

Finding complements: Complements are calculated by a typical mathematical formula. Though, it is arithmetic but very simple at the same time. We calculate the (r-1)'s complement first, then simply by adding 1, we get the r's complement.

(r-1)'s complement: (r-1)'s complement can be calculated by the following formula:

$$((r^n - 1) - N)$$

Here,

r is Radix or Base

n is number of digits in the actual number and

N is the actual number itself.

Examples:

Ex. 1) Find the **(r-1)'s** or 9's compliment of decimal number $(27)_{10}$.

here, $n = 2$, $r = 10$, $N = 27$

$$\begin{aligned} \text{thus, } (r-1)'s \text{ compliment} &= ((10^2 - 1) - 27) \\ &= ((100 - 1) - 27) \\ &= (99 - 27) \\ &= 72 \end{aligned}$$

Ex. 2) Find the **(r-1)'s** or 7's compliment of Octal number $(253)_8$.

here, $n = 3$, $r = 8$, $N = 253$

$$\begin{aligned} \text{thus, } (r-1)'s \text{ compliment} &= ((8^3 - 1) - 253) \\ &= ((512 - 1) - 253) \\ &= (511 - 253) \\ &= (511 - 171) \\ &= (340)_{10} = (524)_8 \end{aligned}$$

Since (253) is in octal and (511) is in decimal, we need to convert (253) to decimal first.

Ex. 3) Find the $(r-1)$'s or 15's complement of Hexadecimal number $(A9)_{16}$.

here, $n = 2$, $r = 16$, $N = A9$

$$\begin{aligned}
 \text{thus, } (r-1)\text{'s complement} &= ((16^2 - 1) - A9) \\
 &= ((256 - 1) - 253) \\
 &= (255 - A9) \\
 &= (255 - 169) \\
 &= (86)_{10} = (56)_{16}
 \end{aligned}$$

Since $(A9)$ is in Hexadecimal and (255) is in decimal, we need to convert $(A9)$ to decimal first.

Ex. 4) Find the $(r-1)$'s or 1's complement of Binary number $(11011)_2$.

here, $n = 5$, $r = 2$, $N = 11011$

$$\begin{aligned}
 \text{thus, } (r-1)\text{'s complement} &= ((2^5 - 1) - 11011) \\
 &= ((32 - 1) - 11011) \\
 &= (31 - 11011) \\
 &= (31 - 27) \\
 &= (4)_{10} = (00100)_2
 \end{aligned}$$

Since (11011) is in octal and (31) is in decimal, we need to convert (11011) to decimal first.

Here in examples 2, 3 and 4; we see that the non-decimal numbers i.e. $(253)_8$, $(A9)_{16}$ and $(11011)_2$ are converted to decimal numbers- 171, 169 and 27 respectively for ease of calculations.

After finding the final results (which are in decimal), we converted them back into their own number systems.

Assignments:

1. Calculate the $(r-1)$'s complements for the following-

a. Decimal number $(36)_{10}$

b. Octal number $(62)_8$

c. Hexadecimal number $(4D)_{16}$

d. Binary number $(101110)_2$