Unit I –Part 04
(Number Systems)

Lecture Slide

AS2023

Hexadecimal to Decimal

- The following steps are adopted:
  - step 1: Separate the digits of the given hexadecimal number, if it contains more than 1 digit.
  - step 2: Multiply each digit of octal number with its increasing power of 16 from right to left (LSB to MSB)
  - step 3: Adding all the individual results provides the equivalent decimal number.

Hexadecimal to Decimal

- Convert $(ABCDEF)_{16}$ to base-10 number

Solutions:

Hexadecimal Number : ABCDEF

$= (A*16^5) + (B*16^4) + (C*16^3) + (D*16^2) + (E*16^1) + (F*16^0)$

$= (10*16^5) + (11*16^4) + (12*16^3) +(13*16^2) + (14*16^1) + (15*16^0)$

$= (10485760+720896+49152+3328+224+15)_{10}$

$=(11259375)_{10}$

Therefore, $(ABCDEF)_{16} = (11259375)_{10}$

Hexadecimal to Binary

- Two options:
  - **Option 1:** Convert to decimal and then convert decimal to binary
  - **Option 2:**
    - Take hexadecimal number as input
    - Convert each hexa-digit into binary.
    - That will be output as binary number.

Hexadecimal to binary

- Convert $(9A)_{16}$ to base-2 number

Solutions:

Hexadecimal Number : 9A

From the table, we get

(1001 1010)

Therefore, $(9A)_8 = (10011010)_2$

Dec	Hex	Oct	Bin
0	0	000	0000
1	1	001	0001
2	2	002	0010
3	3	003	0011
4	4	004	0100
5	5	005	0101
6	6	006	0110
7	7	007	0111
8	8	010	1000
9	9	011	1001
10	A	012	1010
11	B	013	1011
12	C	014	1100
13	D	015	1101
14	E	016	1110
15	F	017	1111

Hexadecimal to Octal

- Steps for conversion:
  - Take hexadecimal Numbers
  - Convert each hexadecimal numbers to binary
  - Form the group of 3 binary bits from the binary equivalent obtained from previous step, to get hexadecimal equivalent

Hexadecimal to Octal

- Convert $(3DC)_{16}$ to base-8 number

Solutions:

Hexadecimal Number : 3DC

From the table, we get

$(0011\ 1101\ 1100)_2$

Form a group of 3 bits:

$(001\ 111\ 011\ 100)_2$

$= 1734$

Therefore, $(3DC)_{16} = (1734)_8$

Dec	Hex	Oct	Bin
0	0	000	0000
1	1	001	0001
2	2	002	0010
3	3	003	0011
4	4	004	0100
5	5	005	0101
6	6	006	0110
7	7	007	0111
8	8	010	1000
9	9	011	1001
10	A	012	1010
11	B	013	1011
12	C	014	1100
13	D	015	1101
14	E	016	1110
15	F	017	1111

CLASS ACTIVITY

Individual Task

- ✓ Solve the given questions (10 Minutes)
- ✓ Volunteer/Random Selection to present your answer

Questions

- Convert $(9AF1)_{16}$ to base-10 number system
- Convert $(F1E4)_{16}$ to base-2 number system
- Convert $(8B2)_{16}$ to base-8 number system

Home Assignment

- What are the importance of number system?
- What is double dabble method? Write a short note on it.
- Convert the following
  - $(8.34)_{10}$ to its equivalent base-8, base-2 and base-16
  - $(10.1001)_2$ to its equivalent base-8, base-10 and base-16
  - $(1.25)_8$ to its equivalent base-10, base-2 and base-16
  - $(F.3C)_{16}$ to its equivalent base-8, base-10 and base-2

Conversion of Decimal number with Fractional part

Convert to Binary, Octal and Hexadecimal

1. Convert the whole number part of decimal to binary/octal/hexadecimal equivalent
2. Convert the fractional part of decimal to binary/octal/hexadecimal equivalent
   - 2.1. The fractional part is multiplied by base
     - »2 (decimal to binary)
     - »8(decimal to octal)
     - »16(decimal to hexadecimal)

Conversion of Decimal number with Fractional part

2.2. Check if the fractional part of that product has become zero or not

- If '***yes***', we stop the process
- If '***no***', we extract the *fractional part* and continue the process till the fractional part becomes zero

Conversion of Decimal number with Fractional part

2.3. The binary/octal/hexadecimal equivalent of the given decimal fractional part is the *integer part extracted from the multiplication from top to bottom*

3. Combine both the whole number and fractional part to get its binary/octal/hexadecimal number equivalent.

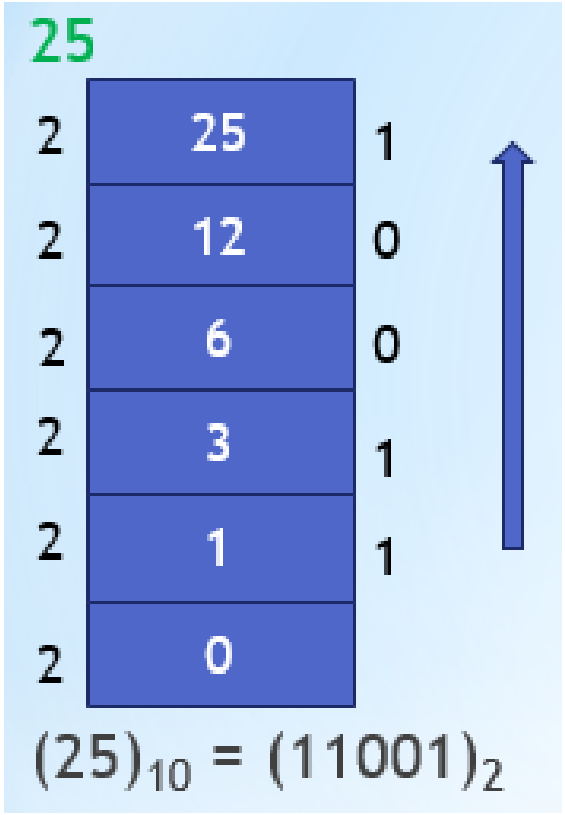
Conversion of Decimal number with Fractional part

Example:

Convert $(25.625)_{10}$ into binary number system

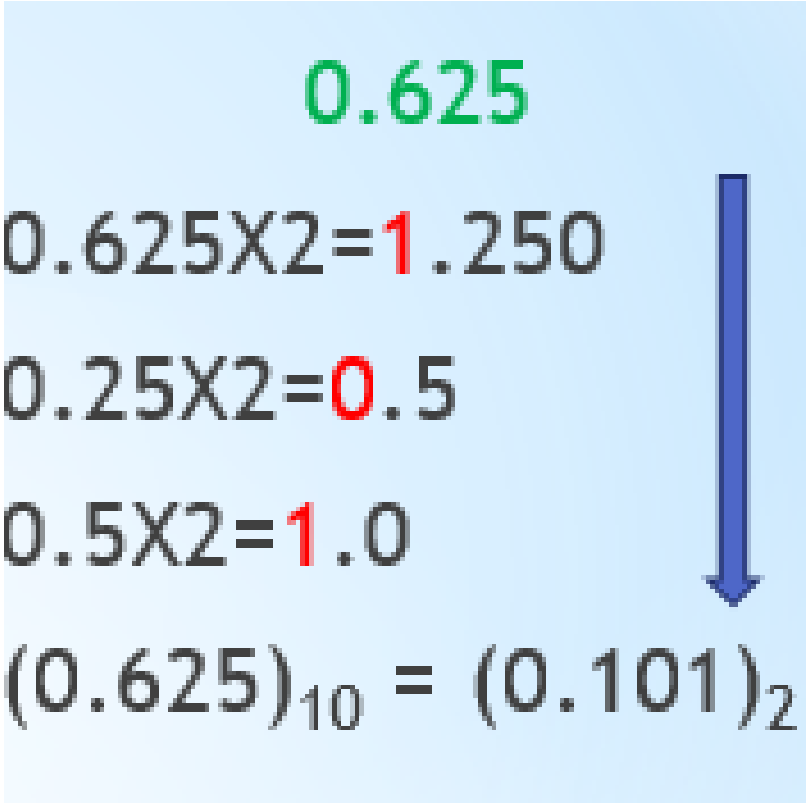
Conversion of Decimal number with Fractional part

1). Convert the integral part of decimal to binary equivalent



Conversion of Decimal number with Fractional part

2). Convert the fractional part of decimal to binary equivalent



Conversion of Decimal number with Fractional part

3) Combine both the integral and fractional part

Thus,

$$(11001.101)_2$$

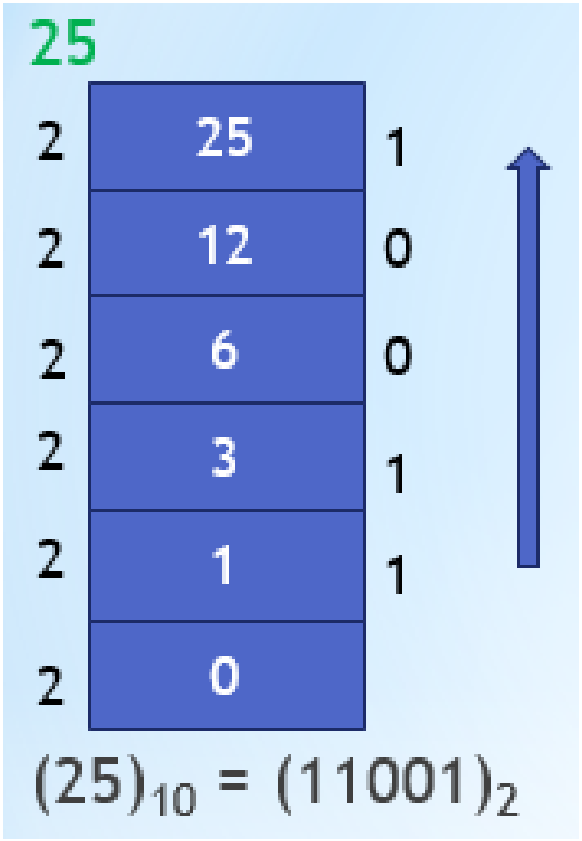
CLASS ACTIVITY (THINK-PAIR-SHARE)

CLASS ACTIVITY

1. Convert $(100.625)_{10}$ into octal number system.
2. Convert $(50.250)_{10}$ into binary number system.

What if we encounter Fractional part of Decimal Number which doesn't become zero??

Example: 25.1?



0.1*2=0.2

0.2*2=0.4

0.4*2=0.8

0.8*2=1.6

0.6*2=1.2

0.2*2=0.4

0.4*2=0.8

0.8*2=1.6

0.6*2=1.2

.....

$(11001.000110011001100110011.....)_2$

Binary, Octal and hexadecimal with fractional part to Decimal Number System

1. Convert the integral part of binary/octal/hexadecimal to decimal equivalent

(Same procedure)

2. Convert the fractional part of binary/octal/hexadecimal to decimal fractional equivalent

2.1. Bits multiplied with base raised to their respective weightage taken as negative starting from the first bit after the decimal point as -1.

2.2. Sum up.

Example:

$(11001.101)_2$

11001

$1X2^0+0X2^1+0X2^2+1X2^3+1X2^4$

1+8+16

$(25)_{10}$

0.101

$1X2^{-1}+0X2^{-2}+1X2^{-3}$

$(0.625)_{10}$

Combining both, we get:

$(25.625)_{10}$

CLASS ACTIVITY (Individual)

CLASS ACTIVITY

1. Convert the followings into decimal number system.
    a) $(1010.101)_2$
    b) $(76.11)_8$

Home Assignment

- Convert the following
  - $(8.250)_{10}$ to its equivalent base-8, base-2 and base-16
  - $(10.1001)_{2}$ to its equivalent base-8, base-10 and base-16
  - $(1.25)_{8}$ to its equivalent base-10, base-2 and base-16
  - $(F.3C)_{16}$ to its equivalent base-8, base-10 and base-2

Thank you