TOOL: Sampling at a frequency greater than twice the highest frequency (called the "Nyquist rate") in a signal preserves all the information in the signal, whereas sampling at less than the Nyquist rate causes aliasing, wherein higher frequencies give the same sample values as lower frequencies. When aliasing occurs, the aliased frequencies get summed up and cannot be separated again to recover the original signal.

The Rosetta Stone method illustrates what happens to the spectrum of a signal when sampled. Fig. 1 below shows aliasing that results from sampling at a low rate. Copies of the spectrum of the signal overlap in the frequency domain.

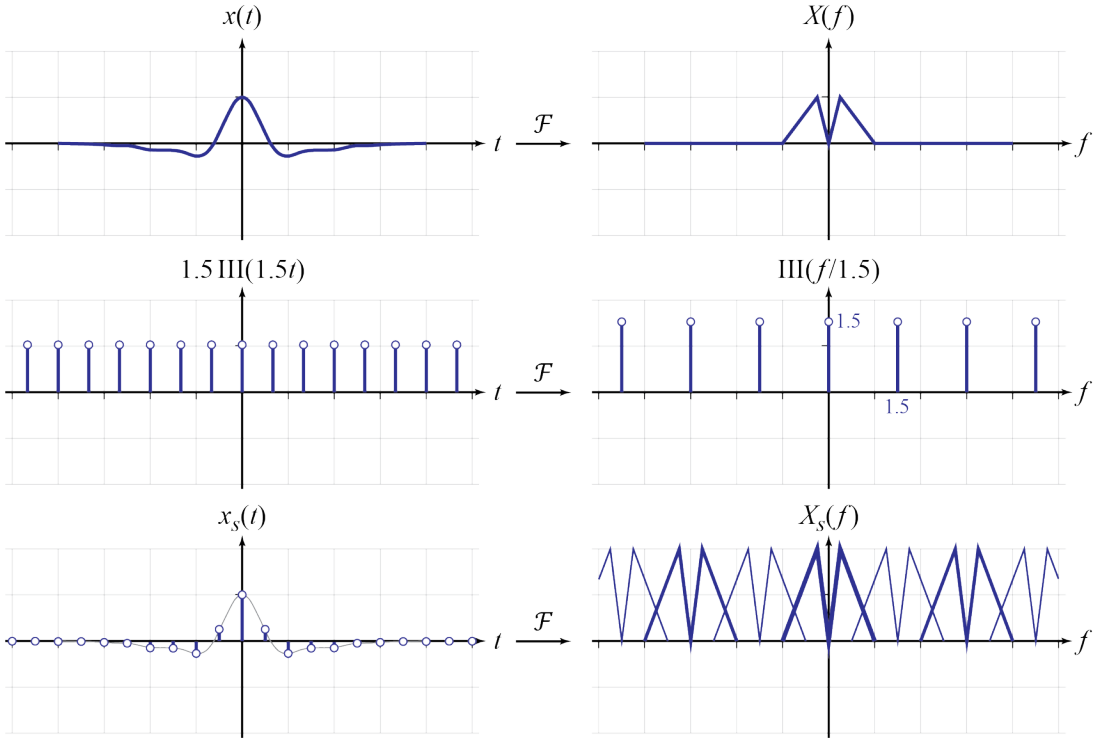

Fig. 1. Any lower sampling rate would cause overlapping spectra or "aliasing".

If we sample at more than twice the highest frequency in the signal's spectrum, the copies of the spectrum after sampling will separated in the frequency domain, as shown in Fig. 2, below. By low-pass filtering, assuming we use a non-causal, low-pass filter that cuts off completely above a specified frequency, we may perfectly recover the original signal.

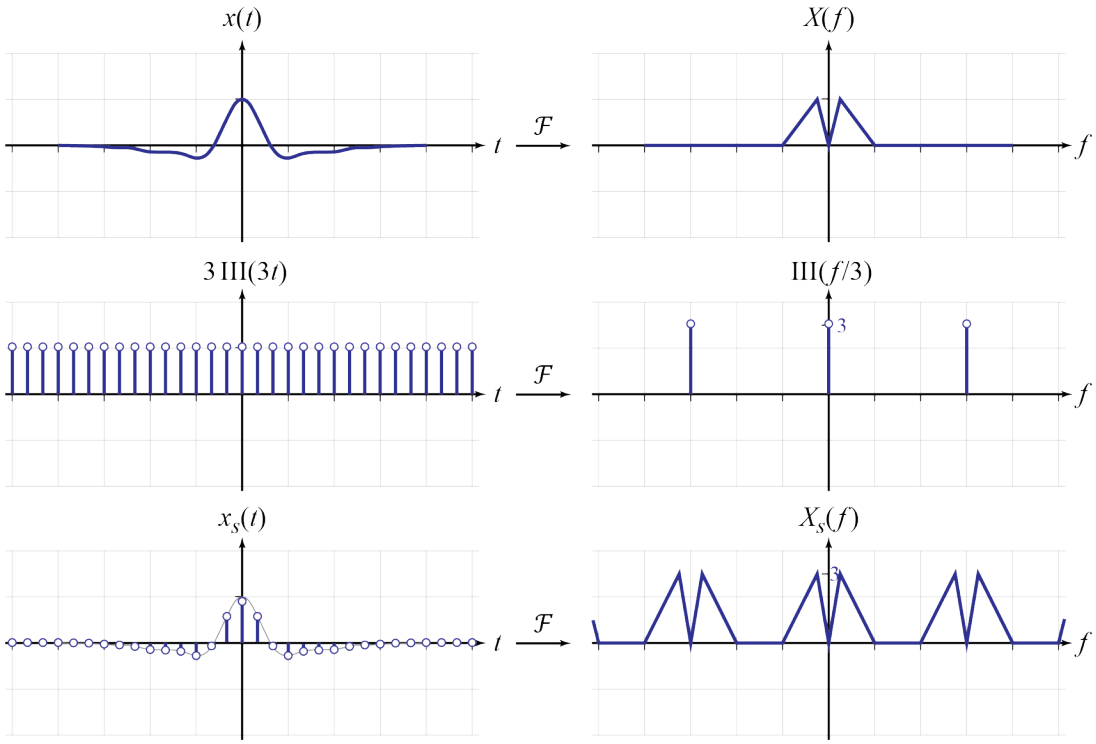

Fig. 2. Sampling higher than twice the highest signal frequency avoids aliasing.