

(r-1)'s Complement For Binary Numbers

- Another way:

The 1's complement of a binary number is even simpler to form: the 1's are changed into 0's and the 0's into 1's.

- **Example:** Find the 1's complement for following:

Will be replaced

$$\begin{array}{cccccc} & (101100)_2 \\ & \downarrow \downarrow \downarrow \downarrow \downarrow \downarrow \\ & = 010011 \end{array}$$

Subtraction with $(r-1)$'s complement

- The procedure for subtraction with the $(r-1)$'s complement is exactly the same as the variation, called, "end-around carry" as shown below. The subtraction of $M-N$, both positive numbers in base r , may be calculated in the following manner.
 - 1) Add the minuend M to the $(r-1)$'s complement of the subtrahend N .
 - 2) Inspect the result obtained in step 1 for an end carry
 - if **there is end carry** occurs, **add 1** to the least significant digit (end-around carry)
 - if **No end carry**, take the $(r-1)$'s complement of the number obtained in step 1 and place a **negative** sign in front.

Subtraction with (1)'s complement

- Example: subtract (1010100 - 1000100) using 1's complement :

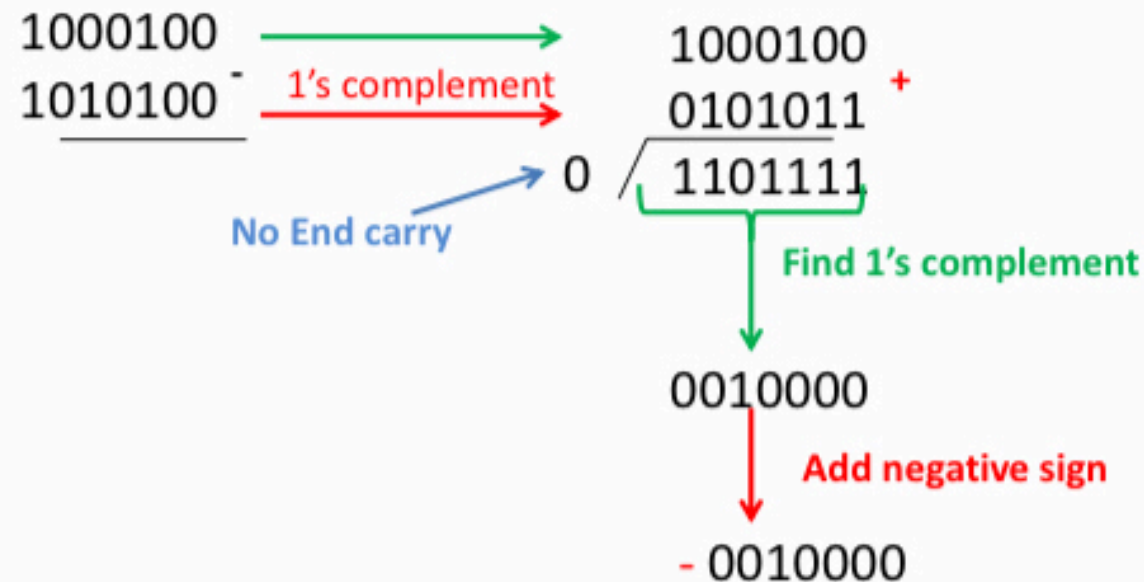
The diagram illustrates the subtraction of 1000100 from 1010100 using 1's complement. On the left, the subtraction is shown: 1010100 minus 1000100. A green arrow points from the minuend to the right, and a red arrow labeled "1's complement" points from the subtrahend to the right. On the right, the addition is shown: 1010100 plus 0111011 (the 1's complement of 1000100). A blue arrow labeled "End carry" points from the left to a circled "1", which is labeled "Add it" in green. This "1" is then added to the rightmost column of the addition, resulting in 0001111 plus 1. The final result, 0010000, is shown at the bottom.

$$\begin{array}{r} 1010100 \\ - 1000100 \\ \hline \end{array} \quad \begin{array}{r} 1010100 \\ + 0111011 \\ + 0001111 \\ + 1 \\ \hline 0010000 \end{array}$$

Answer= 10000

Subtraction with (1)'s complement

- Example: subtract 1010100 using 1's complement :



Answer= - 0010000

Example: Subtract 1010 from 1111 using 1's complement. Also subtract using direct method and compare.

Soln:

Direct Subtraction

$$\begin{array}{r} 1111 \\ - 1010 \\ \hline 0101 \end{array}$$

1's complement method

$$\begin{array}{r} 1111 \\ 1's\ comp \rightarrow + 0101 \\ \hline \end{array}$$

carry 1 0100

$$\begin{array}{r} \text{Add carry } 0100 \\ + \quad \quad 1 \\ \hline 0101 \end{array}$$

Subtract $(1010)_2$ from $(1111)_2$

Direct Subtraction

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

1's complement method

1's complement $\rightarrow$

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

Carry $\rightarrow$

$$1\ 0\ 1\ 0\ 0$$

Add Carry $\rightarrow$

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