# AND Problem

Given $n$

perform.

$n \,\&\, (n-1) \,\&\, (n-2) \,\&\, (n-3)$

$\ldots\ldots \,\&\, (n-K)$

find 'K' for which the above sequence will be 0

'K' is not necessarily zero.

## Example

$n=5$

$5 \,\&\, (5-1) \,\&\, (5-2)$

$\Rightarrow 5 \,\&\, 4 \,\&\, 3 = 0$

So $\boxed{K=3}$

Sol

① Naive Implementation

```
Let res = n
for i = 1 to n
    res = res & (n-i)
    if (res == 0)
        return (number-i)
```

Using this Naive Approach.

finding the result 1 to 560

1 → 0

2 → 1 ; 3 → 1

[4, 7] → 3

[8, 15] → 7

[16, 31] → 15

[32, 63] → 31

[64, 127] → 63

[128, 255] → 127

[256, 511] → 256

[512, 560] → 511

$1 \to 0$

$[2, 3] \to 1$

$[4, 7] \to 3$

$[8, 15] \to 7$

$[16, 31] \to 15$

$[32, 63] \to 31$

$[64, 127] \to 63$

$[128, 255] \to 127$

$[256, 511] \to 255$

$[512, 560] \to 511$

$1 \rightarrow 0$

$[2^1, 3] \rightarrow 1$

$[2^2, 7] \rightarrow 3$

$[2^3, 15] \rightarrow 7$

$[2^4, 31] \rightarrow 15$

$[2^5, 63] \rightarrow 31$

$[2^6, 127] \rightarrow 63$

$[2^7, 255] \rightarrow 127$

$[2^8, 511] \rightarrow 255$

$[2^9, 1023] \rightarrow 511$

$1 \rightarrow 0$

$[2^1, 2^2-1] \rightarrow 1$

$[2^2, 2^3-1] \rightarrow 3$

$[2^3, 2^4-1] \rightarrow 7$

$[2^4, 2^5-1] \rightarrow 15$

$[2^5, 2^6-1] \rightarrow 31$

$[2^6, 2^7-1] \rightarrow 63$

$[2^7, 2^8-1] \rightarrow 127$

$[2^8, 2^9-1] \rightarrow 255$

$[2^9, 2^{10}-1] \rightarrow 511$

$1 \rightarrow 0$

$[2^1, 2^2-1] \rightarrow (2^1-1)$

$[2^2, 2^3-1] \rightarrow (2^2-1)$

$[2^3, 2^4-1] \rightarrow (2^3-1)$

$[2^4, 2^5-1] \rightarrow (2^4-1)$

$[2^5, 2^6-1] \rightarrow (2^5-1)$

$[2^6, 2^7-1] \rightarrow (2^6-1)$

$[2^7, 2^8-1] \rightarrow (2^7-1)$

$[2^8, 2^9-1] \rightarrow (2^8-1)$

$[2^9, 2^{10}-1] \rightarrow (\underline{2^9-1})$

```
if n==1
    return 0
if (n==2)||(n==3)
    return 1.
```

→ Count number of bits in 'n'

```
let count = 0
while(number) {
    Count++;
    number >>=1;
}
```

Bits → Number of Bits in 'number'

Let 'b' be number of bits in 'n'.

**Now**

① $(1<<b)$ gives next 2 power greater than 'n'.

② $1<<(b-1)$ gives

if 'n' is a power of 2 then it gives 'n' itself

if 'n' is not power of 2. then it gives 2 power less than 'n' observe the sequence

$1 \rightarrow 0$

$2, 3 \rightarrow 1$

$[2^1, 2^2-1] \rightarrow (2^1-1)$

$[2^2, 2^3-1] \rightarrow (2^2-1)$

$[2^3, 2^4-1] \rightarrow (2^3-1)$

$[2^4, 2^5-1] \rightarrow (2^4-1)$

$[2^5, 2^6-1] \rightarrow (2^5-1)$

$[2^6, 2^7-1] \rightarrow (2^6-1)$

$[2^7, 2^8-1] \rightarrow (2^7-1)$

$[2^8, 2^9-1] \rightarrow (2^8-1)$

$[2^9, 2^{10}-1] \rightarrow (2^9-1)$

## Solution (Efficient)

```
if(n ==1)
    return 0;

if(n==2|| n==3)
    return 1;

Let b -> Bits in 'n'
return (1<<(b-1))-1;
```

In the above Sequence the lowest term and Answer are related by diff of 1

Lowest term is the lowest power of 2 less than the 'n'.