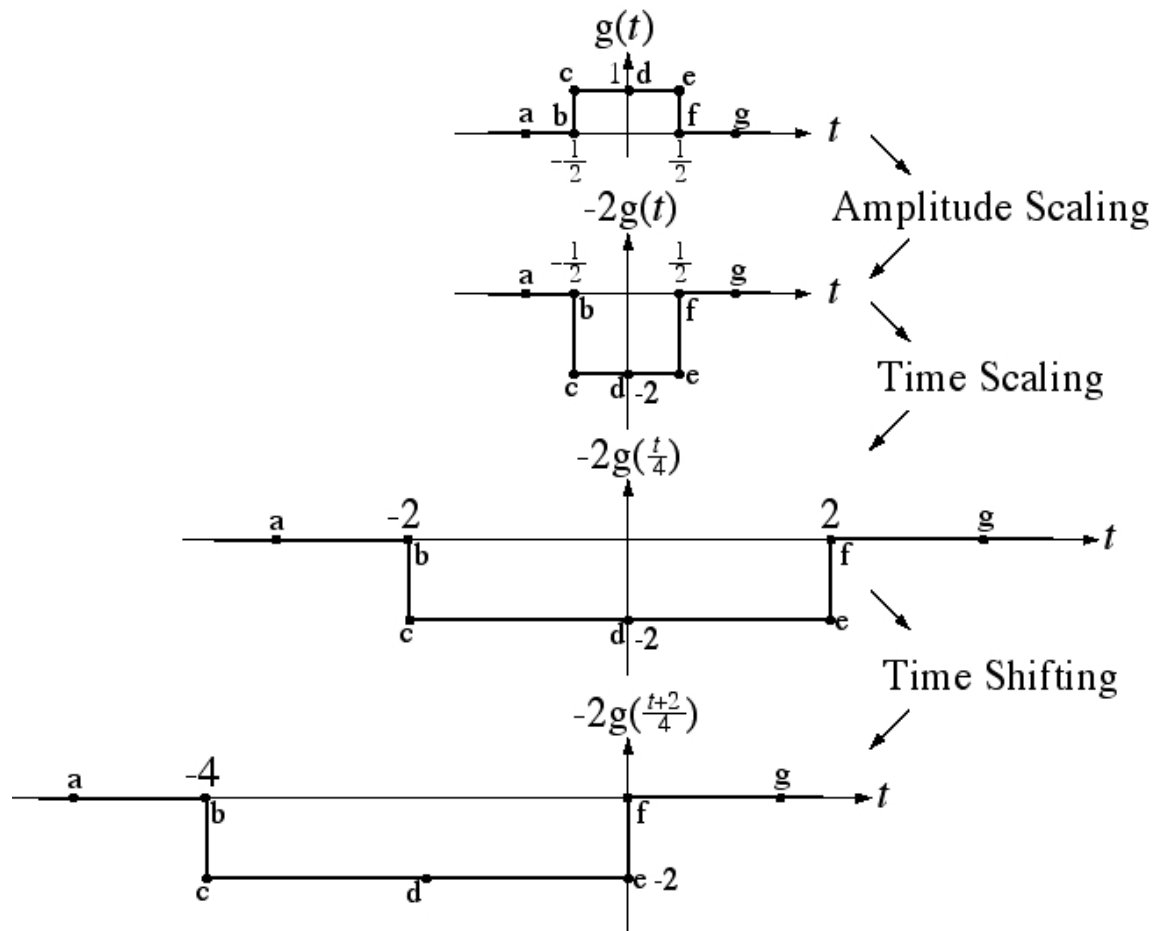
The sequence of the steps is significant

$$g(t) \xrightarrow{\text{amplitude scaling, } A} A g(t) \xrightarrow{t \rightarrow t-t_0} A g(t-t_0) \xrightarrow{t \rightarrow \frac{t}{a}} A g\left(\frac{t}{a}-t_0\right) \neq A g\left(\frac{t-t_0}{a}\right)$$



Transformations of CT Functions

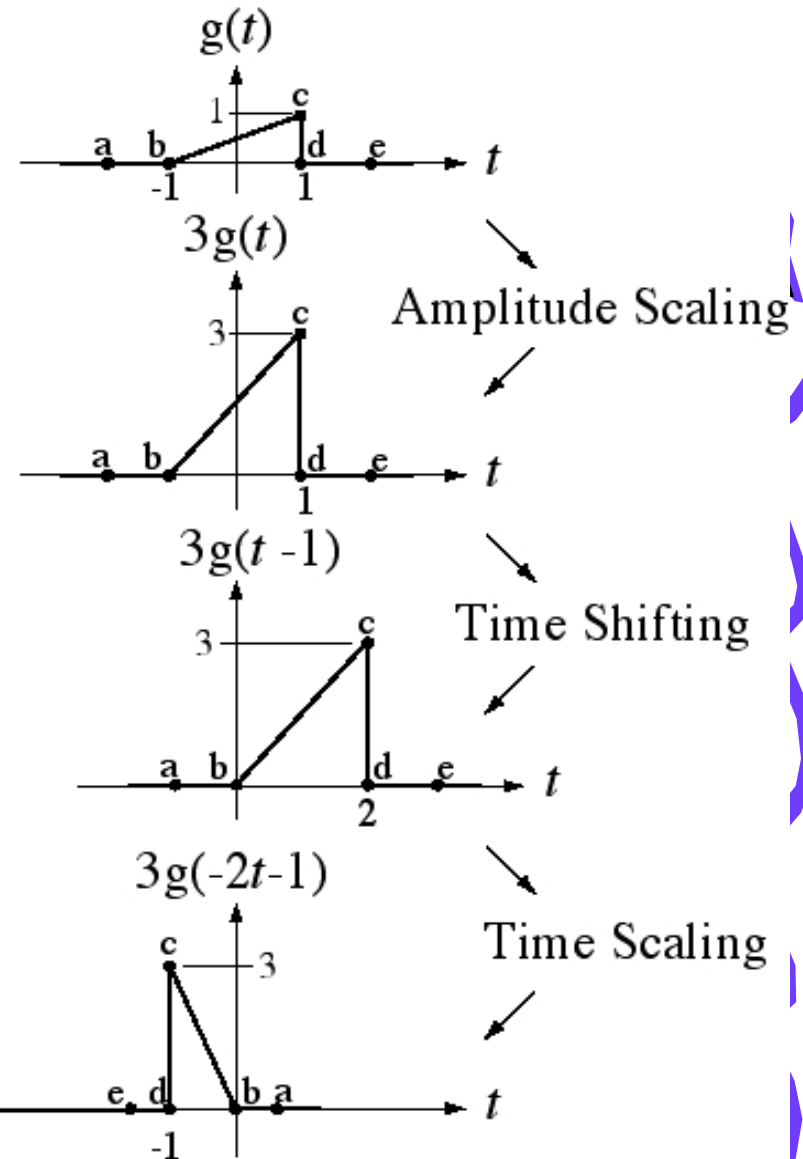
Multiple transformations, $g(t) \rightarrow A g\left(\frac{t-t_0}{a}\right)$



Transformations of CT Functions

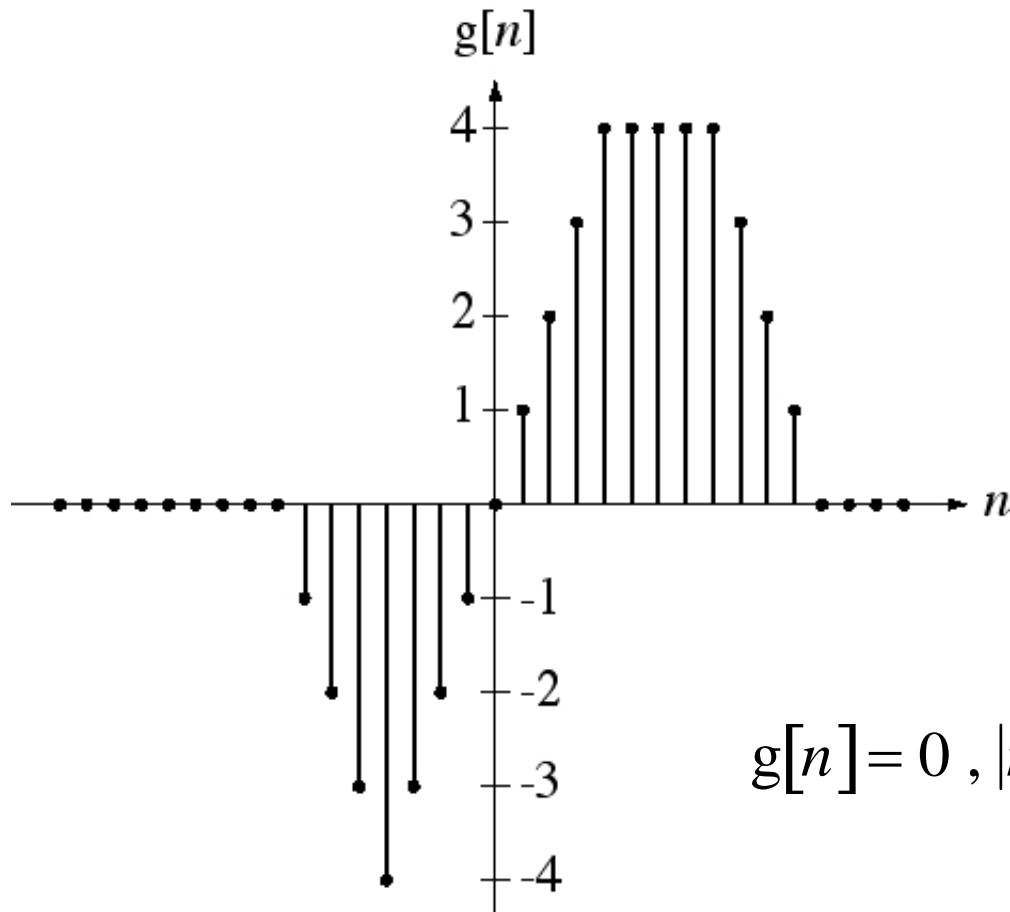


Multiple transformations, $A g(bt - t_0)$

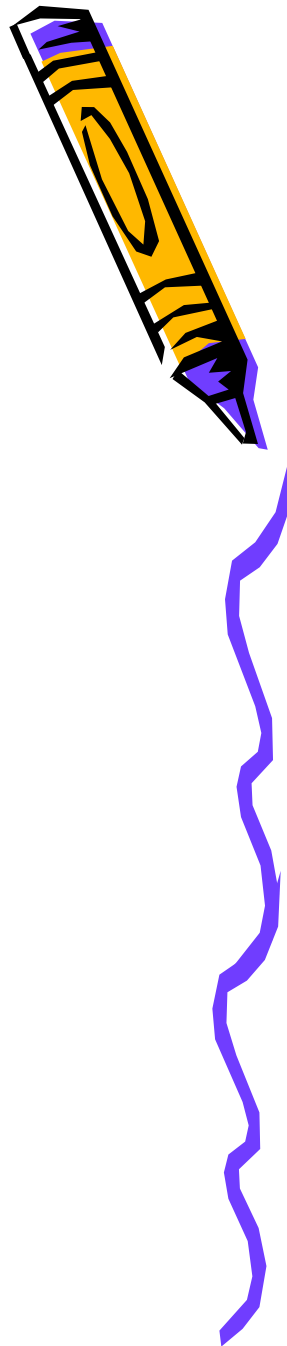


Transformation of DT Functions

Let $g[n]$ be defined by

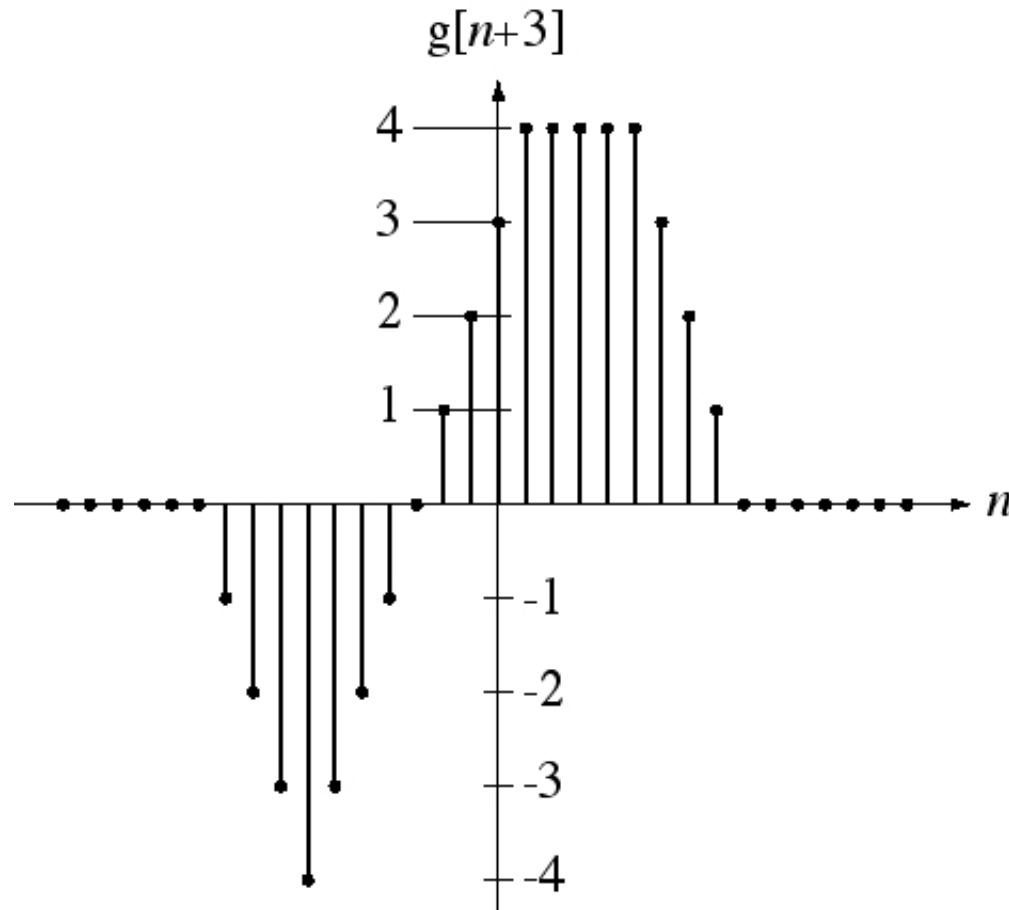


$$g[n] = 0, |n| > 15$$



Transformation of DT Functions

Time Shifting $n \rightarrow n + n_0$, n_0 an integer

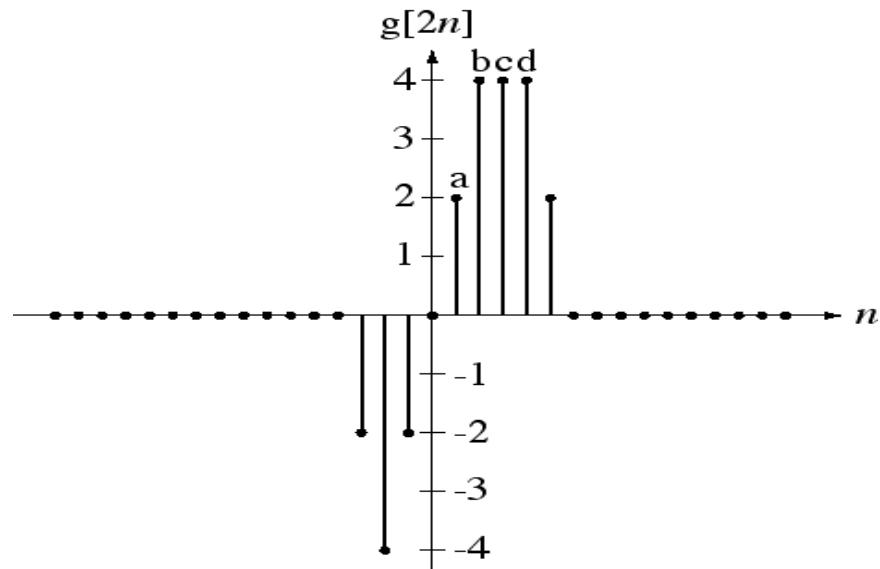
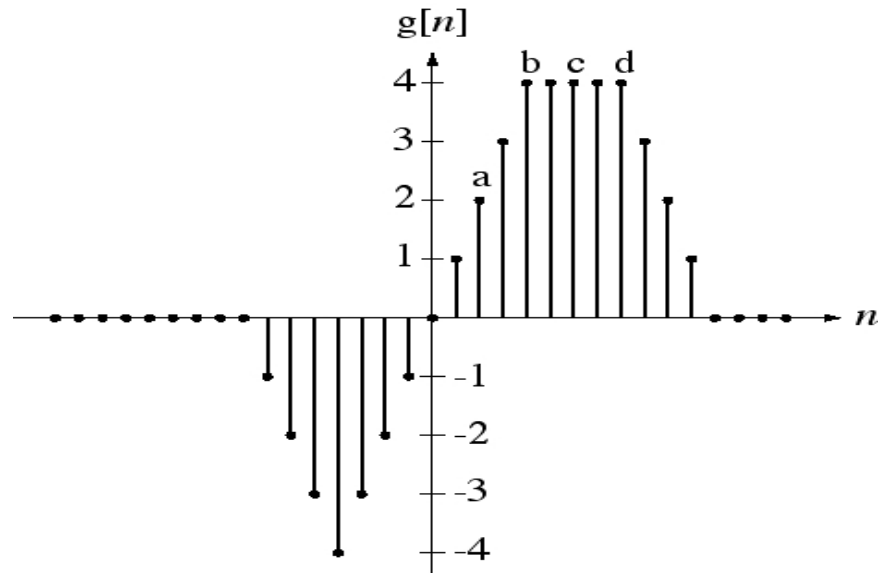


Transformation of DT Functions

Time compression

$$n \rightarrow Kn$$

K an integer > 1

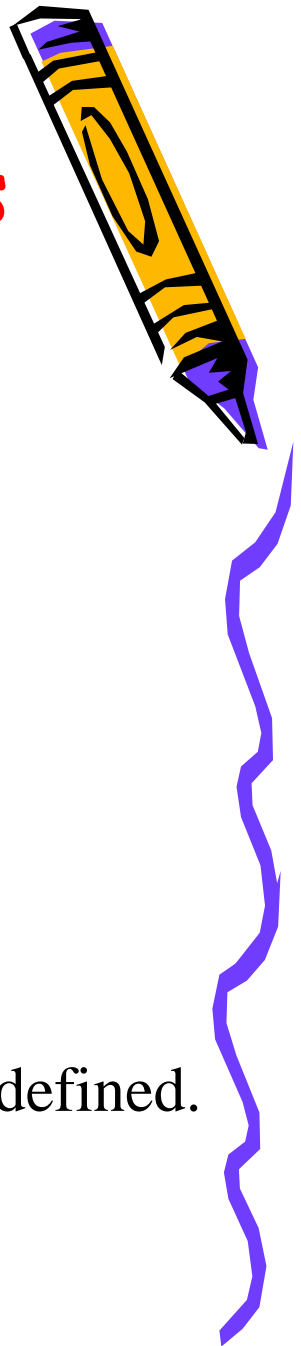


Transformation of DT Functions

Time expansion $n \rightarrow \frac{n}{K}$, $K > 1$

For all n such that n/K is an integer, $g\left[\frac{n}{K}\right]$ is defined.

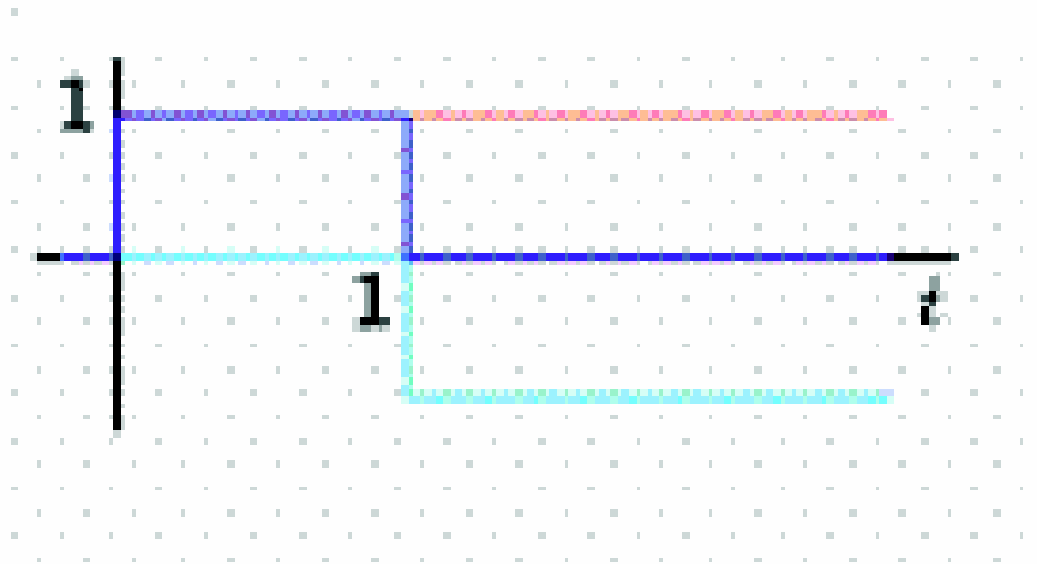
For all n such that n/K is not an integer, $g\left[\frac{n}{K}\right]$ is not defined.



Combination of signals

Unit steps and unit ramps can be combined to produce pulse signals.

$$u(t) - u(t-1)$$



Triangle signal using unit step and ramp signals

$$tu(t) - 2(t-1)u(t-1) + (t-2)u(t-2)$$

