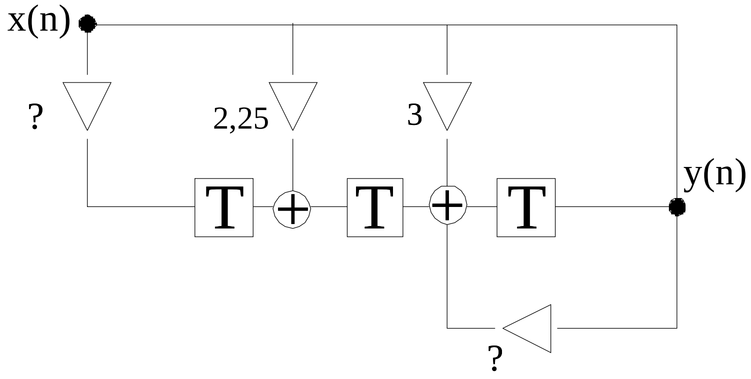
# Digital Signal Processing: Deterministic Signals

## 1. System analysis

1.1. We look again at the digital filter from the „foundations“ experiment.




1.2.Is the filter stable?    Is the filter causal?
1.3.What type of filter do we have (low-pass, high-pass,all-pass,band-pass, inverse band-pass?)
1.4.Our periodic series x(n) = [0,2,0,-2,0,2,0,-2,....]  is now to be understood as a sampling of a signal x(t) = A*sin(2π f t) at times t=nT. What is the amplitude A, the frequency f and the sampling time T? Is this result unique?
1.5.According to the sampling theorem, what minimum sampling frequency $F_S$ = 1/T is needed to fully recover the signal?

## 2. MATLAB Computer experiments

2.1. From H(z), let Matlab compute the frequency response H(f) of  the  filter. Let Matlab draw a scetch of |H(f)| and of arg H(f). All need is the function *freqz*.
2.2.Now modify one of the poles in such a way that the filter becomes non-causal. Again, let Matlab draw a scetch of |H(f)| and of arg H(f).

############

2.3.For the modified H(z), let Matlab perform an inverse z-Transformation in two ways:
a) to give you the corresponding difference equation
b) inverse-transforming the steady state part and the inital part.
2.4.We use the periodic series [0,2,0,-2,0,2,0,-2,....] again. Pass a long series of this nature to the modified filter. What is the output after some time?
2.5.Is there a steady state? What does it look like?
############

2.6.The signal x(t) = A cos(2π t F), with *t=0:0.01:5* is given.

2.7.Let Matlab sample the signal x(t) with frequencies *fa* below and above $F_S$ (use *abtast(x,t,fa)*).

2.8.Compute the spectrum of the sampled signal. Discuss aliasing. Use:
*y=cos(2*pi*(0:1/fa:max(t))*F); % cos-function only with the sampling points*
*Y=fft(yy,FFT_length) with FFT_length=512*

2.9.Repeat the sampling, but this time only a window of length n=5 is known to the observer.
*y2=y(1:n);*
In this range, apply a rectangular window (*rectwin(N)*) and a Hamming (*hamming(N)*) window. Plot the spectrum and discuss the differences between the three situations.
a) no window (2.6.), b) rectangular window n=5, c) Hamming window n=5.