

# Section 1.1: Decimal and Octal

Tuesday, January 09, 2024 11:00 AM

decimal: base 10 (why? 10 fingers)

historical note: (will not be tested)

Sumerians/Babylonians used base 60

Mayans used base 20 as well as Aleut languages of Canada and Alaska

decimal:

0  
1  
2  
3  
4  
5  
6  
7  
8  
9

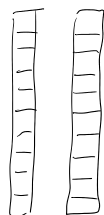
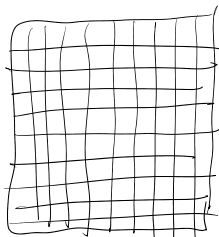
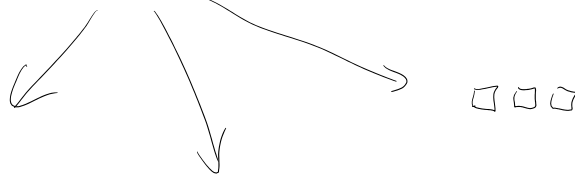
note: in base ten, we use two symbols (10) to represent the base

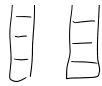
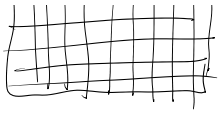
there is no single digit that represents "ten"

10 ← one ten, no ones  
11 ← one ten, one one  
12 ← one ten, two ones

what about

123?





$$\begin{aligned} 123 &= 1 \times 100 + 2 \times 10 + 3 \times 1 \\ &= 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0 \end{aligned}$$

for bases other than ten, it's the same idea!

base four:

- $0_4$
- $1_4$
- $2_4$
- $3_4$
- $10_4$
- $11_4$
- $12_4$
- $13_4$
- $20_4$
- $21_4$
- $22_4$
- $23_4$
- $30_4$
- $31_4$
- $32_4$
- $33_4$
- $100_4$

allowed digits:  
0, 1, 2, 3

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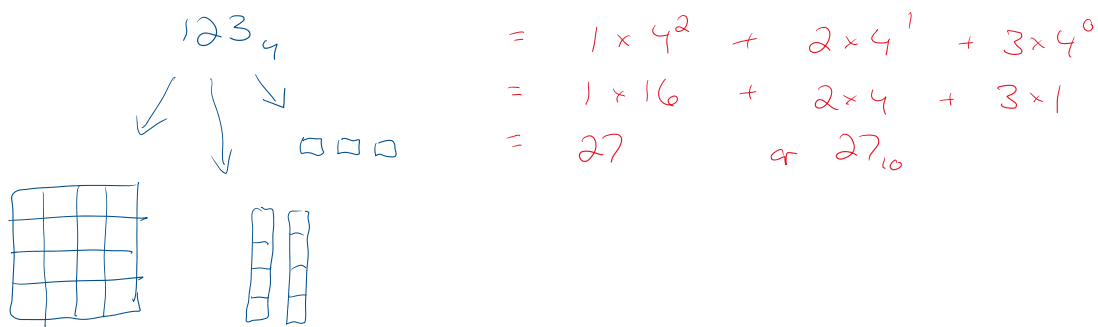
Section 1.1: confid on 2024/01/10

notation:  $123_4$



the subscript is the base in the decimal (base 10) system

if no subscript, default is ten



examples: convert to decimal:

a)  $213_4 = 2 \times 4^2 + 1 \times 4^1 + 3 \times 4^0 = 39 \quad \text{or } 39_{10}$

b)  $3012_4 = 3 \times 4^3 + 0 \times 4^2 + 1 \times 4^1 + 2 \times 4^0 = 198$

what bases are commonly used in computing?

binary - base 2      ← in next section  
 octal - base 8  
 hexadecimal - base 16      ← next section

octal: base 8

allowed digits:

0, 1, 2, 3, 4, 5, 6, 7

<u>decimal</u>	<u>octal</u>
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	$10_8$
9	$11_8$

10	$12_8$
11	$13_8$
12	$14_8$
13	$15_8$
14	$16_8$
15	$17_8$
16	$20_8$

example: convert to decimal. Show your work.

$$a) 72_8 = 7 \times 8^1 + 2 \times 8^0 = 58$$

$$b) 5604_8 = 5 \times 8^3 + 6 \times 8^2 + 0 + 4 \times 8^0 = 2948$$

$$c) 212_3 = 2 \times 3^2 + 1 \times 3^1 + 2 \times 3^0 = 23$$

example: what's wrong with writing  $215_3$ ?

in base 3, the digit 5 is not allowed

(only 0, 1, 2 allowed)