

MAY
1 2 3 4 5 6 7 8
9 10 11 12 13 14 15 16
17 18 19 20 21 22
23 24 25 26 27 28 29 30 31
MTWTFSSMTWTFSS



## Bit Manipulation

Now we will study about 4 major operations -

(i) Get bit → fetch a particular bit

(ii) Set bit → set a particular bit to 1.

(iii) Clear bit. → clear/make zero a particular bit.

(iv) Update bit. → update a particular bit to '0' or '1'.

E.g.) :- Get Bit → Get the 3rd bit (Position 2) of a number n. (here,  $n = 0101$ )

→ Position:  $\begin{matrix} 0 & 1 & 0 & 1 \\ \downarrow & \downarrow & \downarrow & \downarrow \\ 3 & 2 & 1 & 0 \end{matrix}$

(Position is always considered from right to left)

Now, to perform the ask, we will perform 2 steps -

(i) Bit mask,  $1 \ll i$ .

(ii) operation : AND.

$0001 \ll 2$  ( $i=2$ , here) ( $i = \text{Position no.}$ ).

$0100$  ↓ (bit masked result) of  $1 \ll 2$

$0100$   
 $0101$

(Perform AND operation)

$0100$  ↓ if result is non-zero, bit = 1

if result is zero, bit = 0.

∴ 3rd bit (position 2) of  $n$  ( $n = 0101$ ) is 1.

Logic :- if the 3rd bit is 1, the multiplication after bit masking with the original number will yield 1. Also, if it's zero, it would yield zero.

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	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
M	T	W	T	F	S	S	M	T	W	T	F	S					

E.g.,  $m = 0101$ ,  
Position = 3.

~~1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0~~  $1 \ll 3 \rightarrow 0001 \ll 3 \rightarrow 1000$   
2 1000.

Now, 1000  
& 0101  
 $\underline{\quad\quad\quad}$  As result is zero, so, 3rd position  
or 4th bit of 'm' should be '0'.

- we left shift '1' or '0001' by the position no. (i).  
Then perform logical '&' operation with original no.(ii)

### E.g. II) Set Bit

Set the 2nd bit (Position = 1) of a number m.  
 $m = 0101$ .

Steps - (i) Bit mask :  $1 \ll i$   
(ii) operation : OR

$1 \ll i \rightarrow 0001 \ll 1 \rightarrow 0010$ .

0010

0101

0111

Logic :- If we perform bit mask, the logical OR will always set '1' in the desired position.

2022

MAY	1	2	3	4	5	6	7	8
S	9	10	11	12	13	14	15	16
M	17	18	19	20	21	22		
T	23	24	25	26	27	28	29	30
W	31							
F								
S								
S								

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14  
Thursday

Eg. ii) clear Bit

- Q) clear the 3rd bit (Position = 2) of a number n.  
(n = 0101).

Steps:- (i) Bit Mask :  $1 \ll i$   
(ii) operation : AND with NOT. (NOT of bitmask)

$$0001 \ll 2 \rightarrow 0100 \xrightarrow{\text{not}} 1011$$

$$\begin{array}{r} & 0101 \\ \& \underline{0001} \\ (0001)_2 = (1)_{10} \end{array}$$

Logic:- when bit masked,  
it yields 1 in a particular position. Now,  
AND with  $\sim 1$  will always yield 0.

Eg. iii) Update Bit

- Q) update the 2nd bit (Position = 1) of a number n to 1.  
(n = 0101).

For 0,

Bit mask :  $1 \ll i$ 

operation : AND with NOT

For 1,

Bit mask :  $1 \ll i$ 

operation : OR

 $1 \ll 1$ 

$0001 \ll 1 \rightarrow 0010.$

$\sim 0010 \rightarrow 1101.$

 $1 \ll 1$ 

$0001 \ll 1 \rightarrow 0010.$

 $0010$  $0101$  $0111$ 

1101

0101

0101

Ans:- 0101,

2nd bit is 0.

Ans:- 0111

2nd bit is updated to 1.