# Sampling and Quantization (10A)

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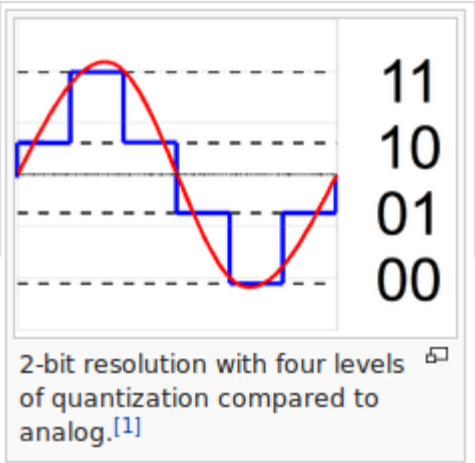
# Quantization

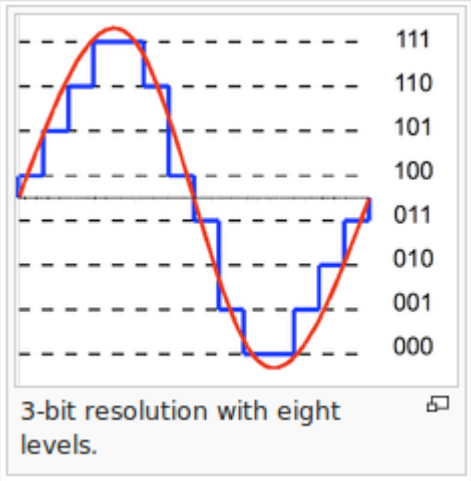

The simplest way to quantize a signal is to choose the digital amplitude value closest to the original analog amplitude. This example shows the original analog signal (green), the quantized signal (black dots), the signal reconstructed from the quantized signal (yellow) and the difference between the original signal and the reconstructed signal (red). The difference between the original signal and the reconstructed signal is the quantization error and, in this simple quantization scheme, is a deterministic function of the input signal.

http://en.wikipedia.org/wiki/

# Quantization Levels



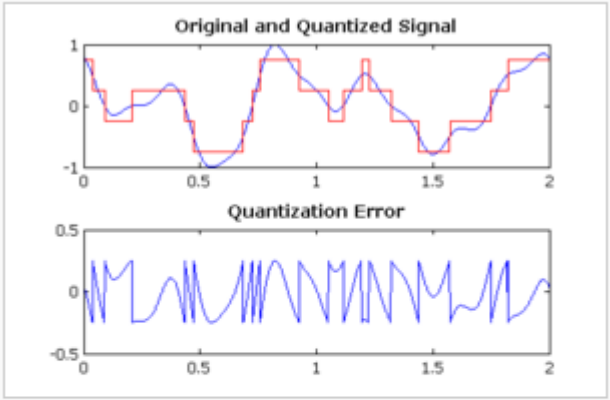

2-bit resolution with four levels of quantization compared to analog.[1]




3-bit resolution with eight levels.

http://en.wikipedia.org/wiki/

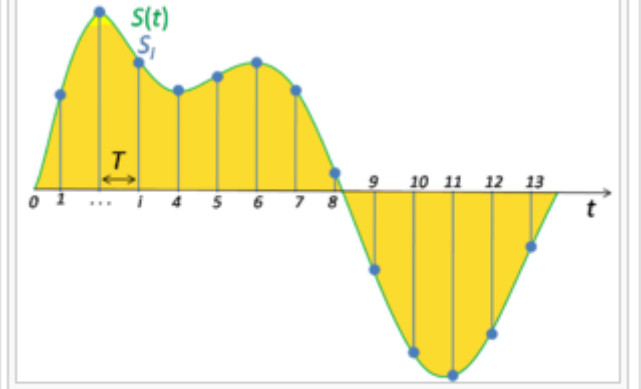
# Quantization Noise




Quantization noise for a 2-bit ADC operating at infinite sample rate. The difference between the blue and red signals in the upper graph is the quantization error, which is "added" to the quantized signal and is the source of noise.

http://en.wikipedia.org/wiki/

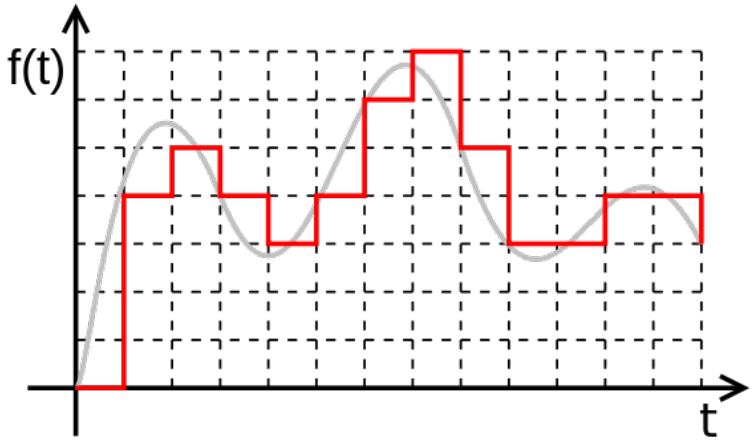
# Signal Sampling

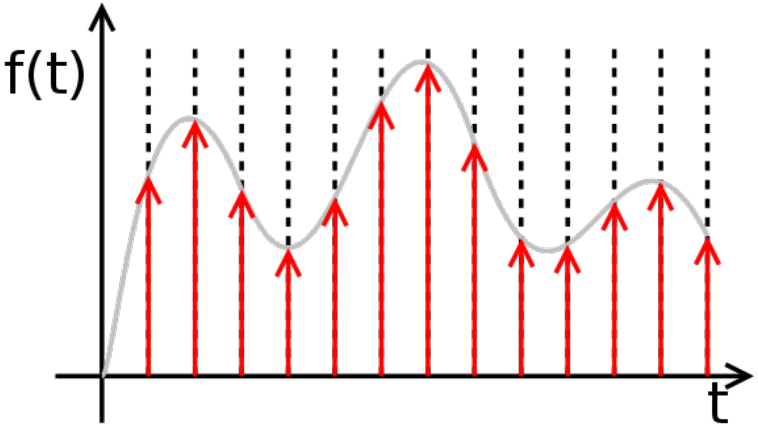


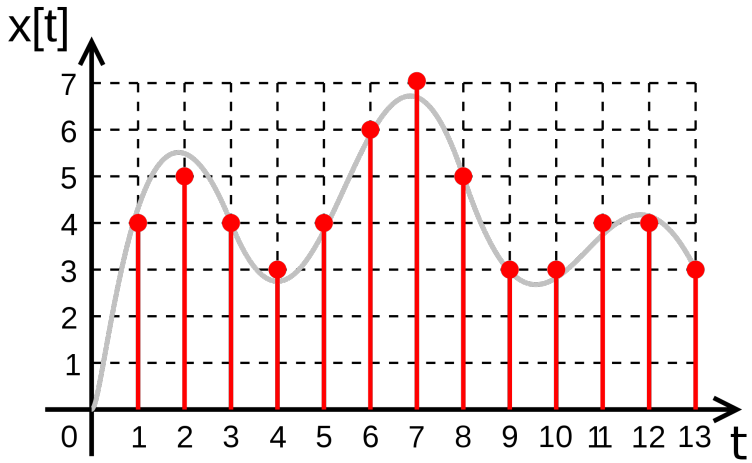

Signal sampling representation. The continuous signal is represented with a green colored line while the discrete samples are indicated by the blue vertical lines.

http://en.wikipedia.org/wiki/

# Sampling and Quantization

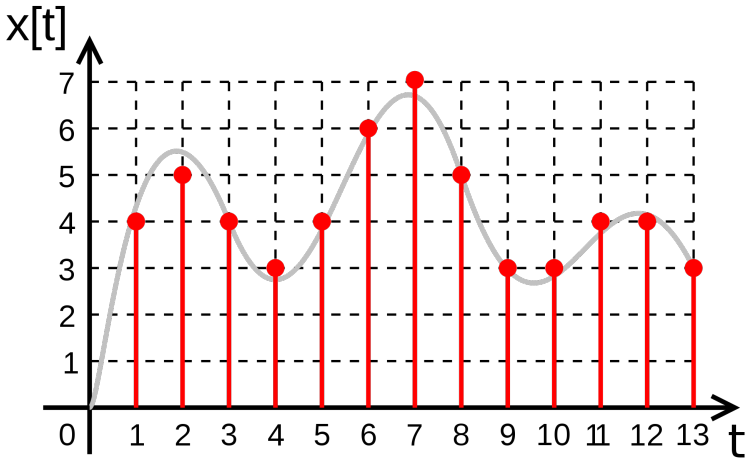



http://en.wikipedia.org/wiki/

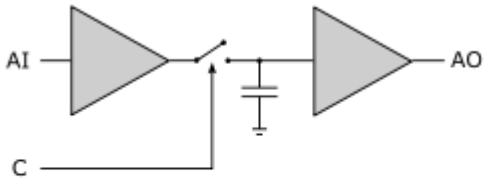
# Analog to Digital Conversion




| x[0] |
| --- |
| x[1] |
| x[2] |
| x[3] |
| ... |
| ... |

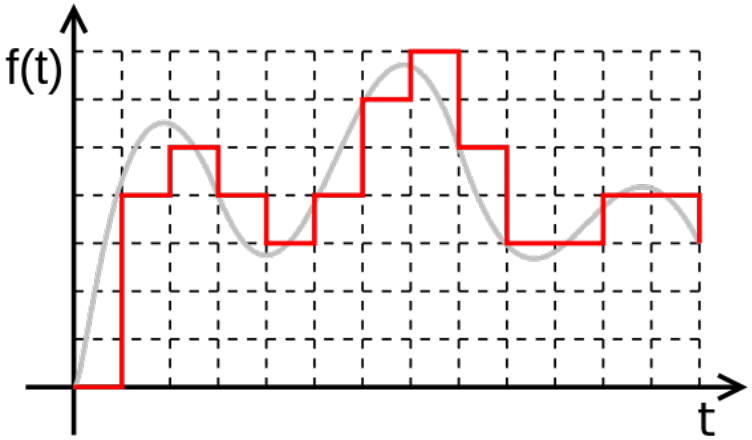
http://en.wikipedia.org/wiki/

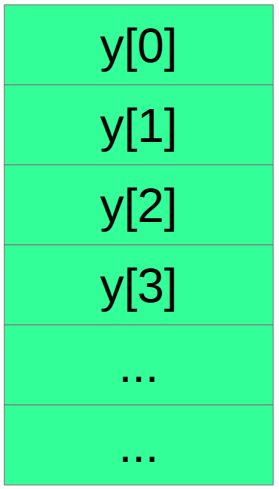
# Sample and Hold




A simplified sample and hold circuit diagram. AI is an analog input, AO — an analog output, C — a control signal.

# Digital to Analog Conversion

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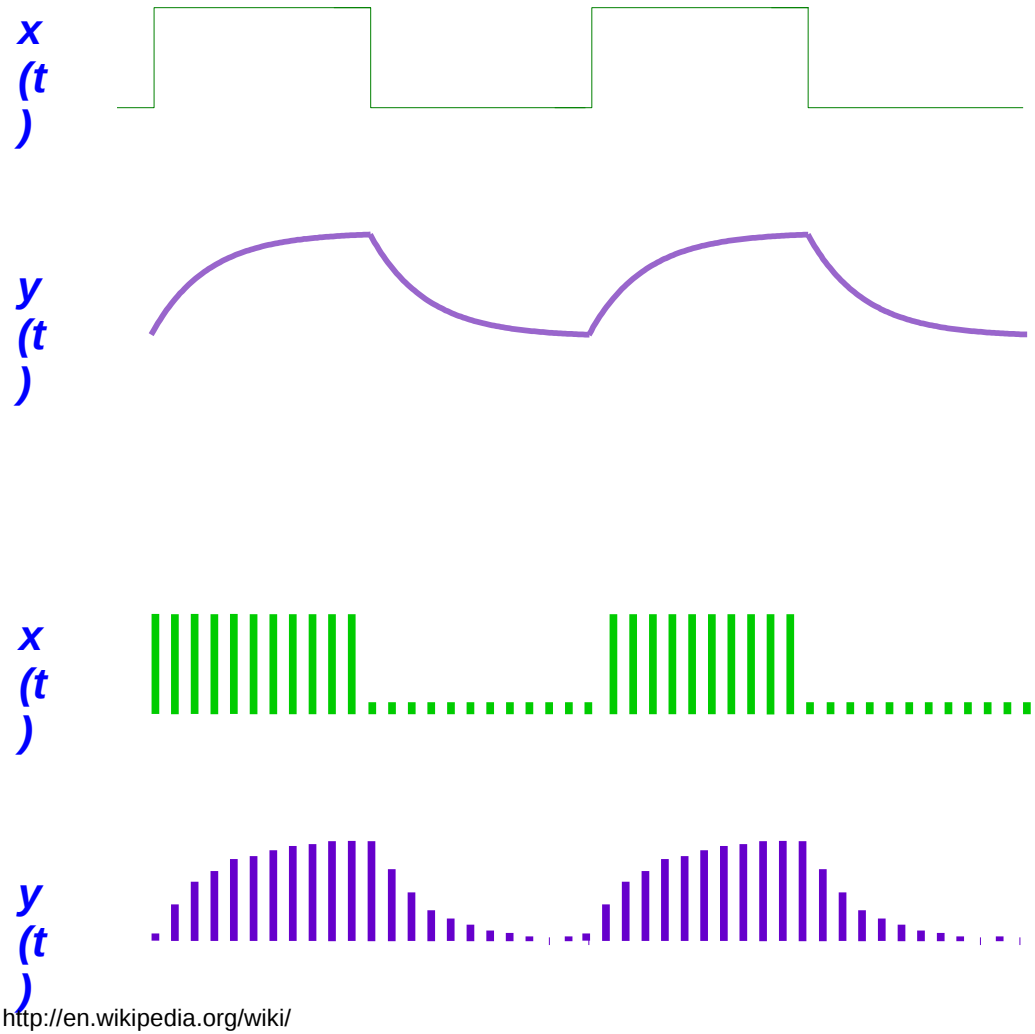
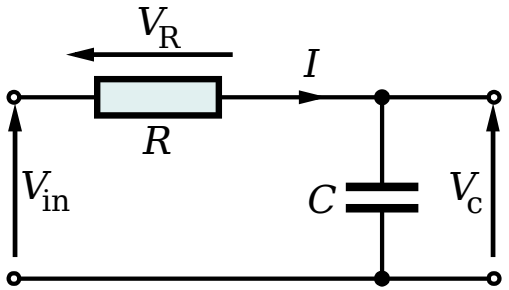



http://en.wikipedia.org/wiki/




$$y[n]=\sum_{m=0}^{n} h[m]x[n-m]=\sum_{m=0}^{n}(0.75)^m$$

## References

[1] http://en.wikipedia.org/
[2] http://planetmath.org/
[3] M.L. Boas, “Mathematical Methods in the Physical Sciences”