Computer Applications in Pharmacy (BP 205T)

Objectives of the course

➢ Know the various applications of databases in pharmacy.

➢ Know the various types of application of computers in pharmacy.

Learning outcomes

1) Students learnt about the various type of number system in computer

Structure of Module -1 Learning Material

Number System

➢ Binary number system

➢ Decimal number system

➢ Octal number system

➢ Hexadecimal number systems

➢ conversion decimal to binary

➢ binary to decimal, octal to binary etc,

➢ binary addition

➢ binary subtraction – One's complement ,Two's complement method

➢ Binary multiplication, binary division.

1. NUMBER SYSTEMS

Number Systems

- A number system defines how a number can be represented using distinct symbols. A number can be represented differently in different systems. For example, the two numbers $(2A)_{16}$ and $(52)_8$ both refer to the same quantity, $(42)_{10}$, but their representations are different.

- Several number systems have been used in the past and can be categorized

Common Number Systems

System	Base	Symbols	Used by humans?	Used in computers?
Decimal	10	0, 1, … 9	Yes	No
Binary	2	0, 1	No	Yes
Octal	8	0, 1, … 7	No	No
Hexa-decimal	16	0, 1, … 9, A, B, … F	No	No

Quantities/Counting (1 of 3)

Decimal	Binary	Octal	Hexa-decimal
0	0	0	0
1	1	1	1
2	10	2	2
3	11	3	3
4	100	4	4
5	101	5	5
6	110	6	6
7	111	7	7

Quantities/Counting (2 of 3)

Decimal	Binary	Octal	Hexa-decimal
8	1000	10	8
9	1001	11	9
10	1010	12	A
11	1011	13	B
12	1100	14	C
13	1101	15	D
14	1110	16	E
15	1111	17	F

Quantities/Counting (3 of 3)

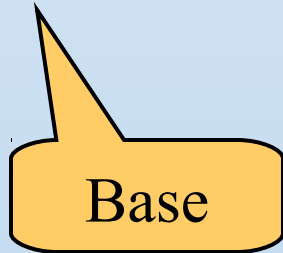| Decimal	Binary	Octal	Hexa-decimal
16	10000	20	10
17	10001	21	11
18	10010	22	12
19	10011	23	13
20	10100	24	14
21	10101	25	15
22	10110	26	16
23	10111	27	17

Etc.

Conversion Among Bases

- The possibilities:
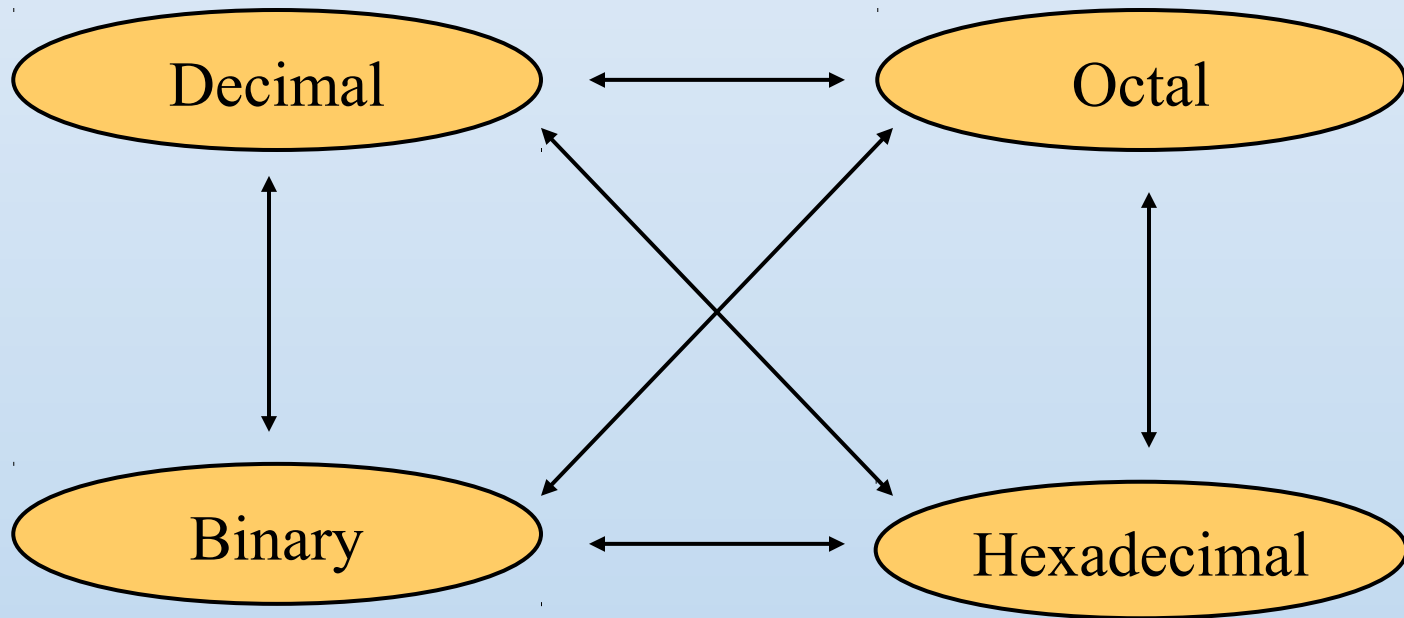
Quick Example

$$25_{10} = 11001_2 = 31_8 = 19_{16}$$

Base

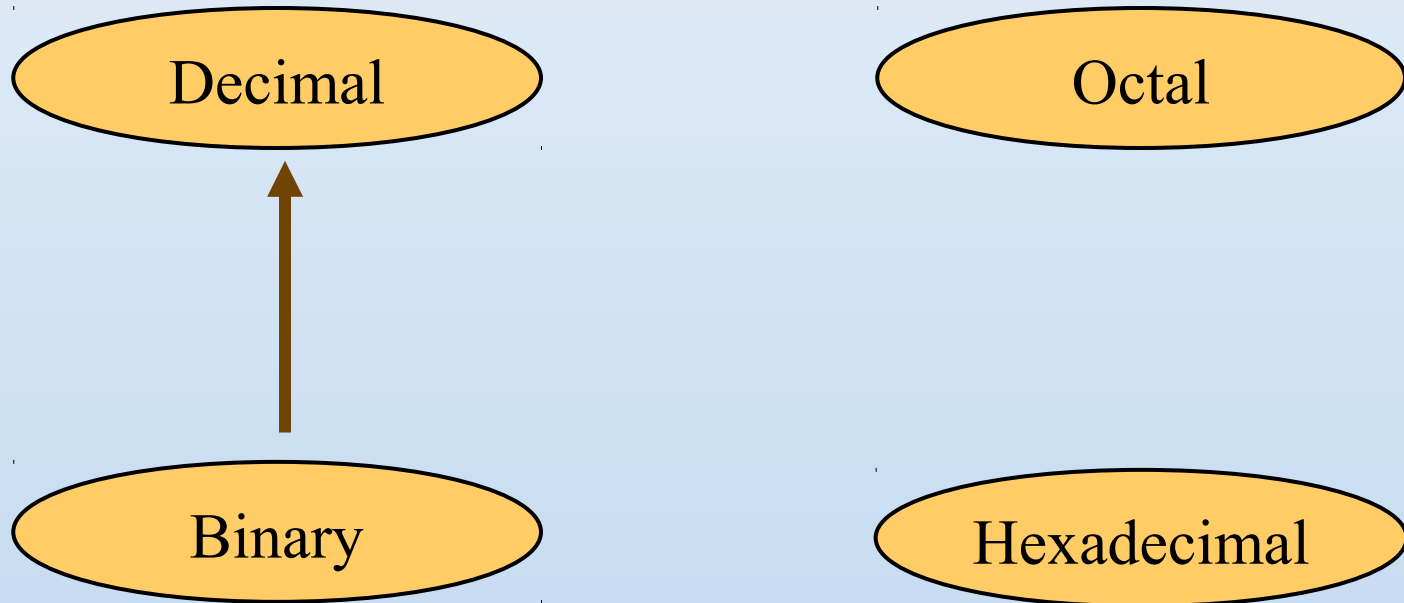# Decimal to Decimal (just for fun)
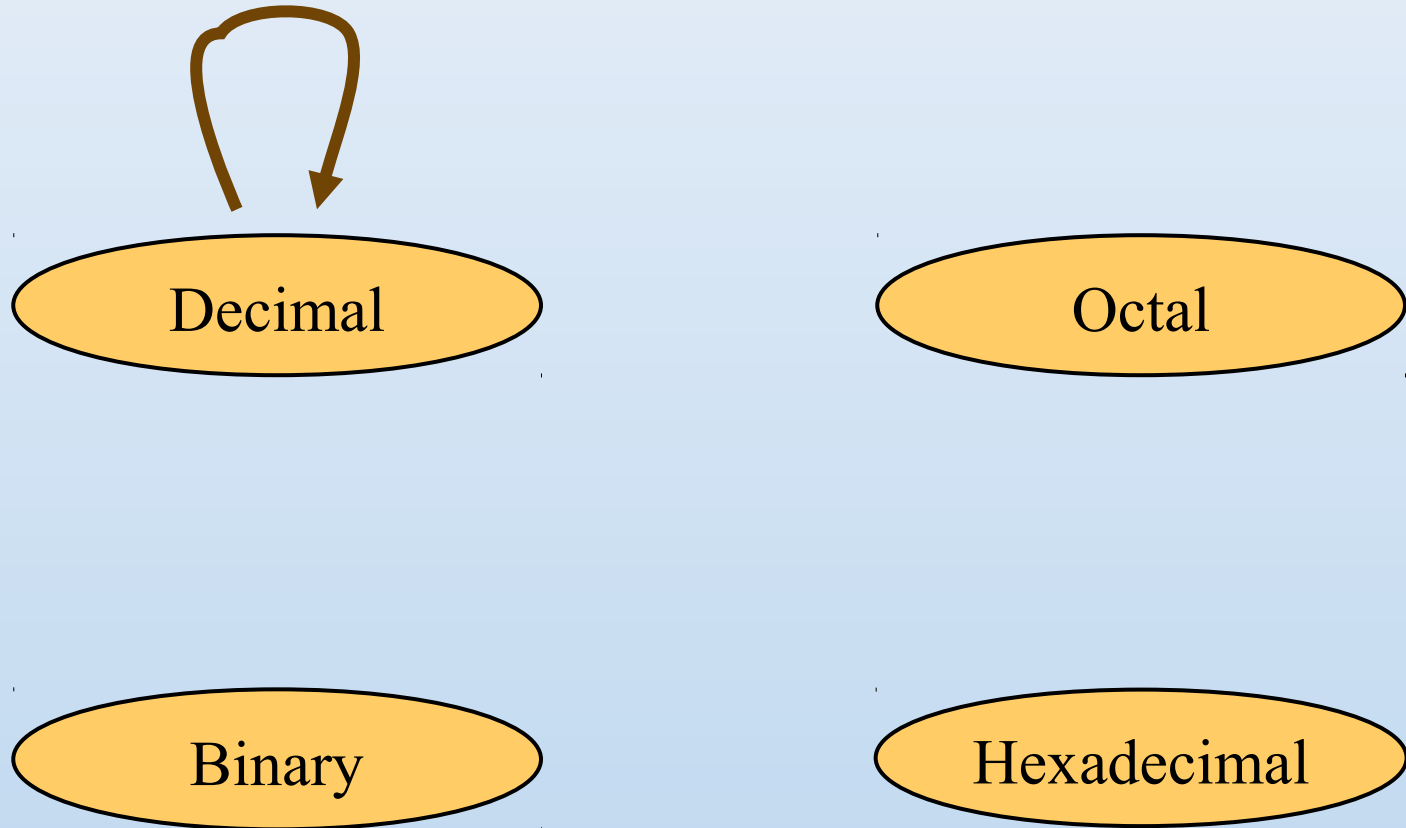
$$1234 = 1 \times 10^3 + 2 \times 10^2 + 3 \times 10^1 + 4 \times 10^0$$
$$= 1000 + 200 + 30 + 4 = 1234_{10}$$

Weight

$$125_{10} \Rightarrow$$

$$
\begin{array}{llll}
5 & \times\ 10^0 & = & 5 \\
2 & \times\ 10^1 & = & 20 \\
1 & \times\ 10^2 & = & \underline{100} \\
 & & & 125
\end{array}
$$

Base

Binary to Decimal

Binary to Decimal

□ Technique

  □ Multiply each bit by 2^n, where n is the "weight" of the bit

  □ The weight is the position of the bit, starting from 0 on the right

  □ Add the results

Example

Bit "0"

$$101011_2 \Rightarrow$$

$$1 \text{ x } 2^0 = 1$$
$$1 \text{ x } 2^1 = 2$$
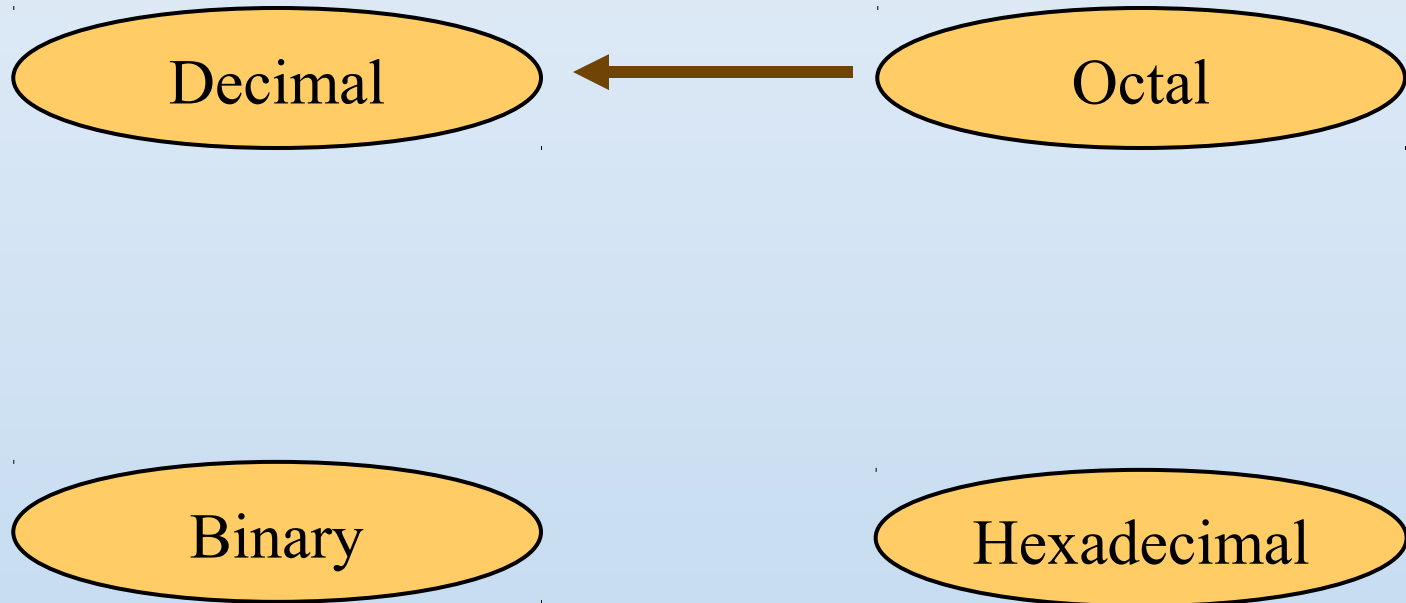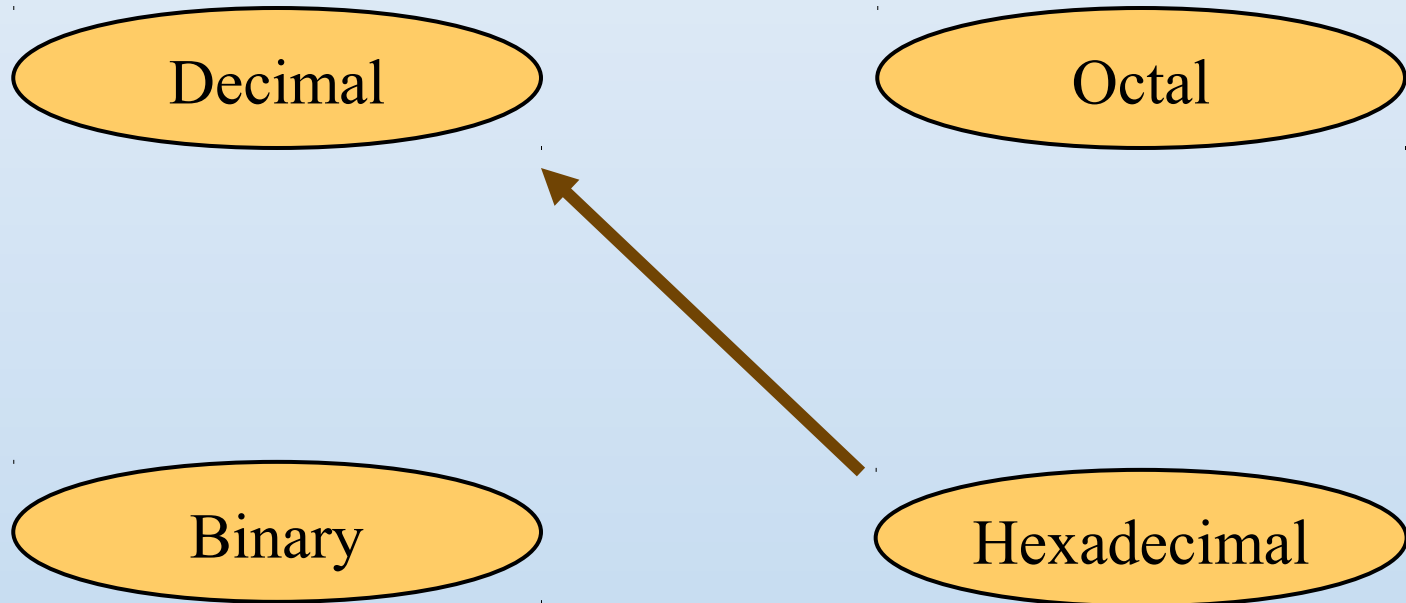$$0 \text{ x } 2^2 = 0$$
$$1 \text{ x } 2^3 = 8$$
$$0 \text{ x } 2^4 = 0$$
$$1 \text{ x } 2^5 = \underline{32}$$

$$43_{10}$$

Octal to Decimal

Octal to Decimal

- Technique
  - Multiply each bit by 8^n, where n is the "weight" of the bit
  - The weight is the position of the bit, starting from 0 on the right
  - Add the results

Example

$$724_8 \implies \quad 4 \times 8^0 = \quad\quad 4$$
$$2 \times 8^1 = \quad\; 16$$
$$7 \times 8^2 = \quad \underline{448}$$
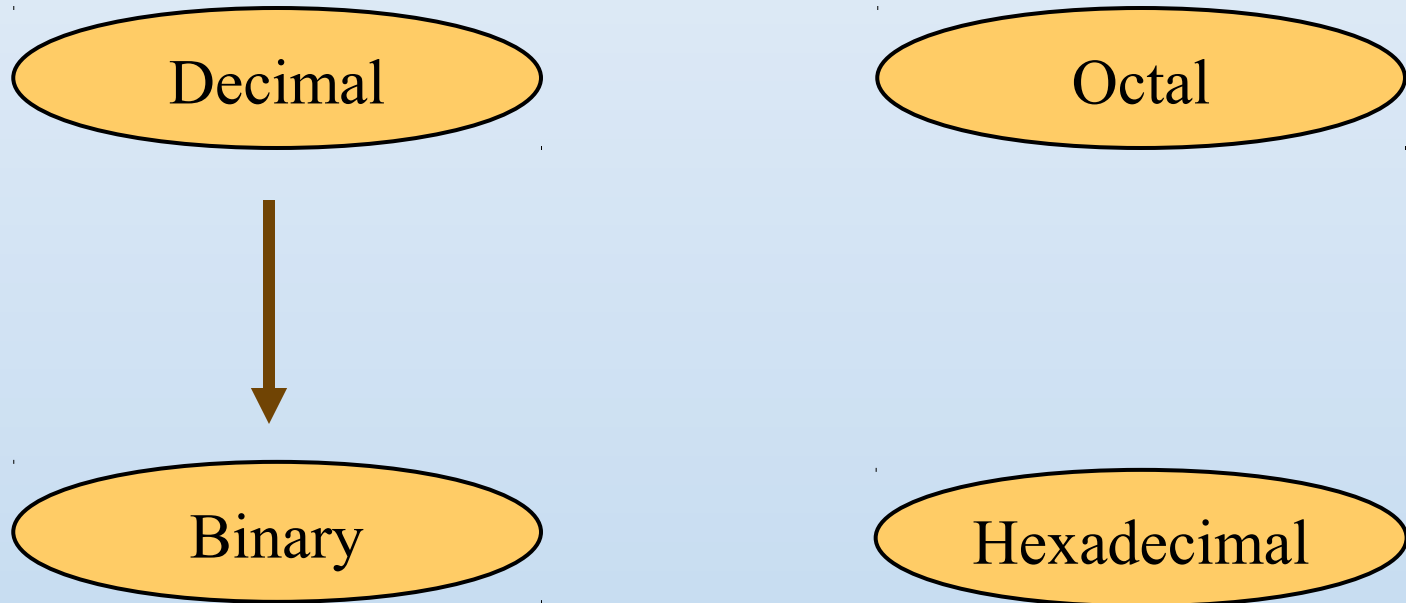$$468_{10}$$

Hexadecimal to Decimal

Hexadecimal to Decimal

- Technique
  - Multiply each bit by 16^n, where n is the "weight" of the bit
  - The weight is the position of the bit, starting from 0 on the right
  - Add the results

Example

$$ABC_{16} \Rightarrow$$

$$C \times 16^0 = 12 \times 1 = 12$$
$$B \times 16^1 = 11 \times 16 = 176$$
$$A \times 16^2 = 10 \times 256 = \underline{2560}$$

$$2748_{10}$$

Decimal to Binary

Decimal to Binary

☐ Technique
  ☐ Divide by two, keep track of the remainder
  ☐ First remainder is bit 0 (LSB, least-significant bit)
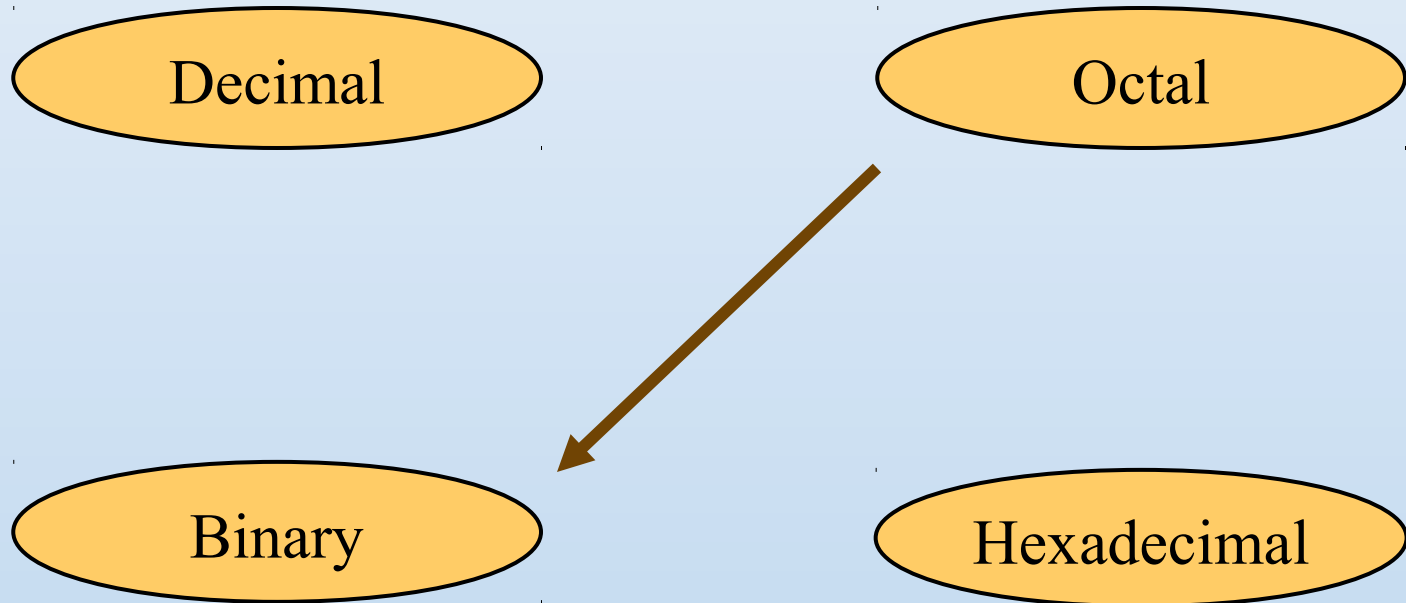 ☐ Second remainder is bit 1
  ☐ Etc.

Example

$125_{10} = ?_2$

```
2 | 125
2 |  62     1
2 |  31     0
2 |  15     1
2 |   7     1
2 |   3     1
2 |   1     1
        0     1
```

$125_{10} = 1111101_2$

Octal to Binary

Decimal

Octal

Binary

Hexadecimal

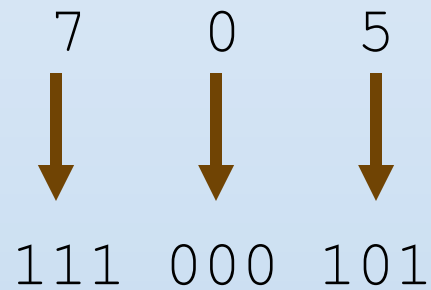# Octal to Binary

□ Technique

    □ Convert each octal digit to a 3-bit equivalent binary representation

Example

$705_8 = ?_2$

7   0   5

111   000   101

$705_8 = 111000101_2$

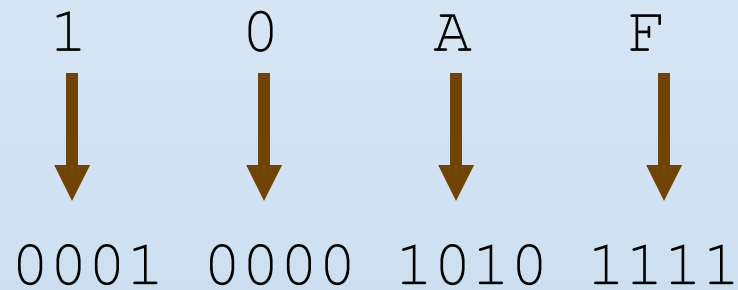# Hexadecimal to Binary

Decimal

Octal

Binary ← Hexadecimal
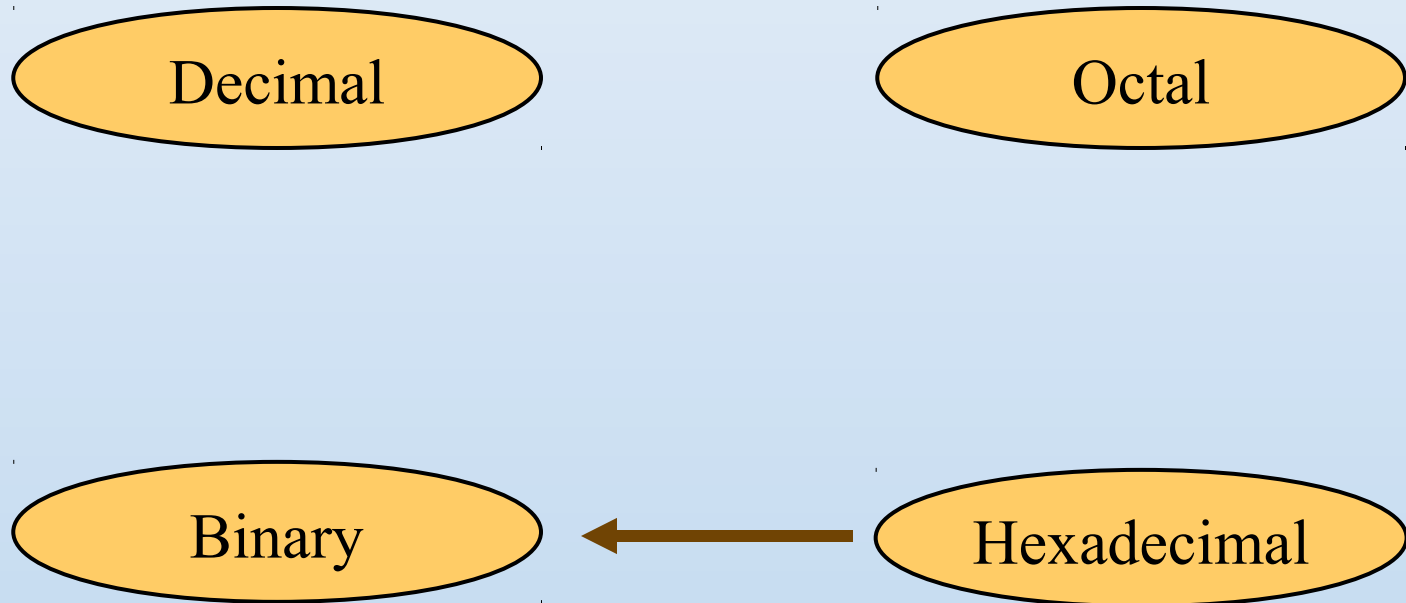
Hexadecimal to Binary

- Technique
  - Convert each hexadecimal digit to a 4-bit equivalent binary representation

Example

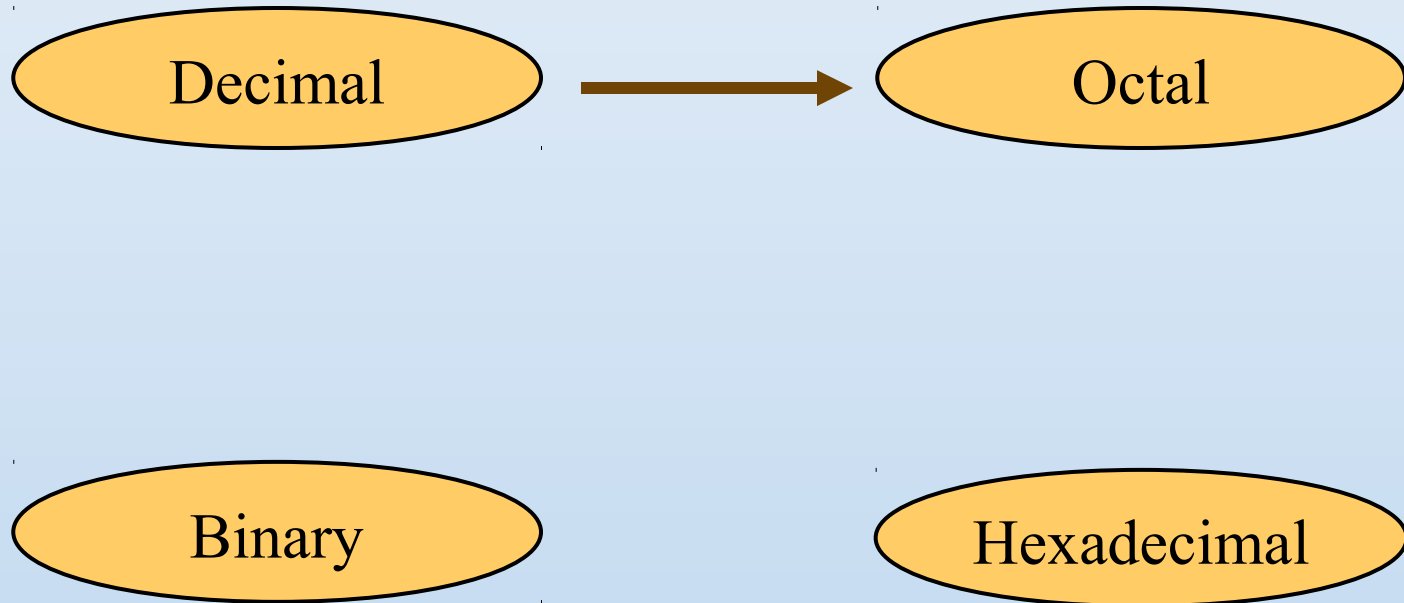$10AF_{16} = ?_2$

1	0	A	F
↓	↓	↓	↓
0001	0000	1010	1111

$10AF_{16} = 0001000010101111_2$

Decimal to Octal

Decimal to Octal

□ Technique
  □ Divide by 8
  □ Keep track of the remainder

Example

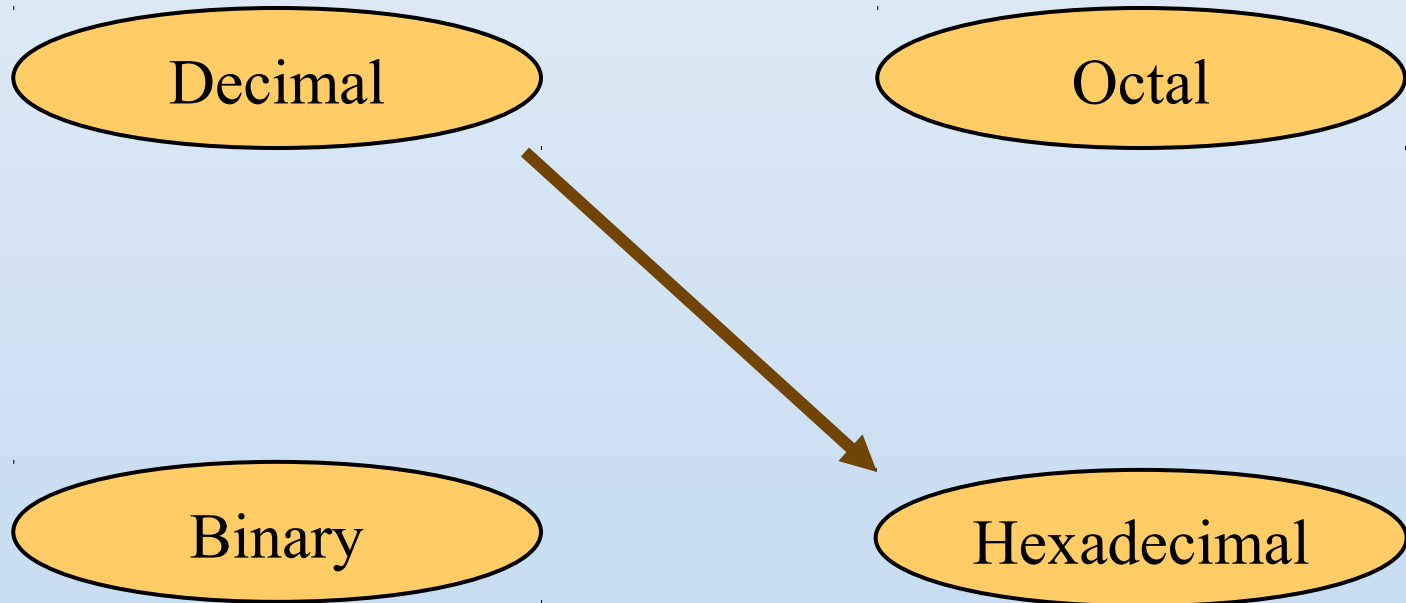$1234_{10} = ?_8$

$$
\begin{array}{r|r r}
8 & 1234 & \\
8 & 154 & 2 \\
8 & 19 & 2 \\
8 & 2 & 3 \\
\hline
 & 0 & 2 \\
\end{array}
$$
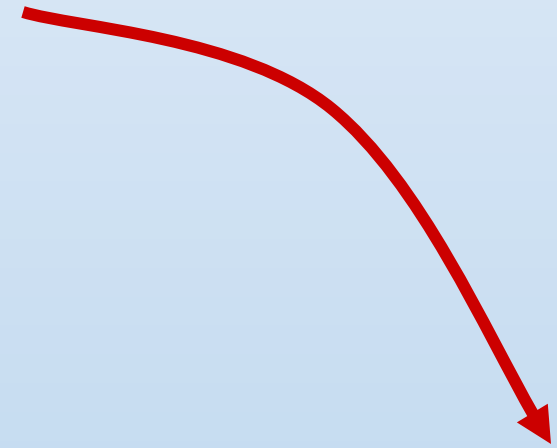
$1234_{10} = 2322_8$

Decimal to Hexadecimal

Decimal

Octal

Binary

Hexadecimal

Decimal to Hexadecimal
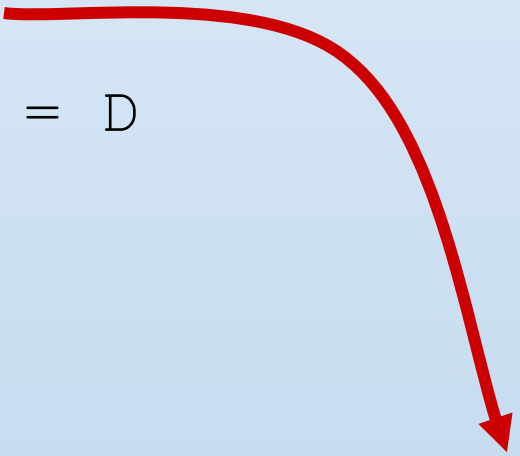
- Technique
  - Divide by 16
  - Keep track of the remainder

Example

$1234_{10} = ?_{16}$

```
16 | 1234
16 |   77     2
16 |    4    13 = D
         0    4
```

$1234_{10} = 4D2_{16}$

Binary to Octal
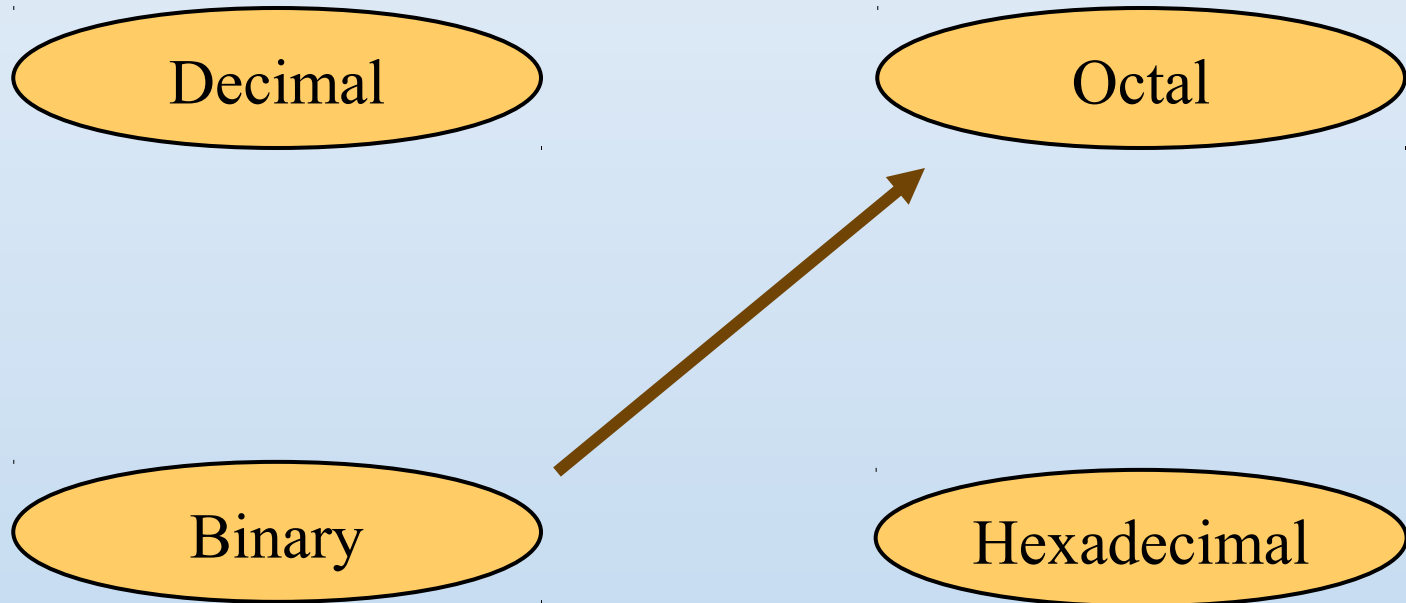
Binary to Octal

- Technique
  - Group bits in threes, starting on right
  - Convert to octal digits

Example

$1011010111_2 = ?_8$
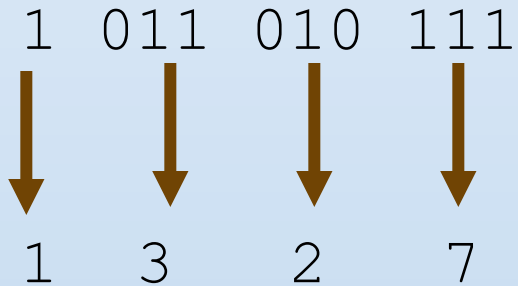
1 011 010 111

1   3   2   7

$1011010111_2 = 1327_8$

Binary to Hexadecimal
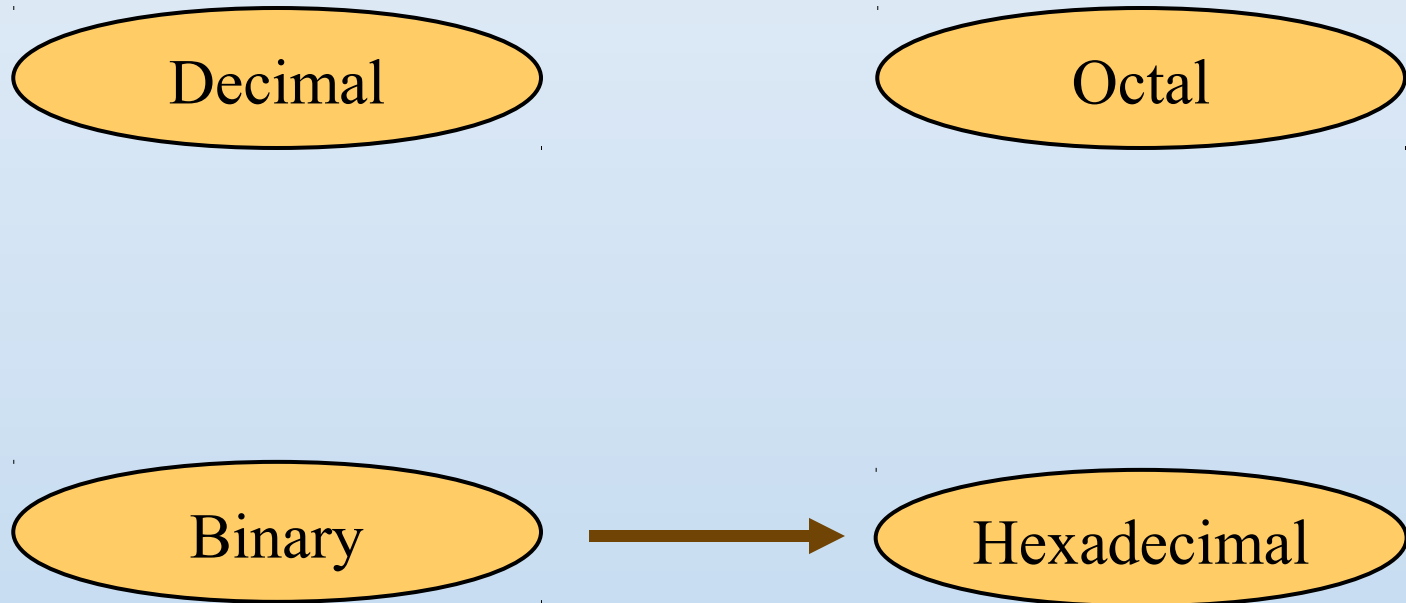
Binary to Hexadecimal

- Technique
  - Group bits in fours, starting on right
  - Convert to hexadecimal digits

Example

$1010111011_2 = ?_{16}$

10 1011 1011

2   B   B
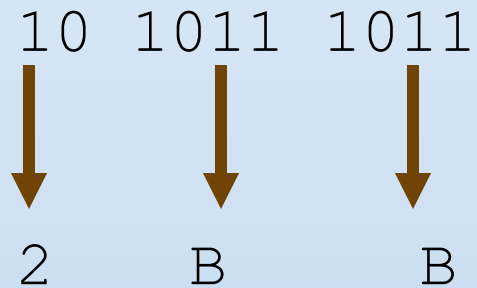
$1010111011_2 = 2BB_{16}$

Octal to Hexadecimal
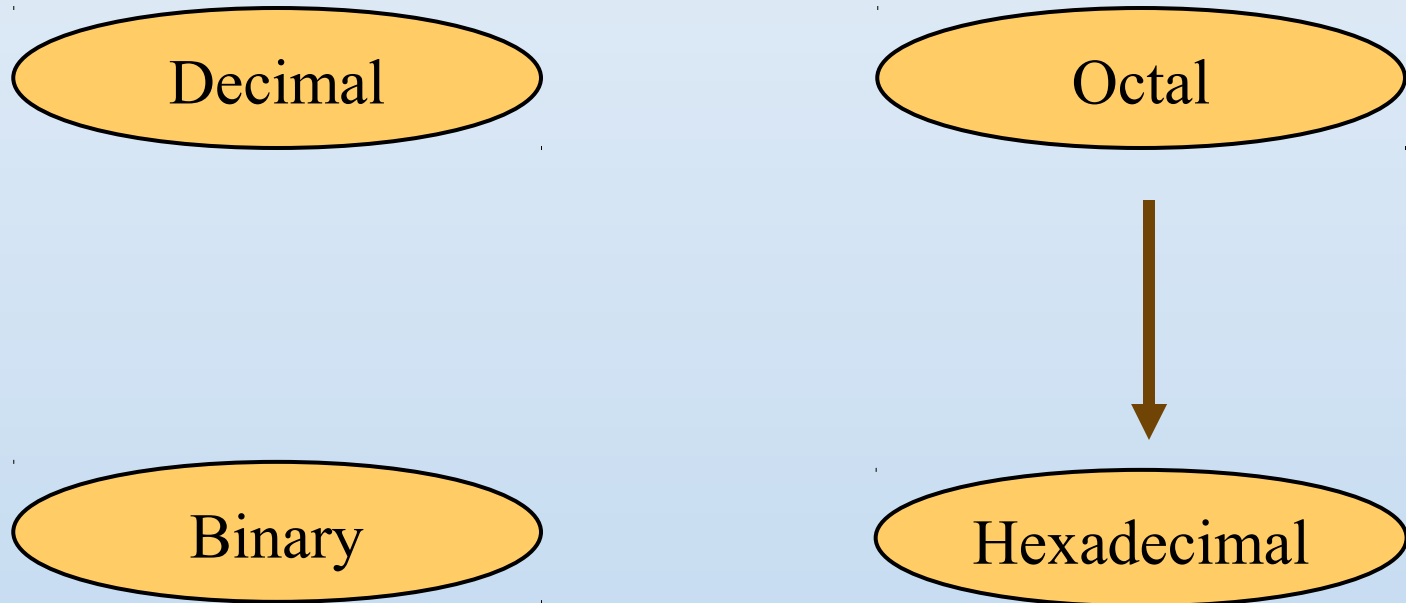
Octal to Hexadecimal

□ Technique

　　□ Use binary as an intermediary

Example

$1076_8 = ?_{16}$

1	0	7	6
↓	↓	↓	↓
001	0｜00	11｜1	110
	2 ｜ 3	｜ E	
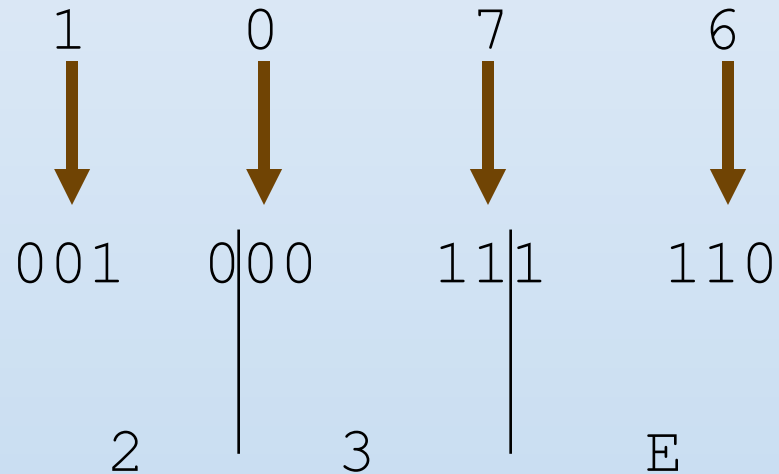
$1076_8 = 23E_{16}$

Hexadecimal to Octal

Decimal

Octal

Binary
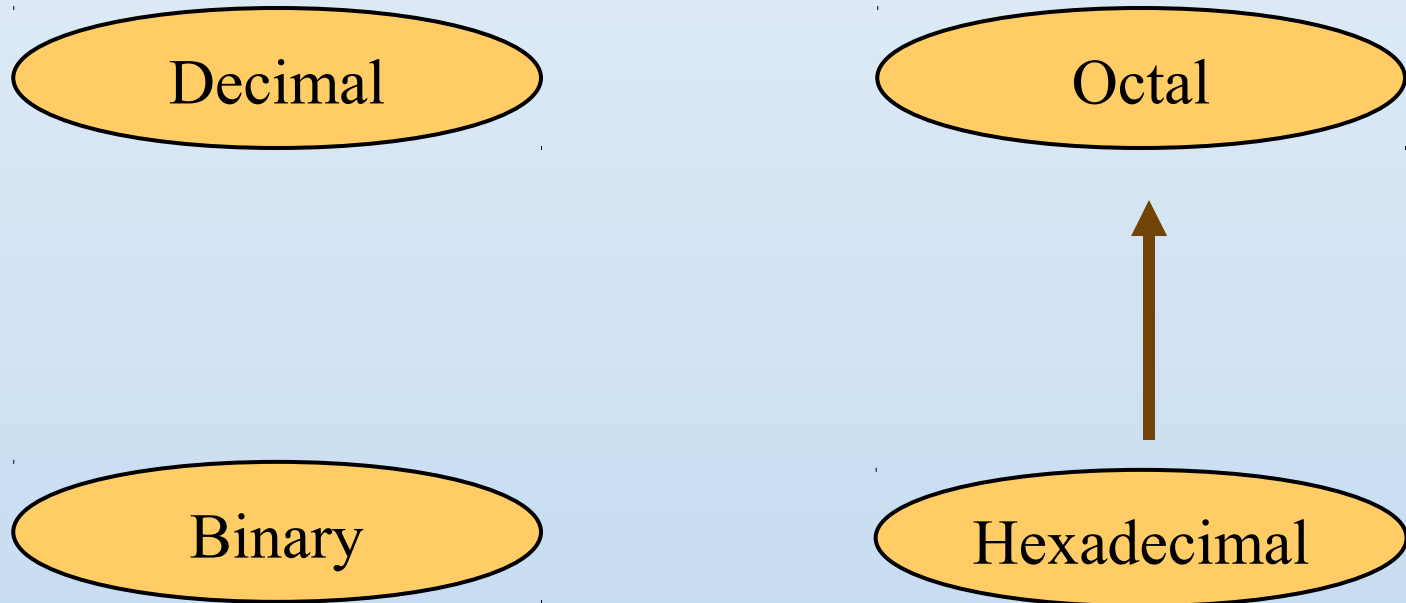
Hexadecimal

Hexadecimal to Octal

□ Technique
  □ Use binary as an intermediary

Example

$1F0C_{16} = ?_8$

1	F	0	C

0|001 | 111|1 | 00|00 | 1|100
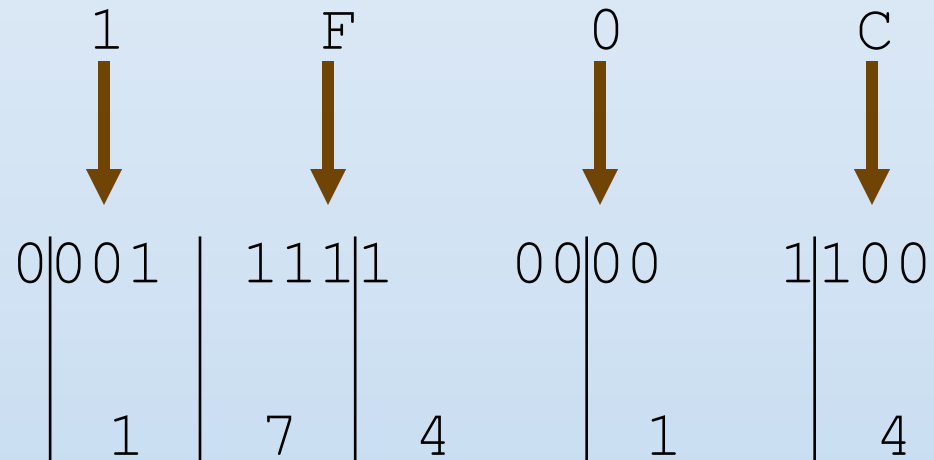
| 1 | 7 | 4 | 1 | 4 |

$1F0C_{16} = 17414_8$

Exercise – Convert ...

Decimal	Binary	Octal	Hexa-decimal
33			
	1110101		
		703	
			1AF

Common Powers (1 of 2)

□ Base 10

Power	Preface	Symbol	Value
10^{-12}	pico	p	.000000000001
10^{-9}	nano	n	.000000001
10^{-6}	micro	μ	.000001
10^{-3}	milli	m	.001
10^{3}	kilo	k	1000
10^{6}	mega	M	1000000
10^{9}	giga	G	1000000000
10^{12}	tera	T	1000000000000

Common Powers (2 of 2)

- Base 2

Power	Preface	Symbol	Value
2^{10}	kilo	k	1024
2^{20}	mega	M	1048576
2^{30}	Giga	G	1073741824

- What is the value of "k", "M", and "G"?
- In computing, particularly w.r.t. <u>memory</u>, the base-2 interpretation generally applies

Example

(C:) Properties

General | Tools

Label:

Type: Local Disk
File system: FAT32

■ Used space: 1,977,475,072 bytes 1.84GB
■ Free space: 8,068,784,128 bytes 7.51GB

Used space: 1,977,475,072 bytes 1.84GB

Drive C

Disk Cleanup...

OK | Cancel | Apply
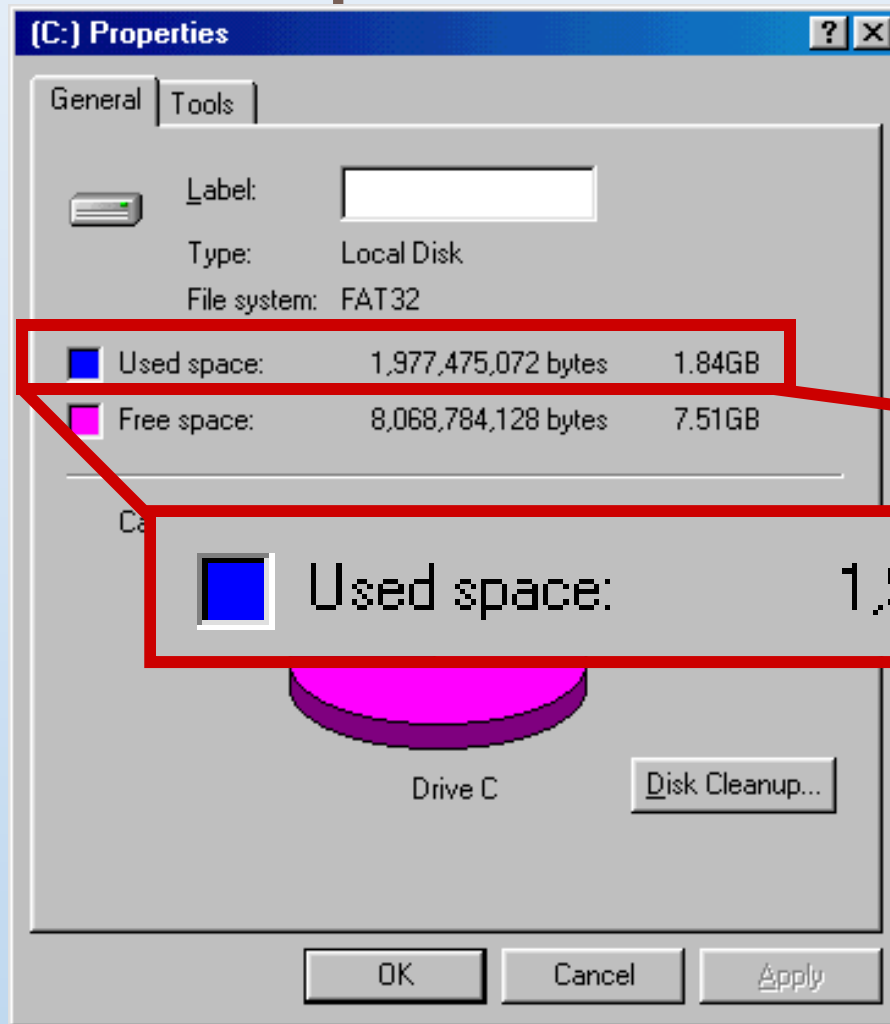
In the lab…
1. Double click on <u>My Computer</u>
2. Right click on <u>C:</u>
3. Click on <u>Properties</u>

$/ \ 2^{30} \ =$

Exercise – Free Space

- Determine the "free space" on all drives on a machine in the lab

Drive	Free space	
	Bytes	GB
A:		
C:		
D:		
E:		
etc.		

Review – multiplying powers

- For common bases, add powers

$$a^b \times a^c = a^{b+c}$$

$$2^6 \times 2^{10} = 2^{16} = 65,536$$

or…

$$2^6 \times 2^{10} = 64 \times 2^{10} = 64k$$

Binary Addition (1 of 2)

□ Two 1-bit values

A	B	A + B
0	0	0
0	1	1
1	0	1
1	1	10

"two"

Binary Addition (2 of 2)

- Two n-bit values
  - Add individual bits
  - Propagate carries
  - E.g.,

$$
\begin{array}{r}
^1\quad\ ^1\quad\ \\
10101 \\
+\ 11001 \\
\hline
101110
\end{array}
\qquad
\begin{array}{r}
21 \\
+\ 25 \\
\hline
46
\end{array}
$$

Multiplication (1 of 3)

- Decimal (just for fun)

```
          35
     x  105
     ‾‾‾‾‾‾‾
         175
         000
          35
     ‾‾‾‾‾‾‾‾
        3675
```

Multiplication (2 of 3)

□ Binary, two 1-bit values

A	B	A × B
0	0	0
0	1	0
1	0	0
1	1	1

Multiplication (3 of 3)

- Binary, two n-bit values
  - As with decimal values
  - E.g.,

$$
\begin{array}{r}
1110 \\
\times\ 1011 \\
\hline
1110 \\
1110 \\
0000 \\
1110\ \ \ \ \\
\hline
10011010
\end{array}
$$

Fractions

☐ Decimal to decimal (just for fun)

$$3.14 \Rightarrow \quad 4 \times 10^{-2} = 0.04$$
$$1 \times 10^{-1} = 0.1$$
$$\underline{3 \times 10^{0} \quad = \;3}$$
$$3.14$$

Fractions

□ **Binary to decimal**

```
10.1011 =>
```

$$1 \times 2^{-4} = 0.0625$$
$$1 \times 2^{-3} = 0.125$$
$$0 \times 2^{-2} = 0.0$$
$$1 \times 2^{-1} = 0.5$$
$$0 \times 2^{0} = 0.0$$
$$1 \times 2^{1} = \underline{2.0}$$
$$2.6875$$

Fractions

☐ Decimal to binary

3.14579

11.001001...

```
 .14579
x       2
0.29158
x       2
0.58316
x       2
1.16632
x       2
0.33264
x       2
0.66528
x       2
1.33056

etc.
```
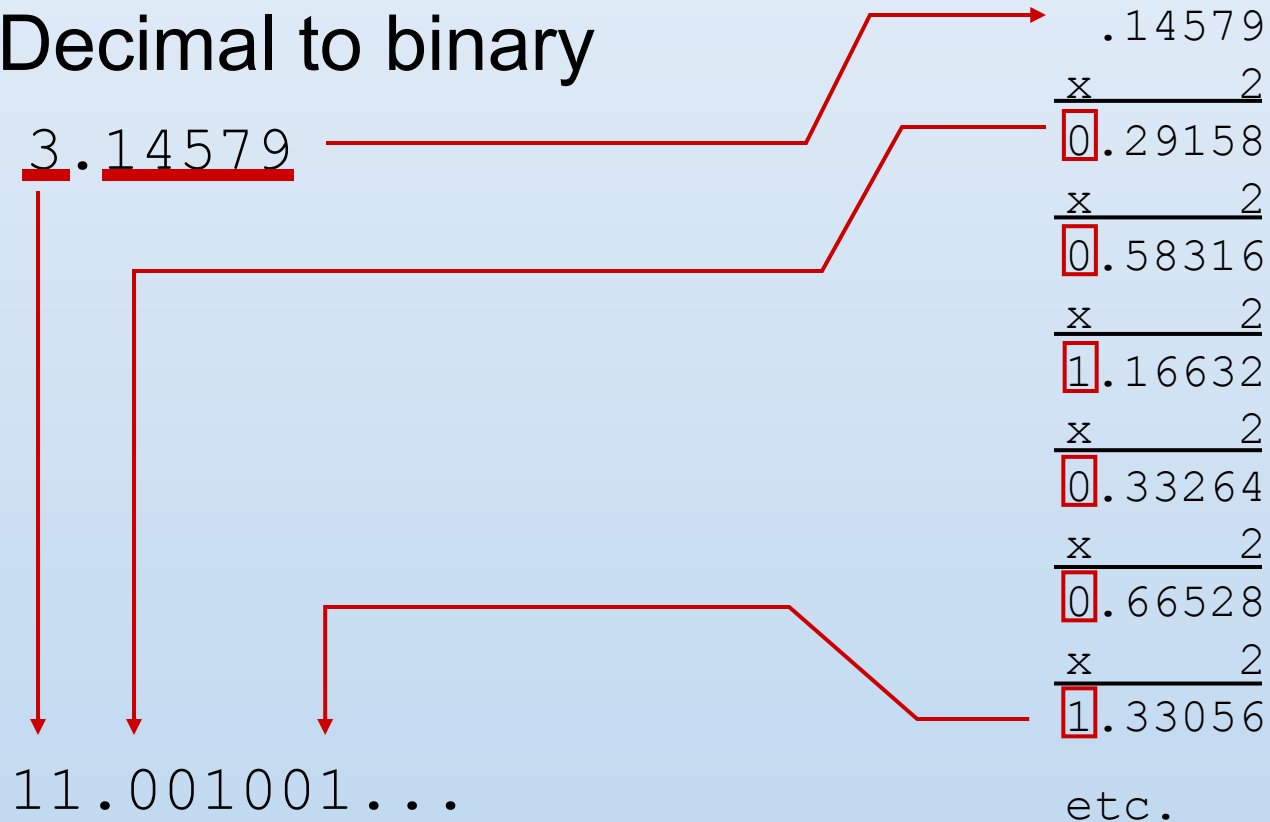
Exercise – Convert ...

Decimal	Binary	Octal	Hexa-decimal
29.8			
	101.1101		
		3.07	
			C.82

Exercise – Convert

Decimal	Binary	Octal	Hexa-decimal
29.8	11101.110011…	35.63…	1D.CC…
5.8125	101.1101	5.64	5.D
3.109375	11.000111	3.07	3.1C
12.5078125	1100.10000010	14.404	C.82

Thank you