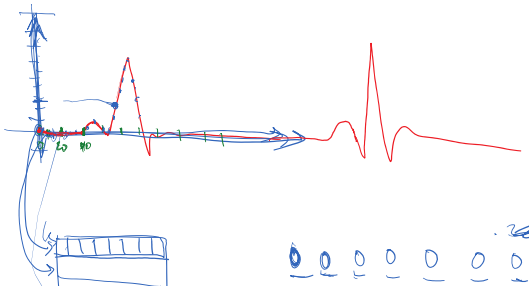
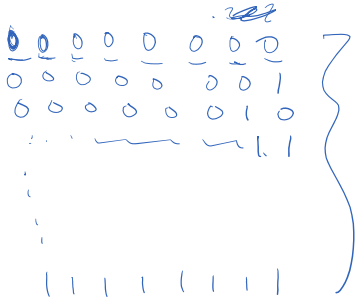
Analog vs digital

Monday, January 25, 2021 9:50 AM

	Analog	Digital	ADC parameter
① Time domain	continuous	discrete	sampling rate
② Amplitude scale.	infinite precision ⇒ continuous	finite precision ⇒ discrete	# of bits.



e.g. 8-bit A/D converter
⇒ ? How many possible values can I represent



2^8 possible values.

bits need = $\lceil \log_2(N_{values}) \rceil$

or tot # possible values = $2^{N_{bits}}$.

Sampling

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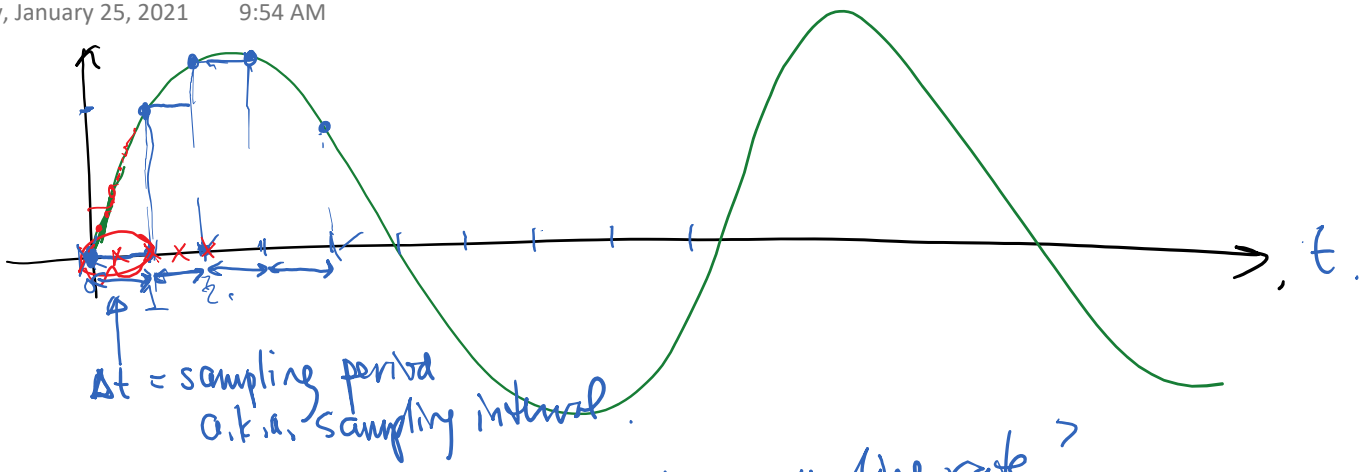

Δt = sampling period
a.k.a. sampling interval.

e.g. $\Delta t = 200$ ms., what is the sampling rate?

f_s = sampling frequency
a.k.a sampling rate.
[samples/sec.] = Hz.

$\Delta t = 1$ sec $\Rightarrow f_s = 1$ Hz.
$= 2$ sec. $\Rightarrow f_s = \frac{1}{2}$ Hz.
$= 0.5$ sec $\Rightarrow f_s = \frac{1}{0.5}$ Hz $\equiv 2$ Hz.
500ms.
$= 200$ ms. $\Rightarrow f_s = \frac{1 \text{ sample}}{0.2 \text{ sec.}} = 5$ samp/sec $\equiv 5$ Hz
$= 0.2$ s

Quantizing

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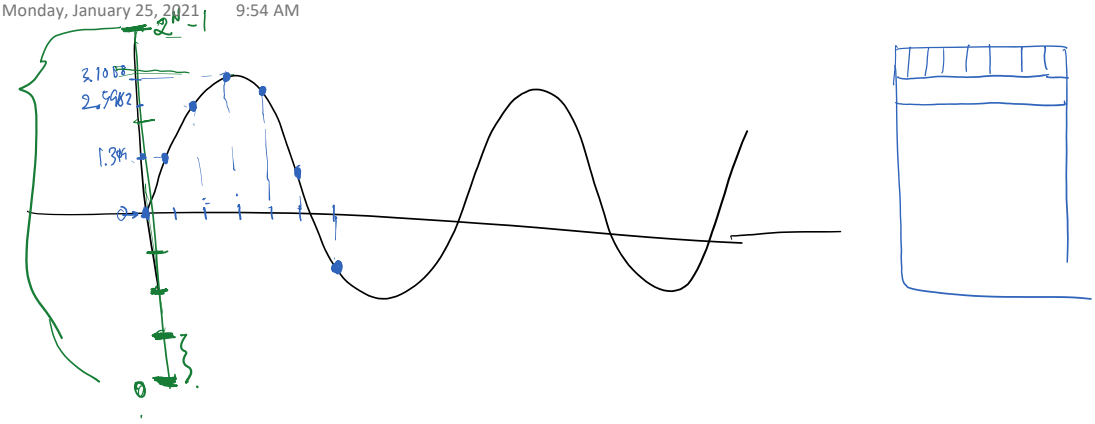
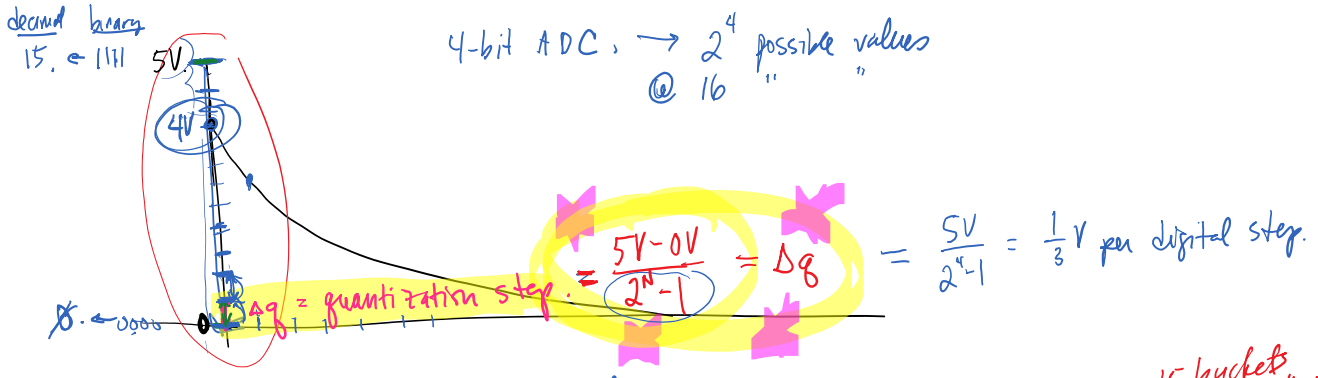
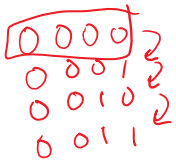




4-bit ADC, → 2^4 possible values
@ 16 " "

$= \frac{5V}{2^4-1} = \frac{1}{3}V$ per digital step.

$2^N - 1$ "bucket-falls" or intervals



how much water is in each bucket?

$\frac{5L}{15 \text{ buckets}} =$ $\frac{1}{3}L$ per bucket.

Now, if I want to fill tub to 4L, how many buckets do I need?

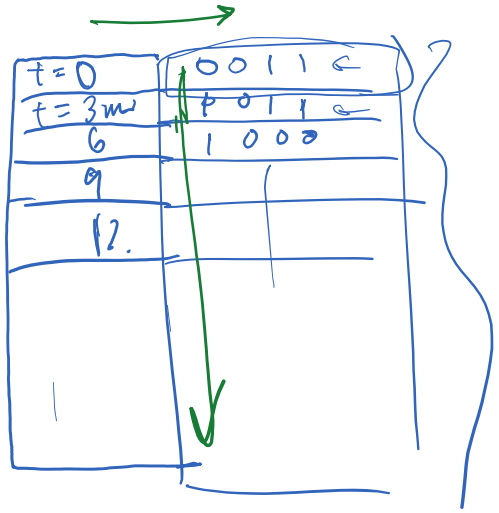
$\frac{4L}{\frac{1}{3}L \text{ per bucket}} = 12$ buckets.

Digital value = $\left[\frac{\text{Analog value}}{\Delta q}\right]$.

@ $\frac{4V}{1/3} = (12) = 0\,1\,1\,0\,0$
$2^3\ 2^2\ 2^1\ 2^0$

Data

Wednesday, January 26, 2022 4:06 PM



array = collection of elements.

matrix = multidimensional array.

Quantization error

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