1.2 Binary and Hexadecimal

Binary : Base 2

Allowed digits are 0,1

These are called "bits" or "binary digits"

Decimal	Binary
0	0_2
1	1_2
2	10_2
3	11_2
4	100_2
⋮	
7	111_2
8	1000_2
9	1001_2

Consider 1010_2

2^3 place $(2^3 = 8)$

2^2 place $(2^2 = 4)$

2 place

1 place

Ex: Convert to decimal

a) $1100_2 = 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

$\qquad\qquad = 1 \times 8 + 1 \times 4$

$\qquad\qquad = 12$

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

$\qquad\qquad\qquad = 1 \times 32 + 1 \times 8 + 1 \times 4 + 1 \times 2$

$\qquad\qquad\qquad = 46$

Hexadecimal : Base 16

Allowed digits : $0, 1, \ldots, 9, A, B, C, D, E, F$

Decimal	Hexadecimal
0	0_{16}
1	1_{16}
9	9_{16}
10	A_{16}
11	B_{16}
12	C_{16}
13	D_{16}
14	E_{16}
15	F_{16}
16	10_{16}

Consider $\quad BA98_{16}$

16^3 place
$(16^3 = 4096)$

16^2 place
$(16^2 = 256)$

16 place

1 place
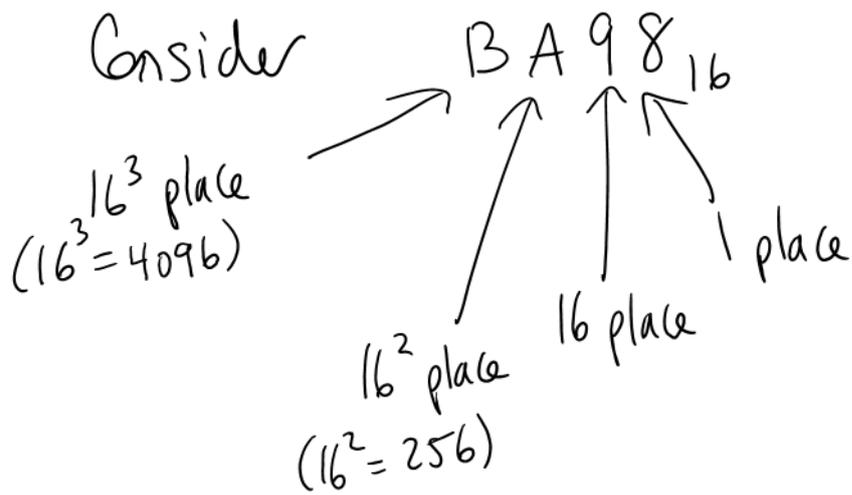
Ex: Convert to decimal

a) $\quad 2B_{16} = 2 \times 16^1 + B \times 16^0$

$\qquad = 2 \times 16 + 11 \times 1$

$\qquad = 43$

b) $\quad 98003_{16} = 9 \times 16^4 + 8 \times 16^3 + 3 \times 16^0$

$\qquad = 9 \times 65536 + 8 \times 4096 + 3 \times 1$

$\qquad = 622\ 595$

c) $\quad BOSS_{16} = B \times 16^3 + S \times 16^1 + S \times 16^0$

$\qquad = 11 \times 4096 + S \times 16 + S \times 1$

$\qquad = 45\ 141$