ASSIGNMENT -03

Name : MOSROOR MOFIZ ARMAN

ID : 1921079642

Course : CSE231

Section : 10

Submitted to : Dr. Mohammad Monirujjaman Khan

Date : 05-03-2021

Number System

Decimal numbers :

$$245.32 = 2\times10^2 + 4\times10^1 + 5\times10^0 + 3\times10^{-1} + 2\times10^{-2}$$

$$= 200 + 40 + 5 + 0.3 + 0.02$$

Binary numbers :

$$(1011)_2 = 1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0$$

$$= 8 + 0 + 2 + 1 = (11)_{10}$$

$$(0.1011)_2 = 1\times2^{-1} + 0\times2^{-2} + 1\times2^{-3} + 1\times2^{-4}$$

$$= 0.5 + 0 + 0.125 + 0.0625 = (0.6875)_{10}$$

Decimal Number	Binary Number (4 digit representation)	Decimal Number	Binary Number (4 digit representation)
0	0 0 0 0	8	1 0 0 0
1	0 0 0 1	9	1 0 0 1
2	0 0 1 0	10	1 0 1 0
3	0 0 1 1	11	1 0 1 1
4	0 1 0 0	12	1 1 0 0
5	0 1 0 1	13	1 1 0 1
6	0 1 1 0	14	1 1 1 0
7	0 1 1 1	15	1 1 1 1

Binary Addition:

4 basic rules for adding binary digits:

$0+0=0$

$0+1=1$

$1+0=1$

$1+1=10$

add 1010 and 1110:

$$\begin{array}{r} 1010 \\ +1110 \\ \hline 11000 \end{array} \qquad \begin{array}{r} 10 \\ +14 \\ \hline 24 \end{array}$$

Binary multiplication:

4 basic rules for multiplying binary digits:

$0\times0=0$

$0\times1=0$

$1\times0=0$

$1\times1=1$

Multiply 111×101:

$$\begin{array}{r} 111 \\ \times 101 \\ \hline 111 \\ 000\times \\ 111\times \\ \hline 100011 \end{array} \qquad \begin{array}{r} 7 \\ \times 5 \\ \hline 35 \end{array}$$

Hexadecimal Numbers:

The Hexadecimal number system has 16 digits:
0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F,
10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 1A, 1B, 1C, 1D,
1E, 1F, 20, 21, ...

Binary to Hexadecimal conversion:

$$\underbrace{1100}_{C}\quad\underbrace{1010}_{A}\quad\underbrace{0101}_{5}\quad\underbrace{0111}_{7} = (CA57)_{16}$$

$$\underbrace{10}_{2}\quad\underbrace{1110}_{E} = (2E)_{16}$$

Hexadecimal to Decimal Conversion:

$$(A1C5)_{16} = 10\times16^3 + 1\times16^2 + 12\times16^1 + 5\times16^0$$
$$= (10\times4096) + 256 + 192 + 5$$
$$= 40960 + 256 + 192 + 5 = (41413)_{10}$$

Octal Numbers: The octal numbers system is composed of eight digits.

0, 1, 2, 3, 4, 5, 6, 7,
10, 11, 12, 13, 14, 15, 16, 17,
20, 21, ----------

Octal to Decimal conversion:

$(437)_8 = 4\times8^2 + 3\times8^1 + 7\times8^0$

$= (4\times64) + 24 + 7 = (287)_{10}$

Octal to Binary conversion:

$(753)_8 = (\underbrace{111}_{7}\ \underbrace{101}_{5}\ \underbrace{011}_{3})_2$

Binary to octal conversion:

$\underbrace{11}_{3}\ \underbrace{100}_{4}\ \underbrace{101}_{5}\ \underbrace{110}_{6} = (3456)_8$

1's Complement of a Binary Number:

1 0	1 1	0 0	1 0	Binary Number
↓ ↓	↓ ↓	↓ ↓	↓ ↓	
0 1	0 0	1 1	0 1	1's Complement

2's Complement of a Binary Number:

2's Complement = 1's complement + 1

1 0	1 1	0 0	1 0	Binary Number
↓ ↓	↓ ↓	↓ ↓	↓ ↓	
0 1	0 0	1 1	0 1	1's Complement
			+1	
0 1	0 0	1 1	1 0	2's Complement.

Decimal to Binary Conversion:

* $(13)_{10} = (??)_2$

Repeated division by 2 method.

Quotient	Remainder	
$\frac{13}{2} = 6$	1	LSB
$\frac{6}{2} = 3$	0	↑
$\frac{3}{2} = 1$	1	↑
$\frac{1}{2} = 0$	1	MSB.

$\therefore (13)_{10} = (1101)_2$

* $(158)_{10} = (??)_2 = (??)_6$

Quotient	Remainder	
$\frac{158}{2} = 79$	0	LSB
$\frac{79}{2} = 39$	1	
$\frac{39}{2} = 19$	1	
$\frac{19}{2} = 9$	1	↑
$\frac{9}{2} = 4$	1	
$\frac{4}{2} = 2$	0	
$\frac{2}{2} = 1$	0	
$\frac{1}{2} = 0$	1	MSB.

$\therefore (158)_{10} = (10011110)_2$

* $(0.375)_{10} = (??)_2$

$0.375 \times 2 = 0.75$ ↓ 0
$0.75 \times 2 = 1.50$ ↓ 1
$0.50 \times 2 = 1.00$ 1

$\therefore (0.375)_{10} = (0.011)_2$

* $(0.59375)_{10} = (??)_2 = (??)_4$

$0.59375 \times 2 = 1.1875$ 1
$0.1875 \times 2 = 0.375$ ↓ 0
$0.375 \times 2 = 0.75$ ↓ 0
$0.75 \times 2 = 1.50$ 1
$0.50 \times 2 = 1.00$ 1

$\therefore (0.59375)_{10} = (0.10011)_2$

Decimal to Octal Conversion:

$(335)_{10} = (??)_8$

$\frac{335}{8} = 41.875$

$\frac{41}{8} = 5.125$

$\frac{5}{8} = 0.625$

$0.875 \times 8 = 7$ LSB

$0.125 \times 8 = 1$ ↑

$0.625 \times 8 = 5$ MSB

$\therefore (335)_{10} = (517)_8$

$\ast (0.8125)_{10} = (??)_8$

$0.8125 \times 8 = 6.5$ 6 ↓

$0.5 \times 8 = 4$ 4

$\therefore (0.8125)_{10} = (.64)_8$

Binary to Octal Conversion:

$\underbrace{001}_{1}\underbrace{101}_{5} \quad \underbrace{110}_{6} \cdot \underbrace{110}_{6} \underbrace{111}_{7} \underbrace{010}_{2}$

$= (156.672)_8$

(b)

Decimal to Hexidecimal conversion :

$(2591)_{10} = (??)_{16}$

$\frac{2591}{16} = 161.9375$ $\quad 0.9375 \times 16 = 15 = F$ LSB

$\frac{161}{16} = 10.0625$ $\quad 0.0625 \times 16 = 1$ MSB

$\therefore (2591)_{10} = (1F)_{16}$

Binary to Hexadecimal conversion :

$\underbrace{0001}_{1}\ \underbrace{1010}_{A}\ \underbrace{0101}_{5}\ \underbrace{1110}_{E} \cdot \underbrace{0111}_{7}\ \underbrace{0100}_{4}\ \underbrace{1100}_{C}$

$= (1A5E \cdot 74C)_{16}$

Binary Coded Decimal (BCD) code :

BCD code mean each decimal digit, 0 through 9, is represented by a binary code of four bits.

Convert decimal number '35' to BCD:

3 → 0011
5 → 0101

$= (00110101)_2$

BCD code for decimal '98':

9 → 1001
8 → 1000

$= (10011000)_2$

Converting BCD codes to decimal:

1001 0100 0111 0000 $= (9470)_{10}$
9 4 7 0

Invalid codes in BCD Codes:

→ Six Conditions: 1010, 1011, 1100, 1101, 1110, 1111.

BCD addition:

(a)
$$\begin{array}{r} 0011 \\ +\ 0100 \\ \hline 0111 \end{array} \qquad \begin{array}{r} 3 \\ +\ 4 \\ \hline 7 \end{array}$$

(b) 00100011 + 00010101

0010 0011	23
0001 0101	+15
0011 1000	38

(c) 1001 + 0100

1001	9
+ 0100	+4
1101	13

→ Invalid BCD number (>9)

+0110

0001 0011

1 3

(d) 1001 + 1001

1001	9
+ 1001	+9
10010	18

→ Invalid because carry generated.

+ 0110 → (Add 6)

0001 1000

1 8

(e) 0 0 0 1 0 1 1 0 + 0 0 0 1 0 1 0 1

```
  0 0 0 1 0 1 1 0        16
+ 0 0 0 1 0 1 0 1       +15
-----------------      ----
  0 0 1 0 1 0 1 1        31
```

→ (Invalid BCD > 9)

```
    + 0 1 1 0   → (Add 6)
-----------------
  0 0 1 1  0 0 0 1
  ---------  ---------
      3          1
```

(f) 0 1 1 0 0 1 1 1 + 0 1 0 1 0 0 1 1

```
  0 1 1 0 0 1 1 1        67
+ 0 1 0 1 0 0 1 1       +53
-----------------      ----
  1 0 1 1 1 0 1 0        120
```

→ (Invalid BCD > 9)

```
  + 0 1 1 0 + 0 1 1 0
-----------------------
  0 0 0 1  0 0 1 0  0 0 0 0
  -------  -------  -------
     1        2        0
```

(g)

	1001	1001
+	1000	1001
	0001 0010	0010
	+0110	+0110
	0001 1000	1000
	1 8	8

99
+89
188

Invalid because carry generated.