



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

$$\begin{array}{r|l} 8 & 60 \\ \hline 8 & 7 \quad 4 \\ \hline & 0 \quad 7 \end{array} \quad \uparrow$$


$$=74_8$$

Something New!


Ever wondered how addition works?

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

Again!


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

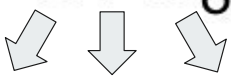
And now... from Octal to Binary?



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

Three! So, simply replace each Octal value

with 375_8 3 bits


$$011 \ 111 \ 101$$
$$=11111101_2$$

And back again?

Reverse the process - remember to start from the

RIGHT!

$$\begin{array}{ccccccc} 1 & 1 & 1 & 1 & 1 & 0 & 1 \\ \underbrace{\hspace{1.5em}} & \underbrace{\hspace{1.5em}} & \underbrace{\hspace{1.5em}} & & & & \\ 3 & 7 & 5 & & & & \end{array}$$

$$= 375_8$$

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

4096	256	16	1
3	2	F	F

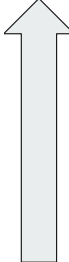
↓ ↓ ↓ ↓

$$12288 + 512 + 240 + 15 = 13055$$

F → 15
 $16 * 15 = 240$

Converting from Decimal to Hex

16	2227	
16	139	3
16	8	11 -> B
16	0	8



$$= 8B3_{16}$$

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 $9D37_{16}$ bits

$1001\ 1101\ 0011\ 0111$

$= 1001110100110111_2$

And back again?

Reverse the process - remember to start from the

RIGHT!

1100111101_2

$3\ 3\ D$

$= 33D_{16}$

Practice

- Convert each of the following:
 - 11001101101111_2 to octal
 - 1011101010011_2 to hexadecimal
- Convert each of the following:
 - 123_8 to binary
 - $FACE_{16}$ to binary
- Convert each of the following:
 - BEE_{16} to octal
 - 765_8 to hexadecimal
- Convert each of the following:
 - 246_8 to decimal
 - $7EE_{16}$ to decimal

Practice

- Convert each of the following:
 - 11001101101111_2 to octal
 $= 31557_8$
 - 1011101010011_2 to hexadecimal
 $\overbrace{1011\ 1010\ 1001\ 1}^{1\ 7\ 5\ 3} = 1753_{16}$
- Convert each of the following:
 - 123_8 to binary
 $= 1010011_2$
 - $FACE_{16}$ to binary
 $= 1111\ 1010\ 1100\ 1110_2$
- Convert each of the following:
 - BEE_{16} to octal
 $= 5756_8$
 - 765_8 to hexadecimal
 $= 1F5_{16}$
- Convert each of the following:
 - 246_8 to decimal
 $= 166_{10}$
 - $7EE_{16}$ to decimal
 $= 2030_{10}$