

Title

Digital Electronics

8/23/2023

Intro

- Software (typically from a high level programming language), abstracts certain computational functions to make writing code more feasible
- the next step will be the assembly process, written in pure references of transistor processes
- transistor switching

Binary Numer Systems

there are three types of number systems → Decimal, Binary, Hexadecimal

Bits

A **bit** is simply a single binary value. These are the following notations for increases in the number of bits.

- 8 bit → 1 byte
- 16 bits → 1 words, 2 bytes
- 32 bits → 2 words, 4 bytes (floats)
- 64 bits → 2 longs, 4 words, 8 bytes (double in programming)

64 bits are usually called a **long** in hardware. Additionally, B → bytes 8B is 8 bytes, and b → bits, 4b is 4 bits.

2^n , where n is the number of bits, is the number of possible values that could be represented by said number of bits. This entails

- Min and max number a binary
- possible input combination to a digital circuit

Number System

Numbers in everyday use are referred to as decimal Numbers

$$7,392 = (7 * 10^3) + (3 * 10^2) + (9 * 10^1) + (2 * 10^0)$$

Value of $\# = V_0(B^d) + V_1(B^d) + V_2(B^d) \dots$ where V is the value of a digit, B is the base, and d is the digit's place.

Binary systems are base 2, only comprised of the value 1 & 0. Hexadecimal and octal numbers are base 16 and 8 respectively. Hex digits have 16 values, and octal digits have 8 values.

Subscripts to the right most of a digit denotes its base.

- $1101_{10} \rightarrow$ base 10
- $1101_2 \rightarrow$ base 2

Converting Binary to decimal

Raise the value to the power of its place. $10011011 \downarrow [V_0(B^d) + V_1(B^d) + V_2(B^d) \dots]$

$$2^7 * 1 + 2^6 * 0 + 2^5 * 0 + 2^4 * 1 + 2^3 * 1 + 2^2 * 0 + 2^1 * 1 + 2^0 * 1$$

- LSB \rightarrow least Significant Bit
- MSB \rightarrow Most Significant Bit

*If the LSB is 1, the decimal number is odd, if 0 it's even.

Converting Decimal to Binary

- Divide decimal number by 2 and remainder is binary value
- continue to divide result by 2 using remainder as binary value
- stop when no more division can occur

10: $10/2 = 0$ (LSB), $5/2 = 1$, $2/2 = 0$, $1/2 = 1$

Hexidecimal

Hex is a convenient way of expressing very large Numbers. One digit is 4 bits and the digits range from 0 - F (16 values). A 0x prefix denotes a Hex value (0x90FBE).

Decimal	4-Bit Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F