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1) Convert the unsigned binary into decimal representations

a) 1001 → | 1 | 0 | 0 | 1 → $(2^3 \cdot 1) + (2^2 \cdot 0) + (2^1 \cdot 0) + (2^0 \cdot 1) = 8 + 0 + 0 + 1 = 9$

b) 11110 → | 1 | 1 | 1 | 1 | 0 → $(2^4 \cdot 1) + (2^3 \cdot 1) + (2^2 \cdot 1) + (2^1 \cdot 1) + (2^0 \cdot 0) = 16 + 8 + 4 + 2 + 0 = 30$

c) 1011011 → | 1 | 0 | 1 | 1 | 0 | 1 | 1 → $(2^6 \cdot 1) + (2^5 \cdot 0) + (2^4 \cdot 1) + (2^3 \cdot 1) + (2^2 \cdot 0) + (2^1 \cdot 1) + (2^0 \cdot 1) = 64 + 16 + 8 + 2 + 1 = 91$

d) 11111 → | 1 | 1 | 1 | 1 | 1 → $(2^4 \cdot 1) + (2^3 \cdot 1) + (2^2 \cdot 1) + (2^1 \cdot 1) + (2^0 \cdot 1) = 16 + 8 + 4 + 2 + 1 = 31$

2) Convert the decimal to its binary representations

a) 25 → $16 + 8 + 1 = 25 \rightarrow 2^4 + 2^3 + 2^0 = 11001$

b) 345 → $\begin{array}{r} 2 | 345 \\ 2 | 172 \\ 2 | 86 \\ 2 | 43 \\ 2 | 21 \\ 2 | 10 \\ 2 | 5 \\ 2 | 2 \\ 2 | 1 \\ 0 \end{array} \rightarrow 101011001$

$\xrightarrow{\quad}$

$\begin{array}{r} 2 | 141 \\ 2 | 70 \\ 2 | 35 \\ 2 | 17 \\ 2 | 8 \\ 2 | 4 \\ 2 | 2 \\ 2 | 1 \\ 0 \end{array} \rightarrow 10001101$

c) 141

c) $4092 \rightarrow$

2	4092	
2	2046	0
2	1023	0
2	511	1
2	255	1
2	127	1
2	63	1
2	31	1
2	15	1
2	7	1
2	3	1
2	1	1
	0	

→ 1111111100

3) Convert unsigned hex2 decimal to their decimal representations

a) $1B \rightarrow$

1	B
1	11

 $= (1 \times 16^1) + (11 \times 16^0) = 27$

b) $FE \rightarrow$

F	E
15	14

 $= (15 \times 16^1) + (14 \times 16^0) = 254$

c) $B9D \rightarrow$

B	D	9
11	13	9

 $= (11 \times 16^2) + (13 \times 16^1) + (9 \times 16^0) = 3033$

d) $B39 \rightarrow$

B	3	9
11	3	9

 $= (11 \times 16^2) + (3 \times 16^1) + (9 \times 16^0) = 2873$

4) Do the following unsigned binary arithmetic

a) $10111 + 10101 = 101100$

$$\begin{array}{r}
 10111 \\
 + 10101 \\
 \hline
 101100
 \end{array}$$

b) $11001 + 01101 = 100110$

$$\begin{array}{r}
 11001 \\
 + 01101 \\
 \hline
 100110
 \end{array}$$

c) $10101 - 00011 = 11101$

$00011 \rightarrow 1's \rightarrow 11100 ; 2's \rightarrow$

$$\begin{array}{r}
 11100 \\
 + 1 \\
 \hline
 11101
 \end{array}$$

Convert

10101
11101
110010

So

$$10101 - 00011 = 110010$$

d) $11001 - 1011$

Convert 1011 \rightarrow 1's: 0100 \rightarrow 2's: 0101

$$\begin{array}{r} 11001 \\ + 0101 \\ \hline 11110 \end{array}$$

So $11001 - 1011 = 11110$

5) Do the following unsigned hexadecimal arithmetic

a) $827D + 1C72 = 9EEF$

$$\begin{array}{r} 827D \\ + 1C72 \\ \hline 9EEF \end{array}$$

b) $E2D + B01 = 192E$

$$\begin{array}{r} E2D \\ + B01 \\ \hline 192E \end{array}$$

c) $FC19 - 3A59 = C100$

$$\begin{array}{r} 111101001001 \\ FC19 \\ - 3A59 \\ \hline C100 \end{array}$$

d) $1E2C - 3C1 = 1A6B$

$$\begin{array}{r} 1318 \\ 1E2C \\ - 3C1 \\ \hline 1A6B \end{array}$$

6) Do the arithmetic as signed binary representations

a) $10110 + 01101 = \boxed{00011}$

$$\begin{array}{r} \boxed{1} \quad 1 \\ 1 \quad 0 \quad 1 \quad 1 \quad 0 \\ + \quad 0 \quad 1 \quad 1 \quad 0 \quad 1 \\ \hline 0 \quad 0 \quad 0 \quad 1 \quad 1 \end{array}$$

- NO overflow since carry in / out is the same

b) $10110 - 11011 = \boxed{11011}$

Convert 11011

using 1's and 2's \rightarrow 1's: 00100 \rightarrow 2's: $\begin{array}{r} 001 \quad 00 \\ + \quad \quad \quad 1 \\ \hline 00101 \end{array}$

$$\begin{array}{r} 0 \quad 0 \quad 1 \\ 1 \quad 0 \quad 1 \quad 1 \quad 0 \\ + \quad 0 \quad 0 \quad 1 \quad 0 \quad 1 \\ \hline 1 \quad 1 \quad 0 \quad 1 \quad 1 \end{array}$$

- No overflow, carry in / out is equal

c) $11011 + 01011 = \boxed{101110}$

$$\begin{array}{r} \boxed{1} \quad 1 \quad 1 \\ 1 \quad 1 \quad 0 \quad 1 \quad 1 \\ + \quad 0 \quad 1 \quad 0 \quad 1 \quad 1 \\ \hline 1 \quad 0 \quad 1 \quad 1 \quad 1 \quad 0 \end{array}$$

- NO overflow, carry in / out is equal

d) $11111 + 01111 = \boxed{10000}$

Convert 01111 using
1's and 2's

\rightarrow 1's: 10000 \rightarrow 2's: $\begin{array}{r} 10000 \\ + \quad \quad \quad 1 \\ \hline 10001 \end{array}$

$$\begin{array}{r} \boxed{1} \quad 1 \quad 1 \quad 1 \quad 1 \\ 1 \quad 1 \quad 1 \quad 1 \quad 1 \\ + \quad 1 \quad 0 \quad 0 \quad 0 \quad 1 \\ \hline 1 \quad 0 \quad 0 \quad 0 \quad 0 \end{array}$$

- No overflow, the carry in and out
aren't equal

7) Assume that

Register 0 contains	0 0 0 0 0 0 2 2
Register 1 contains	0 0 0 0 1 0 2 8
Register 7 contains	E C 0 0 3 5 D 1
Register 9 contains	0 0 0 1 9 C F 2

Calculate $D(x, B)$

a) $492(1) \rightarrow 001028 + 0001EC = \textcircled{001214}$

b) $51(7,0) \rightarrow 0035D1 + 000033 = \textcircled{003604}$

c) $16(9,1) \rightarrow 019CF2 + 000010 = 19D02 + 001028 = \textcircled{01AD2A}$

d) $12(0,2,7) \rightarrow$ not valid, not $D(x, B)$

e) $231(7,1) \rightarrow 0035D1 + 0000E7 = 0036B8 + 061028 = \textcircled{0046E0}$

f) $112(9) \rightarrow 019CF2 + 000070 = \textcircled{019D62}$