Introductory Computation and Hardware

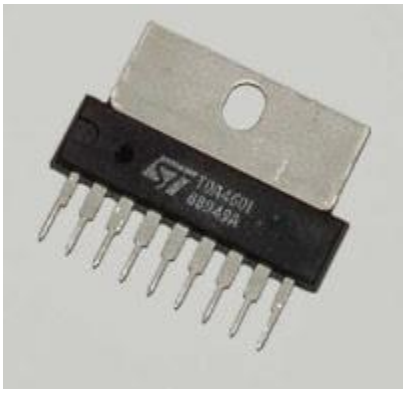
A monolithic IC is an electronic circuit that is fabricated entirely on a small chip of silicon. Depending on functionality ICs are categorized as

1. Fixed Function integrated circuits
2. Programmable integrated circuits

Fixed Function ICs are those ICs their function is fixed, having a finite set of inputs and output.

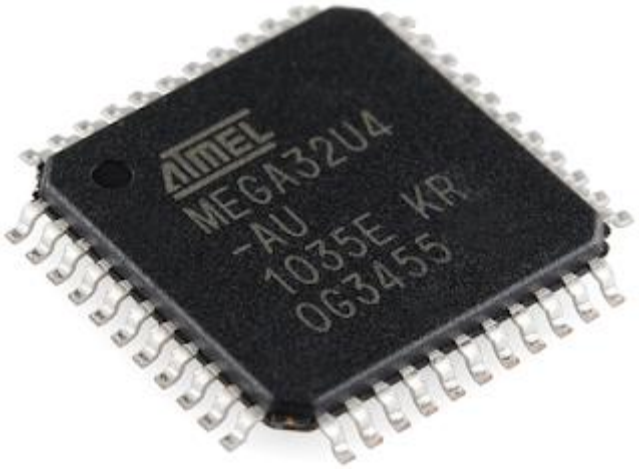
Programmable ICs are those who have the capability to perform a specific function but can be reprogrammed to change its functioning which is not in case of FF ICs. However, according to fabrication layout and design outlet ICs are of numerous types some of those listed below,

Single in Line Package

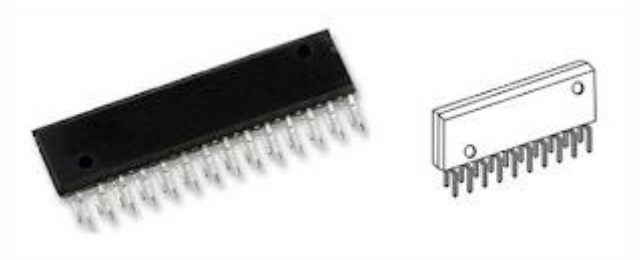


Dual in Line Package

Quad in Line Package



Zig-Zag Package



These outlets of ICs are used for protective packaging, holding and electronically or mechanically connect them to the Printed Circuit Board.

Logic is a realm of human reasoning and proposition is a declarative statement. Several propositions encounter in daily life which is either true or false. A particular proposition is true of the set of conditions are right. e.g. If we say "tomorrow is Sunday" then how it would be right. It is only right if today is Saturday; otherwise, it is false. More rigorously, if we say a "light bulb is ON" if and only if "Light bulb is not burned out" and "switch is ON". Instead of using right and wrong *True* and *False* are analogies used in the computation theories.

Light Bulb is ON is a proposition based on following propositions (conditions)

1. The bulb is not burned out
2. Switch is ON

Boolean Logic

In 1850. Irish logician and mathematician **George Boole** gave the idea of solving logic the same way as of linear algebra named boolean algebra. Logic is applied to the boolean function to implement logic functions. Basic logic operations are represented with logic symbols given below in Figure 1,

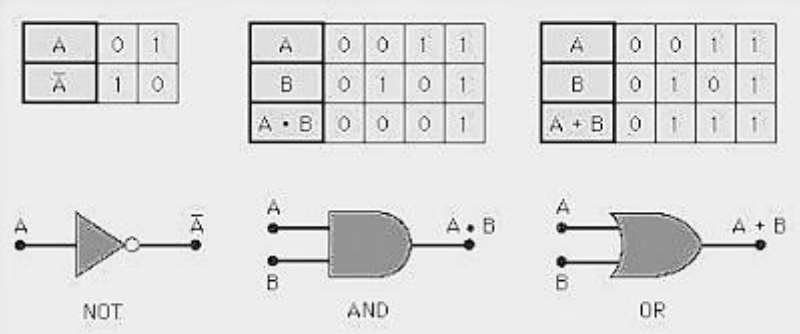


Figure 1

These symbols are of fundamental logic gates. There are other gates as well but will be discussed in later posts. The tables given above are called truth tables defining every possible state of output concerning inputs.

Digital electronics contain circuits and systems in which there are only two possible states. Representation of these states is different voltage levels(High and Low). As we say, open and closed switch or a lamp turned ON or OFF. A combination of these two states in digital systems is called codes.Two state digital system is called binary. And its two digits are 0 and 1. A binary digit is called a bit. The binary digital system is a special type of digital system where there are only two elements of code set (0/1, High/Low, ON/OFF).

Binary Digit and Logic Levels

There are two digits in the binary system. 0 and 1 called bits. The bit is a contraction of two words **Bi**nary Digi**t**. But here, a question arises.
How does an electronic system perceive that 0 and 1 are two different information instances and can not be interchanged and can not be overlapped too?

This is done by setting threshold values for both levels and create a forbidden(not used) gap between these two states refer to Figure 1.

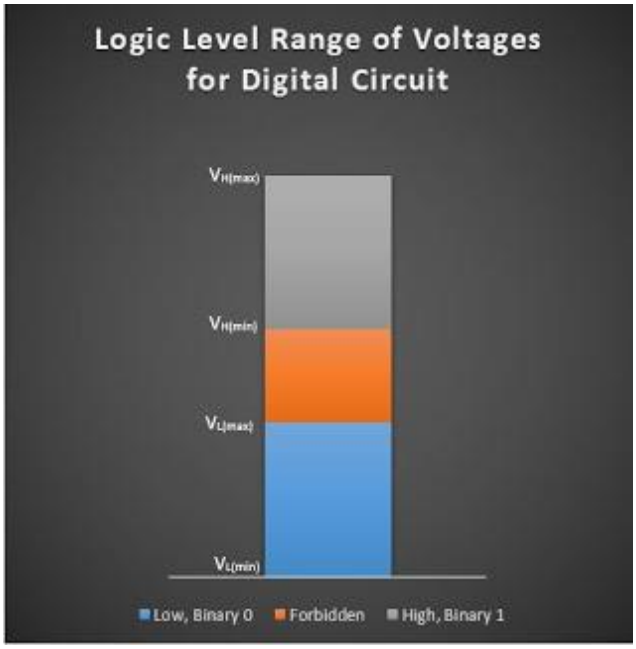


Figure 1

These threshold voltages levels defined lower bound and upper bound of suitable voltage values for given logic levels(Low/High).
Voltage level ranging inside the forbidden gap is either considered High or Low to System which is unacceptable and not used.

Digital Waveforms

Digital waveform is voltages levels changing back and forth between HIGH and LOW levels or states. Usually, these waveforms are represented as timing diagrams used to describe wave behavior relative to time,

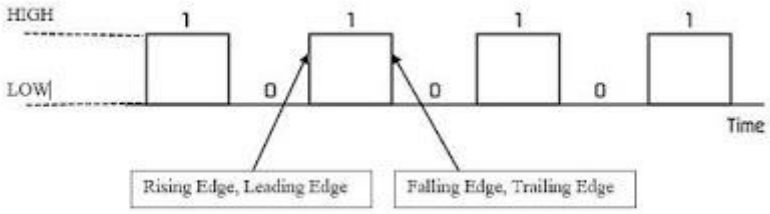


Figure 2

Pulse indicated in Figure 2 has two edges: A leading-edge where pulse goes to HIGH from LOW state and the Falling side where pulse revert. However, it is non-ideal pulse representation because the sudden transition from one state to other is impractical. Depending on practical consideration it will take a small amount of time to get a HIGH transition from LOW and vice versa,

Rise Time: *Time required for the pulse to go from its LOW level to HIGH is called rise time* tr.

Fall Time: *Time required for the pulse to go from its HIGH level to the LOW level is called fall time* tf.

Pulse Width: *It is a measure of duration between rising edge and fall edge of the pulse indicated as* tw.

Frequency (*f) and Time Period*

The frequency of a periodic (which repeats itself) waveform is the rate at which it repeats itself and measured in *Hz.* Whereas the period is the duration after that signal or waveform repeats itself. Mathematical interpretations are given below in equation *(i)* and *(ii).*

$$f = 1/T \quad \textbf{Hz} \qquad (i)$$

$$T = 1/f \quad \textbf{s} \qquad (ii)$$

Duty Cycles

An essential characteristic of a periodic signal that is the ratio of pulse width to the period.

$$\text{Duty Cycle} = (\textit{Pulse-width} / T)\ 100\%$$

Analog Quantity

Analog quantity is one having continuous values. e.g. temperature of the day, pressure on a substance regarding time, the heat of explosion all containing an infinite number of samples. These are continuously variable physical quantities.

Digital Quantity

Digital quantity is one that has a definite number of samples(range of values). Numeric quantities are either recorded for an exact amount of intervals or a countable number of events.

Example

The temperature of the actuator recorded right after the start of its operation. See Figure 1 below.

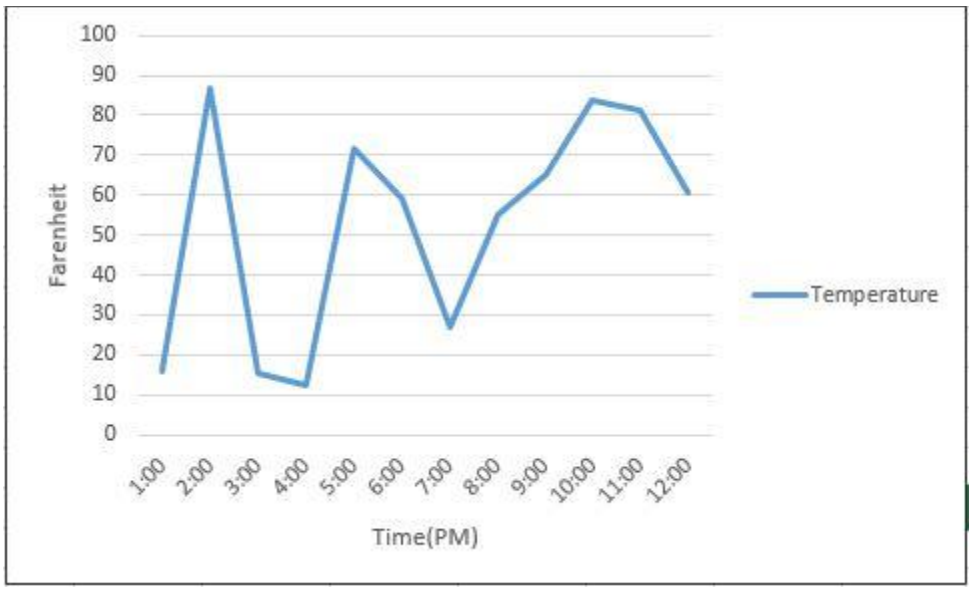


Figure 1• : Infinite Number of Samples

Rather than taking the temperature on a continuous basis, we can take temperature samples every hour eliminating the rest of the values. Have a view of Figure 2.

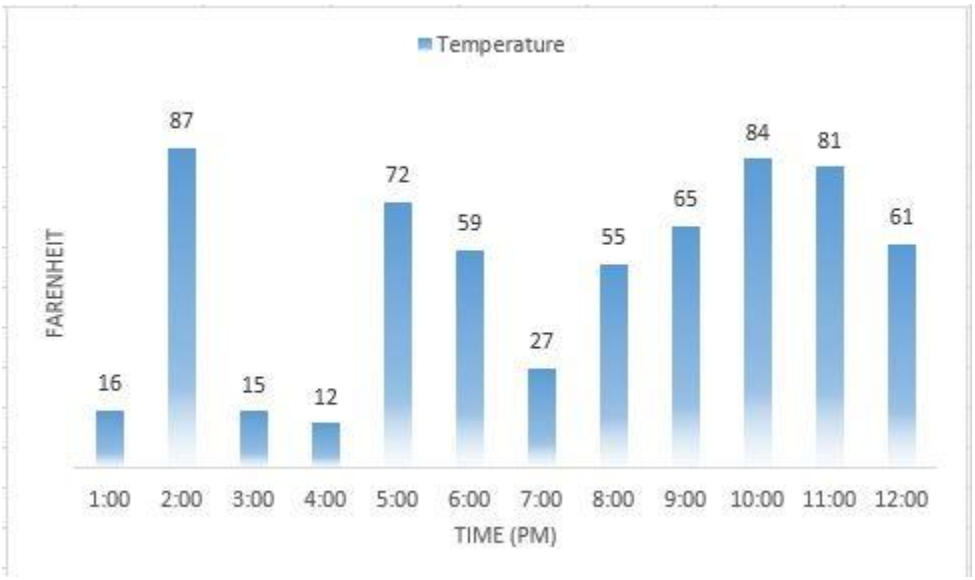


Figure 2: Finite Number of Samples

You have effectively converted an analog quantity to digital. This process of conversion is implied as Analog to Digital Conversion(**ADC**).

The Digital Advantage

- One advantage of digital over analog is that it can be processed and transmitted more efficiently and reliably.

- Storage of digital quantities is more compact and feasible to retrieve exactly. e.g music,images etc.
- Noise does not effect digital data nearly as much it effect analog.