BINARY REVIEW

ECOR 1044

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Definitions

- Binary has two values: 0 and 1
- Each 1 or 0 is called a ‘bit’
- Nibble – 4 bits
- Byte – 8 bits
- Word – Length is processor dependent (Combination of bytes)
- Most Significant Bit (MSB) – Largest contributor to the value
- Least Significant Bit (LSB) – Defines the last increment

Useful Equations

- Highest Number for A Certain Amount of Bits:

$$Num_{max} = 2^n - 1$$

Note:
↳ States is 2^n !
↳ But numerically it is $2^n - 1$.

- Minimum Amount of States (Bits) to Represent A Number:

$$N_{min} = \log_2(num + 1)$$

Analog vs. Digital

Analog:

- Infinite increments
- 0.1% Accuracy is great
- Analog is faster than digital (No conversions to the real world)

Digital:

- Finite values (limited increments)
- More accurate than Analog
- Stores data longer
- More cost effective

Analog to Digital Conversion

Sampling - Must incorporate discrete time periods

Sampling Rate:

- Frequency at which ADC evaluates the analog signal.
- Sample frequency at least twice the maximum frequency.

Min Sample Frequency = 2 x Max Amp of Signal

Analog to Digital Conversion

Quantization

Determines the amount of ranges needed for a certain sample.

It is also known as the resolution of the sample.

When incrementing the ranges, it is UPPER inclusive (not lower)

$$Q = \frac{V_{max} - V_{min}}{N_{states}}$$

Recall states relates to how many bits are being used for conversion.

$N_{states} = 2^n \rightarrow$ n is bit resolution.

Analog to Digital Conversion

Encoding

Determining the amount of output states (from quantization).

Assign each output state a number starting from zero.

For each number, apply it’s binary equivalent.

Voltage to Binary

Suppose we only want to know only one voltage.

① $$\text{ADC reading} = \frac{\text{Num States}}{\text{Voltage Range}} \times \text{Analog Voltage}$$

② Index = ADC reading {rounded up} − 1
↳ OR state

③ Convert index to binary.

First index is zero