Complements are used in digital computer for simplifying the subtraction operation and logical manipulation. There are two types of compliments for each base r system. The **r's** complement and **(r-1)'s** complement.

(r-1)'s complement:- (r-1)'s complement of a number **N** is defined as **$(r^n-1)-N$** where **r** is radix(base) of number **n** is the number of digits in a number **N.**

r's complement:- The **r's** complement of a number **N** is defined as **r^n-N** for $N\neq0$ and for N=0 it is 0. r's complement may also be obtained by adding 1 to (r-1)'s complement.

1's complement:- In Binary number radix or base =2, & r-1 i.e. (2-1)=1, so **1's** complement of a number N is : **$(r^n-1)-N$**

In binary number **2^n** is represented by a binary number that consist of 1 followed by **n** 0's. Again **2^n - 1 is a binary number** represented by **n** 1's.

Ex:- if n=3

Then $2^3=[1000]_2$

& 2^n-1 = 1000-1=111

If n=4

Then $2^4=[10000]_2$

& 2^n-1 = 1000-1=1111

So the 1's complement of a binary number is obtained by subtracting each digit from 1. The subtraction of a binary digit from 1 causes the bit to change from 0 to 1 or from 1 to 0.

Ex:- 1's complement of $[10101]_2$

Formula **$(2^n-1)-N$**

Here, n=5, N=10101

So, $(2^5-1)-10101$

$=(100000-1)-10101$

$=11111 - 10101$

$=(01010)_2$

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2's Complement:- In binary base is 2 so **r's** i.e. 2's complement is **2^n-N.** Where **n** is total number of digits in a number **N.**

Ex:- 2's complement of $(11010)_2$

Formula **2^n-N**

Here, n=5 and N= 11010

So, 2^5-11010

=100000-11010

=00110

Note 1:- We can also obtain 2's complement by adding 1 into 1's complement:

Ex:- Number		1	1	0	1	0
	1's complement	0	0	1	0	1
						+ 1
		0	0	1	1	0

Note 2:- 2's complement can also be formed by leaving all least significant 0's and the first 1 unchanged and then replacing all 1's by 0s and 0's by 1 in all higher significant bit.

Ex:- Number $(1\ 1\ 0\ 1\ 0\ 0)_2$

2's complement $(0\ 0\ 1\ 1\ 0\ 0)_2$

9's Complement:- In decimal number system radix is 10, and [10-1=9], so 9's complement of a number **N** is **(10^n -1)-N.** In decimal 10^n represents a number that consists of a single 1 followed by **n** 0's and **10^n-1** is a number represented by **n** 9's.

Ex:- **If n=4 then 10^4-1=10000-1=9999**

So the 9's complement of a decimal number is obtained by subtracting each digits from 9.

Ex:- 9's complement of 742100

Formula **(10^n -1)-N,** Where n=6 and N=742100

⇨ (10^6-1)-742100

⇨ (1000000-1)-1

⇨ 999999-742100

⇨ 257899

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10's Complement:- The 10's complement of an **n** digit number **N** in base 10 is defined as $10^n - N$ for $N \neq 0$ and 0 for $N=0$. We can also obtain 10's complement by adding 1 to the 9's complement.

10's complement can also be formed by leaving all the least significant 0's unchanged, subtracting the first non-zero least significant digit from 10, and then subtracting all higher significant digits from 9.

Ex:- 10's complement of 74150

Formula $(10^n - N)$

First method

here n=5 and N=74150

$10^5 - 74150$

$100000 - 74150$

25850

second method

```
    9 9 9 9 9
  - 7 4 1 5 0
---------------
    2 5 8 4 9
          + 1
```

Third method

```
7 4 1 5 0
2 5 8 5 0
```


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