

# ChatGPT - Find $s$ in $O(1)$

Give for this question Given  $N$ , find  $s$  such that sum of first  $s$  natural number is  $N$ , in  $O(1)$  time

Example 1:

Input:  $N = 10$

Output: 4

Explanation: Sum of first 4 natural number is  $1 + 2 + 3 + 4 = 10$ .

To solve this problem in  $O(1)$  time, you can use the formula for the sum of the first  $s$  natural numbers:

$$\text{Sum} = \frac{s \times (s + 1)}{2}$$

Here, given  $N$ , you need to find  $s$ . Rearrange the formula to find  $s$ :

$$s^2 + s - 2N = 0$$

This is a quadratic equation. Solve it using the quadratic formula:

$$s = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

For this problem:

- $a = 1$
- $b = 1$
- $c = -2N$

Thus:

$$s = \frac{-1 \pm \sqrt{1 + 8N}}{2}$$

Since  $s$  must be positive, we take the positive root:

$$s = \frac{-1 + \sqrt{1 + 8N}}{2}$$

Finally, since  $s$  must be an integer, take the floor of the result.

### Algorithm:

1. Compute  $\sqrt{1 + 8N}$ .
2. Compute  $\frac{-1 + \sqrt{1 + 8N}}{2}$ .
3. Return the floor of the result.

### Example:

For  $N = 10$ :

1.  $\sqrt{1 + 8 \times 10} = \sqrt{81} = 9$ .
2.  $s = \frac{-1 + 9}{2} = \frac{8}{2} = 4$ .
3. Output: 4.

Let me know if you want me to provide Java code for this!