

# 1's Complement

- In general, the 1's Complement of the **unsigned** numbers 110011 & 11000 are

$$\begin{array}{r} 111111 \\ - 110011 \\ \hline 001100 \end{array}$$

$$\begin{array}{r} 11111 \\ - 11000 \\ \hline 00111 \end{array}$$

or

Generally , we know how to do complement

For 110011, 1's complement is 001100

For 11000, 1's complement is 00111

# 2's Complement

- In general, the 2's Complement of the **unsigned** numbers 110011 & 11000 are

$$\begin{array}{r}
 111111 \\
 - 110011 \\
 \hline
 001100 \\
 + 1 \\
 \hline
 001101
 \end{array}$$

$$\begin{array}{r}
 11111 \\
 - 11000 \\
 \hline
 00111 \\
 + 1 \\
 \hline
 01000
 \end{array}$$

or

Generally , we know how to do complement

For 110011, 2's complement is  $001100 + 1 = 001101$

For 11000, 2's complement is  $00111 + 1 = 01000$

# Subtraction of Unsigned number - 1's Complement

## Example 1 :

Using 1's complement, subtract (84) 1010100 – (67) 1000011 (M > N)

1's Complement of 1000011 is 0111100

$$\begin{array}{r}
 1010100 \\
 + 0111100 \\
 \hline
 \end{array}$$

$$\begin{array}{r}
 1\ 0010000 \\
 + 1 \\
 \hline
 \end{array}$$

0010001



There is end carry



Final Result

End carry indicates that result is Positive. Carry need to be added to obtained value to get final result.

# Subtraction of Unsigned number - 1's Complement

## Example 2 :

Using 1's complement, subtract (67) 1000011 - (84) 1010100 ( $M < N$ )

1's Complement of 1010100 is 0101011

$$\begin{array}{r} 1000011 \\ + 0101011 \\ \hline \end{array}$$

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1101110



There is no end carry.

1's complement of 1101110

0010001



Final Result

No end carry indicates that result is Negative. Do 1's complement of the obtained value to get final result.

# Subtraction of Unsigned number - 2's Complement

## Example 1 :

Using 2's complement, subtract (84) 1010100 – (67) 1000011 (M > N)

2's Complement of 1000011 is  $0111100 + 1 = 0111101$

$$\begin{array}{r} 1010100 \\ + 0111101 \\ \hline \end{array}$$

1 0010001



There is end carry

0010001



Final Result

End carry indicates that final result is Positive. Ignore end carry.

# Subtraction of Unsigned number - 2's Complement

## Example 2

Using 2's complement, subtract (67) 1000011 - (84) 1010100 (M < N)

2's Complement of 1010100 is  $0101011 + 1 = 0101100$

$$\begin{array}{r} 1000011 \\ + 0101100 \\ \hline \end{array}$$

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1101111



There is no end carry.

$$\begin{array}{r} 0010000 \\ + 1 \\ \hline \end{array}$$

0010001



Final Result

No end carry indicates the end result is **Negative**. Do 10's complement of the obtained value to get final result.

# Questions

**Q 1 :** Using 1's complement, Subtract  $1\ 1\ 1\ 1\ 1\ 0\ 1 - 1\ 1\ 0\ 0\ 1\ 0\ 1$

**Q 2 :** Using 1's complement, Subtract  $1\ 1\ 0\ 0\ 1\ 0\ 1 - 1\ 1\ 1\ 1\ 1\ 0\ 1$

Ans: 1's Complement of  $1\ 1\ 0\ 0\ 1\ 0\ 1$  is  $0\ 0\ 1\ 1\ 0\ 1\ 0$

9's Complement of  $1\ 1\ 1\ 1\ 1\ 0\ 1$  is  $0\ 0\ 0\ 0\ 0\ 1\ 0$

$$\begin{array}{r}
 1\ 1\ 1\ 1\ 1\ 0\ 1 \\
 +\ 0\ 0\ 1\ 1\ 0\ 1\ 0 \\
 \hline
 1\ 0\ 0\ 1\ 0\ 1\ 1\ 1 \text{ (End Carry – Re +ve)} \\
 +\ 1 \text{ (Add Carry)} \\
 \hline
 0\ 0\ 1\ 1\ 0\ 0\ 0
 \end{array}$$

$$\begin{array}{r}
 1\ 1\ 0\ 0\ 1\ 0\ 1 \\
 +\ 0\ 0\ 0\ 0\ 0\ 1\ 0 \\
 \hline
 1\ 1\ 0\ 0\ 1\ 1\ 1 \text{ (No End carry – Re –ve)} \\
 \text{(9's Complement of result)} \\
 \hline
 0\ 0\ 1\ 1\ 0\ 0\ 0
 \end{array}$$

1's complement of  $1\ 1\ 0\ 0\ 1\ 1\ 1$  is  $0\ 0\ 1\ 1\ 0\ 0\ 0$

# Questions

**Q 1 :** Using 2's complement, Subtract  $1\ 1\ 1\ 1\ 1\ 0\ 1 - 1\ 1\ 0\ 0\ 1\ 0\ 1$

**Q 2 :** Using 2's complement, Subtract  $1\ 1\ 0\ 0\ 1\ 0\ 1 - 1\ 1\ 1\ 1\ 1\ 0\ 1$

Ans: 2's Complement of  $1\ 1\ 0\ 0\ 1\ 0\ 1$  is  $0\ 0\ 1\ 1\ 0\ 1\ 0 + 1 = 0\ 0\ 1\ 1\ 0\ 1\ 1$

2's Complement of  $1\ 1\ 1\ 1\ 1\ 0\ 1$  is  $0\ 0\ 0\ 0\ 0\ 1\ 0 + 1 = 0\ 0\ 0\ 0\ 0\ 1\ 1$

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

1)  $0\ 0\ 1\ 1\ 0\ 0\ 0$  (End Carry – Re +ve)  
(Ignore carry)

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

$1\ 1\ 0\ 1\ 0\ 0\ 0$  (No End carry Re –ve)  
(2's Complement of result)

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

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

2's complement of  $1\ 1\ 0\ 1\ 0\ 0\ 0$  is  $0\ 0\ 1\ 0\ 1\ 1\ 1 + 1 = 0\ 0\ 1\ 1\ 0\ 0\ 0$