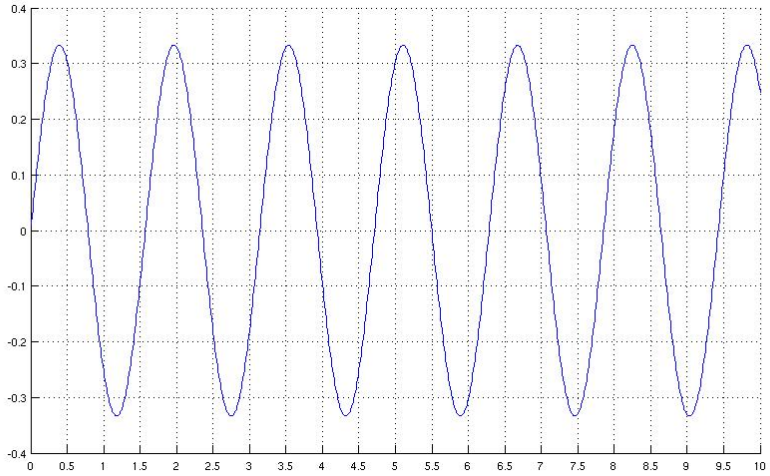
Department of Computer Science University of Bristol

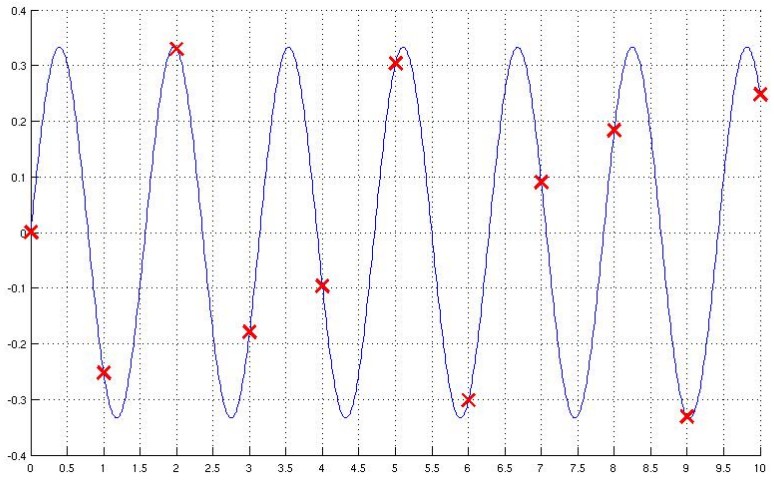
COMS21202: Symbols, Patterns and Signals

Problem Sheet 1: Data Acquisition

1. On the $sin(x)$ signal below, label the following terms and approximate their values: period, frequency and amplitude

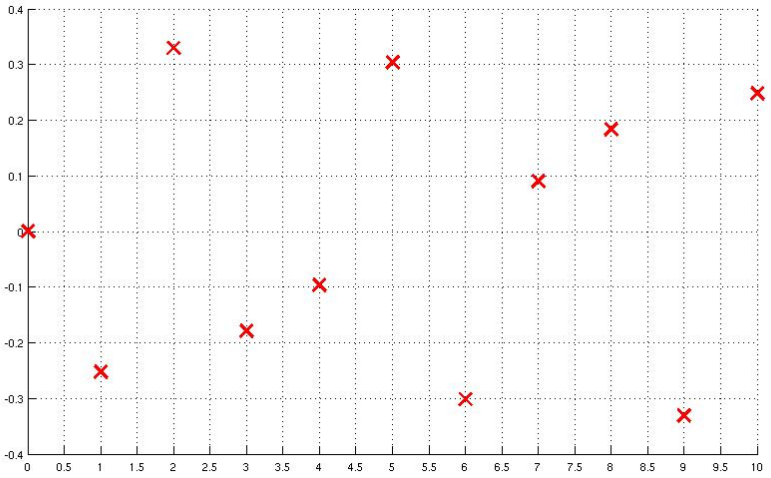


2. For the signal above, convert the signal into its digital representation using the sampled points. You need to think about the number of bits you would represent each sample as. This is referred to as **Quantisation**. Example, if you need 8 different levels of sound, then 3 bits are sufficient ($2^3 = 8$).

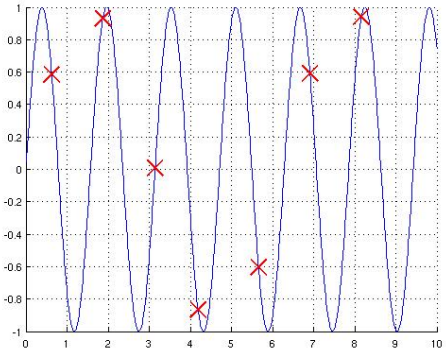


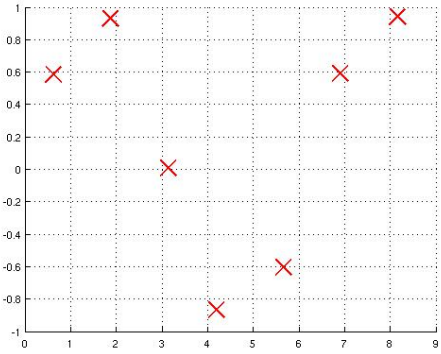
What is the sampling rate in this case??

3. If you have only the sampled data, can you reconstruct the signal from this data? Try for yourself



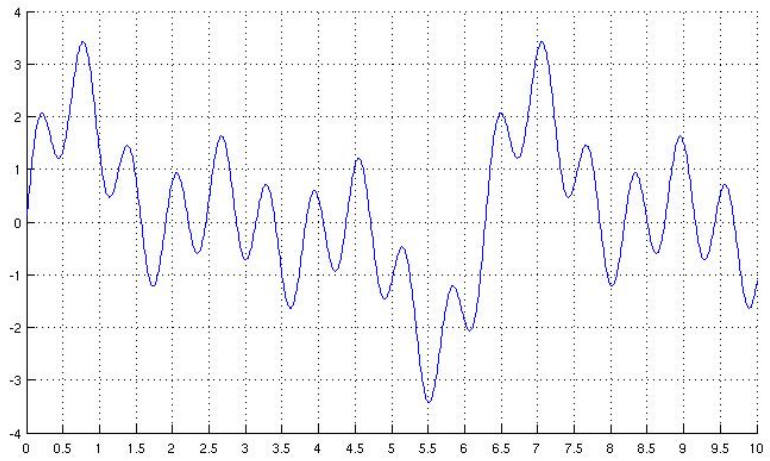
4. Repeat the digitization and reconstruction step for this data below, can you notice any difference?





5. Based on your understanding of the **Nyquist Sampling Rate** theorem, what is a sufficient sampling rate for the signal below?

   Note: You might want to look at Fourier Analysis to understand how was this sinusoidal wave constructed.



6. **Refreshing your memory:**

   For the set of measurements:

   -3, 2, 4, 6, -2, 0, 5

   calculate:

   mean

   median

   variance

   standard deviation

7. **Distance measures:** Assume you were given a set of whatsapp messages, each with a timestamp (yy-mm-dd hh:mm) and text content (word, word, ...). Propose a distance measure for:

   - calculating whether one message is an exact forward of the other message
   - calculating whether one message was sent before the other message
   - calculating whether one message contains the same set of words as the other message
   - calculating whether one message contains the other message (with potential extras at the start and the end)
   - calculating whether both messages discuss the same topic

   Check your distance measures satisfy: non-negativity, reflexive, symmetric and triangule inequality.

8. **Dynamic Time Warping:** For the two signals:
   a = 1110010011110101
   b = 0011011

   calculate the Dynamic Time Warping Distance using the hamming distance as a bit-wise distance measure.