Digital Logic

Lecture 2

2nd Stage

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Topics covered

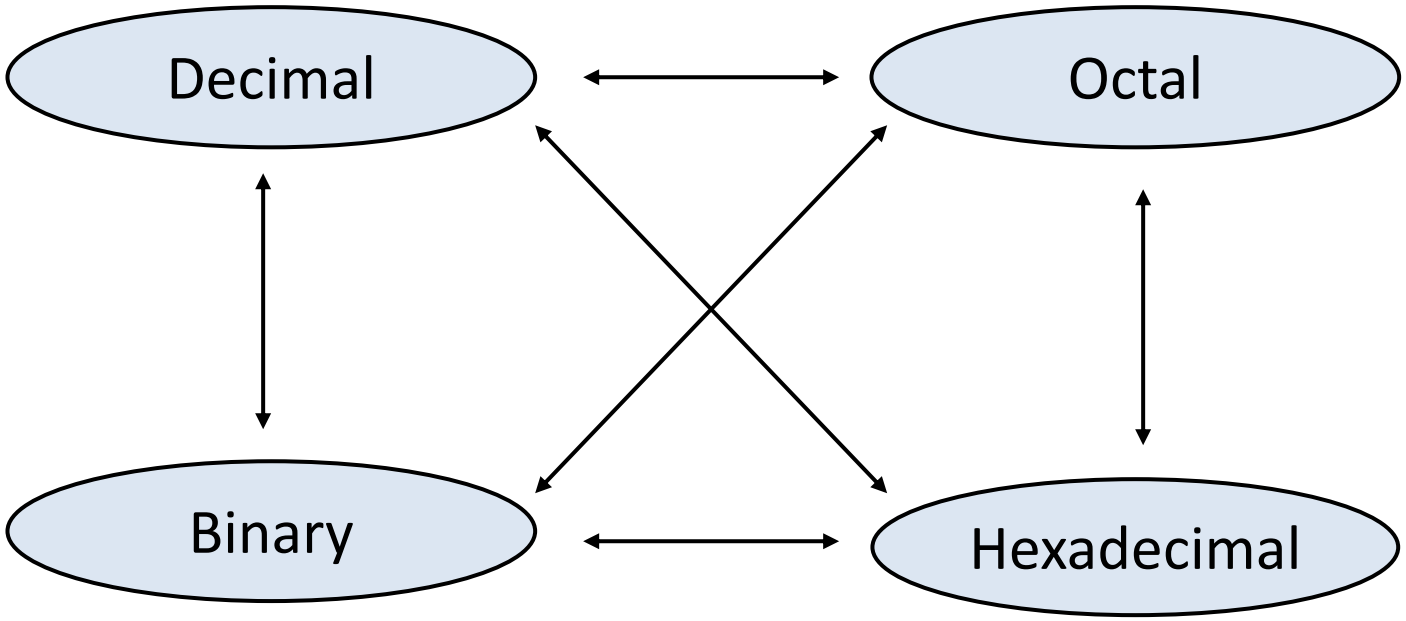
✧ Fractional conversion among bases

✧ Binary arithmetic operations

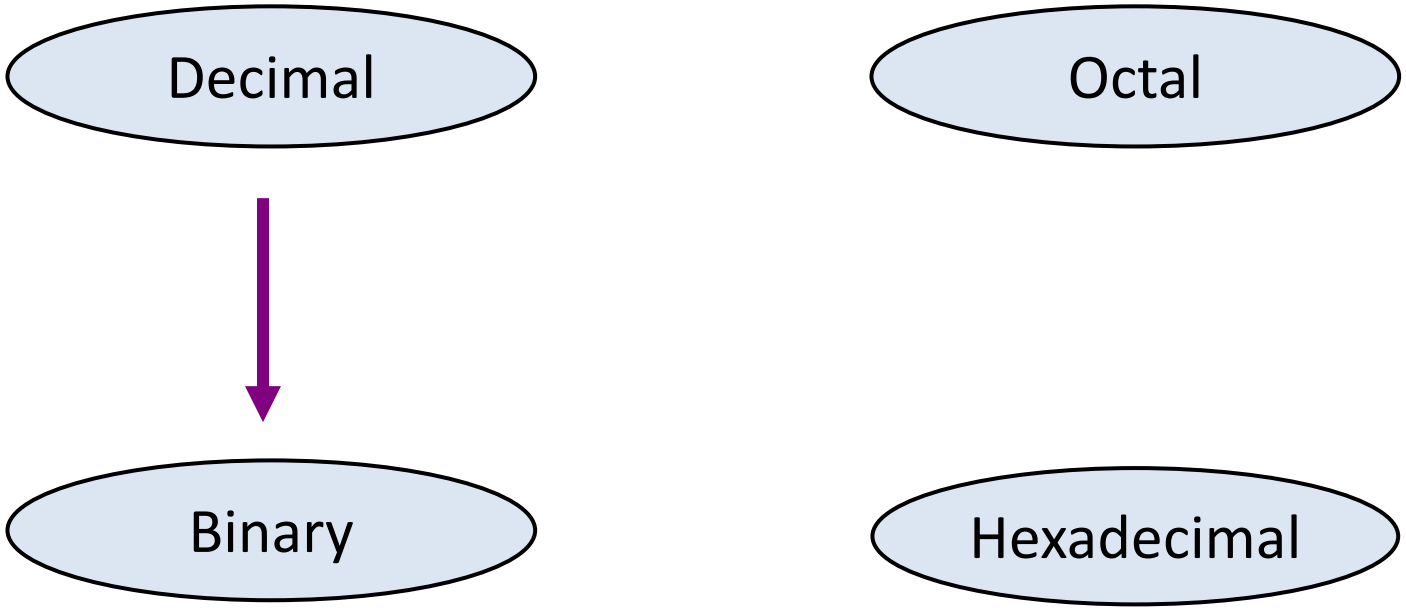
Common Number Systems

System	Base	Symbols
Decimal	10	0, 1, … 9
Binary	2	0, 1
Octal	8	0, 1, … 7
Hexa- decimal	16	0, 1, … 9, A, B, … F

Fractional Conversion Among Bases



Decimal to Binary



Decimal to Binary

$(25.625)_{10} = (?)_2$

$(25)_{10} = (\ )_2$

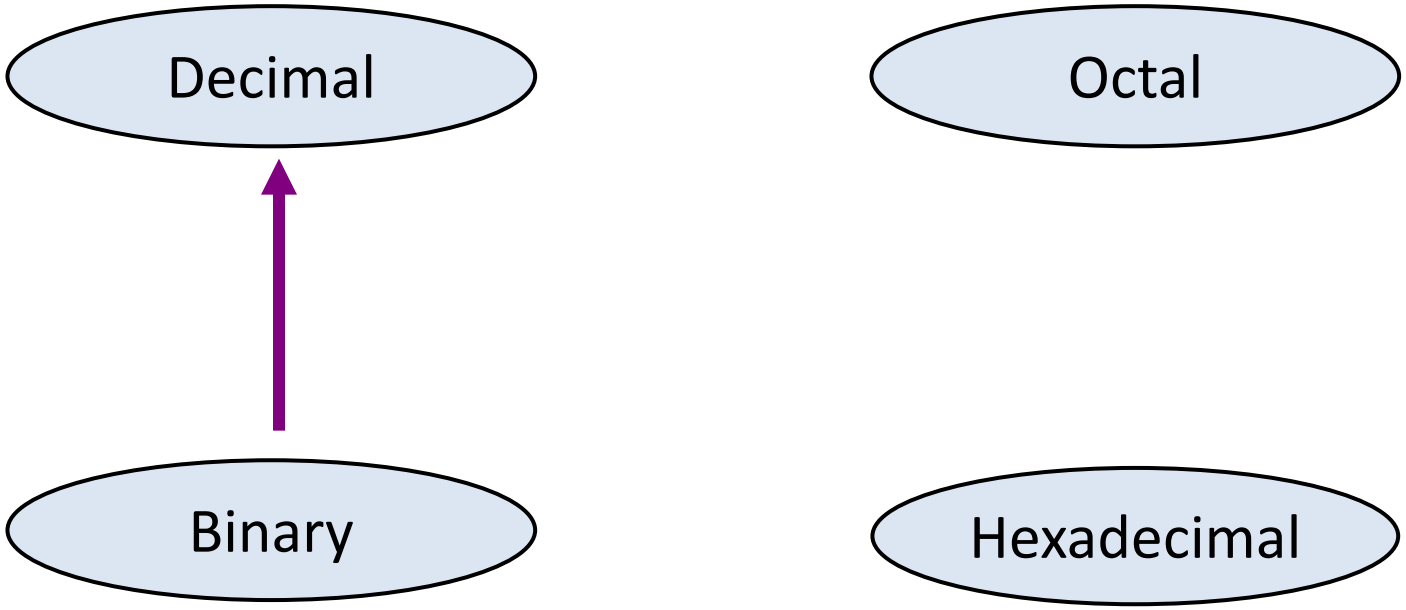
2	25	1
2	12	0
2	6	0
2	3	1
2	1	1
	0	

$(0.625)_{10} = (\ )_2$

0.625 * 2	1.25
0.25 * 2	0.50
0.50 * 2	1.00
0.00 * 2	0.00

$(25.625)_{10} = (11001.101)_2$

Binary to Decimal



Binary to Decimal

$(10101.11)_2 = (\ )_{10}$

$(10101)_2 \Rightarrow 1 \times 2^0 = 1$

$0 \times 2^1 = 0$

$1 \times 2^2 = 4$

$0 \times 2^3 = 0$

$1 \times 2^4 = 16$

$(21)_{10}$

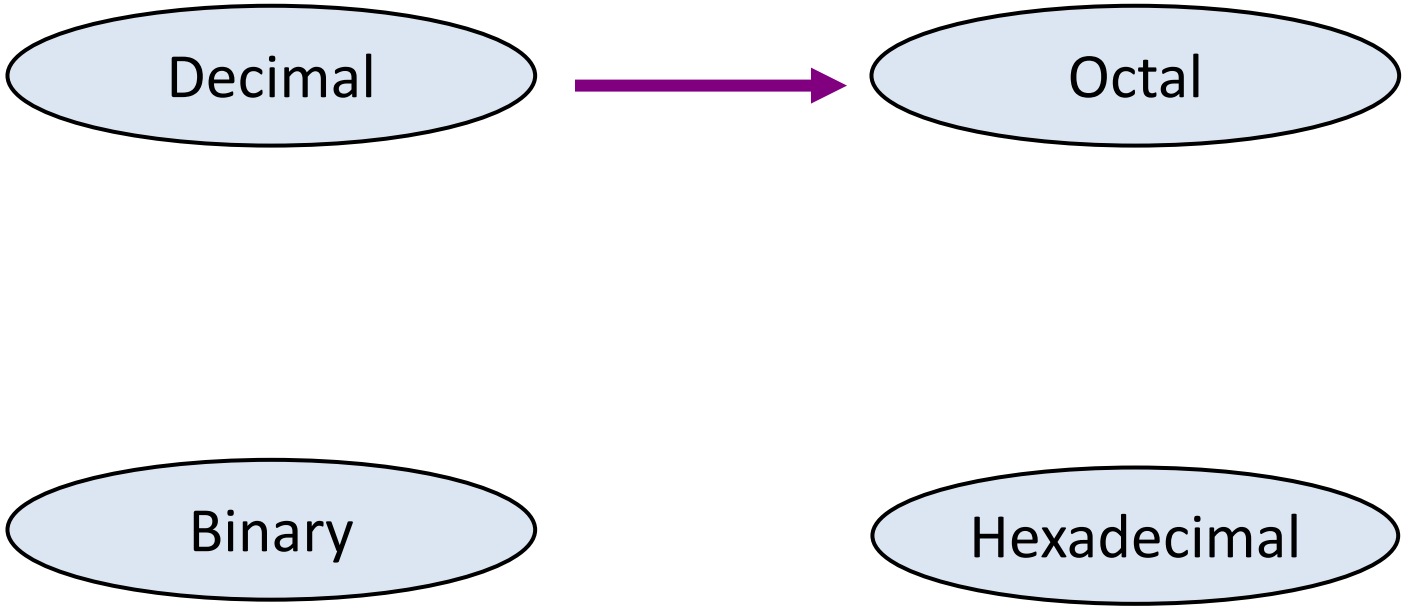
$(0.11)_2 \Rightarrow 1 \times 2^{-1} = 0.5$

$1 \times 2^{-2} = 0.25$

$(0.75)_{10}$

$(10101.11)_2 = (21.75)_{10}$

Decimal to Octal



Decimal to Octal

$(25.625)_{10} = (?)_8$

$(25)_{10} = (\ )_8$

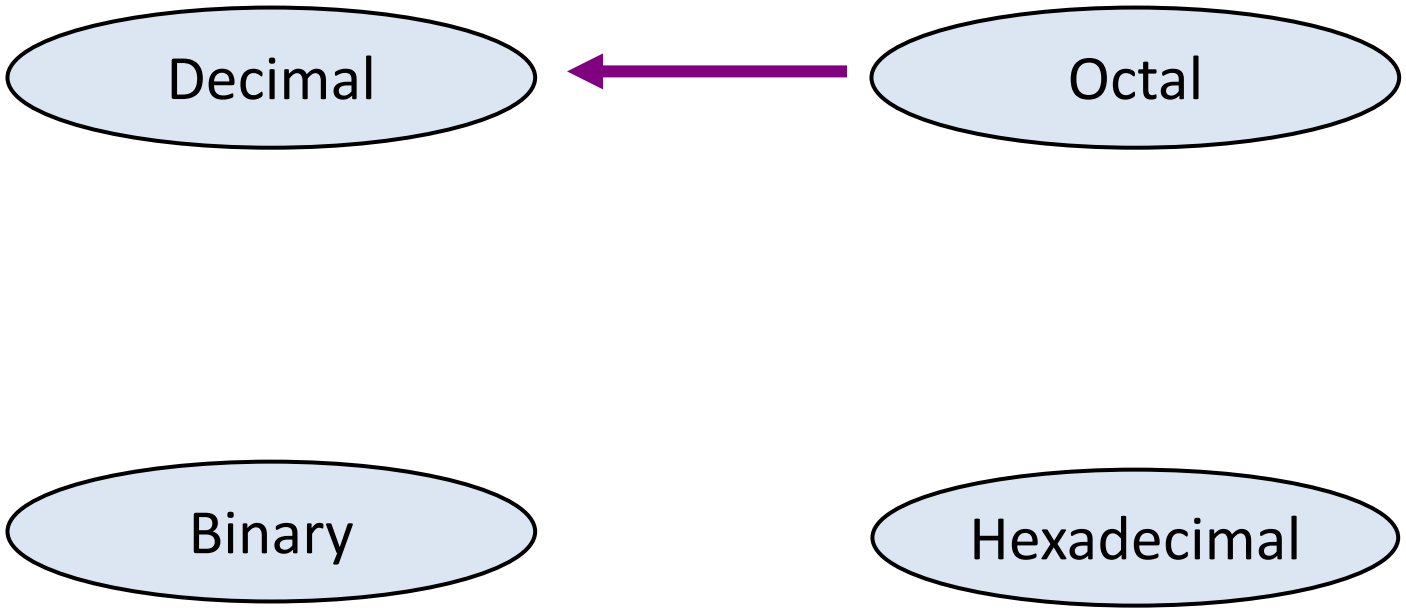
8	25	1
8	3	3
	0	

$(0.625)_{10} = (\ )_8$

0.625 * 8		5.000
0.000 * 8		0.000

$(25.625)_{10} = (31.50)_8$

Octal to Decimal



Octal to Decimal

$(4507.44)_8 = (\ )_{10}$

$(4507)_8 \Rightarrow$

$7 \times 8^0 = 7$

$0 \times 8^1 = 0$

$5 \times 8^2 = 320$

$4 \times 8^3 = 2048$

$(2375)_{10}$

$(0.44)_8 \Rightarrow$

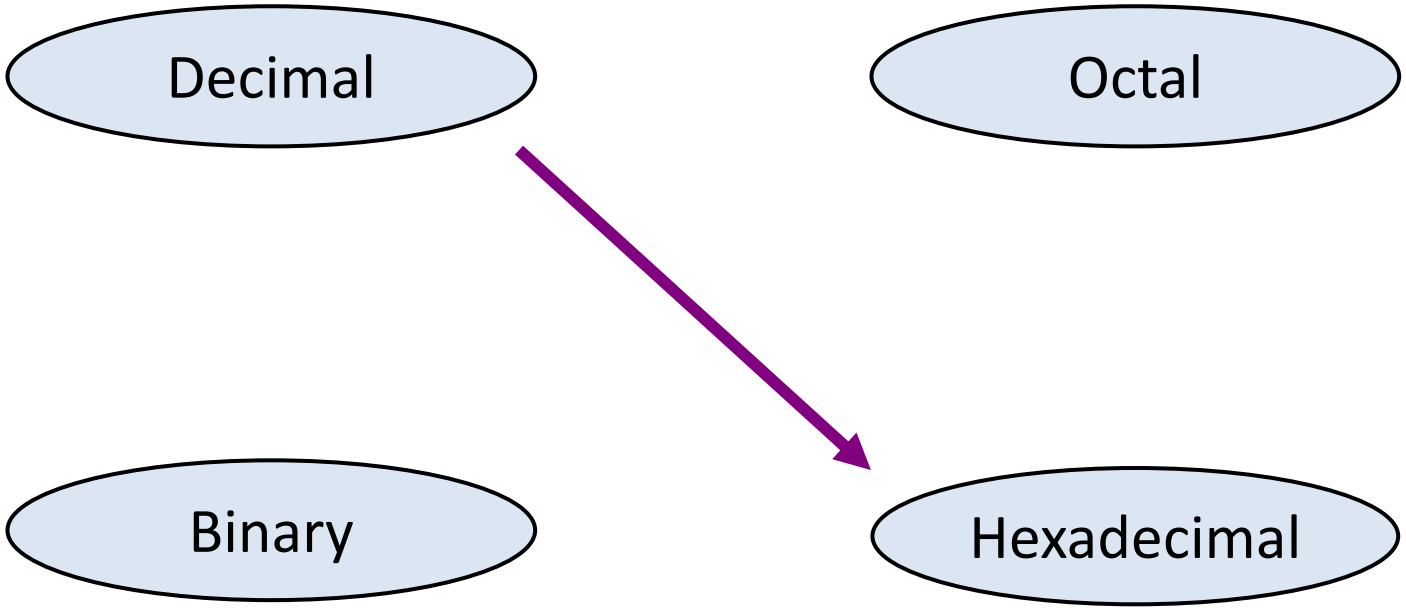
$4 \times 8^{-1} = 0.5$

$4 \times 8^{-2} = 0.0625$

$(0.5625)_{10}$

$(4507.44)_8 = (2375.5625)_{10}$

Decimal to Hexadecimal



Decimal to Hexadecimal

$(25.625)_{10} = (?)_{16}$

$(25)_{10} = (\ )_{16}$

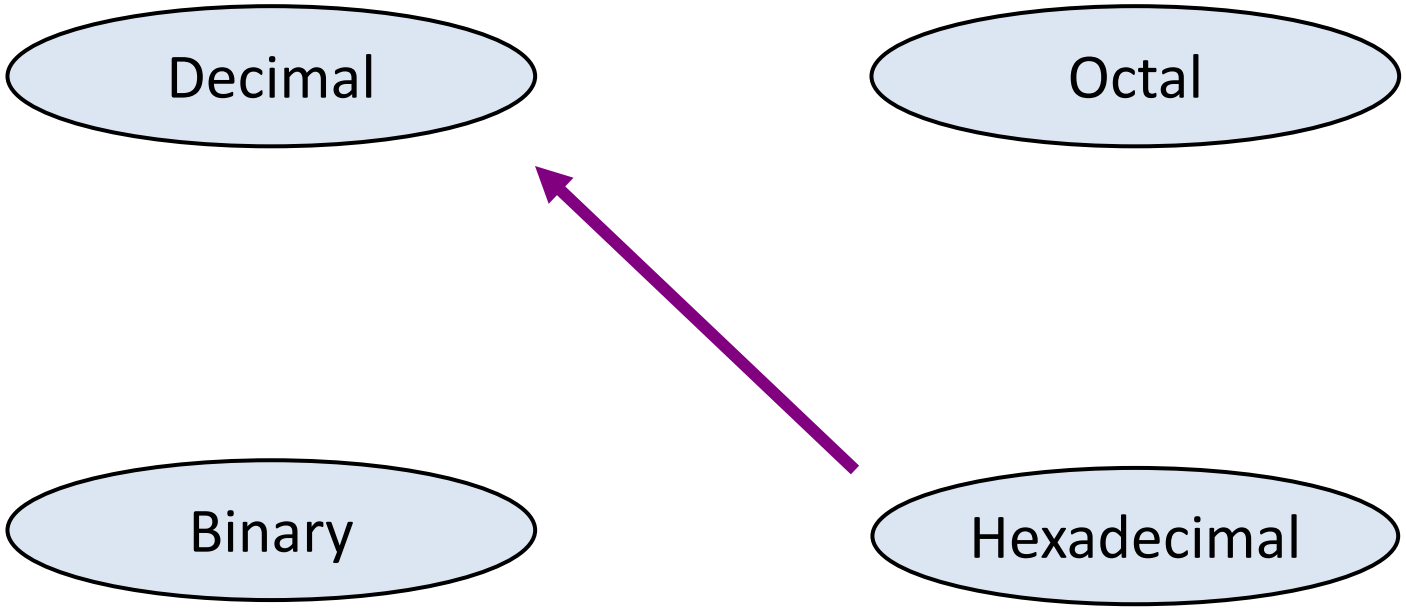
16	25	9
16	1	1
	0	

$(0.625)_{10} = (\ )_{16}$

0.625 * 16		10.000 = A
0.000 * 16		0.000

$(25.625)_{10} = (19.A)_{16}$

Hexadecimal to Decimal



Hexadecimal to Decimal

$(57.4)_{16} = (\ )_{10}$

$(57)_{16} =>$

$7 \times 16^0 = 7$

$5 \times 16^1 = 80$

$(87)_{10}$

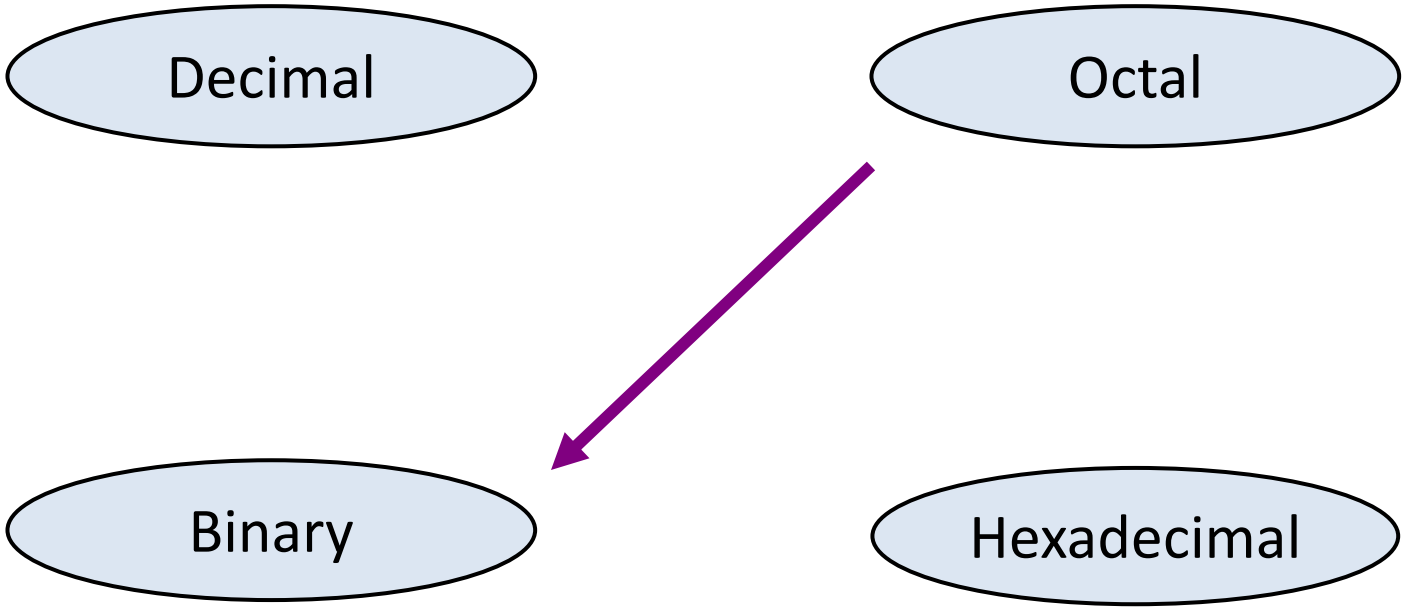
$(0.4)_{16} =>$

$4 \times 16^{-1} = 0.25$

$(0.25)_{10}$

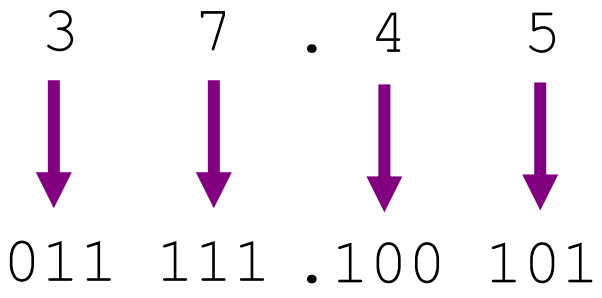
$(57.4)_{16} = (87.25)_{10}$

Octal to Binary



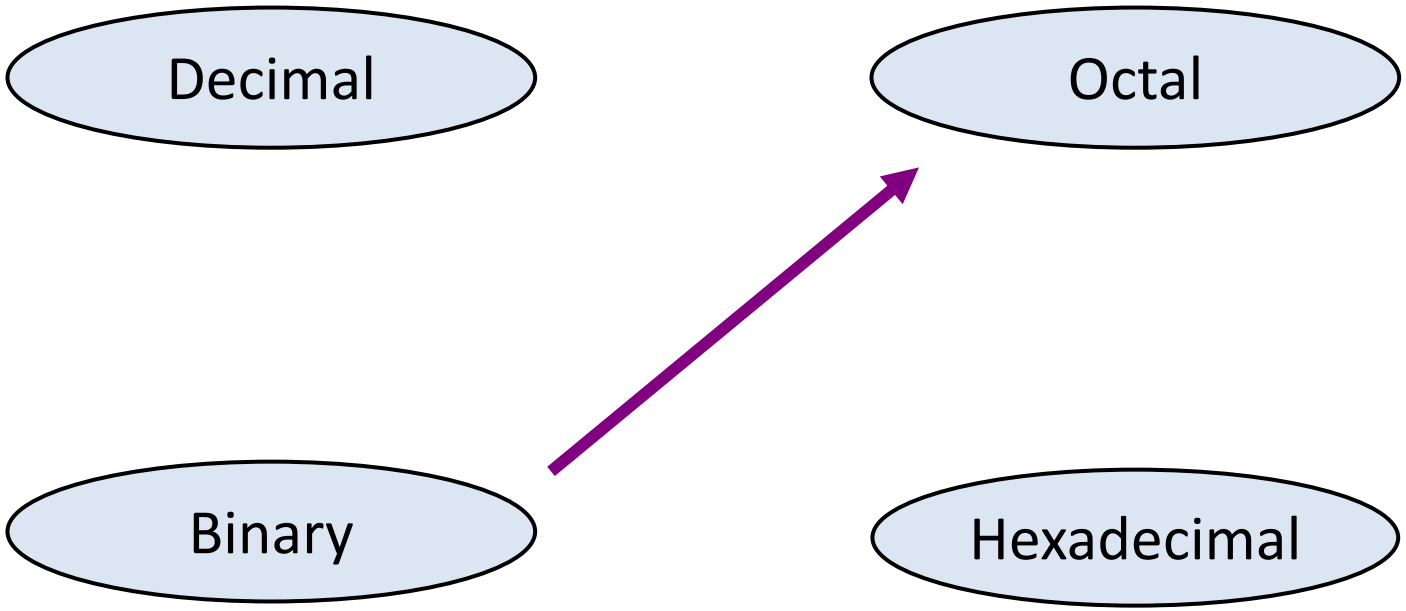
Octal to Binary

$(37.45)_8 = (?)_2$



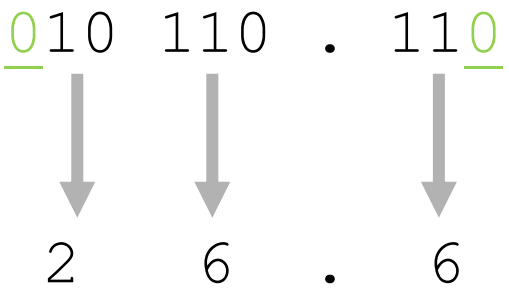
$(37.45)_8 = (011111.100101)_2$

Binary to Octal



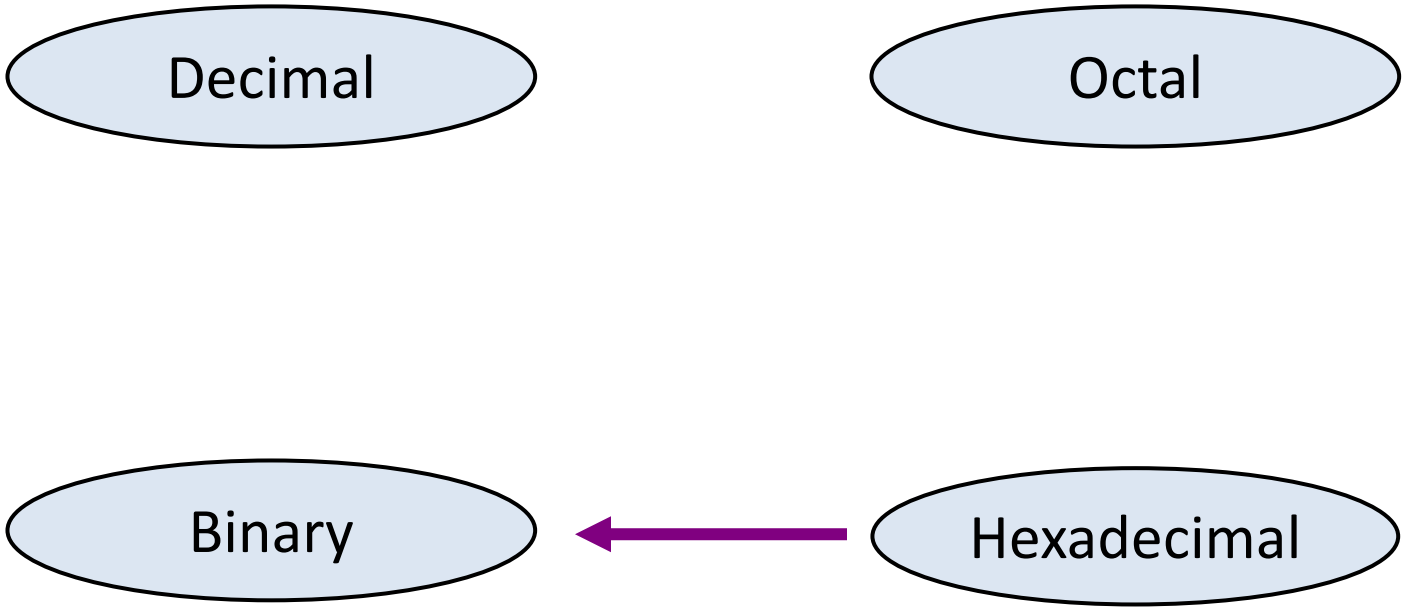
Binary to Octal

$(10110.11)_2 = (?)_8$



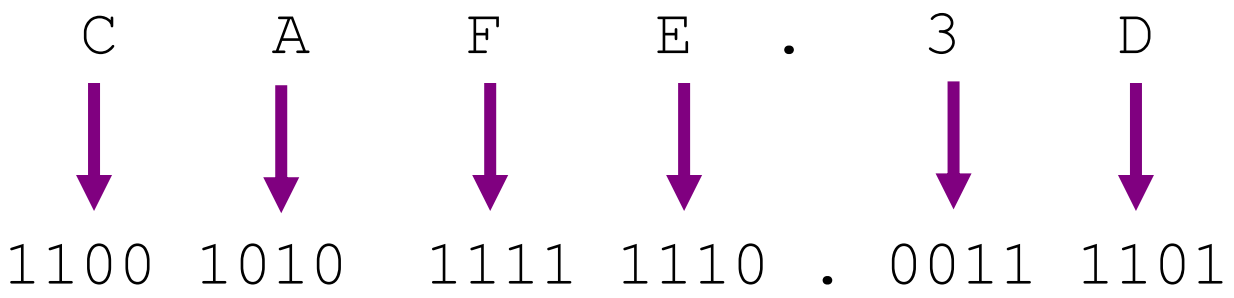
$(10110.11)_2 = (26.6)_8$

Hexadecimal to Binary



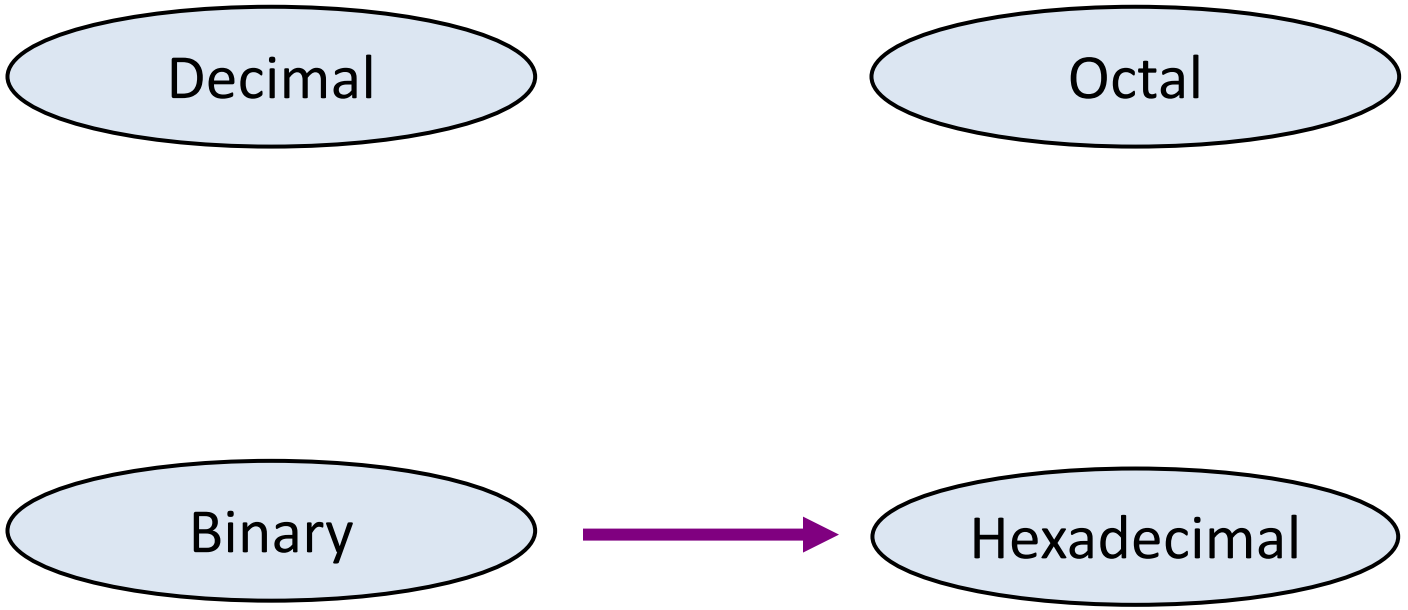
Hexadecimal to Binary

$(CAFE.3D)_{16} = (?)_2$



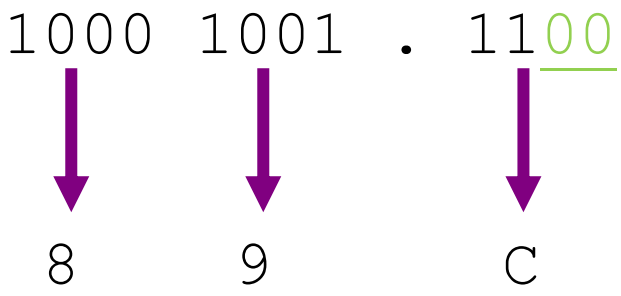
$(CAFE.3D)_{16} = (1100101011111110.00111101)_2$

Binary to Hexadecimal



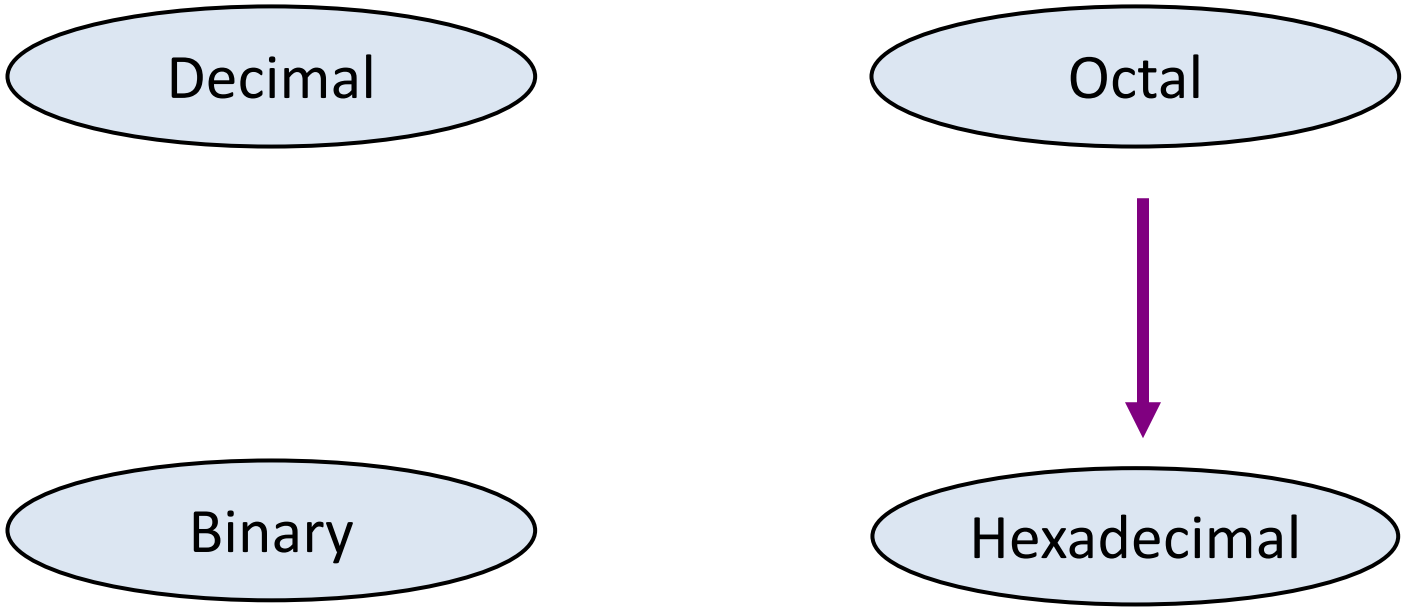
Binary to Hexadecimal

$(10001001.11)_2 = (\ )_{16}$



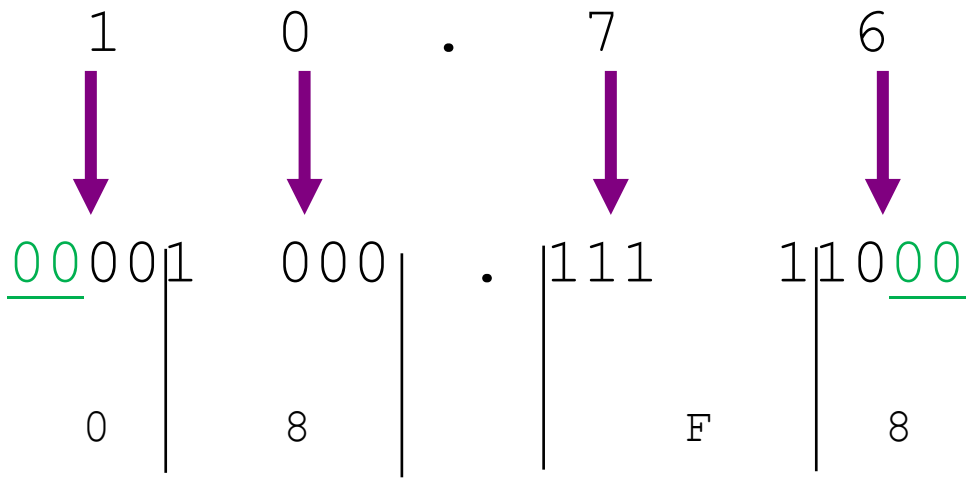
$(10001001.11)_2 = (89.C)_{16}$

Octal to Hexadecimal



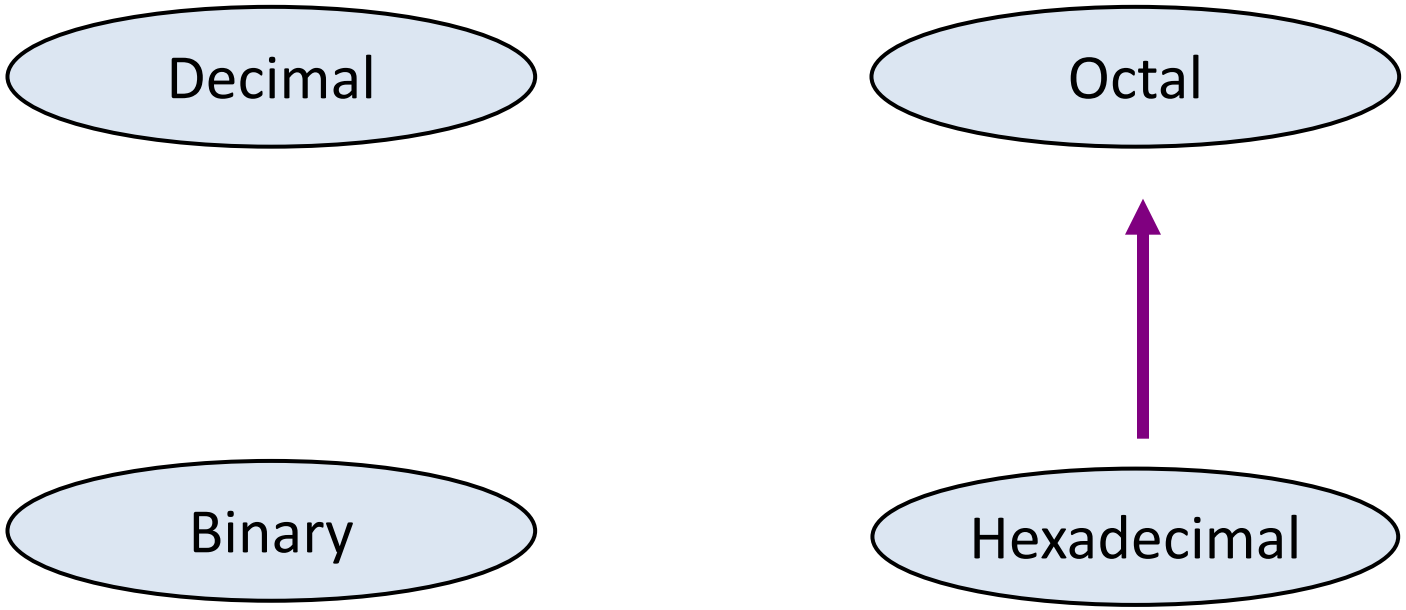
Octal to Hexadecimal

$(10.76)_8 = (?)_{16}$



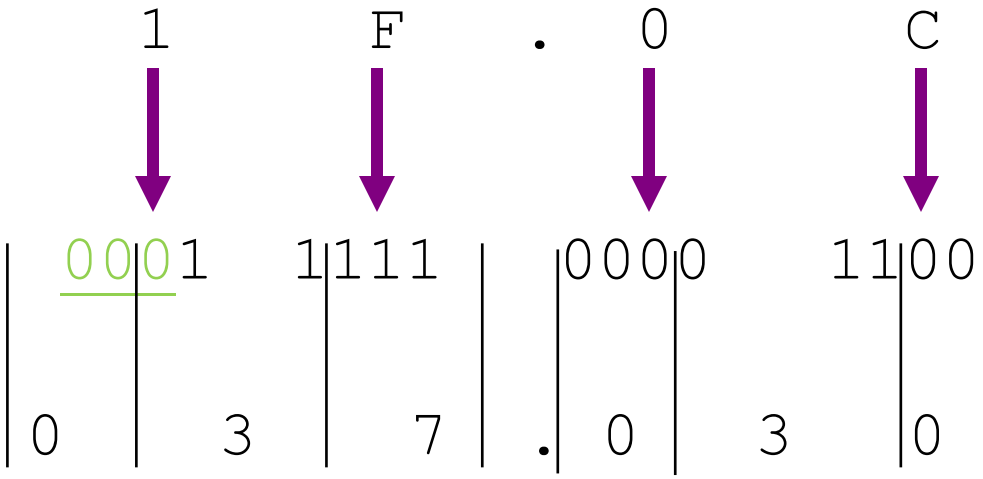
$(10.76)_8 = (08.F8)_{16}$

Hexadecimal to Octal



Hexadecimal to Octal

$1F.0C_{16} = (?)_8$



$(1F.0C)_{16} = (37.03)_8$

Classwork-1

Convert the following numbers

A) $(D.1E)_{16} = (\ ?\ )_{2}$ (show your work)

B) $(10.06)_{8} = (\ ?\ )_{16}$ (show your work)

C) $(1101.0101)_{2} = (\ ?\ )_{10}$ (show your work)

Binary Addition

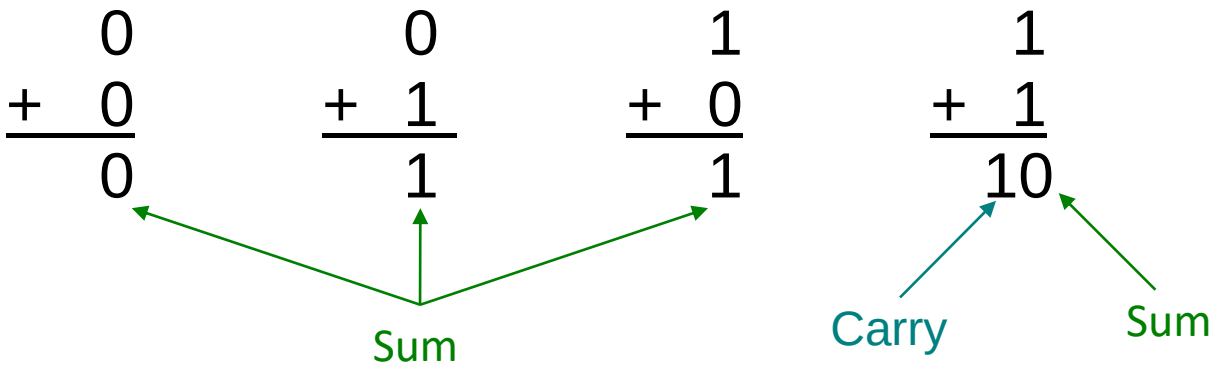
- Two 1-bit values

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

Carry

Binary Addition

- Two 1-bit values



Binary Addition

- Two *n*-bit values

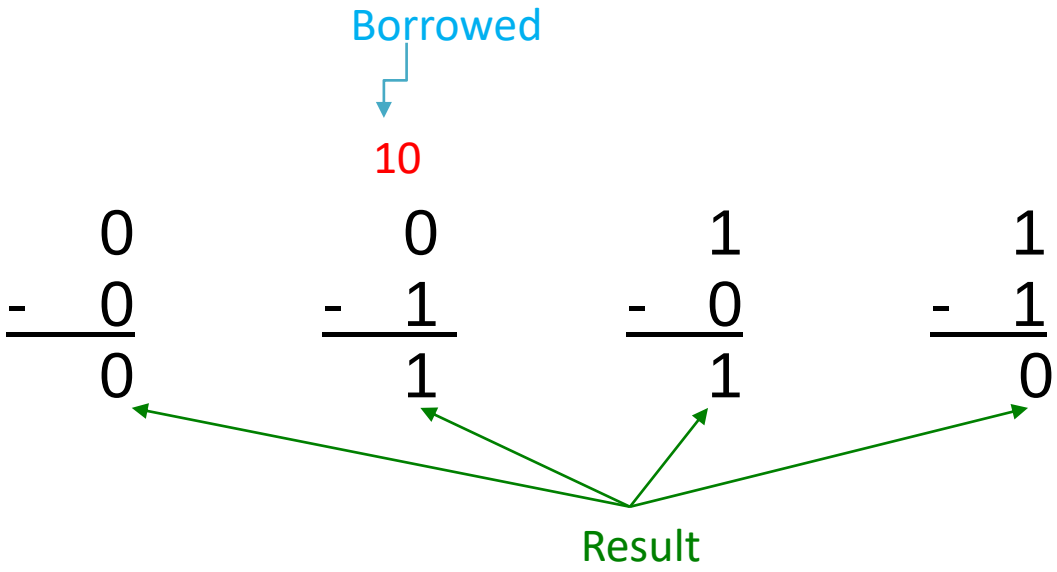
```
  10101        21
+ 11001      + 25
-------      ----
 101110        46
```

```
  01011011
+ 01110010
----------
 11001101
```

```
  10110101
+ 01101100
----------
     ?
```

Binary Subtraction

- Two 1-bit values



Binary Subtraction

- Two n-bit values

```
    1110
-   1001
-------
    0101
```

```
    01110101
-   00110010
-----------
    01000011
```

```
    10110001
-   01101100
-----------
        ?
```

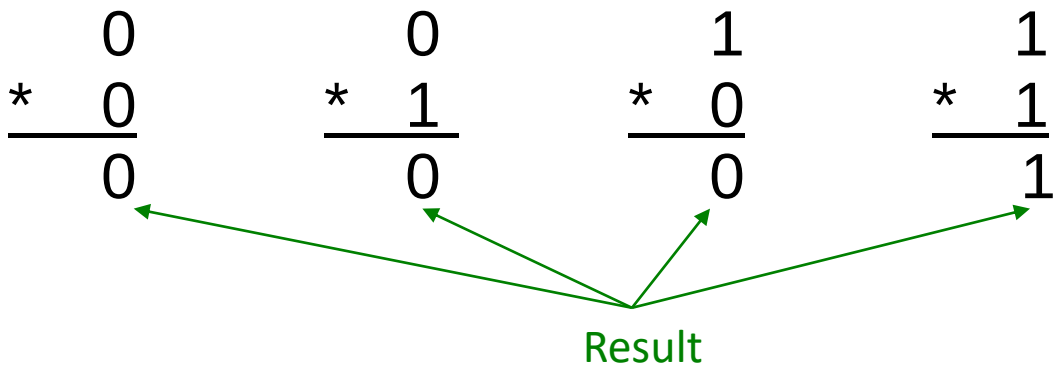
Binary Multiplication

- Binary, two 1-bit values

A	B	A × B
0	0	0
0	1	0
1	0	0
1	1	1

Binary Multiplication

- Binary, two 1-bit values



Binary Multiplication

- Binary, two *n*-bit values

```
   1110
 x 1011
------
   1110
  1110-
 0000--
1110---
--------
10011010
```

```
   1000
 x 0110
------
   0000
  1000-
 1000--
0000---
--------
0110000
```

Binary Multiplication

- Binary, two *n*-bit values

```
  10110001
x 01101101
----------
  10110001
 00000000-
10110001--
10110001---
00000000----
10110001-----
10110001------
00000000-------
----------------
1001011010111101
```

Exercises - 1

Perform the following operations in binary:

A) $(178)_{10} + (82)_{10} = ?$ (show your work)

B) $(138)_{10} - (59)_{10} = ?$ (show your work)

C) $(48)_{10} * (35)_{10} = ?$ (show your work)

Deadline: October 1, 2022 @ 11:59 PM

Homework 2

1) What are octal and hexadecimal number systems are used for?

2) Convert the following numbers, and show your work:

A) $(D7.2E)_{16} = (\ ?\ )_8$

B) $(F16.13)_{16} = (\ ?\ )_2$

C) $(101000.001)_2 = (\ ?\ )_{10}$

D) $(38.04)_{10} = (\ ?\ )_2$

3) Perform the following operations in binary, and show your work:

A) $(61)_8 + (61)_{10}$

B) $(14)_{10} - (7)_{10}$

C) $(73)_8 * (AD)_{16}$

Deadline: October 7, 2022 @ 11:59 PM