

Section 1.1: Decimal and Octal

Tuesday, September 05, 2023 1:39 PM

decimal: base ten (why? ten fingers)

historical note: (will not be tested)

Sumerians / Babylonians used base 60
(sexagesimal, largest base ever used)

Mayans/^{Mexico} and Aleut languages of Canada
and Alaska use base 20
(vigesimal)

decimal: 0
1
2
3
4
5
6
7
8
9

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

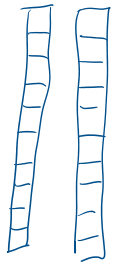
- there is no single
digit to represent
"ten"

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

what about 23?

two tens three ones
□□ □□□

two tens



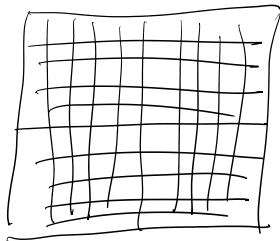
three ones



what about 123?



1 hundred



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

let's look at base four

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

allowed digits:

0, 1, 2, 3

25_4
 30_4
 31_4
 32_4
 33_4
 100_4

$\leftarrow 3 \text{ fours} + 3 \text{ ones}$
 $\leftarrow 1 \text{ sixteen} + 0 \text{ fours} + 0 \text{ ones}$

\uparrow

group of 4 fours

$$4^2 = 16$$

notation: 123_4

\uparrow

the subscript is the base (written as a decimal number)

if no subscript, default is ten

$$\begin{aligned} 123_4 &= 1 \times 4^2 + 2 \times 4^1 + 3 \times 1 \\ &= 1 \times 16 + 2 \times 4 + 3 \\ &= 27 \end{aligned}$$

example: convert to decimal:

$$\begin{aligned} 3012_4 &= 3 \times 4^3 + 0 \times 4^2 + 1 \times 4^1 + 2 \times 4^0 \\ &= 198 \end{aligned}$$

Section 1.1: con'd 2023/09/07

what bases are commonly used in computing?

what bases are commonly used in computing:

binary - base 2
hexadecimal - base 16
octal - base 8

} next section

octal: base 8

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

allowed digits
in octal
0, 1, 2, 3, 4, 5, 6, 7

example: convert to decimal. show your work.

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

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

$$c) 210_2 = 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 = 23$$

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

example: what's wrong with writing 215_3 ?

in base 3, digit 5 is not allowed