

# **4.Sunflower spirals**

Reporter – Olga Koufa

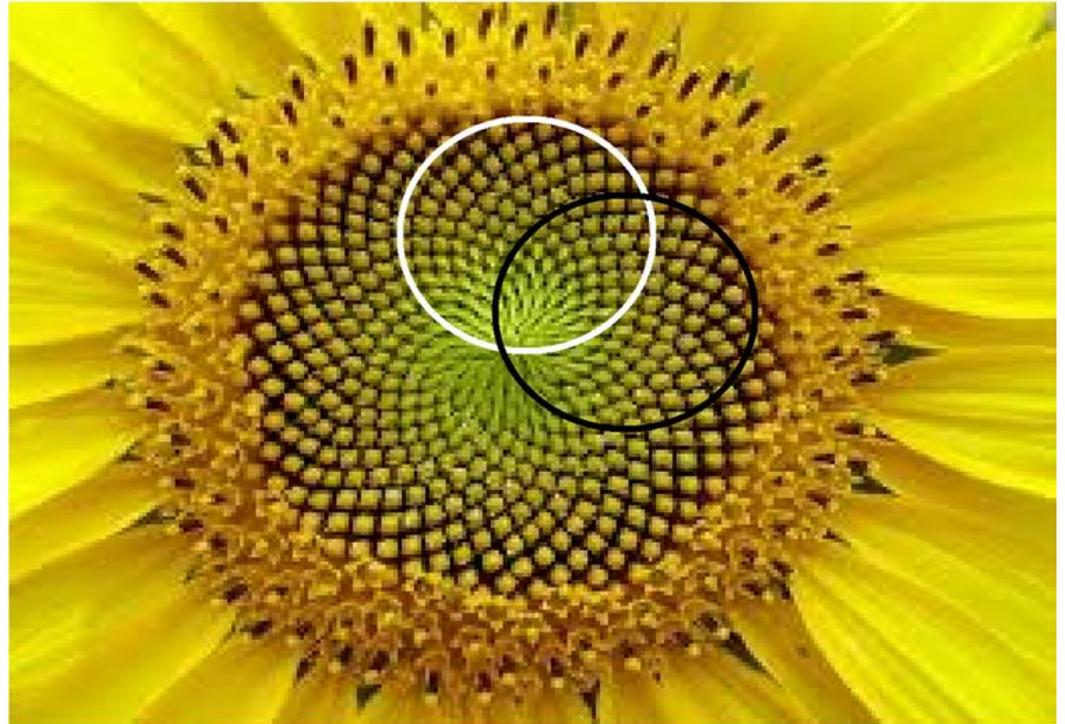
- Patterns of seeds in the head of a sunflower have a very specific geometric structure.



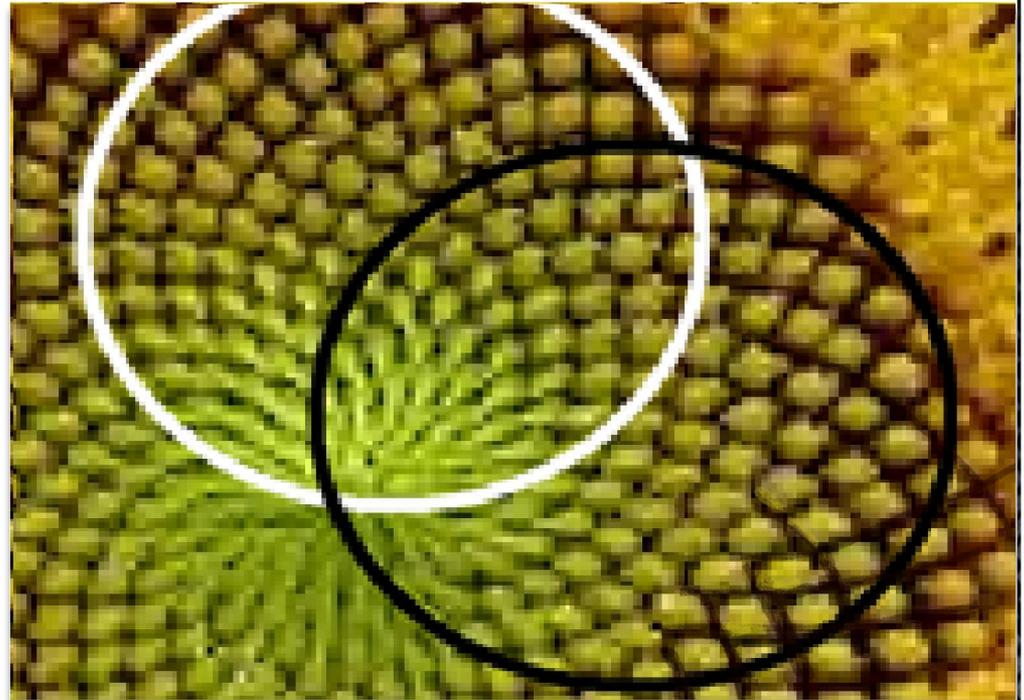
- Similar to this phenomenon are
  - the pineapples
  - the pine cones.



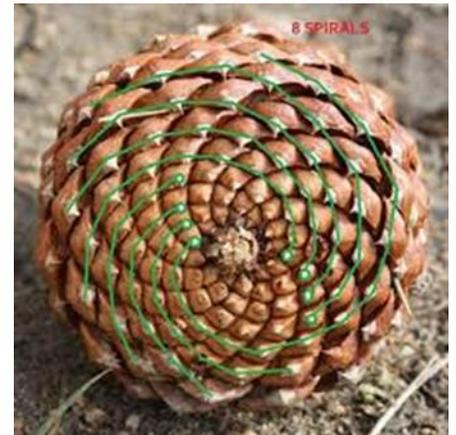
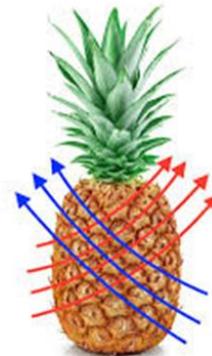
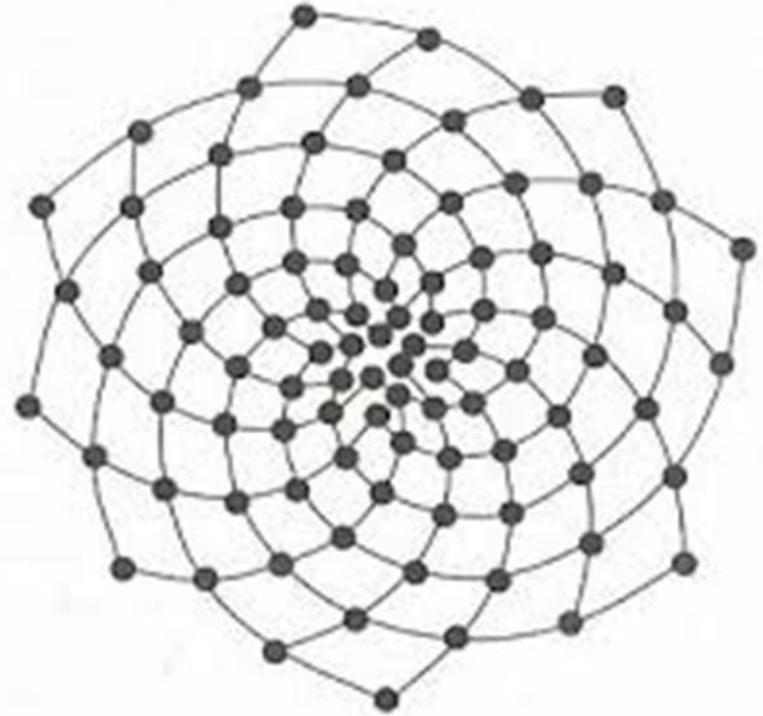
- **First guess was that they were all made up from circles**



- **The circles didn't completely match**
- **At the first half they were mirrored with the seeds**
- **At the second half there was no connection or resemblance**



- The second approach was the Fibonacci numbers

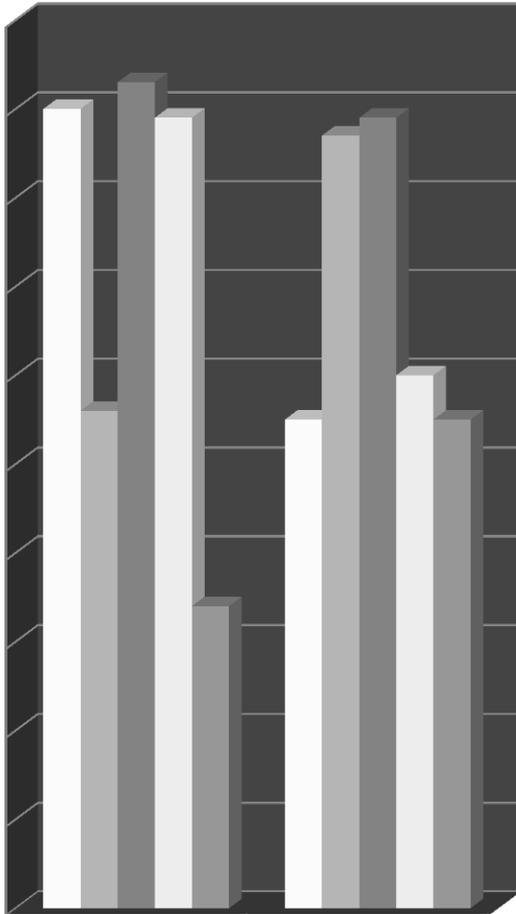


- It starts with 2 seeds  $1+1$ ,
- $1+1=2$  ,  $1+2=3$  ,  $3+2=5$  ....
- The plants that exhibit these spirals grow their seeds from the center point

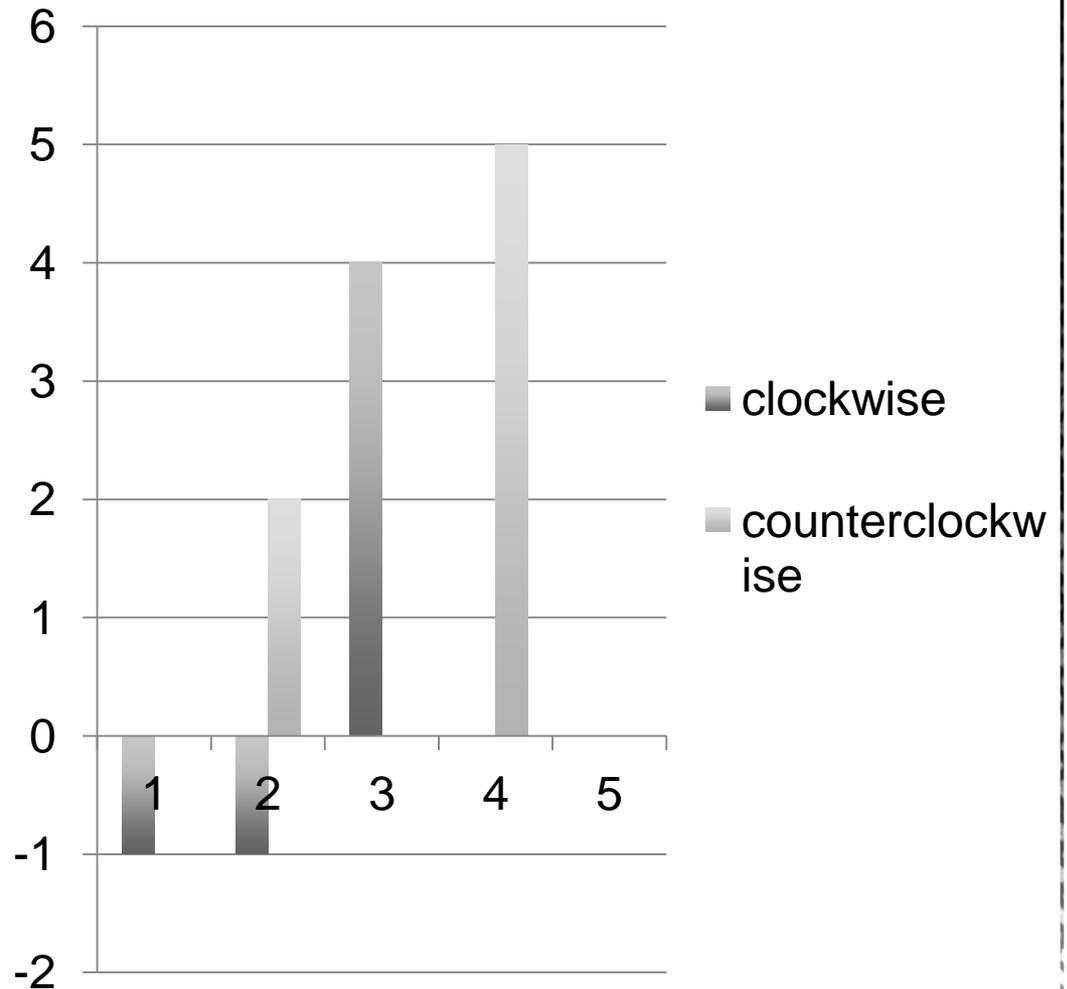
## *The Fibonacci* *sequence*

# The inner spirals where too abstract to count

how much the spirals are off for the perfect Fibonacci pattern

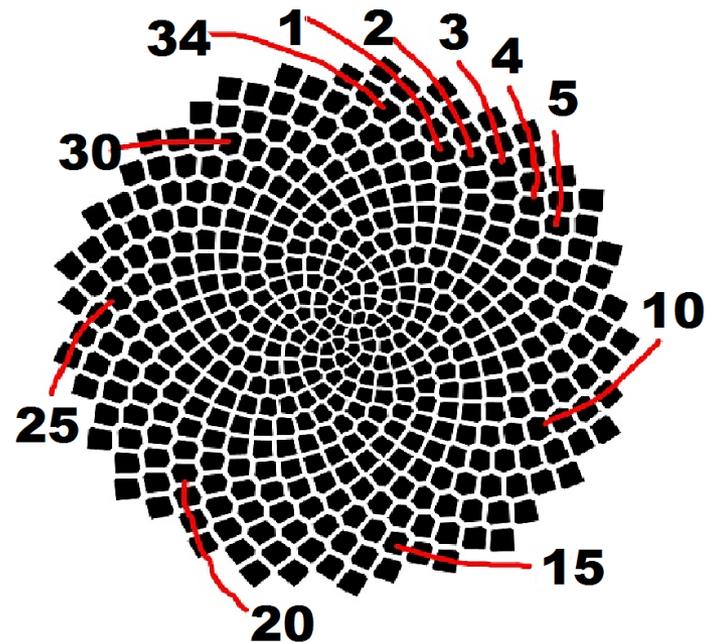
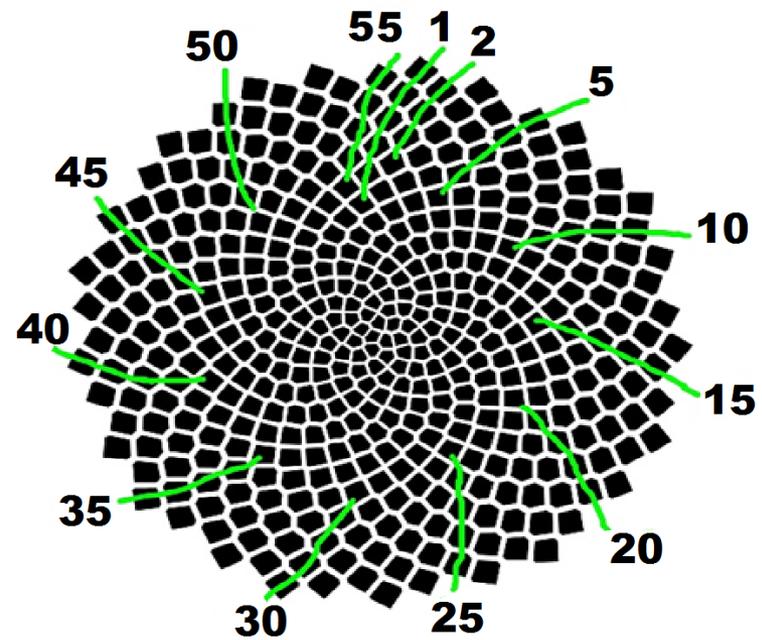


	clockwise	counter cl.
sun/er 1	90	55
sun/er 2	56	87
sun/er 3	93	89
sun/er 4	89	60
sun/er 5	34	55



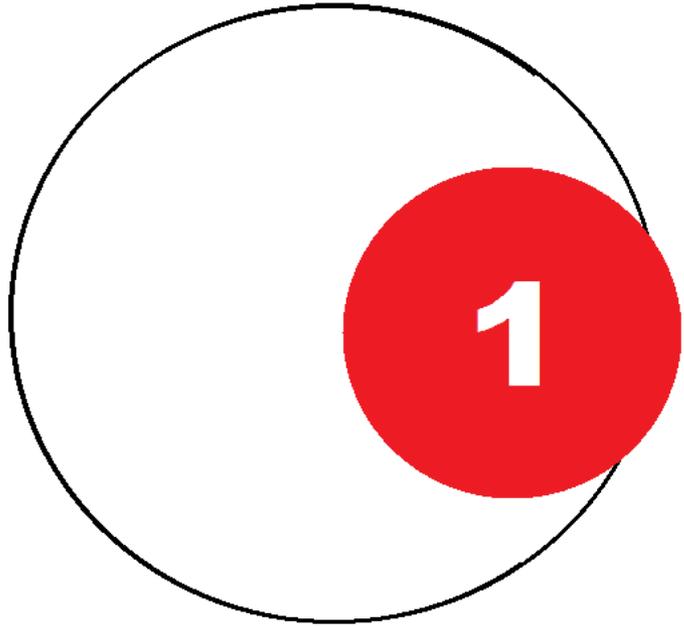
■ clockwise  
 ■ counterclockwise

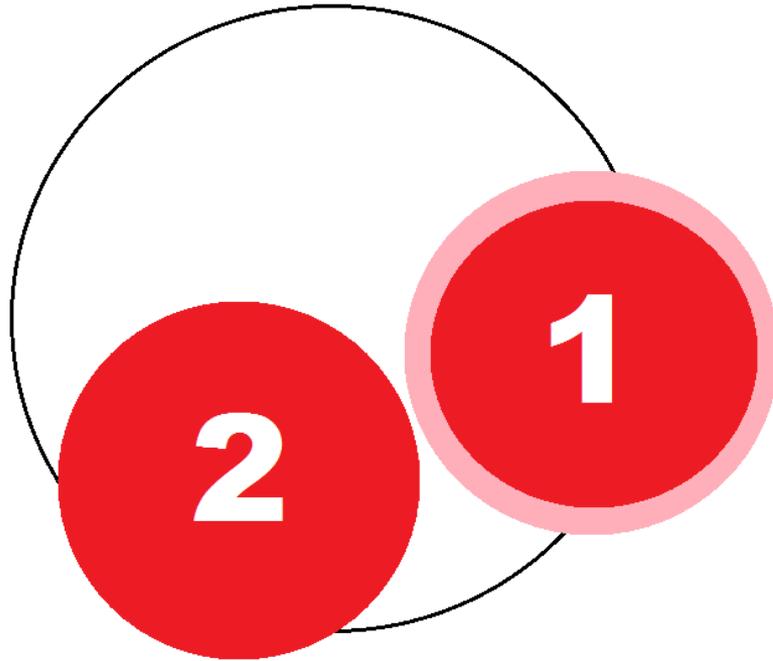
- The spirals which follow a clockwise rotation are 55
- The spirals which follow a counterclockwise rotation are 34

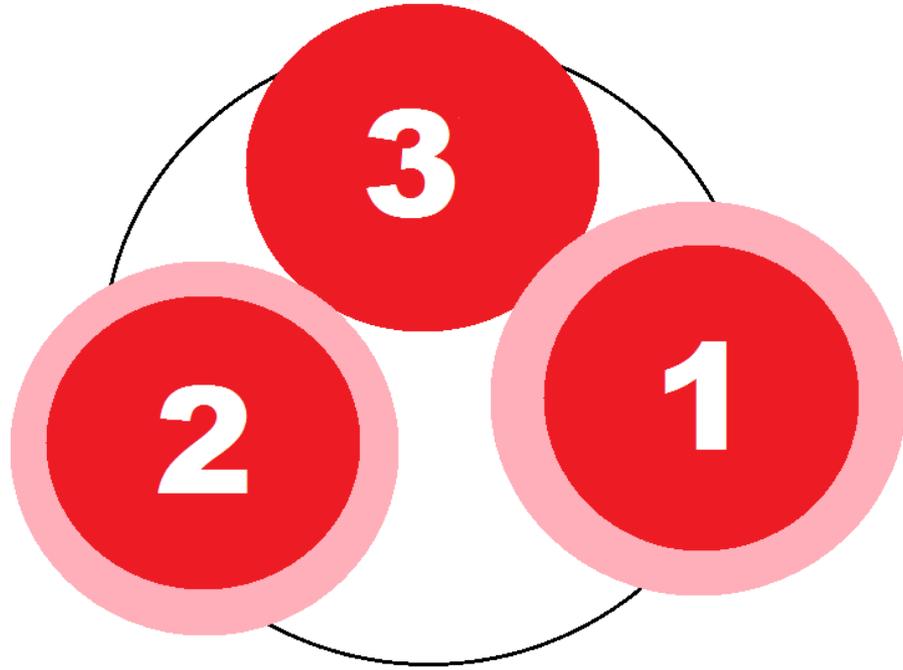


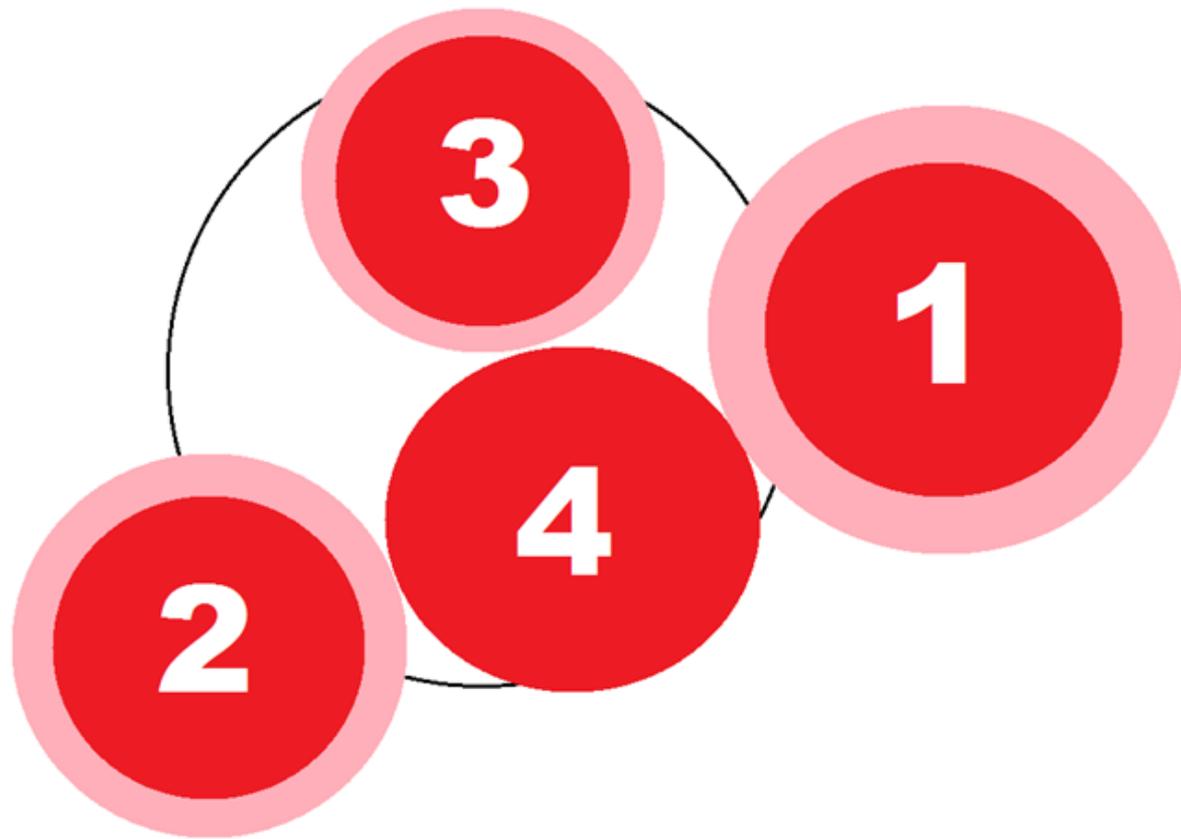
- Both 55 and 34 belong to the Fibonacci numbers
  - 1 1 2 3 5 8 13 21 34 55 89
  - And then I searched for a different pattern that is made up from 21 spirals
- the less spirals the further in

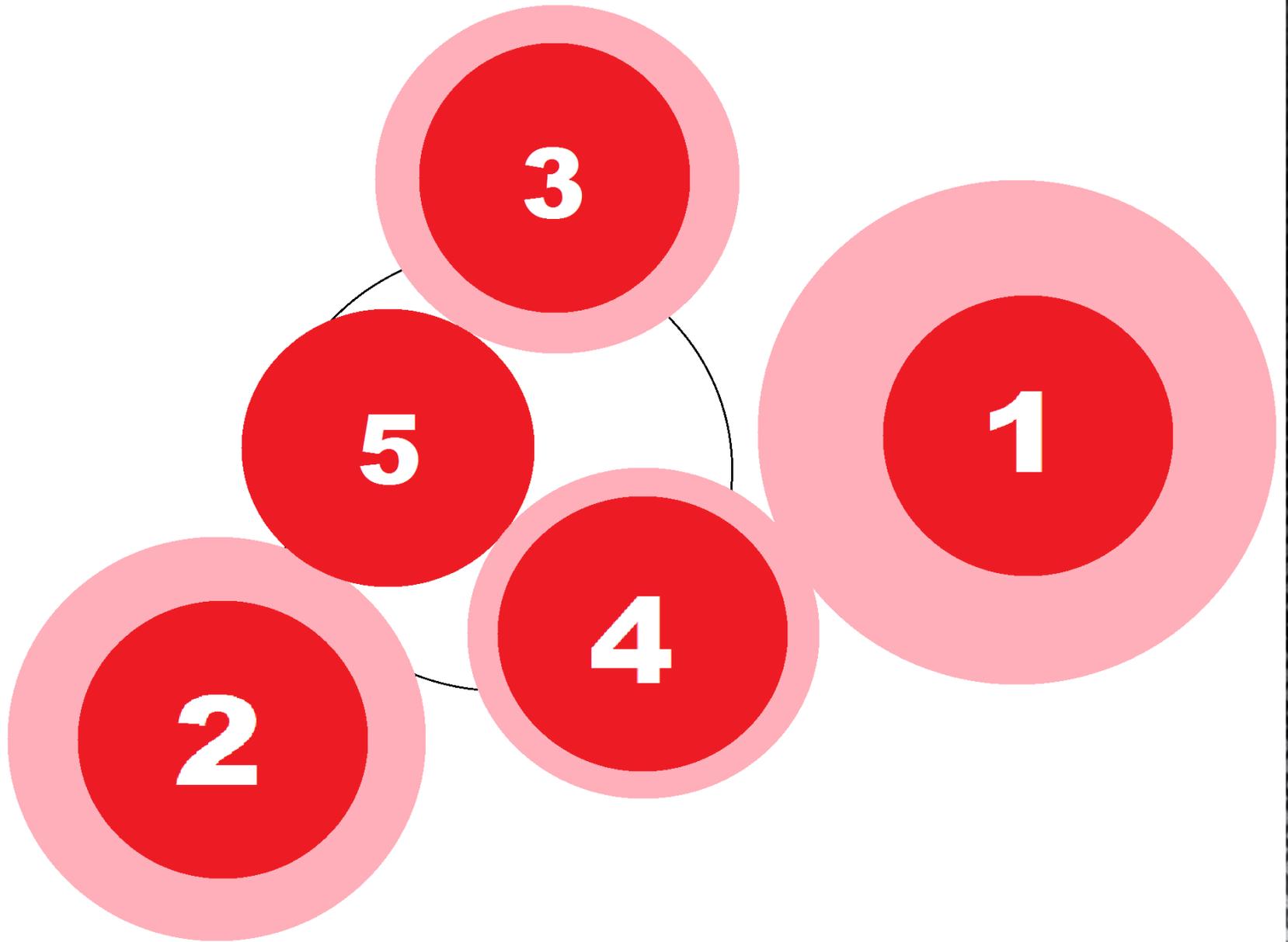






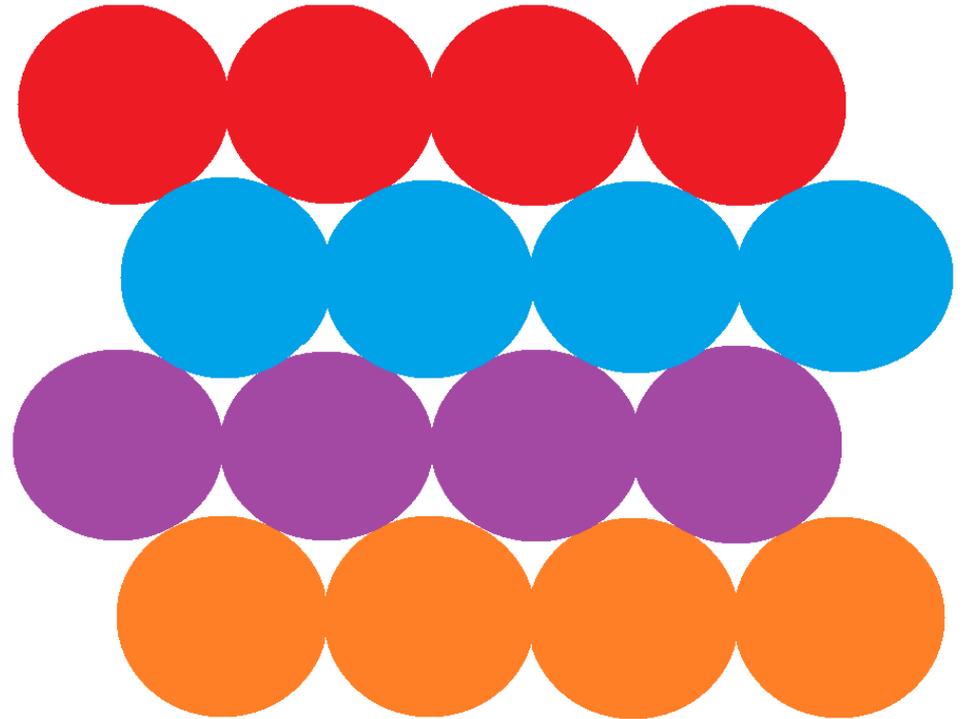


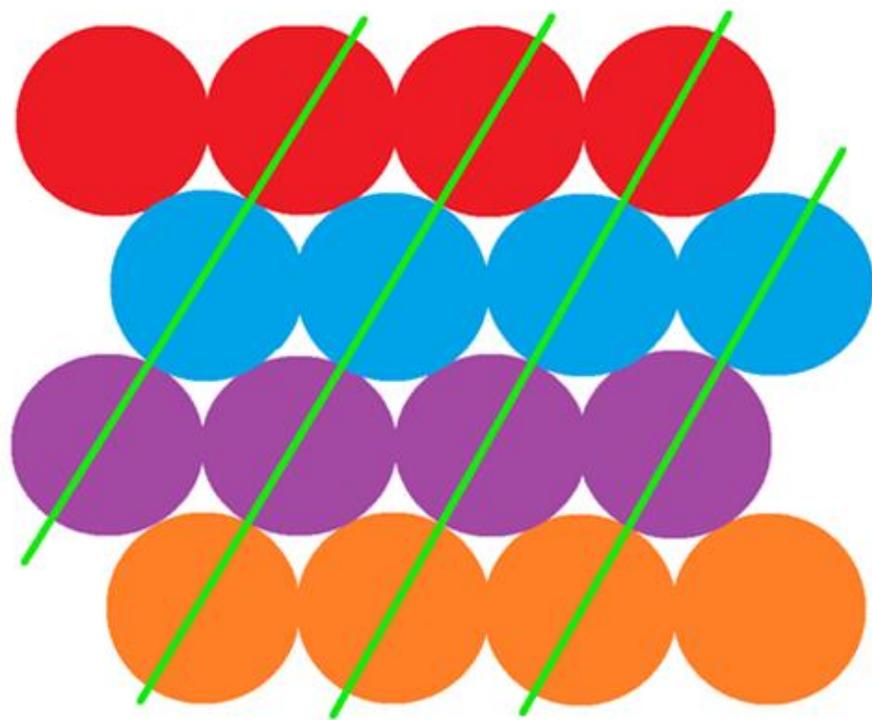
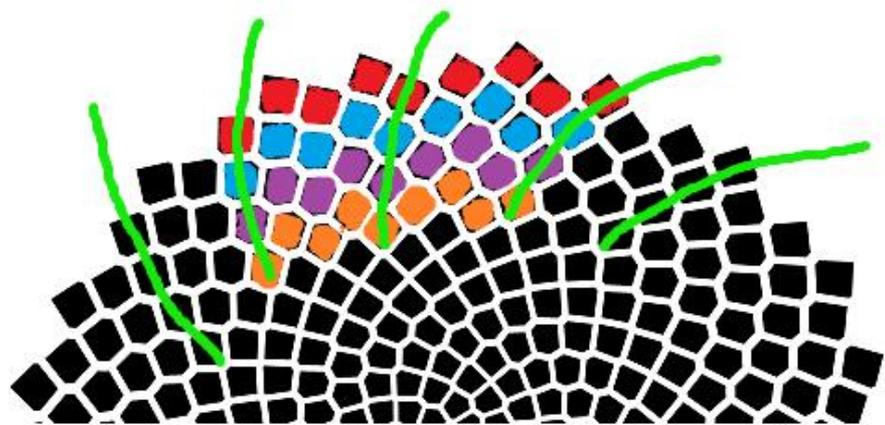


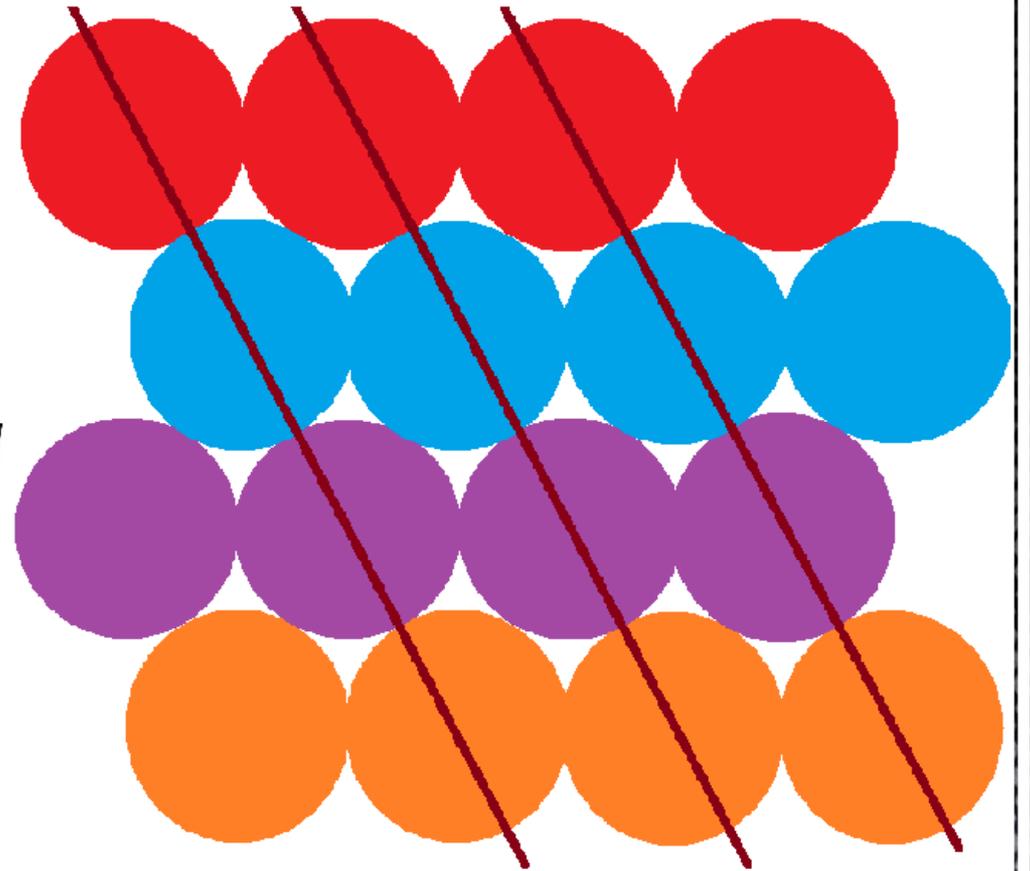
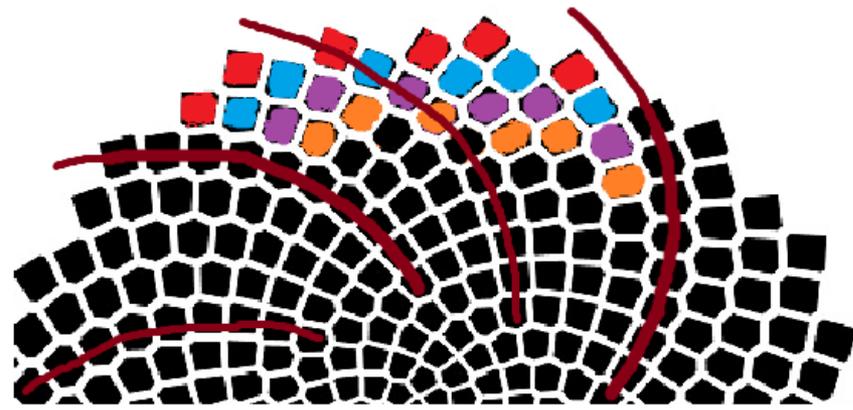


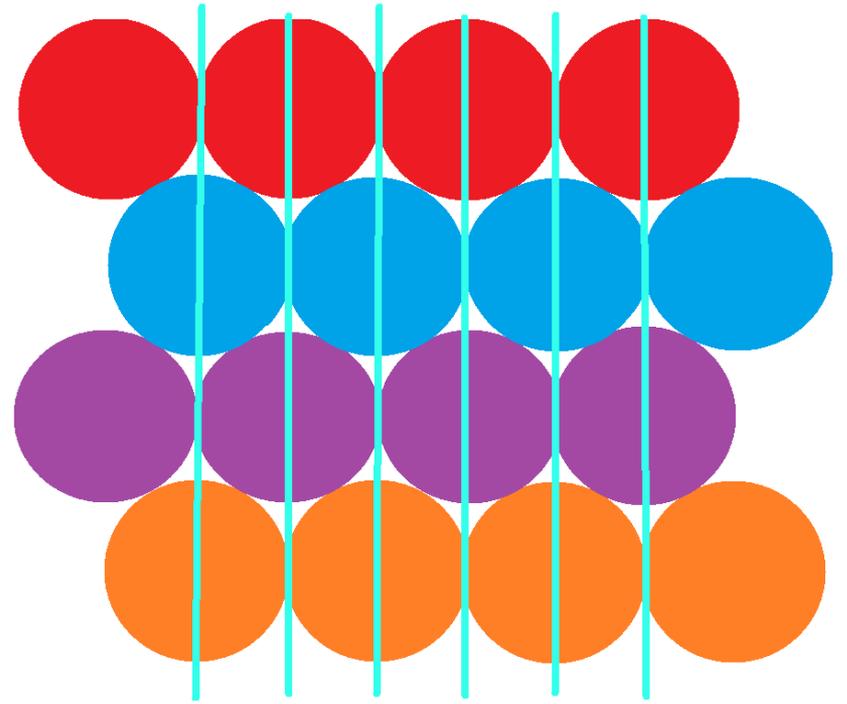
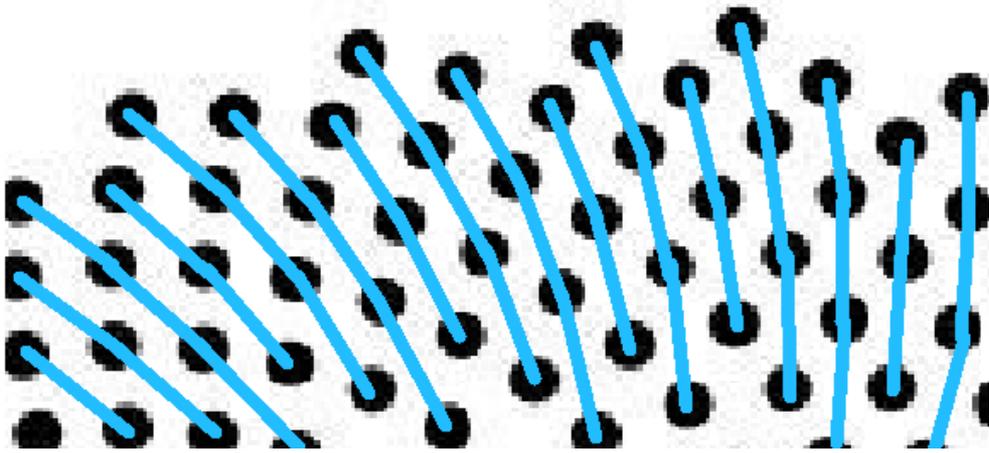
- **The seeds establish a pattern which is :**
- **Robust**
- **Fast paced**
- **Giving equal roles to each seed**
- **Very dense**

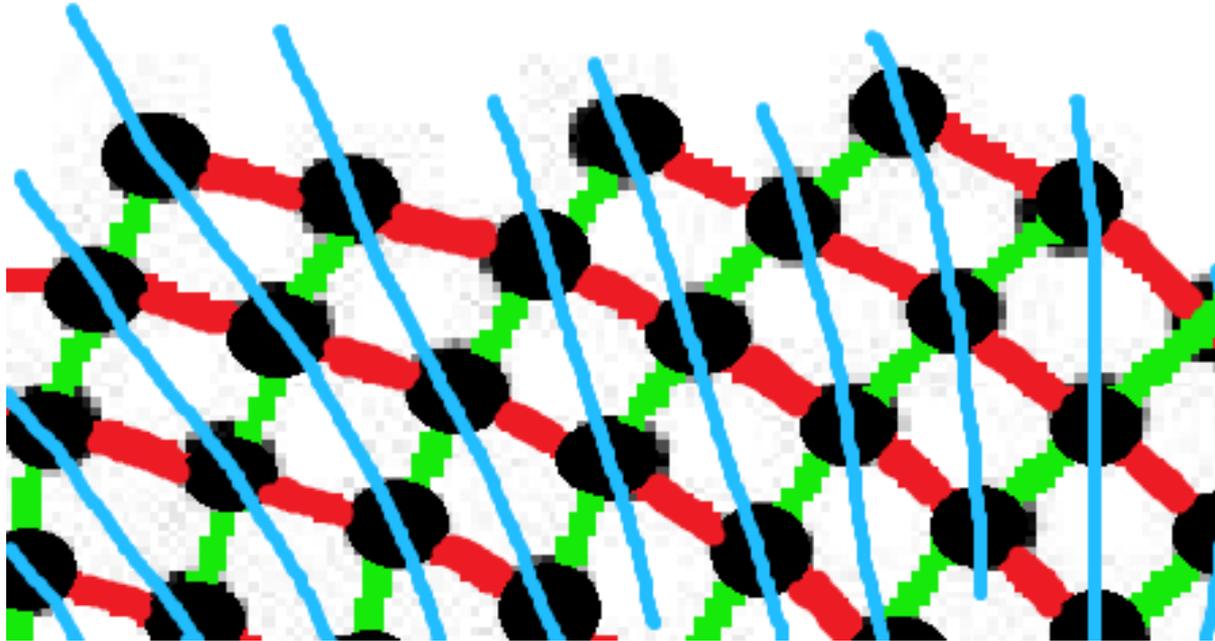
- **This is the densest way to pack spheres or circle-like objects**
- **The seeds follow this pattern**











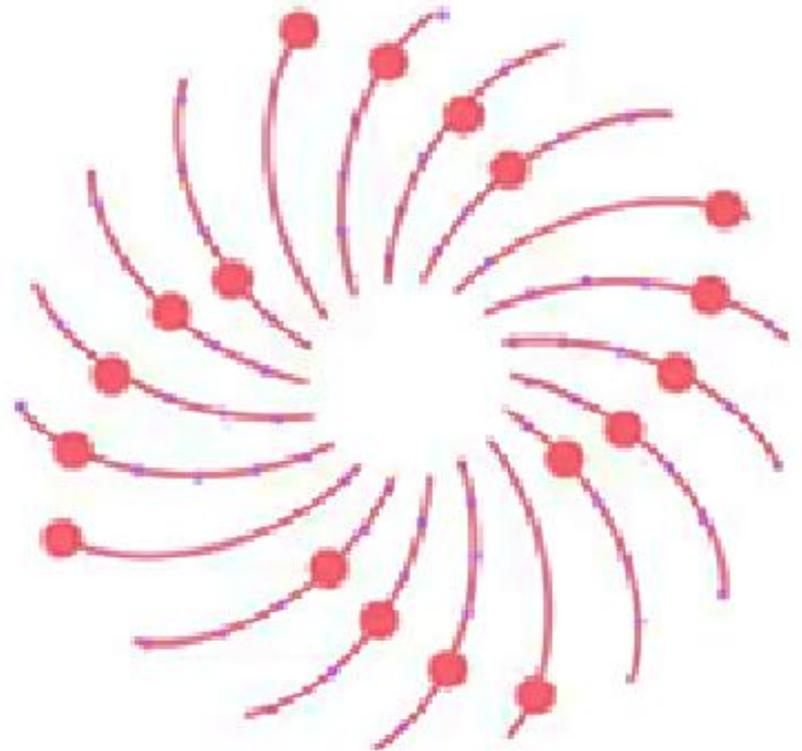
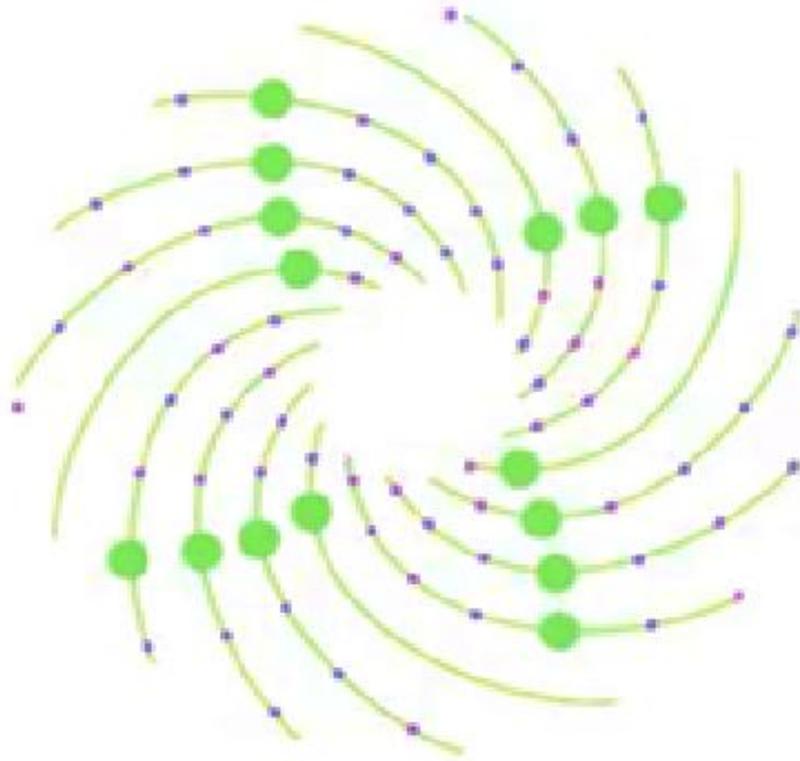
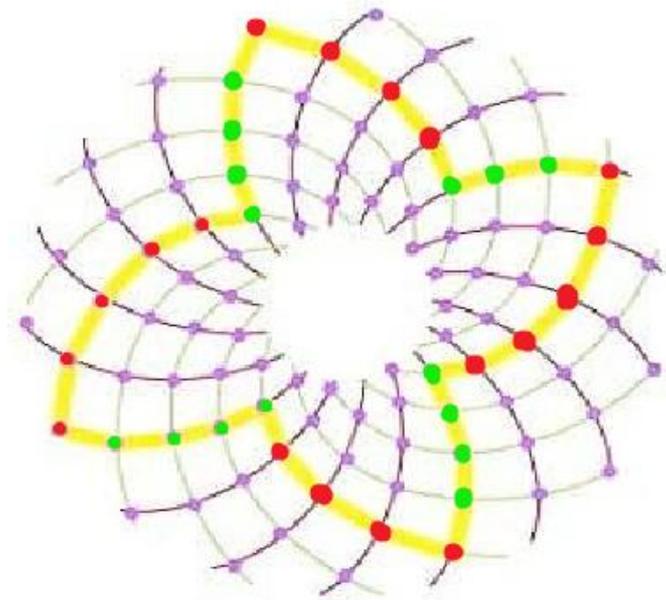
- **These 3 spirals lead to the mathematical core that makes Fibonacci numbers appear in flower heads.**



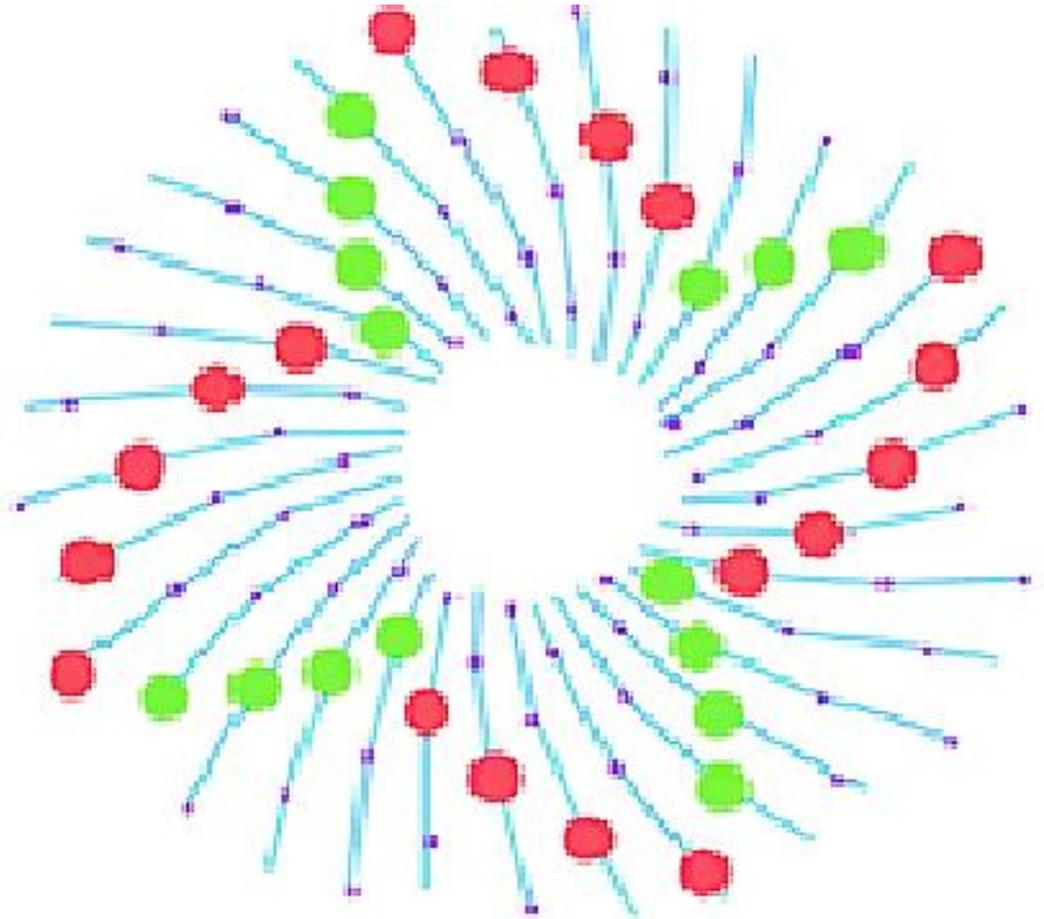
- $34 + 55 = 89$

- 1 1 2 3 5 8 12 21 34 55 89

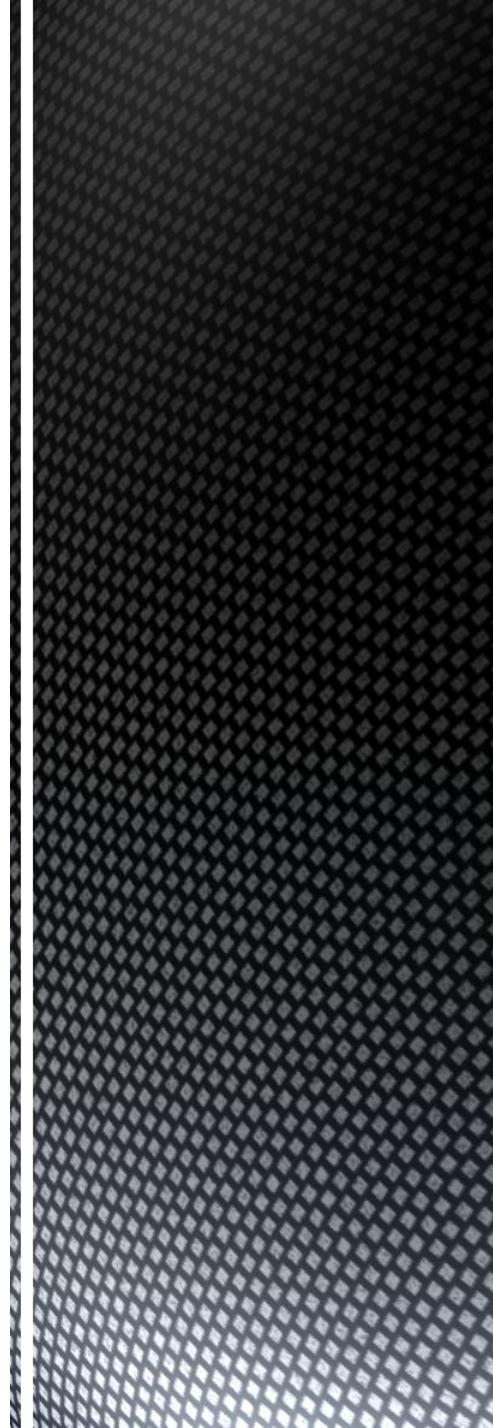
- It doesn't matter how you make the yellow path as long as it is closed
- We highlight the points of intersection on the yellow path



- Green plus red equals to blue
- $18 + 14 = 32$
- There is a dot for each spiral



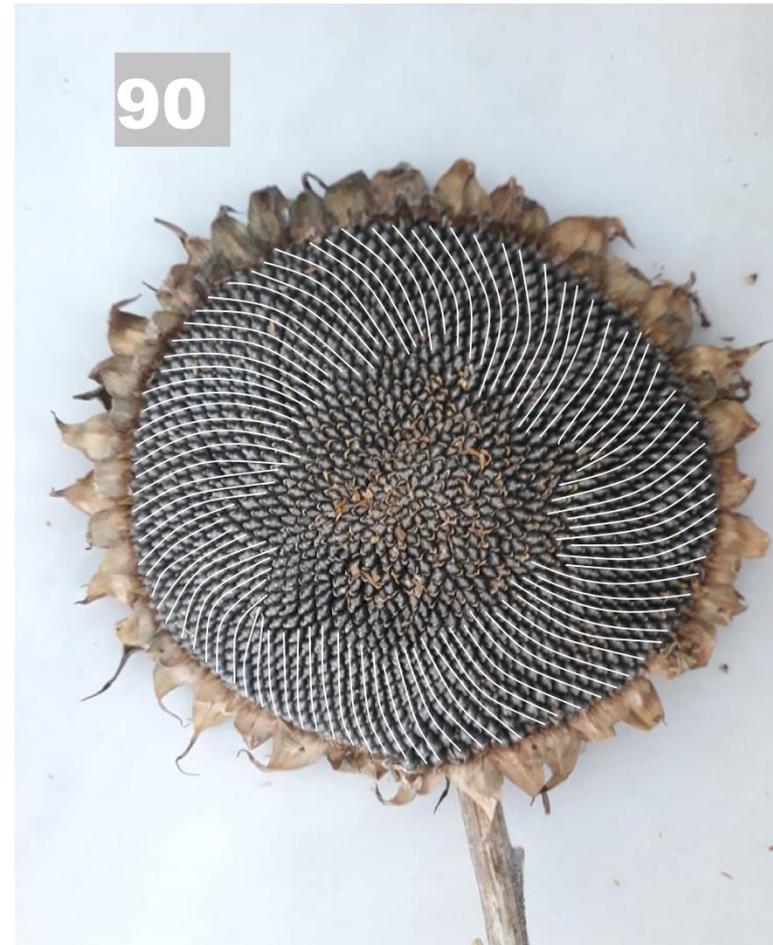
**Thank you for your  
time**



## Clockwise spirals



## Counter clockwise spirals



**34 55 89**  
the counter  
clockwise has +1

## Clockwise spirals



## Counter-clockwise spirals





2 spirals haven't  
yet grown

Clockwise spirals

93



Counterclockwise spirals

89



## Clockwise spirals



## Counterclockwise spirals



clockwise



Counter clockwise

