

Efficient method to find factors of a Number

If we analyze the factors of 24, they are 1, 2, 3, 4, 6, 8, 12, 24. We notice that, $1 \times 24 = 24$, so when we found that 1 is a factor of 24, we also know that 24 is yet another factor. Similarly, $2 \times 12 = 24$. So, when we found that 2 is a factor of 24, we also know that 12 is also a factor of 24. This applies for 3×8 and 4×6 as well. This means that we can find all factors of 24 by looping till 4.

Let's take another example, 16:

```
16 = 1 x 16
16 = 2 x 8
16 = 4 x 4
16 = 8 x 2
16 = 16 x 1
```

Again, we can loop till 4 and find all the factors of 16. In this way, in order to find factors of x , we have to loop till \sqrt{x} .

Process of finding all factors of x in efficient way;

1. Loop from 1 to \sqrt{x} , call it i .
2. If $x \% i == 0$, then add i to the list of factors.
3. Now if $x \% i == 0$, we can say for sure that, x/i is also a factor of x . So, add x/i to the list of factors.
 - For example: in case of 16, we see that $16 \% 2 == 0$, now $16/2$ which is 8 is also a factor of 16.
4. There is one catch in the above step. What if i is same as x/i ?
 - For example: in case of 16, when $i = 4$, $16 \% 4 == 0$, so we add i and $16/i$ to list of factors, but $16/i$ is also 4. We will have to handle this case while converting the process into code.

Note: Time Complexity of the above algorithm to find factors is $O(\sqrt{N})$.