

Question 1 : House of Cards [10 marks]

A house of cards (also known as a card tower) is a structure created by stacking playing cards on top of each other.

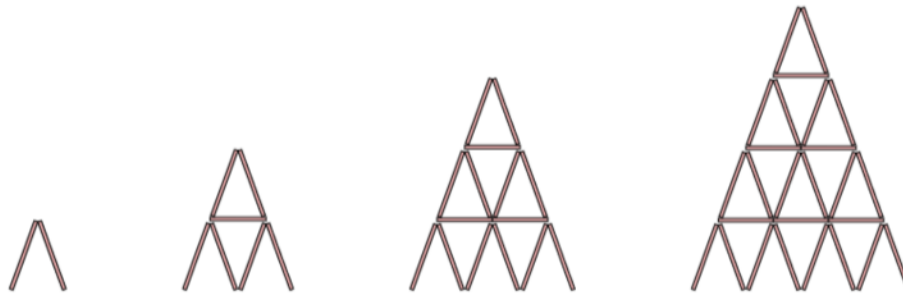
–Source: Wikipedia



A 4-level classic card tower

The tower is created by layers and each layer is created by stacking cards horizontally on top of pairs of supporting cards. As the tower height increases, so does the width of the bottom-most layer.

The following illustrates card towers of heights 1 to 4. Note that there are no cards at the base of the tower.

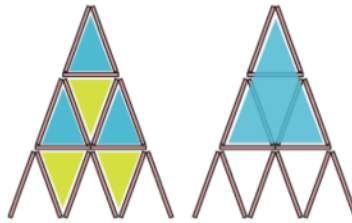


A. Implement the function `num_cards` which takes a non-negative integer h , and returns the number of cards needed to build a tower of height h . Your function should solve the problem computationally, i.e. using recursion or iteration and not simply use a formula. [5 marks]

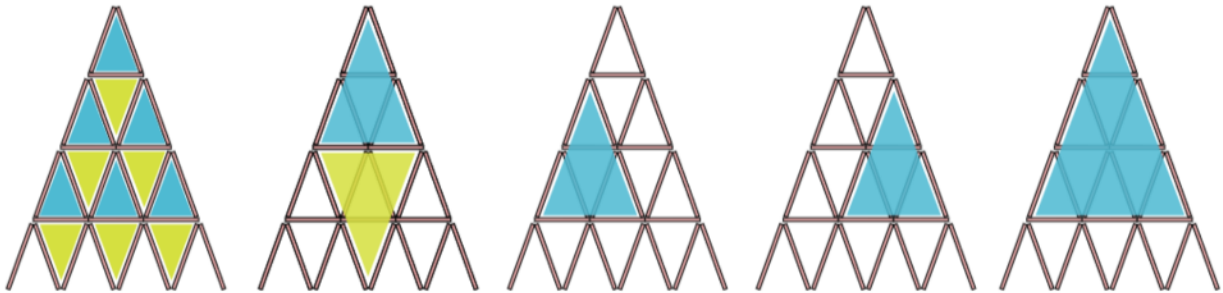
Sample execution:

```
>>> num_cards(1)
2
>>> num_cards(2)
7
>>> num_cards(3)
15
>>> num_cards(4)
26
```

B. Jerryl sees that a card tower is made up of overlapping triangles of different sizes. For example, he counts 7 triangles (4 upright and 3 inverted) in a card tower of height 3:



and 17 triangles (10 upright and 7 inverted) in a card tower of height 4:



Note that as with before, there are no cards on the base to make triangles there.

Implement a function `num_triangles`, which takes a non-negative integer h , and returns the number of triangles that can be formed from a tower of height h . Your function should solve the problem computationally, i.e. using recursion or iteration and not simply use a formula.

Hint: You may want to consider counting upright and inverted triangles separately. [5 marks]

Sample execution:

```
>>> for i in range(1, 10):
      num_triangles(i)

0
2
7
17
33
57
90
134
190
```