Section 1.2: Binary and Hexadecimal

binary = base 2, so only has 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

a) $1010_2 = 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$ ← can omit

$= 8 + 0 + 2 + 0$

$= 10$

b) $101110_2 = 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$

$= 32 + 0 + 8 + 4 + 2 + 0$

$= 46$

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hexadecimal: base 16

decimal	hexadecimal
0	0

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}

need sixteen digits for base 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?

$$DEAD_{16} = D \times 16^3 + E \times 16^2 + A \times 16^1 + D \times 16^0 \quad \Leftarrow \text{can skip this step}$$

$$= 13 \times 16^3 + 14 \times 16^2 + 10 \times 16^1 + 13 \times 16^0$$

$$= 53248 + 3584 + 160 + 13 \quad \Leftarrow \text{can skip this step}$$

$$= 57005$$

example: convert the following numbers to decimal:

a) 15_{16} = $1 \times 16^1 + 5 \times 16^0 = 21$

b) $2B_{16}$ = $2 \times 16^1 + B \times 16^0$
   = $32 + 11 = 43$

c) $C3_{16}$ = $C \times 16^1 + 3 \times 16^0$
   = $12 \times 16 + 3$
   = 195

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

e) $B055_{16}$ = $B \times 16^3 + 0 + 5 \times 16^1 + 5 \times 16^0$
   = $11 \times 16^3 + 0 + 5 \times 16 + 5$
   = $45\ 141$