

Section 1.2: Binary and Hexadecimal

Wednesday, January 8, 2020 12:10 PM

binary = base 2, so only two digits (0, 1)

| decimal | binary |
|---------|----------|
| 0 | 0 |
| 1 | 1 |
| 2 | 10_2 |
| 3 | 11_2 |
| 4 | 100_2 |
| 5 | 101_2 |
| 6 | 110_2 |
| 7 | 111_2 |
| 8 | 1000_2 |
| 9 | 1001_2 |
| 10 | 1010_2 |

example: convert the following binary numbers into decimal:

$$\begin{aligned} \text{a) } 1010_2 &= 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 \\ &= 8 + 0 + 2 + 0 \\ &= 10 \end{aligned}$$

← could omit →

$$\begin{aligned} \text{b) } 101110_2 &= 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 \\ &= 32 + 0 + 8 + 4 + 2 + 0 \\ &= 46 \end{aligned}$$

hexadecimal = base 16

| decimal | hexadecimal |
|---------|-------------|
| 0 | 0 |
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4 |
| 5 | 5 |
| 6 | 6 |
| 7 | 7 |
| 8 | 8 |
| 9 | 9 |
| 10 | A_{16} |
| 11 | B_{16} |
| 12 | C_{16} |
| 13 | D_{16} |
| 14 | E_{16} |
| 15 | F_{16} |
| 16 | 10_{16} |
| 17 | 11_{16} |
| 18 | 12_{16} |
| 19 | 13_{16} |
| 20 | 14_{16} |

So, in hexadecimal:

$$A_{16} = 10$$

$$B_{16} = 11$$

$$C_{16} = 12$$

$$D_{16} = 13$$

$$E_{16} = 14$$

$$F_{16} = 15$$

so $DEAD_{16}$ is a number! what is it in decimal?

$$\begin{aligned} DEAD_{16} &= D \times 16^3 + E \times 16^2 + A \times 16^1 + D \times 16^0 \quad \leftarrow \text{can skip this step} \\ &= 13 \times 16^3 + 14 \times 16^2 + 10 \times 16^1 + 13 \times 16^0 \\ &= 57005 \end{aligned}$$

example: convert the following numbers to decimal:

$$\begin{aligned} \text{a) } 15_{16} &= 1 \times 16^1 + 5 \times 16^0 \\ &= 21 \end{aligned}$$

$$\begin{aligned} \text{b) } 2B_{16} &= 2 \times 16^1 + B \times 16^0 \\ &= 2 \times 16^1 + 11 \times 16^0 = 43 \end{aligned}$$

$$\begin{aligned} \text{c) } C3_{16} &= C \times 16^1 + 3 \times 16^0 \\ &= 12 \times 16 + 3 \\ &= 195 \end{aligned}$$

$$\begin{aligned} \text{d) } 98003_{16} &= 9 \times 16^4 + 8 \times 16^3 + 0 + 0 + 3 \\ &= 622\ 595 \end{aligned}$$

$$\begin{aligned} \text{e) } 6055_{16} &= B \times 16^3 + 0 + 5 \times 16^1 + 5 \times 16^0 \\ &= 11 \times 16^3 + 0 + 5 \times 16 + 5 \\ &= 45\ 141 \end{aligned}$$

$\begin{matrix} \nearrow & \nearrow & \nearrow & \nearrow \\ 3 & 2 & 1 & 0 \end{matrix}$