Lists

The rules The purpose of these exercises is to work with the material and enhance your problem-solving skills. These exercises are not to be submitted and they are not part of the assessment of the course. Some of them will be discussed in the tutorials. The instructors are not able to provide solutions to these exercises, but they may give feedback and hints if you want to discuss some of these problems (and show first what are the approaches that you tried). The problems with a star may require a bit more thinking.

1. Given a positive integer `n`, generate the first `n` rows of Pascal's triangle. You can read about Pascal's triangle on Wikipedia: `https://en.wikipedia.org/wiki/Pascal%27s_triangle`

Example

INPUT: `5`

OUTPUT: `[ [1], [1,1], [1,2,1], [1,3,3,1], [1,4,6,4,1] ]`

2. Given a list of integers, check if it could become an increasing list by modifying at most one element. We say that a list a with n elements is increasing if $a[i] \leq a[i+1]$ for any $1 \leq i < n$.

Example

INPUT: `[4,2,3]`

OUTPUT: `True` (We can change the first element to 1, and the list would become increasing).

INPUT: `[4,2,1]`

OUTPUT: `False`

3. Given a rectangular matrix, print its elements in spiral order.

Example

INPUT: `[ [ 1, 2, 3, 4 ], [ 5, 6, 7, 8 ], [ 9, 10, 11, 12 ] ]`

OUTPUT: `1, 2, 3, 4, 8, 12, 11, 10, 9, 5, 6, 7`.

4. First, read about look-and-say numbers on Wikipedia: `https://en.wikipedia.org/wiki/Look-and-say_sequence`. Then, write a function `look_and_say()` that takes as a parameter a list of numbers `a` and returns a list of numbers that results from "reading off" the initial list using the look-and-say method, using tuples for each (count, value) pair.

Example

```
look_and_say([1, 1, 1]) == [(3, 1)]
look_and_say([-1, 2, 7]) == [(1, -1), (1, 2), (1, 7)]
look_and_say([3, 3, 8, -10, -10, -10]) == [(2, 3), (1, 8), (3, -10)]
```

5. Given a positive integer, you could swap two digits at most once to get the maximum number. Return the maximum number you can get.

Example

Input: `2836`
Output: `8236`
Input: `982`
Output: `982`

6. Quadkeys. See problem description here: `https://open.kattis.com/problems/maptiles2`

7. Given an unsorted list of integers, find the length of longest increasing contiguous subsequence. Your solution should be linear in the size of the list.

Example

Input: `[1, 3, 5, 4, 7]`
Output: `3` (The longest contiguous increasing subsequence is `[1, 3, 5]`. Even though `[1, 3, 5, 7]` is also an increasing subsequence, it is not contiguous).

*__8.__ Given as input a 2D matrix representing an image, rotate it by 90 degrees clockwise. You need to rotate the image in-place, which means that you have to modify the input matrix directly. It is not possible to allocate another matrix to store the result of the rotation.

Example

```
 Input                  Output
 [                     [
   [1, 2, 3],            [7, 4, 1],
   [4, 5, 6],            [8, 5, 2],
   [7, 8, 9]             [9, 6, 3]
]                       ]
```