Octal and Hexadecimal

Aka: Base 8 & Base 16

Octal - Base 8

Works the same!

Base 8 has 8 digits

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

Counting…

0
1
2
3
4
5
6
7
10
11
…

Columns

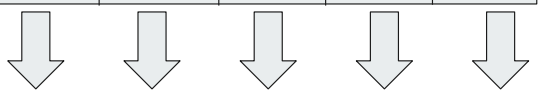
Base 8! Columns are:

8^4	8^3	8^2	8^1	8^0
4096	512	64	8	1

Conversion from Octal to Decimal

Ex: Convert 10222_8 to Decimal

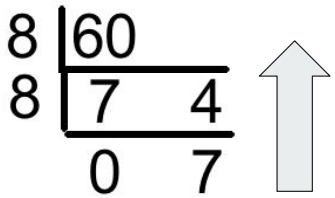
4096	512	64	8	1
1	0	2	2	2



4096 + 0 + 128 + 16 + 2

= 4242

Converting from Decimal to Octal



$=74_8$

Something New!

Ever wondered how addition works?

$$\begin{array}{r} 35_8 \\ +\ 27_8 \\ \hline 64_8 \end{array}$$

Again!

$$\begin{array}{r} 7425_8 \\ +\ 1261_8 \\ \hline 10706_8 \end{array}$$

And now… from Octal to Binary?

First, how many binary bits to represent a single value from 0-7?

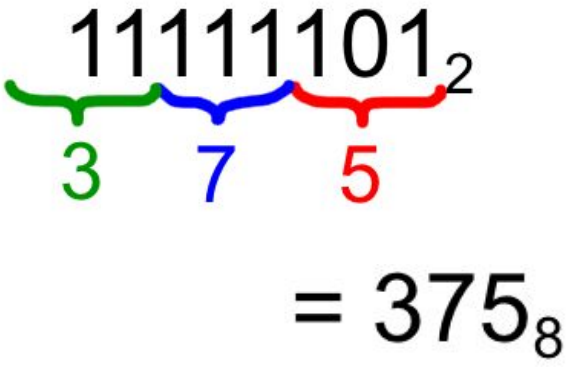
Three! So, simply replace each Octal value with 375_8 bits

011 111 101

$=11111101_2$

And back again?

Reverse the process - remember to start from the RIGHT!



Hexadecimal - Base 16

Works the same!

Base 16 has 16 digits

{ 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F }

Counting…

0	B	16
1	C	17
2	D	18
3	E	19
4	F	1A
5	10	1B
6	11	1C
7	12	1D
8	13	1E
9	14	1F
A	15	20...

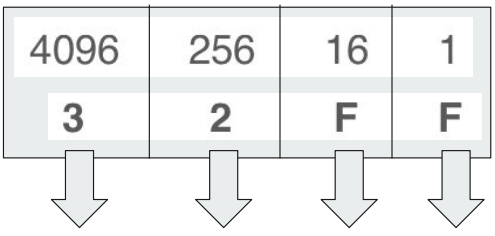
Columns

Base 16! Columns are:

16^3	16^2	16^1	16^0
4096	256	16	1

Conversion from Hex to Decimal

Ex: Convert $32FF_{16}$ to Decimal

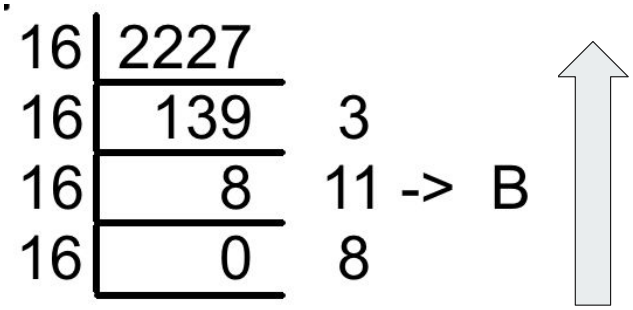


12288 + 512 + 240 + 15

= 13055

F → 15
16 * 15 = 240

Converting from Decimal to Hex



$= 8B3_{16}$

More Addition

$$\begin{array}{r} 1A4 \\ +\ 2E \\ \hline 1D2 \end{array}$$

And now... from Hex to Binary?

First, how many binary bits to represent a single value from 0-15?

FOUR! So, simply replace each Hex value with bits

$9D37_{16}$

1001 1101 0011 0111

$= 1001110100110111_2$

And back again?

Reverse the process - **remember to start from the RIGHT!**

1100111101_2

3 3 D

$= 33D_{16}$

Practice

1. Convert each of the following:
   a) 11001101101111_2 to octal
   b) 1011101010011_2 to hexadecimal
2. Convert each of the following:
   a) 123_8 to binary
   b) $FACE_{16}$ to binary
3. Convert each of the following:
   a) BEE_{16} to octal
   b) 765_8 to hexadecimal
4. Convert each of the following:
   a) 246_8 to decimal
   b) $7EE_{16}$ to decimal

Practice

1. Convert each of the following:
   a) 11001101101111_2 to octal
   $= 31557_8$
   b) 1011101010011_2 to hexadecimal
   1 7 5 3 $= 1753_{16}$
2. Convert each of the following:
   a) 123_8 to binary
   $= 1010011_2$
   b) $FACE_{16}$ to binary
   $= 1111\ 1010\ 1100\ 1110_2$
3. Convert each of the following:
   a) BEE_{16} to octal
   $= 5756_8$
   b) 765_8 to hexadecimal
   $= 1F5_{16}$
4. Convert each of the following:
   a) 246_8 to decimal
   $= 166_{10}$
   b) $7EE_{16}$ to decimal
   $= 2030_{10}$