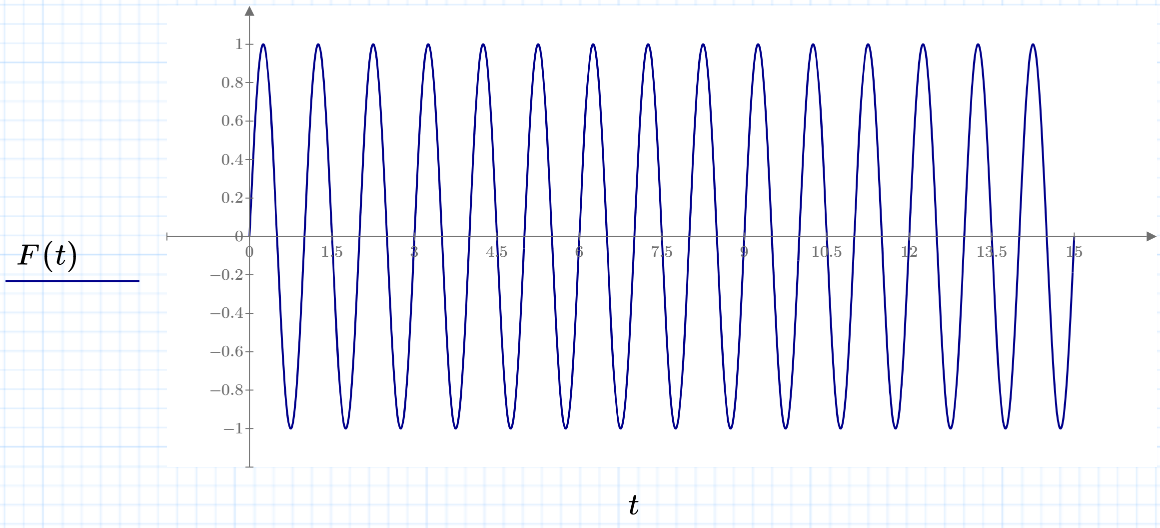
Recovering a signal from sampled data using the sinc reconstruction filter:

Original signal: 15 periods of a 1 Hz sinewave, plotted with fine resolution:

$T := 1 \qquad f := \frac{1}{T} = 1 \qquad \omega := \frac{2 \cdot \pi}{T} \qquad F(t) := \sin(\omega \cdot t)$

$T_s := 15 \cdot T \qquad \Delta t := 0.01 \qquad t := 0, \Delta t .. T_s$

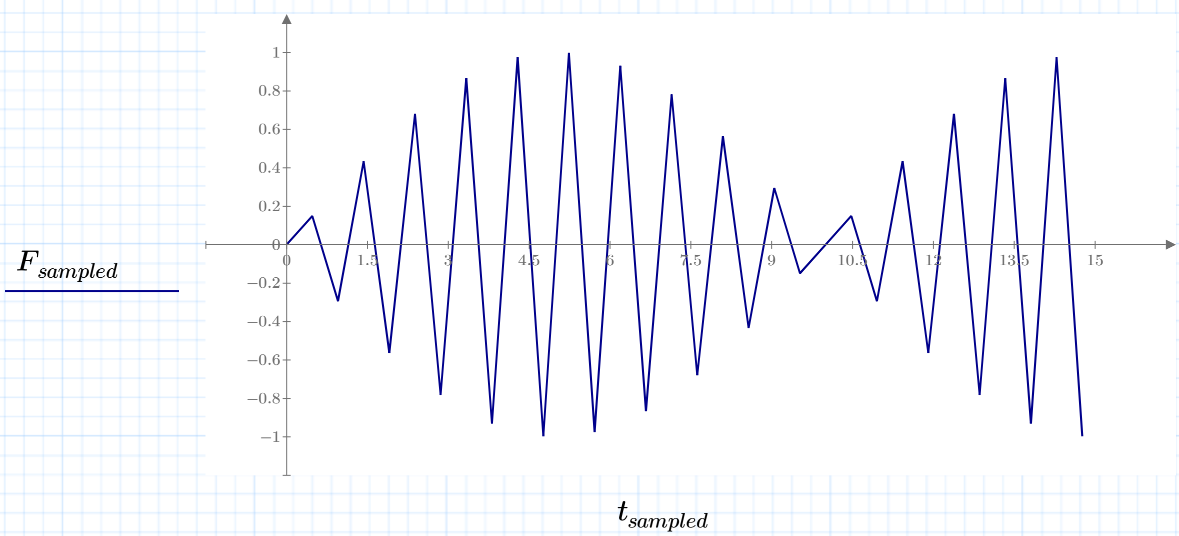


Signal digitally sampled at just over the Nyquist frequency (twice the signal frequency):

$f_s := 2.1 \cdot f$

$\Delta t_s := \frac{1}{f_s} = 0.476 \qquad N_s := \frac{T_s}{\Delta t_s} = 31.5 \qquad i := 0 .. N_s$

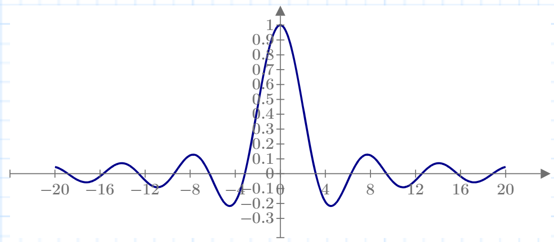
$t_{sampled_i} := i \cdot \Delta t_s \qquad F_{sampled_i} := F\left(t_{sampled_i}\right)$



Signal recreated from the sampled data using the sinc reconstruction filter:

$$t := -20, -19.9 .. 20$$

$$sinc(t) := \begin{cases} 1 & \text{if } (t = 0) \\ \dfrac{\sin(t)}{t} & \text{else} \end{cases}$$



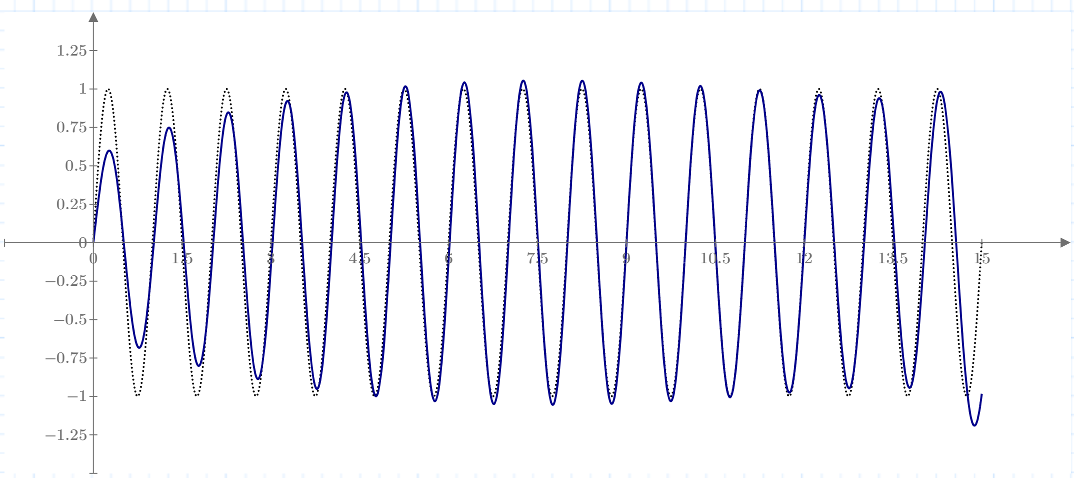
$$f(t) := \sum_{i=0}^{N_s} F_{sampled_i} \cdot sinc\left(\frac{\pi \cdot \left(t - t_{sampled_i}\right)}{\Delta t_s}\right)$$

The peaks of each sinc function occur at each of the sampled data points, with the large central peak occuring at the current point. When all of the scaled sincs are added together, the original signal is reconstructed.

$$N := \frac{T_s}{\Delta t} \qquad i := 0 .. N \qquad t_{recontruct_i} := i \cdot \Delta t$$

$$F_{reconstruct_i} := f\left(t_{recontruct_i}\right)$$

Reconstructed sampled signal compared to the original signal:



Note that the reconstructed wave matches the original signal fairly well. The match is poor only at the beginning and end of the sampling interval, where the signal is started and stopped abruptly.