Unsigned Base-2

Binary!

One (Delicious) **Nibble**

0	0	0	1
3	2	1	0

- A **nibble** is **4 bits** or *half* of one **byte**
- How many unique **nibbles** are there?
  Write them all down!

Base-2 - Binary

- **Binary**, or Base-2, is the number system of computers
  - Digits $\{0, 1\}$

  - High-order place values come before low-order
    - 100_2 is 1 x 2^2 - Four
    - 010_2 is 1 x 2^1 - Two
    - 001_2 is 1 x 2^0 - One

  - Incrementing a place value beyond 1 causes a **carry**
    - $01_2 + 01_2$ is 10_2
      - the next higher-order place value increases by one
      - the lower-order place value resets back to zero

$Decimal_{10}$	$Binary_2$
00	0000
01	0001
02	0010
03	0011
04	0100
05	0101
06	0110
07	0111
08	1000
09	1001
10	1010
11	1011
12	1100
13	1101
14	1110
15	1111

Formalization of *Unsigned* Binary Values

Suppose we define a Base-2 number b, with w place values, (*w stands for width*) as a vector of **binary digits**:

$$\vec{b} = [b_{w-1}, b_{w-2}, \dots, b_0]$$

We can determine the value of $\vec{d}$ with the following summation:

$$Binary2Unsigned_w\left(\vec{b}\right) = \sum_{i=0}^{w-1} b_i 2^i$$

A concrete example:

$$\vec{b} = [0, 1, 1, 0]$$

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$$Binary2Unsigned_w\left(\vec{b}\right) = \sum_{i=0}^{w-1} b_i 2^i$$

A concrete example:

$$w = 4$$

$$\vec{b} = [0, 1, 1, 0]$$

thus

$$b_3 = 0$$
$$b_2 = 1$$
$$b_1 = 1$$
$$b_0 = 0$$

$$Binary2Unsigned_4([0, 1, 1, 0])$$

$$= \sum_{i=0}^{3} b_i 2^i$$

$$= b_0 \times 2^0 + b_1 \times 2^1 + b_2 \times 2^2 + b_3 \times 2^3$$

$$= 0 \times 2^0 + 1 \times 2^1 + 1 \times 2^2 + 0 \times 2^3$$

$$= 0 + 2 + 4 + 0$$

$$= 6$$