

## Section 1.2: Binary and Hexadecimal

Wednesday, January 10, 2024 11:56 AM

binary = base 2, so only two digits: 0, 1

<u>decimal</u>	<u>binary</u>
0	0
1	1
2	10 <sub>2</sub>
3	11 <sub>2</sub>
4	100 <sub>2</sub>
5	101 <sub>2</sub>
6	110 <sub>2</sub>
7	111 <sub>2</sub>
8	1000 <sub>2</sub>
9	1001 <sub>2</sub>
10	1010 <sub>2</sub>

in computing, each digit is a bit (binary digit)

examples: convert to decimal:

$$\begin{aligned} \text{a) } 1110_2 &= 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 \\ &= 8 + 4 + 2 + 0 \\ &= 14 \end{aligned}$$

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

hexadecimal: base 16 need 16 single digits

decimal	hexadecimal	
0	0	0, 1, 2, 3, 4, 5, 6, 7, 8, 9 A, B, C, D, E, F
1	1	
2	2	
3	3	
4	4	
5	5	
6	6	
7	7	
8	8	
9	9	
10	A <sub>16</sub>	we use these 6 extra symbols to complete the set of allowed digits
11	B <sub>16</sub>	
12	C <sub>16</sub>	
13	D <sub>16</sub>	
14	E <sub>16</sub>	
15	F <sub>16</sub>	
16	10 <sub>16</sub>	

so BEAD<sub>16</sub> is a number! how big is it?

$$\begin{aligned}
 \text{BEAD}_{16} &= B \times 16^3 + E \times 16^2 + A \times 16^1 + D \times 16^0 \\
 &= 11 \times 16^3 + 14 \times 16^2 + 10 \times 16 + 13 \times 1 \\
 &= 48\,813
 \end{aligned}$$

Can skip this step! ↙

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Section 1.2: cont'd      2024/01/11

examples: convert to decimal:

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

b)  $2B_{16} = 2 \times 16 + 11 = 43$

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

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

digression: will not be tested

other notations:

$$A5_{16} = 0x A5$$

↑
↑

math notation
computing notation

(Unix and C-based programming)

zero  
 ↓  
 lower case letter X

similarly

$$101_2 = 0b101$$

$$73_8 = 0o73$$

↑
↑

zero
 lower case letter O