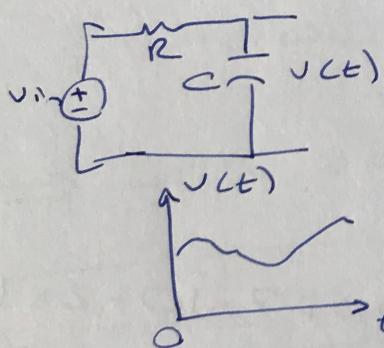


CSE 2037 week 3

- Data Types
- Bit Representation

Digital system

Logic level 0 }  
1 } binary numbers

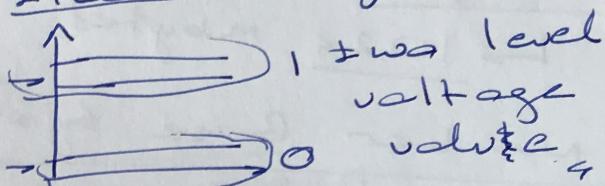
Analog

- No storage
- Not easy to process

Digital

Digit,

Electronic system

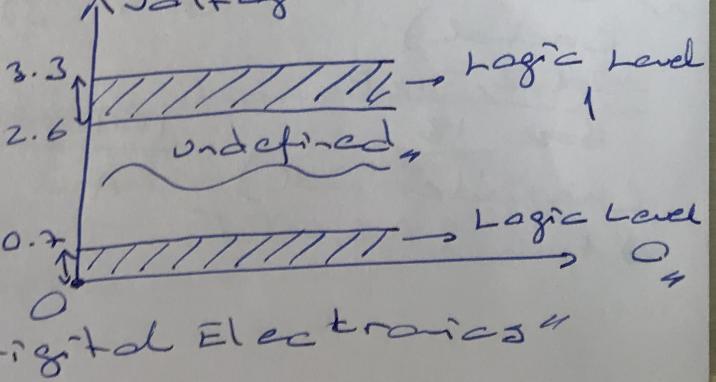


two level  
voltage  
value

Bit Values as Voltage Levels

Digital system  
(simply)

⇒ { 0 "Low"  
1 "High"  
logic level  
"ABSTRACT"

Hardware

Bit  
 ↳ Binary Digit 0/1

Byte  
 ↳ 8-bits

$b_7 \dots b_0$   
 $\boxed{10100011}$  binary

~~8 ???~~ octal  
 = hexadecimal

K Byte  
 ↳ 1024 bytes

M Bytes  
 ↳ 1024 K Byte

G Byte  
 ↳ 1024 Mbytes

### Number Base System

Base 10  
 (decimal)  
0, 1, 2, ..., 9

$$\begin{aligned} \boxed{472} &= 4 \times 100 + 7 \times 10 + 2 \times 1 \\ \text{decimal} &= 4 \times \underbrace{10^2}_1 + 7 \times \underbrace{10^1}_1 + 2 \times \underbrace{10^0}_1 \end{aligned}$$

Base 2  
 (binary)  
0, 1

$$\begin{aligned} \boxed{10100011} &= 1 \times \underbrace{2^7}_1 + 0 \times \underbrace{2^6}_1 + 1 \times \underbrace{2^5}_1 + 0 \\ &\quad + 1 \times \underbrace{2^4}_1 + 1 \times \underbrace{2^3}_1 = 128 + 32 + 2 + 1 = \boxed{163} \\ \text{decimal} & \end{aligned}$$

~ Base 8  
 (octal)  
0, 1, 2, ..., 7

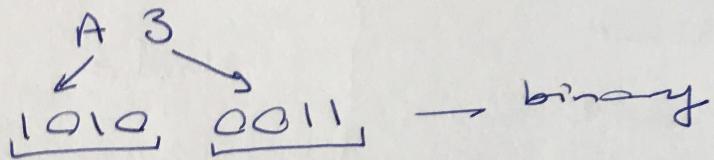
$$(243)_8 = 243 \text{ octal}$$

Base 16  
 (hexadecimal)  
0, 1, ..., 9, A, B, C, D, E, F

$$\boxed{10100011} = A3_{\text{hex}}$$

## Hexadecimal

w3-3



## Decimal

$$\begin{array}{r} \overbrace{163}^{\text{1}} \\ \overbrace{81}^{\text{1}} \\ \overbrace{40}^{\text{1}} \\ \overbrace{20}^{\text{1}} \\ \overbrace{10}^{\text{1}} \\ \overbrace{5}^{\text{1}} \\ \overbrace{2}^{\text{1}} \\ \overbrace{1}^{\text{1}} \end{array} \quad \begin{array}{r} 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \end{array}$$

"10100011" → binary

?? ✓

⇒ LAB SESSION

## Data Types in C Language

I want to store "decimal" value 163 in microcontroller "C" language

⇒ Memory space "Allocate" 8-bits  
unsigned character × 8-bits 0 - 255

\* unsigned char x; variable definition

x = 163; → 10100011

x = 0xA3;  
↳ hex representation in C Lang  
0x positive numbers,

unsigned char → 0 - 255  
positive and negative numbers  
char → -128 - 127

C Language

char

short

int

long

long, long

 $\Rightarrow \text{STM32CubeIDE}$ 

slide

 $\Rightarrow$  No fractional part $\Rightarrow$  C language functions and  
structure