Computer Architecture

Lab 1:
Number Systems

1) Convert the following binary numbers to decimal:
   a. 1111011
      123
   b. 0110101011
      427
   c. 10101101110.1101
      1390.8125

2) Convert the following decimal numbers to binary:
   a. 97.54
      1100001.10001010001111010111

0.54 × 2 = 1 + 0.08
0.08 × 2 = 0 + 0.16
0.16 × 2 = 0 + 0.32
0.32 × 2 = 0 + 0.64
0.64 × 2 = 1 + 0.28
0.28 × 2 = 0 + 0.56
0.56 × 2 = 1 + 0.12
0.12 × 2 = 0 + 0.24000000000001
0.24000000000001 × 2 = 0 + 0.48000000000002
0.48000000000002 × 2 = 0 + 0.96000000000004

Here is the answer to 0.54 decimal to binary number:
0.1000101000

   b. 256.25
      100000000.01
   c. 127.223
      1111111.00111001000101101

3) Convert the following decimal numbers to 8-bit binary values:
   a. 53
      00110101
   b. 98
      01100010
   c. 176
      10110000

4) Convert the following hexadecimal numbers to binary:
   a. AB34
      1010 1011 0011 0100
   b. CE122
      1100 1110 0001 0010 0010
   c. F01DB
      1111 0000 0001 1101 1011

5) Convert the following binary numbers to hexadecimal:
   a. 111001
      39
   b. 1011101101011101
      BB5D
   c. 101101010010100001
      2D4A1

6) Convert the following hexadecimal numbers to decimal:
   a. BA33
      $(BA33)_{16} = (11 \times 16^3) + (10 \times 16^2) + (3 \times 16^1) + (3 \times 16^0) = (47667)_{10}$
   b. FE76B
      $(FE76B)_{16} = (15 \times 16^4) + (14 \times 16^3) + (7 \times 16^2) + (6 \times 16^1) + (11 \times 16^0) = (1042283)_{10}$
   c. 7339D
      $(7339D)_{16} = (7 \times 16^4) + (3 \times 16^3) + (3 \times 16^2) + (9 \times 16^1) + (13 \times 16^0) = (471965)_{10}$

7) Convert the following decimal numbers to hexadecimal:
   a. 872

Divide by the base 16 to get the digits from the remainders:

Division by 16	Quotient	Remainder (Digit)	Digit #
(872)/16	54	8	0
(54)/16	3	6	1
(3)/16	0	3	2

$= (368)_{16}$

b. 1282

Divide by the base 16 to get the digits from the remainders:

Division by 16	Quotient	Remainder (Digit)	Digit #
(1282)/16	80	2	0
(80)/16	5	0	1
(5)/16	0	5	2

$= (502)_{16}$

c. 22014

Divide by the base 16 to get the digits from the remainders:

Division by 16	Quotient	Remainder (Digit)	Digit #
(22014)/16	1375	14	0
(1375)/16	85	15	1
(85)/16	5	5	2
(5)/16	0	5	3

$= (55FE)_{16}$

8) Convert the following octal numbers to binary:

a. 637

Convert each octal digit to 3 binary digits (see conversion table below):

637

= 6 3 7

= 110 011 111

= 110011111

b. 2340

Convert each octal digit to 3 binary digits (see conversion table below):

2340

= 2 3 4 0

= 010 011 100 000

= 010011100000

c. 1571

Convert each octal digit to 3 binary digits (see conversion table below):

1571

= 1 5 7 1

= 001 101 111 001

= 001101111001

9) Convert the following binary numbers to octal:

a. 111001011

Convert every 3 binary digits (from bit0) to octal digit (see conversion table below):

111001011

= 111 001 011

= 7 1 3

= 713

b. 1001010100

Convert every 3 binary digits (from bit0) to octal digit (see conversion table below):

1001010100

= 1 001 010 100

= 1 1 2 4

= 1124

c. 10101011111

Convert every 3 binary digits (from bit0) to octal digit (see conversion table below):

10101011111

= 10 101 011 111

= 2 5 3 7

= 2537

10) Convert the following octal numbers to decimal:

a. 67

$67 = (6 \times 8^1) + (7 \times 8^0) = 55$

b. 532

$532 = (5 \times 8^2) + (3 \times 8^1) + (2 \times 8^0) = 346$

c. 246

$246 = (2 \times 8^2) + (4 \times 8^1) + (6 \times 8^0) = 166$

11) Convert the following decimal numbers to octal:

a. 168

Divide by the base 8 to get the digits from the remainders:

Division by 8	Quotient	Remainder (Digit)	Digit #
(168)/8	21	0	0
(21)/8	2	5	1
(2)/8	0	2	2

$= (250)_8$

b. 129

Divide by the base 8 to get the digits from the remainders:

Division by 8	Quotient	Remainder (Digit)	Digit #
(129)/8	16	1	0
(16)/8	2	0	1
(2)/8	0	2	2

$= (201)_8$

c. 2345

Divide by the base 8 to get the digits from the remainders:

Division by 8	Quotient	Remainder (Digit)	Digit #
(2345)/8	293	1	0
(293)/8	36	5	1
(36)/8	4	4	2
(4)/8	0	4	3

$= (4451)_8$

12) Convert each of the following decimal numbers to BCD:

a. 9

1001

b. 27

0010 0111

c. 568

0101 0110 1000

13) Convert each of the following BCD numbers to decimal:

a. 1001

9

b. 01 0111 0011

173

c. 0101 0010 0100

524

14) Perform the following arithmetic operations:

a. $1000_2 + 1101_2$

1000 + 1101

= 010101

b. $010110100_2 + 01101011_2$

010110100 + 01101011

= 0100011111

c. $11110_2 - 10011_2$

11110 – 10011

= 01011

$$\begin{array}{rr} & {}^{1}8\ {}^{1}A\ B \\ + & B\ 7\ 8 \\ \hline = & 1\ 4\ 2\ 3 \end{array}$$

Hex addition follows the same rules as decimal addition with the only difference being the added numerals A, B, C, D, E, and F. It may be convenient to have the decimal equivalent values of A through F handy

when performing hex operations if the values have not yet been committed to memory. Below is an example of hex addition. Work through the example, and refer to the text below it for further details.

d. $CD_{16} + 7C_{16}$

cd + 7c = 149

e. $E8_{16} - 1A_{16}$

e8 - 1a = CE

f. $FE_{16} - DF_{16}$

fe - df = 1F

*Upload your group work in Wiki