Fundamentals of Electrical Engineering

Computation on a Computer

- Positional representation of numbers
- Base-2 numbers and powers of two

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Number Representation

- One of the critical discoveries of mathematics was *positional notation*

$$257_{10} \text{ means } 2 \times 10^2 + 5 \times 10^1 + 7 \times 10^0$$

$$257_{10} = \text{CCLVII}$$

- In a computer, numbers are represented in *binary* (base 2)

$$100000001_2 \text{ means } 1 \times 2^8 + 0 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$

- Since $2^8 = 256$, $100000001_2 = 257_{10}$

Powers of Two

2^0	1
2^1	2
2^2	4
2^3	8
2^4	16
2^5	32
2^6	64
2^7	128
2^8	256
2^9	512
2^{10}	1024

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Computer Representation of Numbers

unsigned 8-bit integer

0–255

signed 8-bit integer

-128–127

exponent mantissa

floating point

$$m2^e, \ \frac{1}{2} \leq |m| < 1$$

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Computer Representation of Numbers

- Numbers—signal values—are represented in a variety of ways, but always with discrete values
- Numbers are stored in individual memory locations
- Analog signals must be converted to digital signals for computer-based processing

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