

Leonardo

Fusion

1946995

August 23rd

Labs 1

Subash Thakde

Introduction to Number Systems

a) Binary: 11010_2

$16 \ 8 \ 4 \ 2 \ 1$

Decimal (Base 10): $\begin{array}{r} 2^4 2^3 2^2 2^1 2^0 \\ \hline 1 \ 1 \ 0 \ 1 \ 0 \end{array}$

$$(16 \times 1) + (8 \times 1) + (4 \times 0) + (2 \times 1) + (1 \times 0) = \boxed{26_{10}}$$

b) Binary: 10010110_2

$128 \ 64 \ 32 \ 16 \ 8 \ 4 \ 2 \ 1$

Decimal (Base 10): $\begin{array}{r} 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0 \\ \hline 1 \ 0 \ 0 \ 1 \ 0 \ 1 \ 1 \ 0 \end{array}$

$$(128 \times 1) + (64 \times 0) + (32 \times 0) + (16 \times 1) + (8 \times 0) + (4 \times 1) + (2 \times 1) + (1 \times 0) = \boxed{150_{10}}$$

c) Binary: 101100110111_2

$2^{12} 2^{11} 2^{10} 2^9 2^8 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0$

Decimal (Base 10): $\begin{array}{r} 1 \ 0 \ 1 \ 1 \ 0 \ 0 \ 1 \ 1 \ 0 \ 1 \ 1 \ 1 \end{array}$

$$\begin{aligned} & (2^{12} \times 1) + (2^{11} \times 0) + (2^{10} \times 0) + (2^9 \times 1) + (2^8 \times 0) + \\ & (2^7 \times 0) + (2^6 \times 1) + (2^5 \times 1) + (2^4 \times 0) + (2^3 \times 1) + (2^2 \times 0) + (2^1 \times 1) + (2^0 \times 1) \\ & = \boxed{2891_{10}} \end{aligned}$$

Leonardo Fibonacci

2a) Octal values (Base 8)

512	4	8
8	64	1
3	64	8
2	64	64
1	64	512

Decimal :

e) Binary: 11110111_2

128	64	32	16	8	4	2	1
2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
1	1	1	1	0	1	1	1

Decimal (Base 10):

$$(128 \times 1) + (64 \times 1) + (32 \times 1) + (16 \times 1) + (8 \times 0) + (4 \times 1) + \\ (2 \times 1) + (1 \times 1) = \boxed{267_{10}} \quad \text{247}$$

d) Binary: 11100111011_2

512	256	128	64	32	16	8	4	2	1	
2 ⁹	2 ⁸	2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰	
1	1	1	0	1	1	1	1	0	1	1

Decimal (Base 10):

$$(512 \times 1) + (256 \times 1) + (128 \times 1) + (64 \times 0) + (32 \times 1) + \\ (16 \times 1) + (8 \times 1) + (4 \times 0) + (2 \times 1) + (1 \times 1) \\ = \boxed{955_{10}}$$

f) Binary: 1010101010_2

128	64	32	16	8	4	2	1
2 ⁷	2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
1	0	1	0	1	0	1	0

Decimal (Base 10):

$$(128 \times 1) + (64 \times 0) + (32 \times 1) + (16 \times 0) + (8 \times 1) + \\ (4 \times 0) + (2 \times 1) + (1 \times 0) = \boxed{170_{10}}$$

(Question 2 is continued)
on next paper

Leonardo Fesser

August 23rd

a) Octal values (Base 8): 5746_8

Decimal:

$$\begin{array}{r} 512 \ 64 \ 8 \ 1 \\ 8^3 \ 8^2 \ 8^1 \ 8^0 \\ \hline 5 \ 7 \ 4 \ 6 \end{array}$$

$$(1 \times 6) + (8 \times 4) + (64 \times 7) + (512 \times 5) = 3'046_{10} \quad \checkmark$$

b) Octal values (Base 8): 201_8

Decimal:

$$\begin{array}{r} 64 \ 8 \ 1 \\ 8^2 \ 8^1 \ 8^0 \\ \hline 2 \ 0 \ 1 \end{array}$$

$$(1 \times 1) + (8 \times 0) + (64 \times 2) = 129_{10} \quad \checkmark$$

c) Octal values (Base 8): 54_8

Decimal:

$$\begin{array}{r} 8 \ 1 \\ 8^1 \ 8^0 \\ \hline 5 \ 4 \end{array}$$

$$(8 \times 5) + (1 \times 4) = 49_{10} \quad 49$$

d) Octal values (Base 8): 01234567_8

Decimal:

$$\begin{array}{r} 2'047'152 \ 64512 \ 64 \ 8 \ 1 \\ 8^7 \ 8^6 \ 8^5 \ 8^4 \ 8^3 \ 8^2 \ 8^1 \ 8^0 \\ \hline 0 \ 1 \ 2 \ 3 \ 4 \ 5 \ 6 \ 7 \end{array}$$

$$(2'047'152 \times 0) + (262'144 \times 1) + (32'768 \times 2) + (4'096 \times 3) + (912 \times 4) + (64 \times 5) + (8 \times 6) + (1 \times 7) = 342'391_{10}$$

d) Decimal

e) Octal values (Base 8): 755₈

$$\begin{array}{r} \underline{\quad\quad\quad} \\ 64 \quad 8 \quad 1 \\ 8 \quad 8 \quad 8 \\ \hline \boxed{2 \quad 5 \quad 5} \end{array}$$

$$(64 \times 2) + (8 \times 5) + (1 \times 5) = 178$$

3a) Decimal number: 57₁₀

Binaries

111001₂

Binary (work)

$$\begin{array}{r} 28 \\ \hline 2) 57 \\ -4 \\ \hline 17 \\ -16 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 14 \\ 25 \overline{)26} \\ -2 \\ \hline 08 \\ -08 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 67 \\ 25 \overline{)14} \\ -0 \\ \hline 14 \\ -14 \\ \hline 0 \end{array}$$

$$\begin{array}{r} \overset{3}{2} \overline{)5} \\ -4 \\ \hline 1 \end{array}$$

$$\begin{array}{r} \overline{253} \\ -2 \\ \hline 1 \end{array}$$

b) Decimal number: 13_{10}

Binary:

1101₂

Binary (work)

$$\begin{array}{r} 6 \\ 2) 13 \\ -12 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 3 \\ 2 \overline{) 6 } \\ -6 \\ \hline 0 \end{array}$$

$$\begin{array}{r} 1 \\ 2 \overline{) 3} \\ -2 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 6 \\ 2) \overline{1} \\ -0 \\ \hline 1 \end{array}$$

c) Decimal number: 179_{10}

Binary

10010011_b

Binary :

$$\begin{array}{r} 89 \\ 2) \overline{179} \\ -16 \\ \hline 19 \\ -18 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 22 \\ \hline 2544 \\ -4 \quad \quad \\ \hline 0 \end{array}$$

$$\begin{array}{r} 11 \\ 23 \overline{) 22} \\ -2 \\ \hline 02 \end{array}$$

$$\begin{array}{r} 5 \\ 2 \overline{) 11 } \\ -10 \\ \hline 1 \end{array}$$

$$\begin{array}{r} 254 \\ \times 1 \\ \hline 254 \end{array}$$

d) Decimal number: 29_{10}

Binary: $\boxed{11101_2}$

Binary:
(work)

$$\begin{array}{r} 14 \\ 2 \overline{) 29} \\ -28 \\ \hline \textcircled{1} \end{array} \quad \begin{array}{r} 7 \\ 2 \overline{) 14} \\ -14 \\ \hline \textcircled{0} \end{array} \quad \begin{array}{r} 3 \\ 2 \overline{) 7} \\ -6 \\ \hline \textcircled{1} \end{array} \quad \begin{array}{r} 1 \\ 2 \overline{) 3} \\ -2 \\ \hline \textcircled{1} \end{array} \quad \begin{array}{r} 0 \\ 2 \overline{) 1} \\ -0 \\ \hline \textcircled{1} \end{array}$$

e) Decimal number: 2542_{10}

Binary: 100111001110

Binary:
(work)

$$\begin{array}{r} 1'271 \\ 2 \overline{) 2542} \\ -2542 \\ \hline \textcircled{0} \end{array} \quad \begin{array}{r} 635 \\ 2 \overline{) 1271} \\ -12 \\ \hline \textcircled{0}71 \end{array} \quad \begin{array}{r} 312 \\ 2 \overline{) 635} \\ -6 \\ \hline \textcircled{0}35 \end{array} \quad \begin{array}{r} 156 \\ 2 \overline{) 312} \\ -30 \\ \hline \textcircled{1}2 \end{array}$$
$$\begin{array}{r} -70 \\ \hline \textcircled{1} \end{array} \quad \begin{array}{r} -2 \\ \hline \textcircled{1}5 \end{array} \quad \begin{array}{r} -12 \\ \hline \textcircled{0}4 \end{array}$$
$$\begin{array}{r} 73 \\ 2 \overline{) 156} \\ -14 \\ \hline \textcircled{1}6 \end{array} \quad \begin{array}{r} 2 \\ 2 \overline{) 73} \\ -4 \\ \hline \textcircled{0}33 \end{array}$$

f) Decimal number: 511_{10}

Binary: $\boxed{11111111_2}$

Binary:
(work)

$$\begin{array}{r} 255 \\ 2 \overline{) 511} \\ -50 \\ \hline \textcircled{1}1 \end{array} \quad \begin{array}{r} 127 \\ 2 \overline{) 255} \\ -255 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} 63 \\ 2 \overline{) 127} \\ -127 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} 31 \\ 2 \overline{) 63} \\ -63 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} 15 \\ 2 \overline{) 31} \\ -30 \\ \hline \textcircled{1}1 \end{array} \quad \begin{array}{r} 07 \\ 2 \overline{) 15} \\ -14 \\ \hline \textcircled{0}1 \end{array}$$
$$\begin{array}{r} 3 \\ 2 \overline{) 7} \\ -6 \\ \hline \textcircled{1} \end{array} \quad \begin{array}{r} 1 \\ 2 \overline{) 3} \\ -2 \\ \hline \textcircled{0}1 \end{array} \quad \begin{array}{r} 11 \\ 2 \overline{) 10} \\ -10 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} 55 \\ 2 \overline{) 54} \\ -54 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} 7 \\ 2 \overline{) 6} \\ -6 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} 3 \\ 2 \overline{) 2} \\ -2 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} 11 \\ 2 \overline{) 10} \\ -10 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} 15 \\ 2 \overline{) 14} \\ -14 \\ \hline \textcircled{0}0 \end{array}$$
$$\begin{array}{r} -50 \\ \hline \textcircled{1} \end{array} \quad \begin{array}{r} -2 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} -12 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} -6 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} -2 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} -10 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} -14 \\ \hline \textcircled{0}0 \end{array}$$
$$\begin{array}{r} 5 \\ \hline \textcircled{0}0 \end{array} \quad \begin{array}{r} 0 \\ \hline \textcircled{0}0 \end{array}$$

4a) Binary: 1 1 1 1 1 1 1

Decimal (Base 10):

128	64	32	16	8	4	2	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	1	1	1	1	1	1

$$(128 \times 1) + (64 \times 1) + (32 \times 1) + (16 \times 1) + (8 \times 1) + \\ (4 \times 1) + (2 \times 1) + (1 \times 1) = \boxed{255_{10}}$$

b) Binary: 1 1 1 1 1 1 1 1 1 1 1 1 1

Decimal (Base 10):

32'768	16'384	8'192	4'096	2'048	1'024	512	256	128	64	32	16	8	4	2	1
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

$$(32'768 \times 1) + (16'384 \times 1) + (8'192 \times 1) + (4'096 \times 1) + (2'048 \times 1) + \\ (1'024 \times 1) + (512 \times 1) + (256 \times 1) + (128 \times 1) + (64 \times 1) + (32 \times 1) + \\ (16 \times 1) + (8 \times 1) + (4 \times 1) + (2 \times 1) + (1 \times 1) = \boxed{65'535_{10}}$$