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Homework #2

Problem 1: Convert the following unsigned binary numbers to decimal.

(C) 10 0110 1101

$= 2^9 + 2^6 + 2^5 + 2^3 + 2^2 + 2^0$

$= 512 + 64 + 32 + 8 + 4 + 1$

$= 621_{10}$

$2^0 = 1$
$2^1 = 2$
$2^2 = 4$
$2^3 = 8$
$2^4 = 16$
$2^5 = 32$
$2^6 = 64$
$2^7 = 128$
$2^8 = 256$
$2^9 = 512$
$2^{10} = 1024$
$2^{11} = 2048$
$2^{12} = 4096$

(F) 0000 1111 0000

$= 2^7 + 2^6 + 2^5 + 2^4$

$= 128 + 64 + 32 + 16$

$= 240_{10}$

(9) 1100 1100 1100

$= 2^{11} + 2^{10} + 2^7 + 2^6 + 2^3 + 2^2$

$= 2048 + 1024 + 128 + 64 + 8 + 4$

$= 3276_{10}$

Problem 2: Convert the following decimal numbers to binary. Assume all numbers are unassigned and represented by 12 bits.

Power	12	11	10	9	8	7	6	5	4	3	2	1	0
Decimal	4096	2048	1024	512	256	128	64	32	16	8	4	2	1

(a) $73 = 64 + 8 + 1 = 2^6 + 2^3 + 2^0$

$= 100\ 1001_2$

(b) $127 = 64 + 32 + 16 + 8 + 4 + 2 + 1$

$= 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$

$= 111\ 1111_2$

Problem 3: Convert the following numbers to hexadecimals

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
									↓	↓	↓	↓	↓	↓
									A	B	C	D	E	F

$2^0 = 1$ $\quad$ $2^2 = 4$

$2^1 = 2$ $\quad$ $2^3 = 8$

(b) 1011010000101_2

10 1101 0000 0101

0010 1101 0000 0101

2 13 0 5

$= 2D05_{16}$

(c) $791_{10} = 512 + 256 + 16 + 4 + 2 + 1$

791/2 = 395 w/ remainder of 1

395/2 = 197 w/ remainder of 1

197/2 = 98 w/ remainder of 1

98/2 = 49 w/ remainder of 0

49/2 = 24 w/ remainder of 1

24/2 = 12 w/ remainder of 0

12/2 = 6 w/ remainder of 0

6/2 = 3 w/ remainder of 0

3/2 = 1 w/ remainder of 1

1/2 = 0 w/ remainder of 1

1100010111

0011	0001	0111
8421	8421	8421
3	1	7

$= 317_{16}$

Problem 4: Convert the following numbers to decimal.

(c) $3FF_{16} = 0011\ 1111\ 1111_2$

$= 2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$

$= 512 + 256 + 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1$

$= 1023_{10}$

Problem 5: Compute the sum of the following pairs of 6-bit unsigned numbers. If the answer is to be stored in a 6-bit location, indicate which of the sums produce overflow. Also, show the decimal equivalent of both operands and the result.

(a) 000011 + 001100

$$\begin{array}{r} 000011 \\ +\ 001100 \\ \hline 001111 \end{array} \Rightarrow \begin{array}{r} 3 \\ +\ 12 \\ \hline 15 \end{array} \Rightarrow \text{Integer} = 15$$

(b) $010100 + 101101$

$$\begin{array}{r} {\scriptstyle (1)(1)(1)} \\ 010100 \\ +\ 101101 \\ \hline 1000001 \end{array} \Rightarrow \begin{array}{r} 20 \\ +\ 45 \\ \hline 65 \end{array}$$

Binary Integers = 65

Problem 6: The following numbers are to be stored in a 6-bit signed binary format. Show how they are stored.

(d) $+15 = 2^3 + 2^2 + 2^1 + 2^0 = 001111_2$

$= 001111_2$

(e) -15

$001111_2 \rightarrow 110000$

$$\begin{array}{r} 110000 \\ +\ \quad 1 \\ \hline 110001_2 \end{array}$$

$= 110001_2$

Problem 7: The following 6-Bit signed binary numbers were found in a computer. What decimal number do they represent?

(e) 011111

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

$= 16 + 8 + 4 + 2 + 1$

$= +31_{10}$

(f) 111001

$\Rightarrow 111001 = 000110$

$$\begin{array}{r} 000110 \\ + \quad\quad 1 \\ \hline 000111 \end{array}$$

$= 2^2 + 2^1 + 2^0$

$= 4 + 2 + 1$

$= 7$

$\Rightarrow 111001 = -7_{10}$

Problem 9: Each of the following pairs of signed integers are stored in computer words (6 bit). Compute the sum as it is stored in a 6-bit computer word. Show the decimal equivalent of each operand and the sum. Indicate if there is overflow.

(a) $110101 + 001111$

$$\begin{array}{r} 110101 \\ +\ 001111 \\ \hline 1\ 10100 \end{array}$$

$110100 = 001011$

$= 2^3 + 2^1 + 2^0$

$= 8 + 2 + 1$

$= 11$

$\Rightarrow 001011 = 110100 = -11_{10}$

Chapter 2 - Problem 2: Show Truth Table for each of the following.

(c) The system has four inputs. The first two, a and b, represent a number in the range 1 to 3 (0 is not used). The other two, c and d, represent a second number in the same range. The output, y, is to be 1 if and only if the first number is greater than the second or the second is 2 greater than the first.

a	b	c	d	y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	1
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

(f) The system has four inputs. The first two, a and b, represent a number in the range 0 to 2 (3 is not used). The other two, c and d, represent a second number in the same range. The output, Y, is to be 1 if and only if the two numbers do not differ by more than 1.

a	b	c	d	Y
0	0	0	0	1
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	1