

## Number Systems

04/02/24

### Assignment Week-0

1) Convert the below numbers from decimal to

Binary:-

a)  $(103)_{10} \rightarrow (1100111)_2$

$$\begin{array}{r} 2 | 103 \\ 2 | 51 - 1 \\ 2 | 25 - 1 \\ 2 | 12 - 1 \\ 2 | 6 - 0 \\ 2 | 3 - 0 \\ 1 - 1 \end{array}$$

b)  $(999)_{10} \rightarrow (1111100111)_2$

$$\begin{array}{r} 2 | 999 \\ 2 | 499 - 1 \\ 2 | 249 - 1 \\ 2 | 124 - 1 \\ 2 | 62 - 0 \\ 2 | 31 - 0 \\ 2 | 15 - 1 \\ 2 | 7 - 1 \\ 2 | 3 - 1 \\ 1 - 1 \end{array}$$

2) Convert the below numbers from Binary to Decimal:

a)  $(1111\ 0101)_2 \rightarrow (245)_{10}$

$$\begin{array}{r} 64 \\ 32 \\ 16 \\ 8 \\ 4 \\ 2 \\ 1 \\ \hline 128 \\ 64 \\ 32 \\ 16 \\ 8 \\ 4 \\ 2 \\ 1 \\ \hline 1111 \\ 0 \\ 1 \\ 0 \\ 1 \\ 1 \\ 0 \\ 1 \\ \hline \end{array}$$
$$128 + 64 + 32 + 16 + 0 + 4 + 0 + 1 = 245$$

b)  $(1000\ 1111)_2 \rightarrow (143)_{10}$

$$\begin{array}{r} 64 \\ 32 \\ 16 \\ 8 \\ 4 \\ 2 \\ 1 \\ \hline 128 \\ 64 \\ 32 \\ 16 \\ 8 \\ 4 \\ 2 \\ 1 \\ \hline 1000 \\ 1111 \\ 0 \\ 0 \\ 0 \\ 1 \\ 1 \\ 1 \\ 1 \\ \hline \end{array}$$
$$128 + 0 + 0 + 0 + 8 + 4 + 2 + 1 = 143$$

3) What is the octal equivalent of  $(9910)_{10}$ .

$(9910)_{10} \rightarrow (23266)_8$

$$\begin{array}{r} 8 | 9910 \\ 8 | 1238 - 6 \\ 8 | 154 - 6 \\ 8 | 19 - 2 \\ 2 - 3 \end{array}$$

4) convert the following numbers to base indicated  
and vice-versa:

a)  $(1101)_2 \rightarrow (15)_8$

$$\begin{array}{r} 001 \\ \underline{\quad\quad\quad} \\ 1 \end{array} \quad \begin{array}{r} 101 \\ \underline{\quad\quad\quad} \\ 5 \end{array} \rightarrow \text{3-bit equivalent}$$

$$8 \cancel{(15)}_{17} \quad (15)_8 \rightarrow (1101)_2$$

$$\begin{array}{r} 1 \quad 5 \\ \underline{\quad\quad\quad} \\ 1 \quad 101 \end{array}$$

b)  $(76)_8 \rightarrow (62)_{10}$

2048

1024

512

256

128

64

32

16

8

4

2

1

7      6  
8      8

$$56 + 6 = 62$$

$$8 \cancel{62}_{7-6}$$

$$(62)_{10} \rightarrow (76)_8$$

c)  $(1111 \ 1111 \ 1110)_2 \rightarrow (4094)_{10}$

128

64

32

16

8

4

2

1

1111      1111      1110  
2<sup>7</sup> 2<sup>6</sup> 2<sup>5</sup> 2<sup>4</sup> 2<sup>3</sup> 2<sup>2</sup> 2<sup>1</sup>

512 256 128 64 32 / 16      8 4 2 1

1024

2048

4096

18

4095

$$(4094)_{10} \rightarrow (1111 \ 1111 \ 1110)_2$$

$$\begin{array}{r} 4094 \\ \underline{\quad\quad\quad} \\ 2047-0 \end{array}$$

$$\begin{array}{r} 1023-1 \\ \underline{\quad\quad\quad} \end{array}$$

$$\begin{array}{r} 511-1 \\ \underline{\quad\quad\quad} \end{array}$$

$$\begin{array}{r} 255-1 \\ \underline{\quad\quad\quad} \end{array}$$

$$\begin{array}{r} 127-1 \\ \underline{\quad\quad\quad} \end{array}$$

$$\begin{array}{r} 63-1 \\ \underline{\quad\quad\quad} \end{array}$$

$$\begin{array}{r} 31-1 \\ \underline{\quad\quad\quad} \end{array}$$

$$\begin{array}{r} 15-1 \\ \underline{\quad\quad\quad} \end{array}$$

$$\begin{array}{r} 7-1 \\ \underline{\quad\quad\quad} \end{array}$$

$$\begin{array}{r} 3-1 \\ \underline{\quad\quad\quad} \\ 1-1 \end{array}$$

$$d) (0x\text{FOO})_{16} \rightarrow (111100000000)_2 \rightarrow (7400)_8$$

$$\begin{array}{r} F \ 0 \ 0 \\ 15 \ 0 \ 0 \\ \hline 001111 \ 0000 \ 0000 \\ \hline 7 \ 4 \ 0 \ 0 \end{array}$$

$$\begin{array}{r} 7 \ 4 \ 0 \ 0 \\ 111 \ 100 \ 000 \ 000 \\ \hline 15 \ 0 \ 0 \\ F \ 0 \ 0 \end{array}$$

$$(7400)_8 \rightarrow (111100000000)_2 \rightarrow (0xF00)_{16}$$

~~$$e) (0xDACE)_{16} \rightarrow (1101101011001110)_2 \rightarrow (56014)_{10}$$~~

~~$$\begin{array}{r} D \ A \ C \ E \\ 13 \ 10 \ 12 \ 14 \\ \hline 1101 \ 1010 \ 1100 \ 1110 \end{array}$$~~

~~$$\begin{array}{r} 13 \quad 10 \quad 12 \quad 14 \\ 16^3 \quad 16^2 \quad 16^1 \quad 16^0 \\ 512 \quad 256 \quad 16 \quad 1 \\ 4096 + \end{array}$$~~

~~$$851968 + 2560 + 192 + 14 = 854734$$~~

~~$$4096 + 256 + 16 = 4328$$~~

~~$$\begin{array}{r} 4096 \quad 13 \times 4096 = 53148 \\ 256 \quad 10 \times 256 = 2560 \\ 16 \quad 12 \times 16 = 192 \\ 14 \quad 14 \times 1 = 14 \end{array} \quad \left. \begin{array}{l} \\ \\ \\ \end{array} \right\} = 56014$$~~

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b)  $(0x2B)_{16} \rightarrow (053)_8$

2 B

2 11

$$\begin{array}{r} 0010 \\ + 1011 \\ \hline 0 \quad 5 \quad 3 \end{array}$$

$(53)_8 \rightarrow (2B)_{16}$

$$\begin{array}{c} 5 \quad 3 \\ \swarrow \quad \searrow \\ 0101 \quad 0011 \\ \swarrow \quad \searrow \\ 2 \quad 11 \\ \swarrow \quad \searrow \\ 5 \quad 3 \\ \swarrow \quad \searrow \\ 0101 \quad 0011 \end{array}$$

5) Convert the following base 10 number to indicated

a)  $(5610)_{10} \rightarrow (1200210)_3$

$$\begin{array}{r} 3 | 5610 \\ 1870 - 0 \\ 3 | 69 - 0 \\ 3 | 23 - 0 \\ 3 | 7 - 2 \\ 2 - 1 \end{array}$$

b)  $(5610)_{10} \rightarrow (12752)_8$

$$\begin{array}{r} 8 | 5610 \\ 701 - 2 \\ 8 | 87 - 5 \\ 10 - 7 \\ 1 - 2 \end{array}$$

$$\begin{array}{r} 16 | 5610 \\ 350 - 10 - A \\ 21 - 14 - E \\ 1 - S \end{array}$$

c)  $(5610)_{10} \rightarrow (15EA)_{16//}$

$$\begin{array}{r} 16 | 5610 \\ 350 - 10 - A \\ 21 - 14 - E \\ 1 - S \end{array}$$

$$d) \begin{pmatrix} 22110 \\ 10 \end{pmatrix} \rightarrow \begin{pmatrix} 10966 \\ 12 \end{pmatrix}$$

$$\begin{array}{r} 12 \\ 24 \\ 36 \\ 48 \\ 60 \\ 72 \\ 84 \\ 96- \\ 108 \\ 120 \\ 132 \\ 144 \\ 22 \\ 12 \\ 101 \\ 96 \end{array} \quad \begin{array}{r} 12 \left[ \begin{array}{r} 221015130 \\ 18042 - 6 \\ 1533 - 6 \\ 12 - 9 \\ 1 - 0 \end{array} \right] \end{array}$$

16.

$$16 \overline{)10} \\ 0 - 10 \underline{\underline{0}}$$

$$\begin{array}{r} 51 \\ 48 \end{array}$$

$$\begin{array}{r} 30 \\ 24 \\ \hline 6 \end{array}$$

$$\begin{array}{r} 42 \\ 36 \\ \hline 6 \end{array}$$

$$\begin{array}{r} 33 \\ 29 \\ \hline 9 \end{array}$$

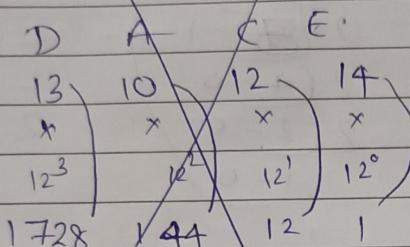
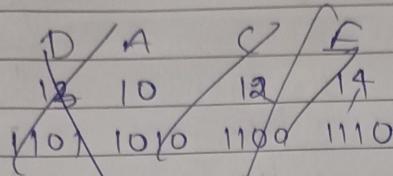
$$\begin{array}{r} 16 \\ \times 16 \\ \hline 256 \\ \times 16 \\ \hline \end{array}$$

$$2.56 \times 16 = \underline{\underline{40.96}} \\ 40.96 \\ 0.96 \times 16$$

$$0.56 \times 16$$

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$$4) \text{ (O}_n \text{DACE)}_{16} \rightarrow (\text{284BA})_{12}$$



$$22464 \quad 1440 \quad 44 \quad 14 = 24062$$

$$284 \quad 11 \quad 10$$

$$\begin{array}{r} 011112 \\ 100012 \\ 12 \\ \hline 56014 \end{array}$$
$$\begin{array}{r} 466710 \\ 384611 \\ \hline 2122 \end{array}$$

D A C E

13	10	12	14
16 <sup>3</sup>	16 <sup>2</sup>	16 <sup>1</sup>	16 <sup>0</sup>
4096	256	16	1

$$12 \quad 56014$$

$$12 \quad 466710$$

$$12 \quad 382811$$

$$12 \quad 3247$$

$$28$$

$$\begin{aligned} 13 \times 4096 &= 53248 \\ 10 \times 256 &= 2566 \\ 12 \times 16 &= 192 \\ 14 \times 1 &= 14 \end{aligned} \quad \left. \begin{array}{l} \\ + \\ + \\ + \end{array} \right\} = (56014)_{10}$$

$$\begin{array}{r} 2841110 \\ (284BA)_{12} \end{array}$$

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6. Binary Addition :

a)  $40 - 101000$

$31 - \underline{11111}$

$\underline{71 - 1000111}$

$71 - 1000111$

$$\begin{array}{r} 2 | 81 \\ 2 | 15 \\ 2 | 7 \\ 2 | 3 \end{array}$$

$$\begin{array}{r} 1-1 \\ 2 | 40 \\ 2 | 20 \\ 2 | 10 \\ 2 | 5 \\ 2 | 2 \\ 1-0 \end{array}$$

b)  $\begin{array}{r} 1100001 \\ + 0101110 \\ \hline 100100001 \end{array}$

$$\begin{array}{r} 2 | 11 \\ 2 | 5 \\ 2 | 2 \\ 1-0 \end{array} \quad \begin{array}{r} 2 | 17 \\ 2 | 8 \\ 2 | 4 \\ 2 | 2 \\ 1-0 \end{array}$$

7) Binary Subtraction :

$$\begin{array}{r} 2 | 6 \\ 2 | 3 \\ 1-1 \end{array}$$

a)  $17 - 10001$

$$\begin{array}{r} 11 - 01011 \\ \hline 6 - 0110 \end{array}$$

b)  $11011010101$

$$\begin{array}{r} - 01000111 \\ \hline 10001010 \end{array}$$

8) Binary multiplication

a) 
$$\begin{array}{r} 20 \\ \times 5 \\ \hline 100 \end{array}$$
    
$$\begin{array}{r} 10100 \\ \times 101 \\ \hline 10100 \end{array}$$

$$\begin{array}{r} 00000x \\ 10100xx \\ \hline 100 - 1100100 \end{array}$$

$$\begin{array}{r} 2 | 5 \\ 2 | 27 \\ 1 - 0 \\ 2 | 5 - 0 \\ 2 | 2 - 1 \\ 1 - 0 \end{array}$$

$$\begin{array}{r} 2 | 100 \\ 2 | 510 - 0 \\ 2 | 25 - 0 \\ 2 | 12 - 1 \\ 2 | 6 - 0 \\ 2 | 3 - 0 \\ 1 - 1 \end{array}$$

b)  $0110\ 0111$

$$\begin{array}{r} 111 \quad \times 101 \\ \hline 101100111 \\ 100000000x \\ 01100111x \\ \hline 10000000011 \end{array}$$

9) Binary division

a)  $\frac{121}{14}$

14

14

28

42

56

70

84

98

112

126

140

14)  $121 \text{ } (\underline{8.642})$

$$\begin{array}{r} 142 \\ \hline 90 \\ 84 \\ \hline 60 \\ 56 \\ \hline 40 \\ 28 \\ \hline 120 \end{array}$$

$$\begin{array}{r} 2 | 121 \\ 2 | 60 - 1 \end{array}$$

$$\begin{array}{r} 2 | 30 - 0 \\ 2 | 15 - 0 \\ 2 | 7 - 1 \\ 2 | 3 - 1 \\ 1 - 1 \end{array}$$

129-1111001

SA - 1110

— / — /

$$\begin{array}{r|rr|r} 14 & 121 & 8 \\ \hline & 112 & \\ & 9 & \end{array}$$

b)

0111 | 1010 0110 10  
- 0111 -  
1010 1010 11  
- 0111 -  
~~1001 0110~~  
0111 |  
1001 0110  
- 0111 -  
1000 0110  
- 0111 -  
~~1010 1010~~  
0111 |  
1000 0111  
- 0111 -  
~~1010 1010~~  
0111 |  
1110 1010  
- 0111 -  
~~1101 0110~~  
0111 |  
1101 0111  
- 0111 -  
~~1010 1010~~  
0111 |  
1010 1010

10) Convert the following floating number

a)  $(34.34)_{10} \rightarrow (100010.01010)_2$

$$\begin{array}{r}
 2) 314 \\
 \hline
 2 | 17 - 0 & 0.34 & 0.68 & 0.36 & 0.72 & 0.48 \\
 2 | 8 - 1 & \times 2 \\
 2 | 4 - 0 & 0.68 & 1.36 & 0.72 & 1.44 & 0.88 \\
 2 | 2 - 0 \\
 1 - 0
 \end{array}$$

b)  $(10.16)_{10} \rightarrow (A.28F...)_{16}$

$$\begin{array}{r}
 16) 10 \\
 \hline
 0 - 10 - A \\
 \hline
 0.16 & 0.56 & 0.96 \\
 \times 16 & \times 16 & \times 16 \\
 \hline
 2.56 & 8.96 & 15.36 \\
 & & F
 \end{array}$$

11)

$$2^{n-1} - 1$$

$$2^{12-1} - 1$$

$$2^{11} - 1$$

$$2048 - 1$$

$$2047$$

In decimal - 2047

In Binary

$$(1100\ 1111\ 1111)$$

$$\begin{array}{r} 2 \\ \hline 2047 \\ -1023 \\ \hline 1023 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 5111 \\ -1 \\ \hline 5110 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 2515 \\ -2 \\ \hline 515 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 127 \\ -1 \\ \hline 126 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 63 \\ -1 \\ \hline 62 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 31 \\ -1 \\ \hline 30 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 25 \\ -1 \\ \hline 24 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 12 \\ -1 \\ \hline 11 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 6 \\ -0 \\ \hline 6 \end{array}$$

$$\begin{array}{r} 2 \\ \hline 3 \\ -0 \\ \hline 3 \end{array}$$

12)

"CODE/TH3 2022".

~~from fed~~

dec-

67 79 68 69 47 84 72 83 32 50 48 50 50

Hex

43 4F 44 45 2F 54 48 53 20 32 30 32 32

13)

$$(ABC7)_{16} \rightarrow (\quad)_2$$

$$\begin{array}{cccc} 10 & 11 & 12 & 7 \\ 1010 & 1011 & 1100 & 0111 \end{array}$$

$$(ABC7)_{16} \rightarrow (1010101111000111)_2$$

14) Bin to dec of fraction nos

a)  $(0.1001)_2 \rightarrow (0.5625)_{10}$

$$0.1001$$

$$\begin{matrix} 1 & 0 & 0 & 1 \\ 2^0 & 2^1 & 2^2 & 2^3 & 2^4 \end{matrix}$$

$$\frac{1}{2} + \frac{1}{2^4}$$

$$0.5 + \frac{1}{16} = 0.5 + 0.0625 = 0.5625$$

b)  $(1.1111)_2 \rightarrow (1.9375)_{10}$

$$1.1111$$

$$\begin{matrix} 1 & 1 & 1 & 1 & 1 \\ 2^0 & 2^1 & 2^2 & 2^3 & 2^4 \end{matrix}$$

$$1. \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \frac{1}{16}$$

$$1. 0.5 + 0.25 + 0.125 + 0.0625 = 1.9375$$

F1  
1  
0

— / —

### 15) Binary expansion

a)  $11/17 = (0.647)_2 \rightarrow (0.101001)_10$

$$\begin{array}{r} 0.647 \\ \times 2 \\ \hline 1.294 \end{array} \quad \begin{array}{r} 0.588 \\ \times 2 \\ \hline 1.176 \end{array} \quad \begin{array}{r} 0.352 \\ \times 2 \\ \hline 0.704 \end{array}$$
$$\begin{array}{r} 0.294 \\ \times 2 \\ \hline 0.588 \end{array} \quad \begin{array}{r} 0.176 \\ \times 2 \\ \hline 0.352 \end{array}$$

b)  $3/11 = (0.2727)_2 \rightarrow (0.01100)_10$

$$\begin{array}{r} 0.2727 \\ \times 2 \\ \hline 0.5454 \end{array} \quad \begin{array}{r} 0.0908 \\ \times 2 \\ \hline 0.1816 \end{array} \quad \begin{array}{r} 0.3633 \\ \times 2 \\ \hline 0.7264 \end{array}$$
~~$$\begin{array}{r} 0.0908 \\ \times 2 \\ \hline 0.1816 \end{array}$$~~  
~~$$\begin{array}{r} 0.1816 \\ \times 2 \\ \hline 0.3632 \end{array}$$~~

### 16. Bonk 2 - Decode

4D 41 54 48 40 ..... 66 75 6E

→ "The quick brown fox jumps over the 13 dogs"

→ "MATH@....fun" (or) with morse code  
"MATH@ISfun"