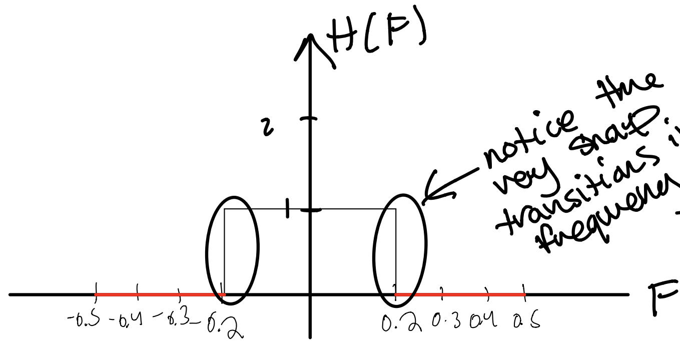
(1)

$$H(F) = \begin{cases} 1, & |F| \le 0.2 \\ 0, & 0.2 < |F| \le 0.5 \end{cases}$$



notice the very sharp transitions in the frequency response

* the result is an unlimited amount of samples in the time domain * this is not practical cannot have a filter with infinite coefficients

(1) h(n)

$$h(n) = F^{-1}[H(F)]$$

$$h(n) = \int_{-0.5}^{0.5} H(F) e^{j2\pi f n}\, df$$

$$h(n) = \int_{-0.2}^{0.2} (1) e^{j2\pi f n}\, df$$

$$= \frac{1}{j2\pi n} e^{j2\pi f n} \Big|_{-0.2}^{0.2} \Rightarrow \frac{1}{j2\pi} \underbrace{\left[e^{j2\pi 0.2n} - e^{-j2\pi 0.2n} \right]}_{\Downarrow \; 2j\sin(2\pi 0.2n)}$$

$$h(n) = \frac{1}{\cancel{j2}\pi n} \cdot \cancel{2j} \sin(2\pi 0.2n)$$

$$h(n) = \frac{1}{\pi n} \sin(2\pi 0.2n)$$

Real sinc function

$$* \; \text{sinc}(x) = \frac{\sin(\pi x)}{\pi x}$$

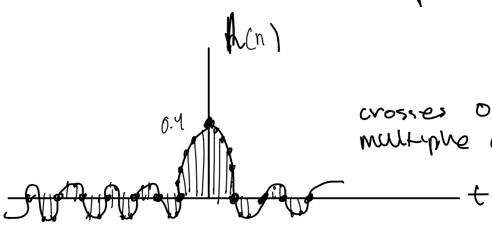
* So that MATLAB code runs correctly we need to find the value of the sinx function at 0 analytically

$$\lim_{n \to 0} \frac{\sin(0.4\pi n)}{\pi n}$$

$$\lim_{n \to 0} h(n) = 0.4$$

$$\lim_{n \to 0} \sin(n) = n$$

$$\boxed{\mathrm{inc}(x) = \frac{\sin(\pi x)}{\pi x}}$$ $\longleftarrow$ mathematical form for the ideal low pass filters impulse response



crosses 0 by integer multiple of T

• Thus one can see that as you move away from the origin the amplitude decreases

$h(n-n_0) \longrightarrow$ shifted to the right by n_0

The purpose of this lab is as such:

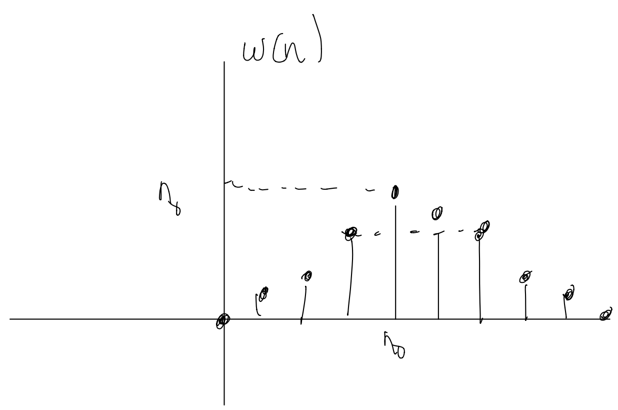
Starting from an ideal filter, how can we change it to make it more practical.

② $g[n] = h[n-n_0]\,w[n]$

where

$$w[n] = \begin{cases} n, & 0 \le n \le n_0 \\ 2n_0 - n, & n_0 \le n \le 2n_0 \end{cases}$$

w(n)



$0.4\pi n = k\pi$

$k = \frac{2}{5} \times n$

length of triangle $2n_0+1$ = # of samples