

**Q1.** You have been given 2 special, extremely rugged Xboxes. You are in an office building that is 120 stories high. Using the fewest possible number of drops from windows in your office building, determine the highest floor you can drop an Xbox from and have it survive: for example, they might be able to take the drop from the 30th floor, but not the 31st. You can break both Xboxes in your search. State the worst-case number of drops needed and explain how you arrived at that answer.

Ans.

What we can do is always having the same maximum number of drops left regardless of the outcome. Every time the Xbox doesn't break, we should have  $n-1$  drops remaining; and if the Xbox does break, we should have  $n-1$  drops remaining. This forces us to always increment our floor by one fewer whenever the first Xbox does not break. If we were to start at floor 10, we would then have to move to floor 19, then 28, and so on. Thus, the floors on which we should drop the first Xbox (assuming no breaks) are:

$n$   
 $n + n - 1$   
 $n + n - 1 + n - 2$   
 $n + n - 1 + n - 2 + n - 3$   
...

Which, after  $n$  iterations, needs to be above 120. To simplify, this basically means we should find the minimum value for  $n$  such that  $\text{SUM}(1..n) \geq 120$ .

$n(n+1)/2 > 120$  implies  $n = 15$ , both our starting floor and the number of iterations required to figure out the strength of the Xboxes.