

EGC220 Class Notes 2/3/2023

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$-(xyz.w)_n$ can be represented by its n 'th complement.

$(n-1)$ 'th
Comp.

$$\begin{array}{r}
 \begin{array}{cccc}
 n-1 & n-1 & n-1 & \cancel{n-1} \\
 -X & Y & Z & W \\
 \hline
 M & N & O & P \\
 \hline
 + & & & \\
 \hline
 Q & R & S & T
 \end{array}
 \end{array}$$

$$\begin{array}{r}
 -(xyz.w)_n \\
 + \text{same } (QRS.T)_n \\
 \hline
 \begin{array}{cccc}
 0 & 0 & 0 & 0
 \end{array}
 \end{array}$$

$(cy=1)$ → Result is POS.

1. Find the 9th and 10th complement of following decimal numbers

a. 9815634

$$\begin{array}{r}
 \text{a.} \quad 9999999 \\
 - 9815634 \\
 \hline
 \text{9th} \quad 0184365 \\
 \hline
 \text{10th} \quad 0184366
 \end{array}$$

$$\begin{array}{r}
 0184366 \\
 + 9815634 \\
 \hline
 10000000
 \end{array}$$

\hookrightarrow (y=1) ✓

b. 7204870

$$\begin{array}{r}
 9999999 \\
 + 7204870 \\
 \hline
 2795129 \\
 \hline
 2795130
 \end{array}$$

c. 10000000

$$\begin{array}{r}
 9999999 \\
 + 10000000 \\
 \hline
 19999999
 \end{array}$$

$$\begin{array}{r}
 \text{9th} \quad 8999999 \\
 + 10000000 \\
 \hline
 18999999
 \end{array}$$

~~10000000~~

d. 00000000

$$\begin{array}{r}
 9999999 \\
 - 0000000 \\
 \hline
 9999999 \\
 \hline
 \text{10th Comp} \quad 0000000
 \end{array}$$

\hookrightarrow (y=1)

2. Find the 16th complement of (ACB3.B2)₁₆

$$\begin{array}{r}
 \overset{1}{A} \quad \overset{1}{C} \quad \overset{1}{B} \quad \overset{1}{3} \quad \overset{1}{B} \quad 2 \\
 + 5 \quad 3 \quad 4 \quad C \quad . \quad 4E \\
 \hline
 0 \quad 0 \quad 0 \quad 0 \quad . \quad 00 \\
 \rightarrow \text{CY} = 1
 \end{array}$$

$$\begin{array}{r}
 F \quad F \quad F \quad F \quad F \quad F \\
 - A \quad C \quad B \quad 3 \quad . \quad B \quad 2 \\
 \hline
 5 \quad 3 \quad 4 \quad C \quad . \quad 4 \quad D \\
 1 \\
 \hline
 5 \quad 3 \quad 4 \quad C \quad . \quad 4 \quad E \quad E
 \end{array}$$

15th
Comp

Binary

$$\begin{array}{r} \text{11111} \quad \text{11} \quad \text{11} \quad \text{11} \quad \text{1111} \\ \hline - 10100 \quad 11010. \quad 0010 \\ \hline 01011 \quad 00101. \quad 1101 \\ + \\ \hline 01011 \quad 00101. \quad 1100 \end{array}$$

1's
Comp

2's
Comp

3. Perform subtraction on the following unsigned binary numbers using the 2's complement of the subtrahend. If the result should be negative, 2's complement it and affix a minus sign.

a. $11011 - 10111$

Handwritten work for problem a:

2's comp

$$\begin{array}{r} 11011 \\ -10111 \\ \hline 00100 \end{array}$$

Annotations: $CX=1$ (circled), 2^5 comp, 2^3 (pointing to the result).

Handwritten work for problem a (continued):

1's comp: 01000

2's comp: 10100

Final result: $11011 + 10100 = 110011$

b. $100100 - 10101$

Handwritten work for problem b:

$$\begin{array}{r} 100100 \\ -010101 \\ \hline 001111 \end{array}$$

Annotations: $CX=1$ (circled), $Ans. POS.$ (underlined), 2^6 , 2^5 , 2^4 , 2^3 , 2^2 , 2^1 , 2^0 (bit positions).

c. $101001 - 110000$

Handwritten work for problem c:

$$\begin{array}{r} 101001 \\ -110000 \\ \hline 111001 \end{array}$$

Annotations: $CX=1$ (circled), $Ans. NEG.$ (underlined), 2^6 , 2^5 , 2^4 , 2^3 , 2^2 , 2^1 , 2^0 (bit positions), NEG , AC , $CX=0$.

Handwritten work for problem c (continued):

2's comp of a neg. #: 001111

$$\begin{array}{r} 101001 \\ +001111 \\ \hline 111001 \end{array}$$

Final result: -111001

d. $101010 - 101011$

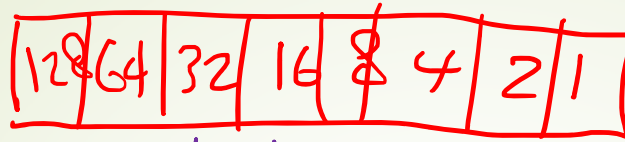
unsigned domain.

In 2's complement subtraction, Final carry of 1 indicates the result is positive.

Final carry of 0 indicates the result is negative and is represented in 2's complement form.

I. unsigned

=



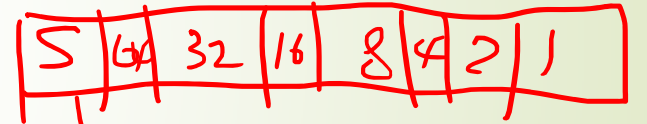
255

II. signed magnitude



0 + +127
1 - -127

III. signed two's comp



+
→ 2's comp form

Coded

4. What does the following binary numbers represent in

- a. Unsigned domain
- b. Signed magnitude
- c. Signed 2's complement

I. 01011101

unsigned $\rightarrow 128$
 signed = 8 = 0
 (+)

II. 11011100

64 32 16 8 4 2 1
 1 1 0 1 1 0 0
 128 64 32 16 8 4 2 1
 1 1 0 1 1 0 0

III. 11111111

a. 255

b. -127

c. -0000 0001
 -

b
 \downarrow
 +93

c
 +93

(b) ~~92~~

a = 220

(c) \rightarrow

32 16 8 4 2 1
 -0 0 1 0 0 1 0 0

-36

5. Perform the following arithmetic operations in the indicated bases.

a. $(23.6)_8 \times (76.5)_8$

b. $(23.6)_{12} \times (76.5)_{12}$

c. $(23.6)_{16} \times (76.5)_{16}$

23.6

76.5

$42 \div 8 = 5 \quad R=2$

$26 \div 8 = 3 \quad R=2$

$17 \div 8 = 2 \quad R=1$

2 1 2 2

$(23.24.66)_8$

$30 \div 8 = 3 \quad R=6$

$18 \div 8 = 2 \quad R=2$

$12 \div 8 = 1 \quad R=4$

$36 \div 8 = 4 \quad R=4$

$22 \div 8 = 2 \quad R=6$

$14 \div 8 = 1 \quad R=6$