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→ Math 156

Math 156 Overview

Topics that are relevant to programming and app development.

Some examples:

Number Systems (Decimal, Binary, Hexadecimal etc.)

Logic

Statistics

1.1 Decimal and Octal

Decimal: base 10

Allowed digits: 0, 1, 2, 3, ..., 9

Decimal numbers:

0

1

2

3

⋮

9

10

11

12

⋮

← 1 ten and 0 ones

← 1 ten and 1 one

← 1 ten and 2 ones

Consider 549

$\swarrow$ $\uparrow$ $\nwarrow$
 100 place 10 place 1 place
 (or 10^2 place) (or 10^1 place) (or 10^0 place)

549 is 5 hundreds and 4 tens and 9 ones.

In base 4 the allowed digits are 0, 1, 2, 3.

Decimal (base 10)	Base 4
0	0_4
1	1_4
2	2_4
3	3_4
4	$10_4 \leftarrow 1 \text{ four and } 0 \text{ ones}$
5	$11_4 \leftarrow 1 \text{ four and } 1 \text{ one}$
6	$12_4 \leftarrow 1 \text{ four and } 2 \text{ ones}$
$\vdots$	
15	$33_4 \leftarrow 3 \text{ fours and } 3 \text{ ones}$
16	$100_4 \leftarrow 1 \text{ sixteen}$
17	$101_4 \leftarrow 1 \text{ sixteen and } 1 \text{ one}$

Notation:

The base is written as a subscript.

If there is no base then

base 10 (decimal) is assumed.

$$27 = 27_{10}$$

$$7 = 13_4$$

$$7_{10} = 13_4$$

Ex: Convert to decimal

a) $123_4 = 1 \times 4^2 + 2 \times 4^1 + 3 \times 4^0$

16 place
(4^2 place)

4 place
(4^1 place)

1 place
(4^0 place)

$$= 1 \times 16 + 2 \times 4 + 3 \times 1$$

$$= 27$$

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

4^3
place

4^0
place

$$= 3 \times 64 + 0 \times 16 + 1 \times 4 + 2 \times 1$$

$$= 198$$

Octal: Base 8

Allowed digits: 0, 1, 2, ..., 7

Decimal	Octal
0	0_8
1	1_8
2	2_8
...	
7	7_8
8	$10_8 \leftarrow 1 \text{ eight and } 0 \text{ ones}$
9	$11_8 \leftarrow 1 \text{ eight and } 1 \text{ one}$
...	
63	77_8
64	$100_8 \leftarrow 1 \text{ sixty-four}$
65	101_8

Consider

645_8
 64 place (8^2 place) 8 place (8^1 place) 1 place (8^0 place)

Ex: Convert to decimal

a) 5604_8 $= 5 \times 8^3 + 6 \times 8^2 + 0 \times 8^1 + 4 \times 8^0$

$\begin{array}{c} \nearrow \nearrow \nearrow \nearrow \\ 8^3 \quad 8^2 \quad 8^1 \quad 8^0 \\ \text{place} \quad \text{place} \end{array}$

$$= 5 \times 512 + 6 \times 64 + 0 \times 8 + 4 \times 1$$
$$= 2948$$

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

$\begin{array}{c} \nearrow \nearrow \nearrow \\ 3^2 \quad 3^1 \quad 3^0 \\ \text{place} \quad \text{place} \quad \text{place} \end{array}$

$$= 2 \times 9 + 1 \times 3 + 2 \times 1$$
$$= 23$$