Daffodil International University

ASSIGNMENT

Topic: Assignment on Number System Conversion

Course Title: Computer Fundamentals
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Computer Fundamentals

CSE112

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Section: 65-K

1. Binary to Decimal

i) $10101_2 = 1\times2^4 + 0\times2^3 + 1\times2^2 + 0\times2^1 + 1\times2^0$

$= 16+0+4+0+1$

$= 21_{10}$

ii) $11011_2 = 1\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0$

$= 16+8+0+2+1$

$= 27_{10}$

iii) $110101.1101 = 1\times2^5 + 1\times2^4 + 0\times2^3 + 1\times2^2 + 0\times2^1 + 1\times2^0 +$
$1\times2^{-1} + 1\times2^{-2} + 0\times2^{-3} + 1\times2^{-4}$

$= 32+16+0+4+0+1+0.5+0.25+0+0.0625$

$= 53.8125_{10}$

2. Binary to Octal

i) $110110_2 = (?)_8$

3 digit binary, $\frac{110}{6}$ $\frac{110}{6}$

$\therefore 110110_2 = 66_8$

ii) $1101010_2 = ?_8$

3 digit binary $\frac{001}{1}$ $\frac{101}{5}$ $\frac{010}{2}$

$\therefore 1101010_2 = 152_8$

iii) $11001.0011_2 = ?_8$

3 digit binary $\frac{011}{3}$ $\frac{001}{1}$. $\frac{001}{1}$ $\frac{100}{4}$

$\therefore 11001.0011_2 = 31.14_8$

3. <u>Binary to Hexadecimal</u>

i) $111101_2 = ?_{16}$

4 digit binary $\frac{0011}{3}$ $\frac{1101}{13\,(D)}$

$\therefore 111101_2 = 3D_{16}$

ii) $1101001_2 = ?_{16}$

4 digit binary $\frac{0110}{6}$ $\frac{1001}{9}$

$\therefore 1101001_2 = 69_{16}$

iii) $10101101.1101_2 = ?_{16}$

4 digit binary

1010	1101.	1101
10(A)	13(D)	13(D)

$\therefore 10101101.1101_2 = AD.D_{16}$

4. Octal to Binary

i) $64.27_8 = ?_2$

Converting each octal digit to binary

$6 \rightarrow 110$
$4 \rightarrow 100$
$2 \rightarrow 010$
$7 \rightarrow 111$

$\therefore 64.27_8 = 110100.010111_2$

ii) $345.12_8 = ?_2$

$3 \rightarrow 011$
$4 \rightarrow 100$
$5 \rightarrow 101$
$1 \rightarrow 001$
$2 \rightarrow 010$

$\therefore 345.12_8 = 011100101.001010$

iii) $777_8 = ?_{16}$

$7 \rightarrow 111$

$\therefore 777_8 = 111111111_2$

5. Octal to Decimal

i) $64.38_8 = ?_{10}$

$$6 \times 8^1 + 4 \times 8^0 + 3 \times 8^{-1} + 8 \times 8^{-2} = 48 + 4 + 0.375 + 0.125$$
$$= 52.5$$

$\therefore 64.38_8 = 52.5_{10}$

ii) $312.45_8 = ?_{10}$

$$3 \times 8^2 + 1 \times 8^1 + 2 \times 8^0 + 4 \times 8^{-1} + 5 \times 8^{-2} = 192 + 8 + 2 + 0.5 + 0.078$$
$$= 202.578$$

$\therefore 312.45_8 = 202.578_{10}$

iii) $37.72_8 = ?_{10}$

$$3 \times 8^1 + 7 \times 8^0 + 7 \times 8^{-1} + 2 \times 8^{-2} = 24 + 7 + 0.875 + 0.03125$$
$$= 31.90625$$

$\therefore 37.72_8 = 31.90625_{10}$

6. Octal to Hexadecimal

i) $152.34_8 = ?_{16}$

$$1\ 5\ 2\ .\ 3\ 4$$

3 digit binary → 001 101 010 011 100

4 digit binary → $\frac{0110}{6}$ $\frac{1010}{10(A)}$. $\frac{0111}{7}$

$\therefore 152.34_8 = 6A.7_{16}$

ii) $27.21_8 = ?_{16}$

$$2\ 7\ .\ 2\ 1$$

3 digit binary → 010 111 010 001

4 digit binary $\frac{0001}{1}$ $\frac{0111}{7}$. $\frac{0100}{4}$ $\frac{0100}{4}$

$\therefore 27.21_8 = 17.44_{16}$

iii) $217.77_8 = ?_{16}$

$$2\ 1\ 7\ .\ 7\ 7$$

3 digit binary → 010 001 111 111 111

4 digit binary $\frac{1000}{8}$ $\frac{1111}{15(F)}$ $\frac{1111}{15(F)}$ $\frac{1100}{12(C)}$

$\therefore 217.77_8 = 8F.FC_{16}$

7. Decimal to Binary

i) $115_{10} = ?_2$

$$
\begin{array}{r|l}
2 & 115 \\
2 & 57 - 1 \\
2 & 28 - 1 \\
2 & 14 - 0 \\
2 & 7 - 0 \\
2 & 3 - 1 \\
2 & 1 - 1 \\
 & 0 - 1
\end{array}
$$

$\therefore\ 115_{10} = 1110011_2$

ii) $227_{10} = ?_2$

$$
\begin{array}{r|l}
2 & 227 \\
2 & 113 - 1 \\
2 & 56 - 1 \\
2 & 28 - 0 \\
2 & 14 - 0 \\
2 & 7 - 0 \\
2 & 3 - 1 \\
2 & 1 - 1 \\
 & 0 - 1
\end{array}
$$

$\therefore\ 227_{10} = 11100011_2$

iii) $69.25_{10} = ?_2$

$$
\begin{array}{r|l}
2 & 69 \\
2 & 34 - 1 \\
2 & 17 - 0 \\
2 & 8 - 1 \\
2 & 4 - 0 \\
2 & 2 - 0 \\
2 & 1 - 0 \\
 & 0 - 1
\end{array}
$$

$69_{10} = 1000101_2$

$$
\begin{array}{r}
0.25 \\
\times 2 \\ \hline
0.5 \\
\times 2 \\ \hline
1.0
\end{array}
$$

$\therefore\ 0.25_{10} = 01_2$

$\therefore\ 69.25_{10} = 1000101.01_2$

8. Decimal to Octal

i) $93_{10} = ?_8$

$$\begin{array}{r|l} 8 & 93 \\ \hline 8 & 11 - 5 \\ \hline 8 & 1 - 3 \\ \hline & 0 - 1 \end{array}$$

$\therefore 93_{10} = 135_8$

ii) $824_{10} = ?_8$

$$\begin{array}{r|l} 8 & 824 \\ \hline 8 & 103 - 0 \\ \hline 8 & 12 - 7 \\ \hline 8 & 1 - 4 \\ \hline & 0 - 1 \end{array}$$

$\therefore 824_{10} = 1470_8$

iii) $245.7_{10} = ?_8$

$$\begin{array}{r|l} 8 & 245 \\ \hline 8 & 30 - 5 \\ \hline 8 & 3 - 6 \\ \hline & 0 - 3 \end{array}$$

$\therefore 245_{10} = 365_8$

$$\begin{array}{r|l} & 0.7 \\ & \times 8 \\ \hline 5 & .6 \\ & \times 8 \\ \hline 4 & .8 \\ \hline & \times 8 \\ 6 & .4 \\ \hline & \times 8 \\ 3 & .2 \\ \hline & \times 8 \\ 1 & .6 \\ \hline & \times 8 \\ 4 & .8 \\ \hline & \times 8 \\ 6 & .4 \\ \hline \end{array}$$

$\therefore 245.7_{10} = 365.5463146\ldots_8$

9. Decimal to Hexadecimal

i) $227_{10} = ?_{16}$

$$\begin{array}{r|l} 16 & 227 \\ \hline 16 & 14 - 3 \\ \hline & 0 - 14(E) \end{array}$$

$\therefore 227_{10} = E3_{16}$

ii) $7865_{10} = ?_{16}$

$$\begin{array}{r|l} 16 & 7865 \\ \hline 16 & 491 - 9 \\ \hline 16 & 30 - 11\,(B) \\ \hline 16 & 1 - 14\,(E) \\ \hline & 0 - 1 \end{array}$$

$\therefore 7865_{10} = 1EB9_{16}$

iii) $2446.41_{10} = ?_{16}$

$$\begin{array}{r|l} 16 & 2446 \\ \hline 16 & 152 - 14\,(E) \\ \hline 16 & 9 - 8 \\ \hline & 0 - 9 \end{array}$$

$\therefore 2446_{10} = 98E_{16}$

$$\begin{array}{r|l} & 0.41 \\ & \times 16 \\ \hline 6 & .56 \\ & \times 16 \\ \hline 8 & .96 \\ & \times 16 \\ \hline (F)\ 15 & .36 \\ & \times 16 \\ \hline 5 & .76 \\ & \times 16 \\ \hline (C)\ 12 & .16 \\ & \times 16 \\ \hline 2 & .56 \\ & \times 16 \\ \hline 8 & .96 \end{array}$$

$0.41_{10} = 68F5C28\ldots_{16}$

$\therefore 2446.41_{10} = 98E.68F5C28\ldots_{16}$

10. Hexadecimal to Binary

i) $9E5_{16} = ?_2$

Converting each hexadecimal digit to 4 digit binary -

9	E	5
1001	1110	0101

$\therefore 9E5_{16} = 100111100101_2$

ii) $17A3D_{16} = ?_2$

Converting each hexadecimal digit to 4 digit binary -

1	7	A	3	D
0001	0111	1010	0011	1101

$\therefore 17A3D_{16} = 00010111101000111101_2$

iii) $243C.9FA_{16} = ?_2$

Converting each hexadecimal digit to 4 digit binary -

2	4	3	C.	9	F	A
0010	0100	0011	1100.	1001	1111	1010

$\therefore 243C.9FA_{16} = 10010000111100.100111111010_2$

11. <u>Hexadecimal to Octal</u>

i) $243B_{16} = ?_8$

	2	4	3	B	
4 digit binary →	0010	0100	0011	1011	
3 digit binary →	010	010	000	111	011
Octal →	2	2	0	7	3

$\therefore 243B_{16} = 22073_8$

ii) $7CE9B_{16} = ?_8$

	7	C	E	9	B		
4 digit binary →	0111	1100	1110	1001	1011		
3 digit binary →	001	111	100	111	010	011	011
Octal →	1	7	4	7	2	3	3

$\therefore 7CE9B_{16} = 1747233_8$

iii) $259A.3CD_{16} = ?_8$

	2	5	9	A	.	3	C	D	
4 digit binary →	0010	0101	1001	1010	.	0011	1100	1101	
3 digit binary →	010	010	110	011	010 .	001	111	001	101
Octal →	2	2	6	3	2 .	1	7	1	5

$\therefore 259A.3CD_{16} = 22632.1715_8$

12. Hexadecimal to Decimal

i) $844EA_{16} = ?_{10}$

$$844EA_{16} = 8\times16^4 + 4\times16^3 + 4\times16^2 + 14\times16^1 + 10\times16^0$$
$$= 541930_{10}$$

$\therefore 844EA_{16} = 541930_{10}$

ii) $125C2D_{16} = ?_{10}$

$$125C2D_{16} = 1\times16^5 + 2\times16^4 + 5\times16^3 + 12\times16^2 + 2\times16^1 + 13\times16^0$$
$$= 1203245_{10}$$

$\therefore 125C2D_{16} = 1203245_{10}$

iii) $2BC2.9AF_{16} = ?_{10}$

$$2BC2.9AF_{16} = 2\times16^3 + 11\times16^2 + 12\times16^1 + 2\times16^0 + 9\times16^{-1} + 10\times16^{-2} + 15\times16^{-3}$$
$$= 11202.605224609375_{10}$$

⇒ Complementary Number System

i) Subtract 0111000_2 from 1011100_2 using complementary method.

Solution:

1's Complement of $0111000_2 = 1000111_2$

Now,

$$
\begin{array}{r}
1011100 \\
+\ 1000111 \\
\hline
10100011 \\
\hookrightarrow 1 \text{ (Adding the carry of 1)} \\
\hline
0100100
\end{array}
$$

$\therefore$ Result $= 0100100_2 = 36_{10}$

ii) Subtract 62_{10} from 94_{10} using complementary method.

Solution:

Step 1: Complement of $62_{10} = 10^2 - 1 - 62 = 99 - 62 = 37_{10}$

Step 2: $94 + 37$ (complement of 62)

$= 131$ (1 carry)

Step 3: $31 + 1$ (Adding carry 1 to sum)

$= 32$

$\therefore$ Result $= 32_{10}$

iii) Subtract 17_8 from 35_8 using complementary method.

Solution:

$17_8 = 0001111_2$

$35_8 = 0011101_2$

Complement of $0001111_2 = 1110000_2$

Now,

$$
\begin{array}{r}
0011101 \\
+\ 1110000 \\
\hline
1\,0001101 \\
\rightarrow 1 \\
\hline
001110
\end{array}
$$

(Adding the carry 1)

$\therefore$ Resut $= 001110_2 = 16_8$

⇒ Addition/Subtraction using 2's Complement Method

i) Subtract 32_{10} from 50_{10}

$50_{10} = 00110010_2$

$32_{10} = 00100000_2$

2's complement of 00100000_2 = 11011111
+ 1
11100000

Now,

$$\begin{array}{r} 00110010 \\ +\ 11100000 \\ \hline 100010010 \end{array}$$

Ignore Carry

Answer = $10010_2 = 18_{10}$

ii) Add -5_{10} and -7_{10}

$5_{10} = 0101_2$

2's complement of 0101_2 = 1010
+1
1011_2

$\therefore -5_{10} = 1011_2$

$7_{10} = 0111_2$

2's complement of 0111_2 = 1000
+1
1001_2

$\therefore -7_{10} = 1001_2$

Now, $\begin{array}{r} 1011 \\ +1001 \\ \hline 10100 \end{array}$

ignore carry

Re complementing the answer

2's complement of $0100 = (1011+1) = 1100_2$
$= 12_{10}$

So, the answer 0100 is the 2's complement of 1100_2

$\therefore$ Answer $= 0100_2 = -12_{10}$

iii) Subtract -3_{10} from -5

$$\begin{array}{rr} -5 = & 1011 \\ -(-3) = 3 = & 0011 \\ \hline & 1110 \end{array}$$

Re complementing 1110_2

2's complement of $1110_2 = 0001+1 = 0010 = 2$

So, $1110_2 = -2_{10}$

$\therefore$ Answer $= -2_{10}$

Gray Code

Gray code is a sequence of binary numbers known as reflected binary code (RBC). Gray code was introduce by Frank Gray. In gray code, two successive values differ by only 1 bit. Conversion of binary codes to gray codes results in reducing the switching operations.

Gray codes are unweighted codes, unlike binary codes.

Converting Binary to Gray Code:

There are 3 basic steps in order to convert a binary to gray code:

1. Record the Most Significant Bit (MSB) of binary code as it is.
2. Add the MSB to the next bit of the binary code, record the sum and neglect the carry. In the 2nd step, the XOR operation can also be done instead of adding MSB to the next bit and neglecting the carry.
3. Repeat step 2 again till the end of the binary code.

Here is the XOR truth table to check the results:

A	B	A⊕B
0	0	0
0	1	1
1	0	1
1	1	0

Convertion of Binary to Gray Code

i) Binary 1011_2 to Gray Code

MSB → 1 0 1 1

1

Step 1: Recording MSB as it is

1 0 1 1

1 1

Step2: MSB XOR Next Bit

$1 \oplus 0 = 1$

1 0 1 1

1 1 1 0

Step 3: MSB XOR Next bit till binary ends

$0 \oplus 1 = 1$, $1 \oplus 0 = 1$

∴ Gray Code = 1 1 1 0

ii) Binary 100110010_2 to Gray Code

Following the previous steps we get

Original Binary : 1 0 0 1 1 0 0 1 0

Gray Code : 1 1 0 1 0 1 0 1 1

iii) Binary 1101001_2 to Gray Code

Following the previous steps we get

Original Binary : 1 1 0 1 0 0 1

Gray Code : 1 0 1 1 1 0 1