

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 switchces 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