

# First day Lecture

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## Intro

- Understand devices and how they are used to create digital circuits
- Design techniques for digital circuits
- Testing and implementing digital designs onto physical hardware

## 1 Digital Overview

**Digital** refers to the representation of an element with a set of *discrete* values.

**Analog** represents an element as a set of continuous values. To give an example, a sine wave represents a smooth and continuous (digital) course of motion

### Digital size

Digital information size is determined by the number of bits, and each bit represents a digit for the digital information. The more digits, the larger the element can be represented, or greater precision.

- An analog value represents with 10 → bits will have less precision than with 12 bits

### Advantages of digital

- Easier to use for computing & storing data
- Digital signals are less prone to noise effects
- Fast data transmission with ability to encrypt, modulate, etc.
- multiple functionality in a small form factor device

## Started with Analog

- Transistor is base for digital electronics: Analog devices with operates as an ON/OFF switch
- an input voltage swithces the output voltage ON of OFF
- Output voltage of transistor is 0 V or a specific voltage ( $V_{cc}$ ,  $V_{dd}$ )  $\rightarrow$  therefore, value is digital output value is also binary

Early logic chips used BJT (bipolar junction) transistors that operated at 5 V. Known as TTL logic (transistor  $\rightarrow$  transistor logic)

## MOS Technology

MOSFET (metal oxide semiconductor field effect) revolutionized digital logic by allowing miniaturization, high density, and lower power consumption.

overtime, transistors were able to be manufactured ever smaller.

**Moore's law:** Density of transistors on a chip doubles about every 2 years. Leads to increased performance, capacity, functionality, etc.

### 1.1 digital Voltage

Digital voltage levels can be described by different terms

- Low high
- 0,1
- False, True
- Positive logic, Negative Logic

The high voltage level is typically the operating voltage of the logic device

## Why Digital Voltage

Digital voltage is analogous to a “yes” or “no” for a logical expression. don't want "maybe" Logical expressions are implemented in logic circuits.

Logic circuits are the next step in building functions for a digital system (computers). Transistors turning on and off is how a digital system works, only understanding the concept of high/low, true/false, 1& 0 etc. 1

## Implementing Digital Circuit