CSC103

Computer Programming for Scientists & Engineers

Lesson (1) : Numbering Systems

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

$(10)_{10} = (1010)_2 = (12)_8 = (A)_{16}$

8 4 2 1

4 2 1
0 1 0

$0010 = 2$

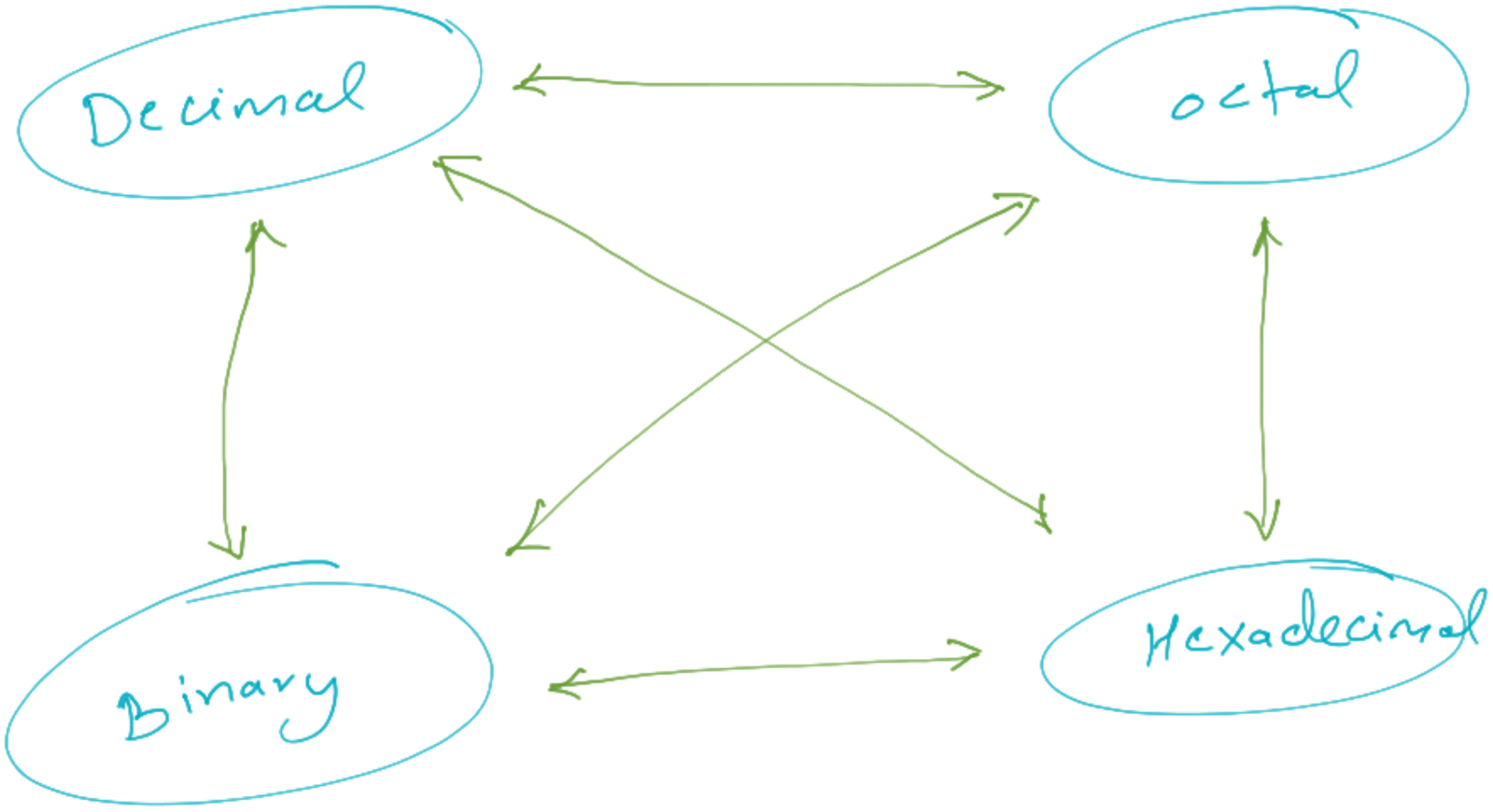
1010 → A

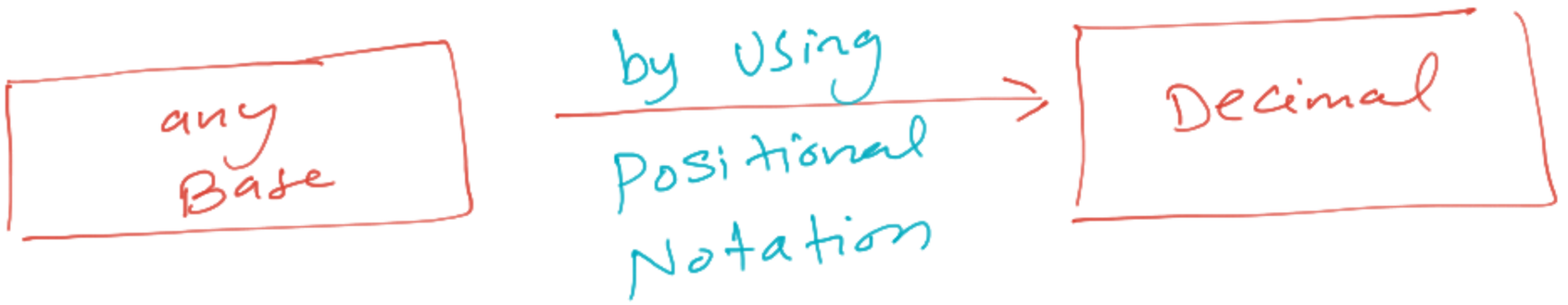
0

9

10	A	13	D
11	B	14	E
12	C	15	F

Conversion Among Bases





Binary to Decimal

$$(1001)_2 \longrightarrow (\quad 9 \quad)_{10}$$

3 2 1 0

$2^3\ 2^2\ 2^1\ 2^0$

$1 \times 2^3 = 8$

$0 \times 2^2 = 0$

$0 \times 2^1 = 0$

$1 \times 2^0 = 1$ +

9

64 32 16 8 4 2 1

$(1001101)_2 = (\quad 77 \quad)_{10}$

- octal to Decimal

$(75)_8 = (\quad 61 \quad)_{10}$

$8^1 \quad 8^0$

$5 \times 8^0 = 5$

$7 \times 8^1 = 56$ +

61

7 5

32 16 8 4 2 1

111 101 =

32 + 16 + 8 + 4 + 1 = 61

Ex : $(724)_8 = (468)_{10}$

Decimal	Binary
0	0000
1	0001
2	0010
3	0011
4	100
5	101
6	110
7	111

8 4 2 1

8 → 1000

$(724)_8$

128 32 16 8 4 2 1

111 010 100

256 64

$256 + 128 + 64 + 16 + 4 = (468)_{10}$

$4 \times 8^0 = 4$

$2 \times 8^1 = 16$

$7 \times 8^2 = 448$

Hexadecimal to Decimal

16^1 16^0

$(A2)_{16} = (162)_{10}$

64 16 8 4 2 1

1010 0010

128 32

$128 + 32 + 2 = 162$

$2 \times 16^0 = 2$

$10 \times 16^1 = 160$ +

162

0

8 4 2 1

9

10 A 1010

11 B

⋮

15 F 1111

3 2 1 0

$(ABC7)_{16} = (\quad)_{10}$

A	10
B	11
C	12
D	13
E	14
F	15

$7 \times 16^0 = 7$

$12 \times 16^1 = 192$

$11 \times 16^2 = 2816$

$10 \times 16^3 = 40960$ +

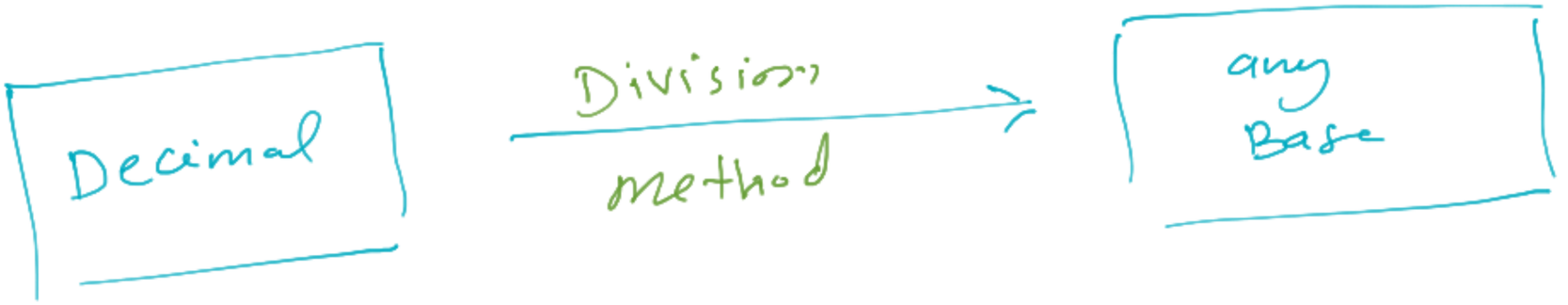
43975

16384 4096 1024 512 256 128 64 32 16 8 4 2 1

1 0 1 0 1 0 1 1 1 1 0 0 0 1 1 1

32768 8192 2048

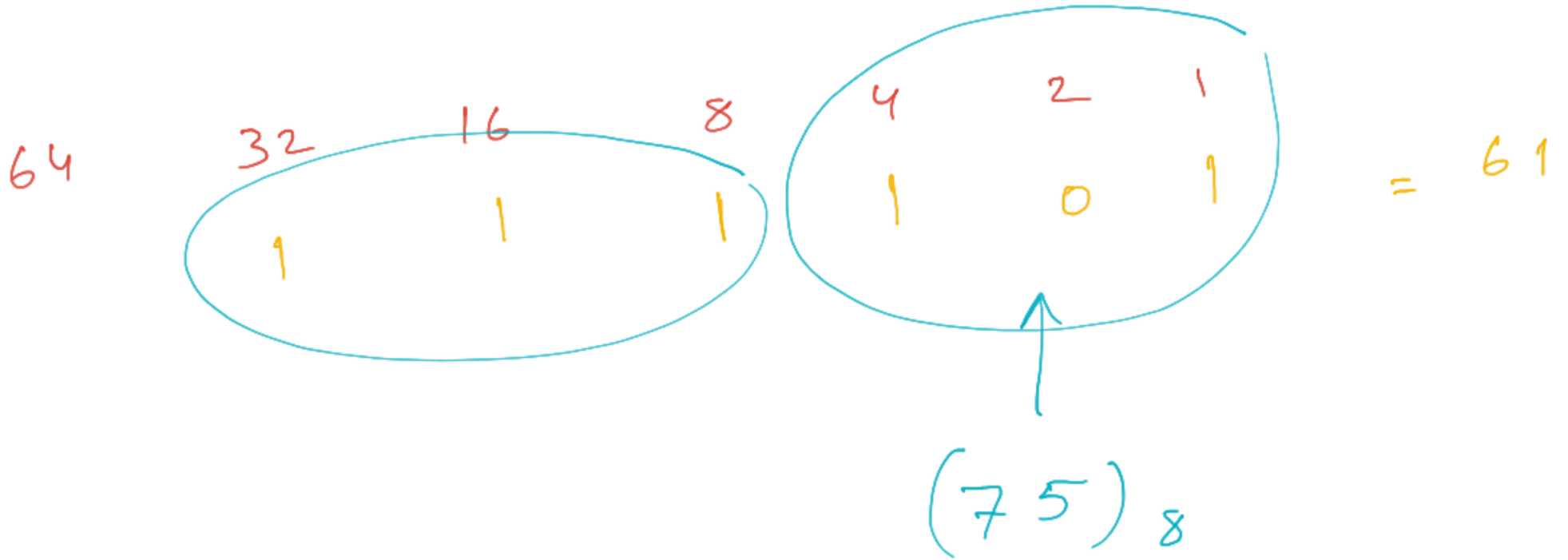
Convert from Decimal to any Base



$(21)_{10} \longrightarrow (10101)_2$

16	8	4	2	1
1	0	1	0	1

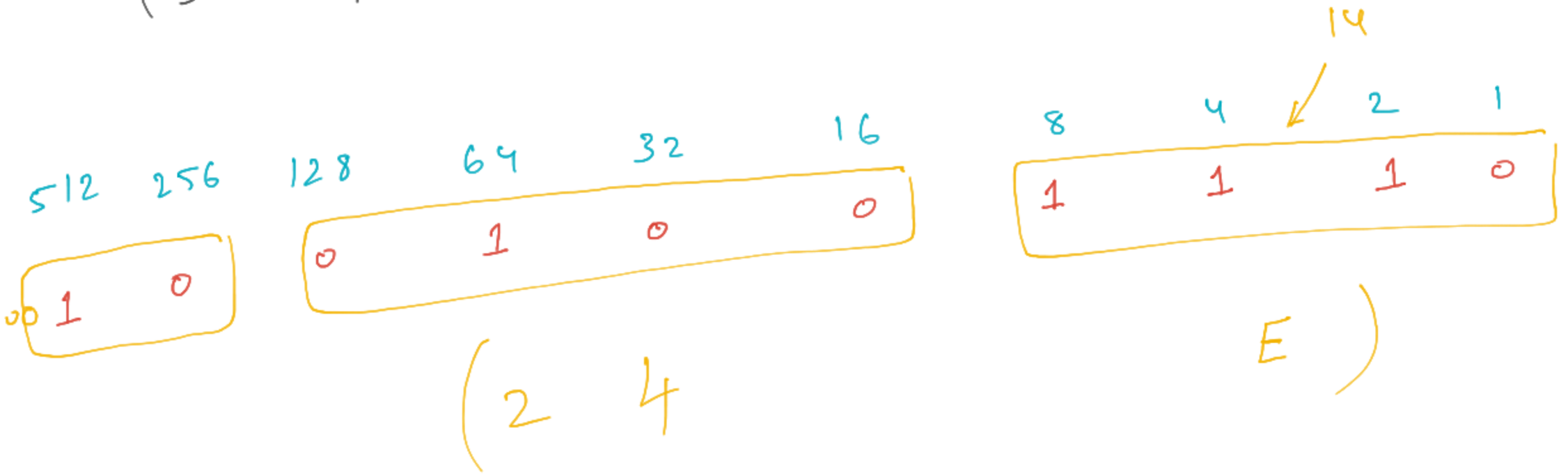
$(61)_{10} = (75)_8$



$= 61$

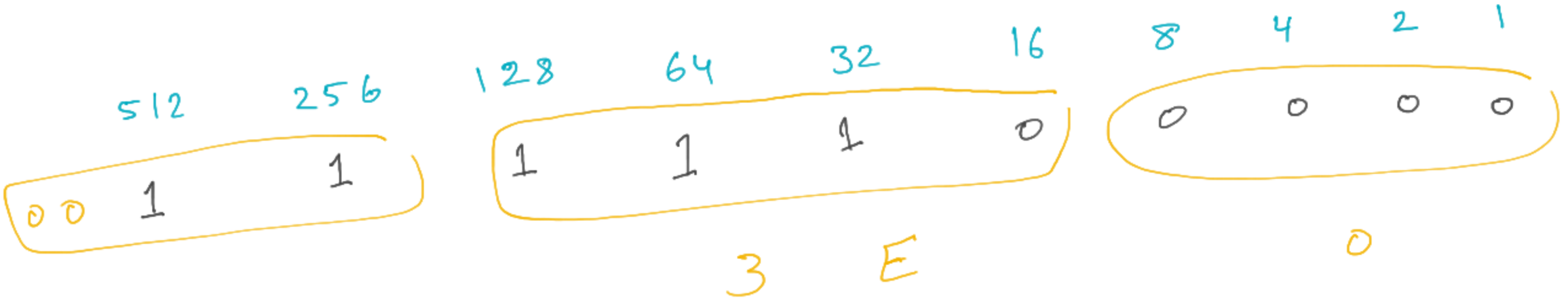
Decimal to Hexadecimal

$(590)_{10} = (24E)_{16}$



1 1 1 0	14	E
0 1 0 0	4	4
0 0 1 0	2	2

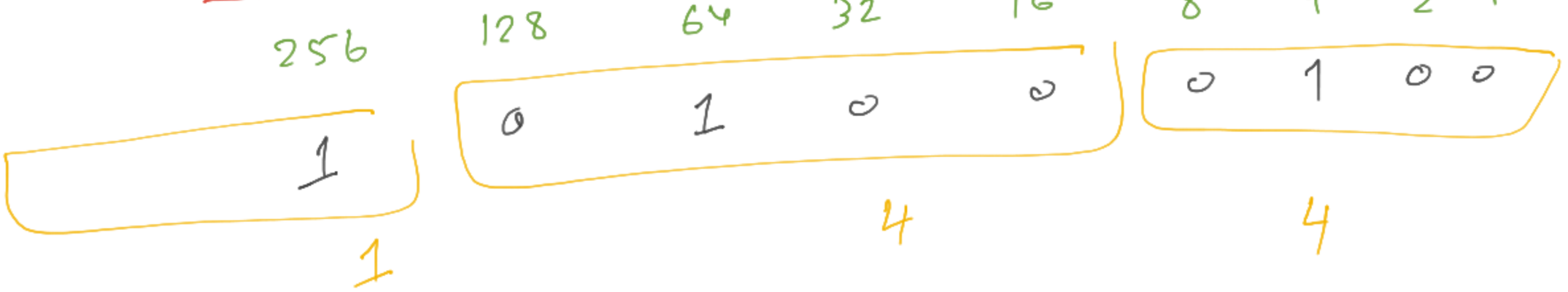
$(992)_{10} = (3E0)_{16}$



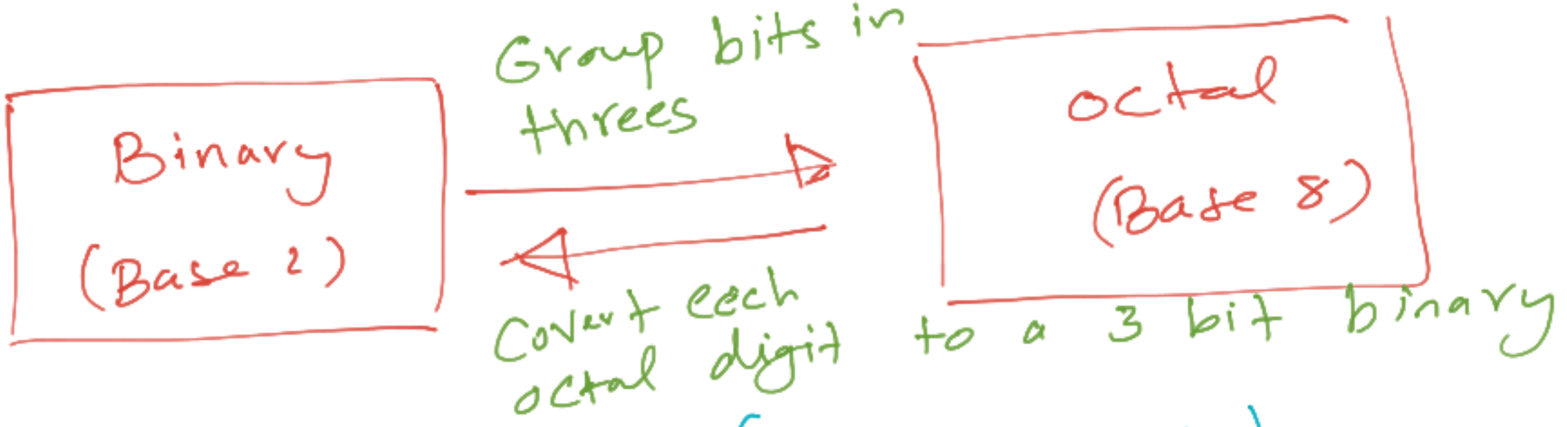
$(324)_{10} = (144)_{16}$

324	16
20	16

Result	Reminder
20	4
1	4
0	1



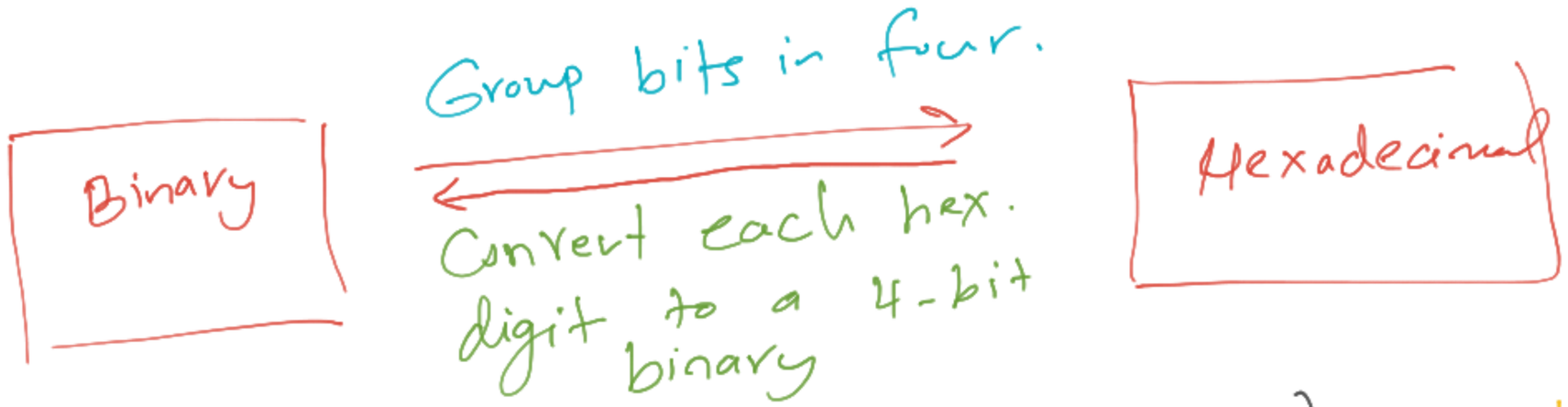
Binary to octal & vice versa



$(735)_8 = (111\ 011\ 101)_2$

$(111\ 011\ 101)_2 = (735)$

Binary to Hexadecimal & vice versa



$(1001101)_2 = (4D)_{16}$

8 4 2 1

4 D

$(A7)_{16} = (1010\ 0111)_2$

A	10
B	11
C	12
D	13
E	14
F	15