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→ Math 156

Sugg. HW and Answers on website

Schedule Update :

Math 156 is in CBA213 on Wednesdays

## Math 156 Main Topics

Binary and Hexadecimal

Logic

Algorithmic Complexity

Statistics

### 1.1 Decimal and Octal

Decimal : base 10

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

Decimal numbers :  
0  
1  
2  
⋮  
9

10 ← 1 ten and 0 ones

11 ← 1 ten and 1 one

$12 \leftarrow 1 \text{ ten and } 2 \text{ ones}$   
 $\vdots$   
 $37 \leftarrow 3 \text{ tens and } 7 \text{ ones}$

Consider  $549$   
 $\swarrow$     $\uparrow$     $\uparrow$   
 100 place   10 place   1 place  
 ( $10^2 = 100$ )

$549$  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	$10_4 \leftarrow \text{one four and no ones}$
5	$11_4 \leftarrow \text{one four and one one}$
$\vdots$	
8	$20_4 \leftarrow \text{two fours}$
9	$21_4$
$\vdots$	
12	$30_4$
13	$31_4$
14	$32_4$
15	$33_4$
16	$100_4 \leftarrow \text{one sixteen}$
17	$101_4 \leftarrow \text{one sixteen and one one}$

Consider  $3312_4$

$\uparrow$   $\uparrow$   $\uparrow$   $\uparrow$   
 1 place ( $4^0=1$ )  
 4 place  
 16 place ( $4^2=16$ )  
 64 place ( $4^3=64$ )

$3312_4$  is : 3  $64$ 's  
 and 3  $16$ 's  
 and 1  $4$   
 and 2  $1$ 's

$$3312_4 = 3 \times 64 + 3 \times 16 + 1 \times 4 + 2 \times 1$$

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)  $123_4$

$\uparrow$   $\uparrow$   $\uparrow$   
 $4^2$   $4^1$   $4^0$

$$\begin{aligned}123_4 &= 1 \times 4^2 + 2 \times 4^1 + 3 \times 4^0 \\ &= 1 \times 16 + 2 \times 4 + 3 \times 1 \\ &= 27\end{aligned}$$

$$\text{b) } 3012_4$$

$\uparrow$              $\uparrow$   
 $4^3$          $4^0$

$$\begin{aligned}3012_4 &= 3 \times 4^3 + 0 \times 4^2 + 1 \times 4^1 + 2 \times 4^0 \\ &= 3 \times 64 + 1 \times 4 + 2 \times 1 \\ &= 198\end{aligned}$$

ASIDE

$4^3$  "4 cubed"  
 $4^2$  "4 squared"