Question 1 by Dan Nguyen (z5206032)

There is n given stacks of blocks, S, where the ith stack contains $h_i > 0$ blocks i.e. stacks cannot be empty. The height of each stack is also given. Blocks can only be moved from the ith stack to the $(i+1)$th stack.

Suppose that a set of stacks, T, has strictly increasing stack heights i.e. stack 1 has a stack height of 1, stack 2 has a stack height of 2, and so on:

$$T = (1, 2, 3, ..., n-2, n-1, k), k \geq n$$

To rearrange S into T, for each stack in S, starting at the 1st stack and up to the nth stack: ensure the ith stack has exactly i blocks. If the ith stack has more than i blocks, then move the excess blocks to the $(i+1)$th stack.

If the ith stack has less than i blocks or the $(i+1)$th stack has less than $(i+1)$ blocks then it's not possible to have strictly increasing stack heights.

Counting the stack height (and thus moving blocks between stacks) has a time complexity of $O(1)$ since it is a given input.

Iterating through each stack has a time complexity of $O(n)$ as required.