

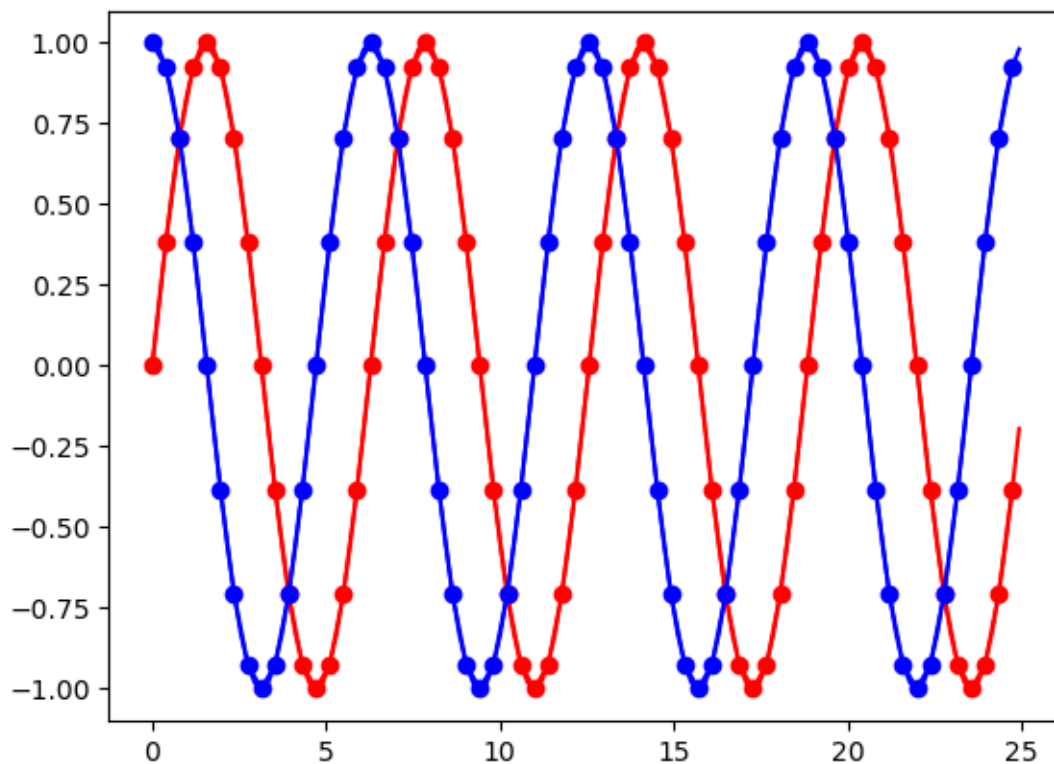
# Nyquist sampling theorem

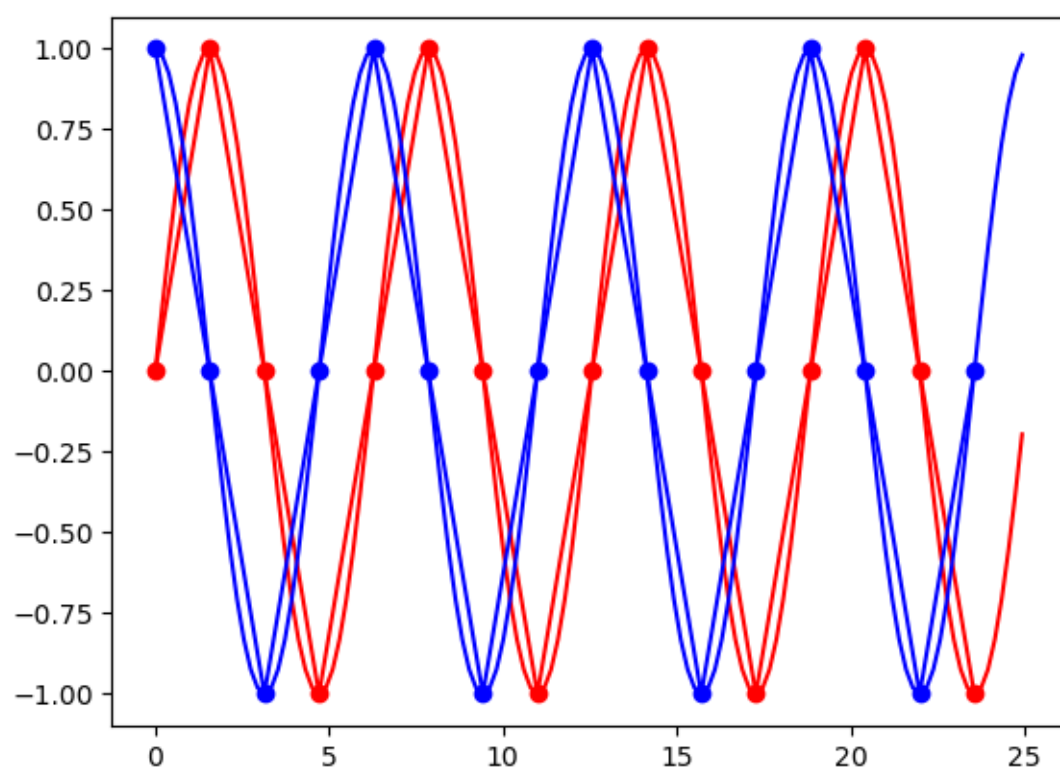
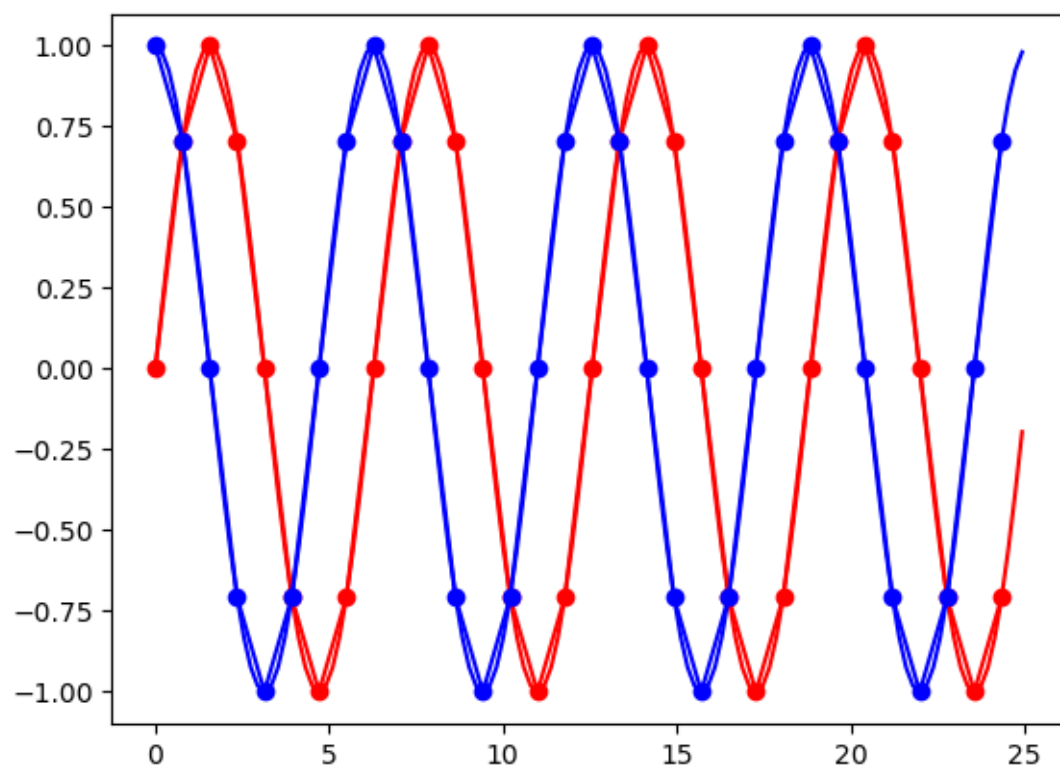
October 23, 2023

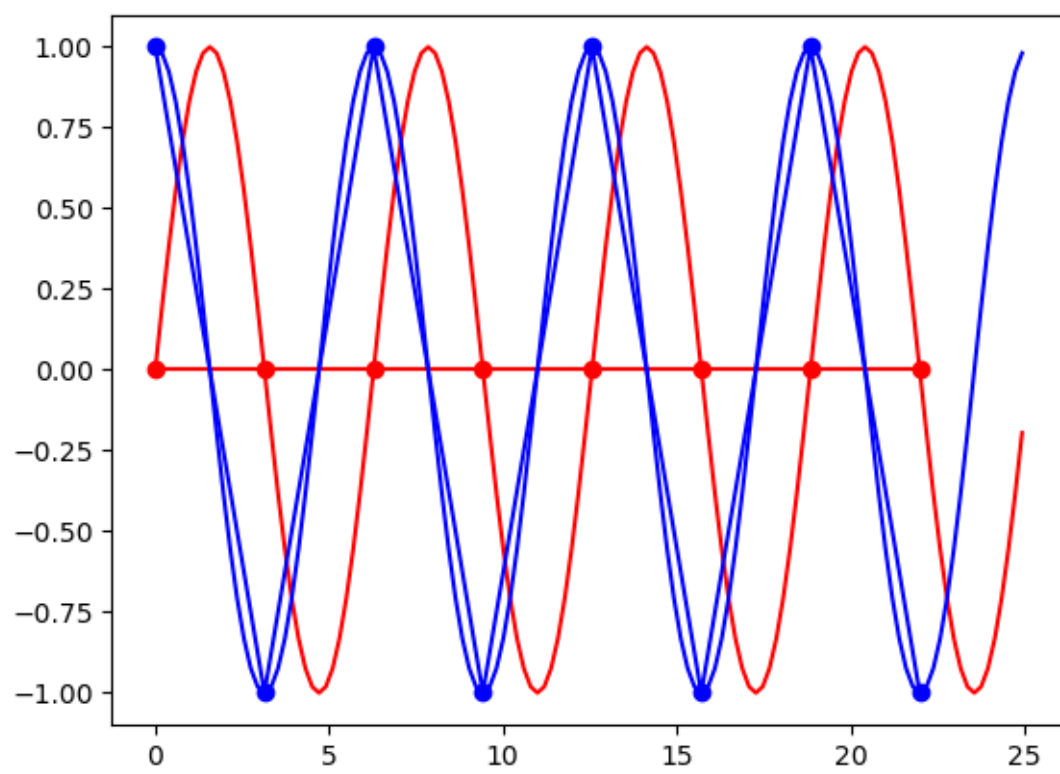
## 1 Nyquist sampling theorem

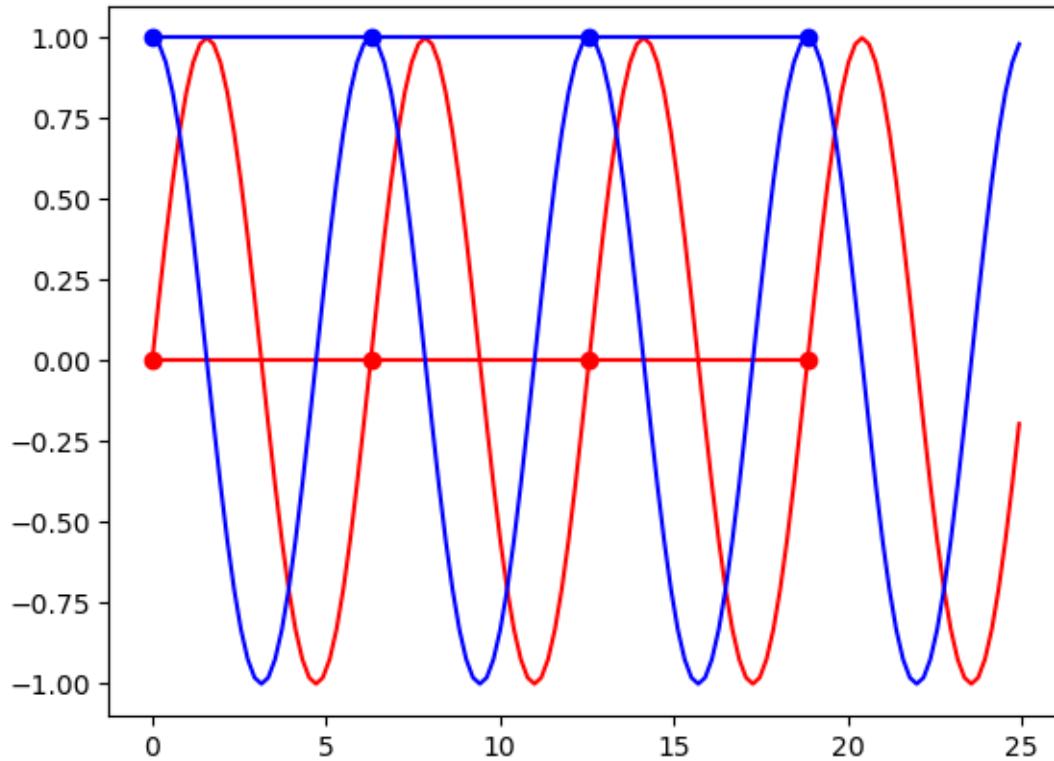
### 1.1 Entropy of binary encoding: the binary entropy function

Consider  $M = 4$  periods of a sine and a cosine that has been sampled such that each period contains  $N = 32$  samples. Plot the signal with its  $N$  samples per period and the start to reduce the number of samples by a factor of two (2, 4, 8, 16, and 32). Note that above  $N/2$  (hence less than 2 sample per period), it is no longer possible to reconstruct the original signal (= the Nyquist sampling theorem).









## 2 Capacity of a PAM modulated signal.

A 1Gigabit Ethernet communication uses a PAM-5 modulation with Trellis Code Modulation (TCM) over 4 parallel lines. This implies that it transmits 2bits at each sampling instance and this over each line. Note: the 5th level of the PAM-5 is used to obtain a better error correcting capability. What is the minimal signal bandwidth that is required for the transmission of this signal?

BW\_min: 62.5MHz