

# Bit Manipulation In C++

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Left shift ( $a \ll b = a * 2^b$ )

Right shift ( $a \gg b = a / 2^b$ )

For all odd numbers the last bit is 1, and for even it's 0

Odd/Even ( $n \& 1$ )? cout << "Odd" : cout << "Even";

Some properties of bitwise operations:

1.  $a | b = a \oplus b + a \& b$
2.  $a \oplus (a \& b) = (a | b) \oplus b$
3.  $b \oplus (a \& b) = (a | b) \oplus a$
4.  $(a \& b) \oplus (a | b) = a \oplus b$

Addition:

1.  $a + b = a | b + a \& b$
2.  $a + b = a \oplus b + 2(a \& b)$

Subtraction:

1.  $a - b = (a \oplus (a \& b)) - ((a | b) \oplus a)$
2.  $a - b = ((a | b) \oplus b) - ((a | b) \oplus a)$
3.  $a - b = (a \oplus (a \& b)) - (b \oplus (a \& b))$
4.  $a - b = ((a | b) \oplus b) - (b \oplus (a \& b))$

Get ith Bit

```
int get_ith_bit(int n, int i)
{
    int mask = (1<<i);
    return (n&mask)>0?1:0;
}
```

Clear ith Bit

```
int clear_ith_bit(int n, int i)
{
    int mask = ~(1<<i);
    n = (n&mask);
    return n;
}
```

### Set ith Bit

```
int set_ith_bit(int n, int i)
{
    int mask = (1<<i);
    n=(n|mask);
    return n;
}
```

### Update ith Bit

```
int update_ith_bit(int n, int i, int v)
{
    clearIthBit(n,i);
    int mask = (v<<i);
    n=(n|mask);
    return n;
}
```

### Clear last i Bit

```
int clear_last_i_bit(int n, int i)
{
    int mask = (-1<<i);
    n = (n&mask);
    return n;
}
```

### Clear Bits In Range

```
int clear_bits_in_range(int n, int i, int j)
{
    int a = (-1<<j+1);
    int b = (i<<i-1);
    int mask = (a|b);
    n = (n&mask);
    return n;
}
```

## Update Bits In Range

```
int replace_bits_in_range(int n, int v, int i, int j)
{
    n = clear_bits_in_range(n,i,j);
    int mask = (v<<i);
    cout << (n|mask);
}
```

## Check N is power of 2 or not

```
void n_is_power_of_two(int n)
{
    (n&(n-1)) ? cout << "false" : cout << "true";
}
```

## Count Set Bits (Method one)

```
int count_set_bits(int n)
{
    int cont=0;
    while(n>0)
    {
        n = (n&(n-1));
        cont ++;
    }
    return cont;
}
```

## Count Set Bits (Method Two)

```
int count_set_bits(int n)
{
    int cont=0;
    while(n>0)
    {
        int last_bit = (n&1);
        cont+=last_bit;
        n = n>>1;
    }
    return cont;
}
```