

## Next Power of 2

Write a function that, for a given no n, finds a number p which is greater than or equal to n and is a power of 2.

IP 5

OP 8

IP 17

OP 32

IP 32

OP 32

There are plenty of solutions for this. Let us take the example of 17 to explain some of them.

### Method 1(Using Log of the number)

1. Calculate Position of set bit in p(next power of 2):  
pos = ceil(lgn) (ceiling of log n with base 2)
2. Now calculate p:  
p = pow(2, pos)

### Example

Let us try for 17

pos = 5

p = 32

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## Method 2 (By getting the position of only set bit in result )

```
/* If n is a power of 2 then return n */
1 If (n & !(n&(n-1))) then return n
2 Else keep right shifting n until it becomes zero
  and count no of shifts
  a. Initialize: count = 0
  b. While n != 0
      n = n>>1
      count = count + 1

/* Now count has the position of set bit in result */
3 Return (1 << count)
```

Example:

```
Let us try for 17
      count = 5
      p      = 32
```

```
unsigned int nextPowerOf2(unsigned int n)
{
    unsigned count = 0;

    /* First n in the below condition is for the case where n is 0*/
    if (n && !(n&(n-1)))
        return n;

    while( n != 0)
    {
        n >>= 1;
        count += 1;
    }

    return 1<<count;
}

/* Driver program to test above function */
int main()
{
```



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```

unsigned int n = 0;
printf("%d", nextPowerOf2(n));

getchar();
return 0;
}

```

### Method 3(Shift result one by one)

Thanks to coderyogi for suggesting this method . This method is a variation of method 2 where instead of getting count, we shift the result one by one in a loop.

```

unsigned int nextPowerOf2(unsigned int n)
{
    unsigned int p = 1;
    if (n && !(n & (n - 1)))
        return n;

    while (p < n) {
        p <<= 1;
    }
    return p;
}

/* Driver program to test above function */
int main()
{
    unsigned int n = 5;
    printf("%d", nextPowerOf2(n));

    getchar();
    return 0;
}

```

**Time Complexity:**  $O(\lg n)$

### Method 4(Customized and Fast)

1. Subtract n by 1  
n = n -1

2. Set all bits after the leftmost set bit

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2. Set all bits after the leftmost set bit.

```
/* Below solution works only if integer is 32 bits */
n = n | (n >> 1);
n = n | (n >> 2);
n = n | (n >> 4);
n = n | (n >> 8);
n = n | (n >> 16);

3. Return n + 1
```

Example:

Steps 1 & 3 of above algorithm are to handle cases of power of 2 numbers e.g., 1, 2, 4, 8, 16,

Let us try for 17(10001)

step 1

n = n - 1 = 16 (10000)

step 2

```
n = n | n >> 1
n = 10000 | 01000
n = 11000
n = n | n >> 2
n = 11000 | 00110
n = 11110
n = n | n >> 4
n = 11110 | 00001
n = 11111
n = n | n >> 8
n = 11111 | 00000
n = 11111
n = n | n >> 16
n = 11110 | 00000
n = 11111
```

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step 3: Return n+1


We get  $n + 1$  as 100000 (32)

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### Program:

```
# include <stdio.h>

/* Finds next power of two for n. If n itself
   is a power of two then returns n*/

unsigned int nextPowerOf2(unsigned int n)
{
    n--;
    n |= n >> 1;
    n |= n >> 2;
    n |= n >> 4;
    n |= n >> 8;
    n |= n >> 16;
    n++;
    return n;
}

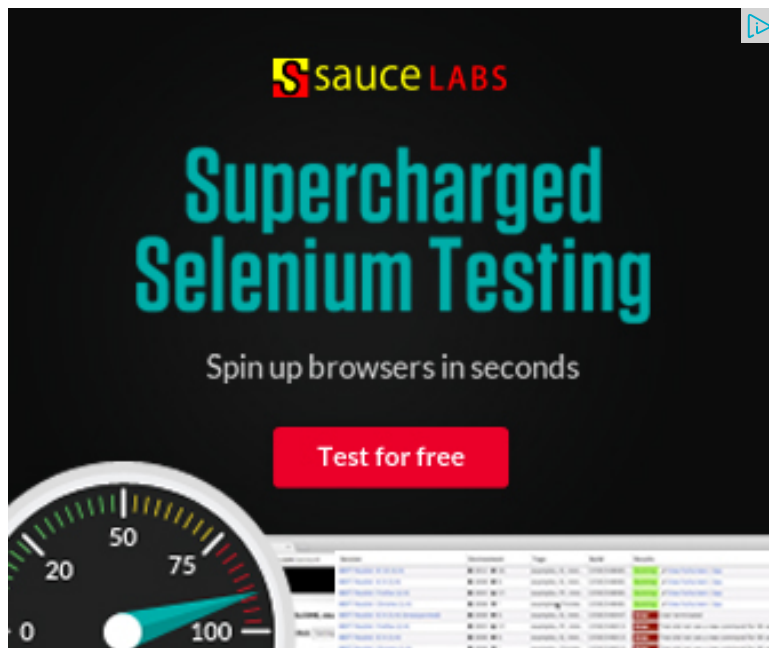
/* Driver program to test above function */
int main()
{
    unsigned int n = 5;
    printf("%d", nextPowerOf2(n));

    getchar();
    return 0;
}
```

**Time Complexity:**  $O(\lg n)$

### References:

[http://en.wikipedia.org/wiki/Power\\_of\\_2](http://en.wikipedia.org/wiki/Power_of_2)



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