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

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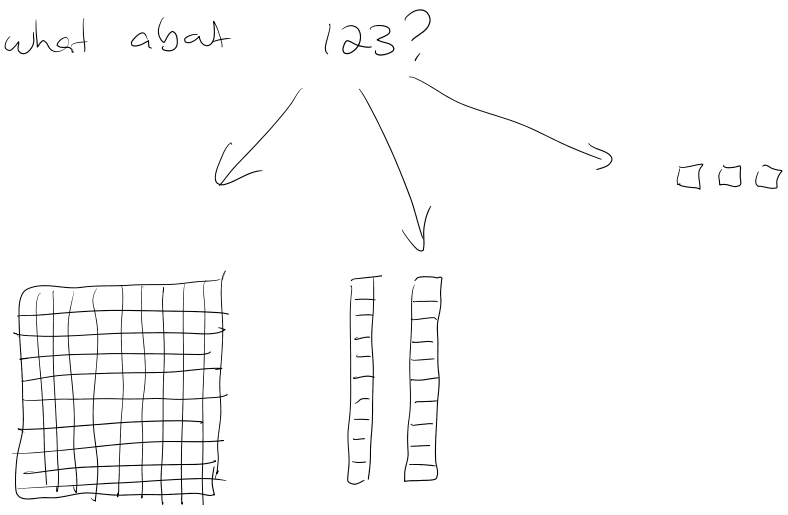
decimal:

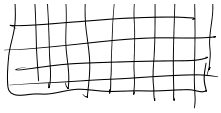
0
1
2
3
4
5
6
7
8
9
10 ← one ten, no ones
11 ← one ten, one one
12 ← one ten, two ones

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

there is no single digit that represents "ten"

what about 123?





$$123 = 1 \times 100 + 2 \times 10 + 3 \times 1$$

$$= 1 \times 10^2 + 2 \times 10^1 + 3 \times 10^0$$

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

base four:

allowed digits: 0, 1, 2, 3

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

Section 1.1: cont'd on 2024/01/10

notation: 123_4

↑

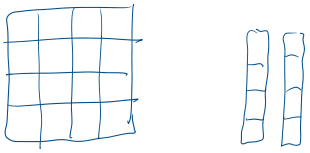
the subscript is the base in the decimal (base 10) system

if no subscript, default is ten

$123_4 = 1\times4^2 + 2\times4^1 + 3\times4^0$

$= 1\times16 + 2\times4 + 3\times1$

$= 27$ or 27_{10}



examples: convert to decimal:

a) $213_4 = 2\times4^2 + 1\times4^1 + 3\times4^0 = 39$ or 39_{10}

b) $3012_4 = 3\times4^3 + 0\times4^2 + 1\times4^1 + 2\times4^0 = 198$

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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

decimal	octal
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) $72_8 = 7\times8^1 + 2\times8^0 = 58$

b) $5604_8 = 5\times8^3 + 6\times8^2 + 0 + 4\times8^0 = 2948$

c) $212_3 = 2\times3^2 + 1\times3^1 + 2\times3^0 = 23$

example: what's wrong with writing 215_3 ?

in base 3, the digit 5 is not allowed

(only 0, 1, 2 allowed)