

**M**  
**A**  
**T**  
**h e**  
**h e m a t i c s**  
**o f**  
**a t t r a c t i o n**

Presented by Angie Schirck-Matthews

Broward College Davie Florida

[amatthew@broward.edu](mailto:amatthew@broward.edu)

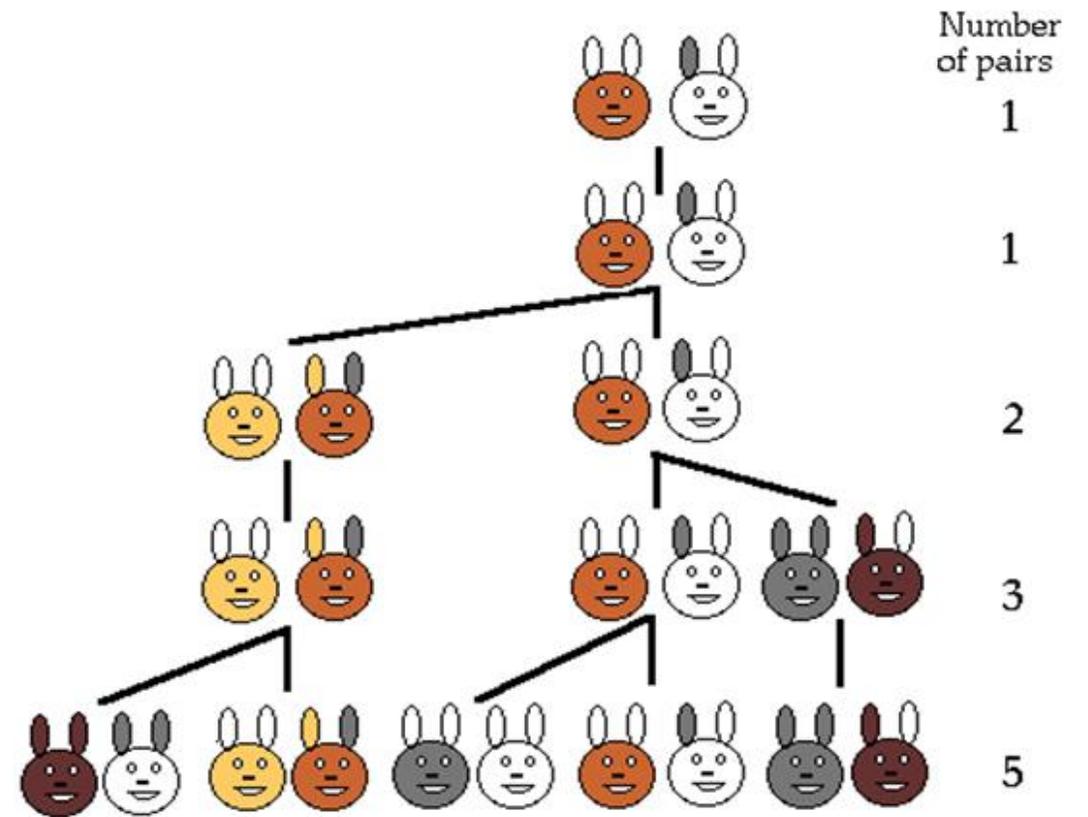
# Leonardo of Pisa



- Leonardo of Pisa AKA Fibonacci was a 12<sup>th</sup> century mathematician most famously known for introducing the Fibonacci Sequence.
- The sequence was discovered as an answer to the following riddle:
  - “How many pairs of rabbits would there be in a year if it was assumed that every month each pair produces a new pair, which begins to bear young two months after its own birth?”

# Rabbits

- Fibonacci's question led to the following sequence known as the Fibonacci Sequence:
  - 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, ...
  - Each term of the sequence is the sum of the previous two terms.



# The Fibonacci Sequence



The most interesting sequence in the world!

# What's so special about this sequence?

- I'm glad you asked!
- Eerily, many things in nature adhere to this sequence of numbers.
- Things that are visually pleasing follow this sequence.
- Things that are acoustically pleasing conform to this sequence.
- The human body yields to this sequence.

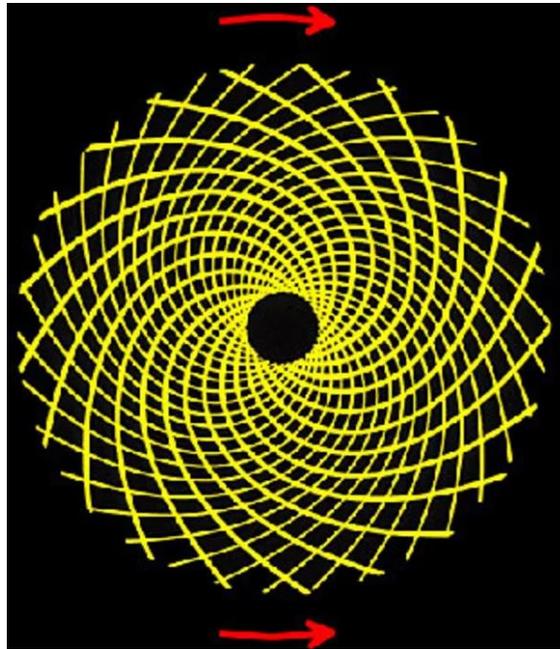
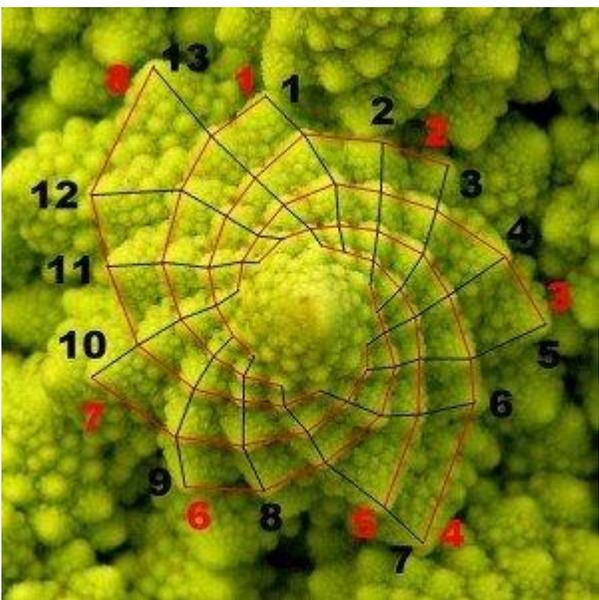
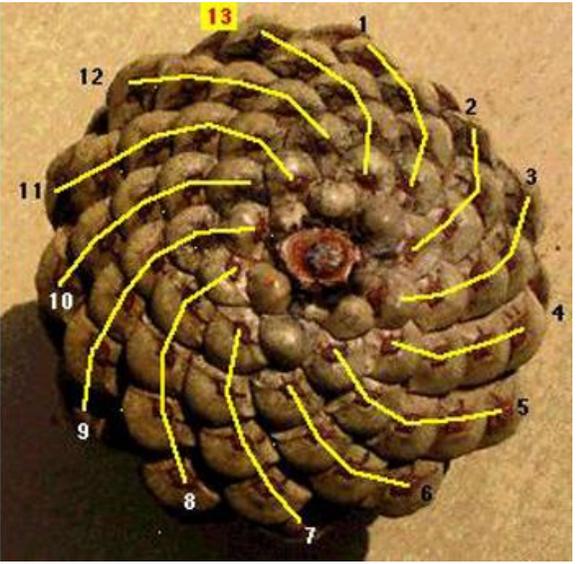
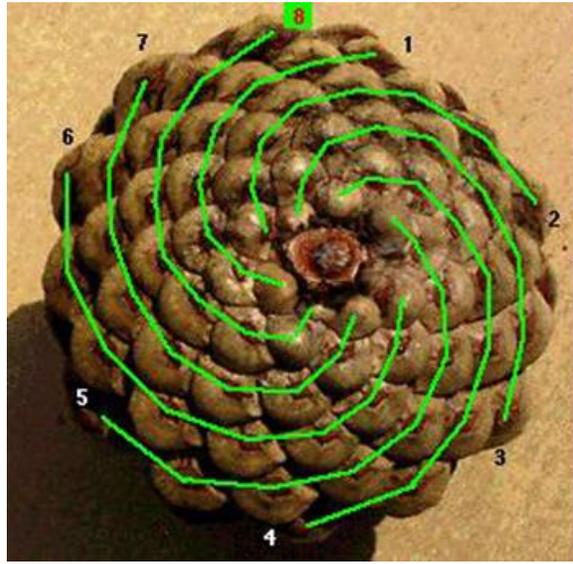
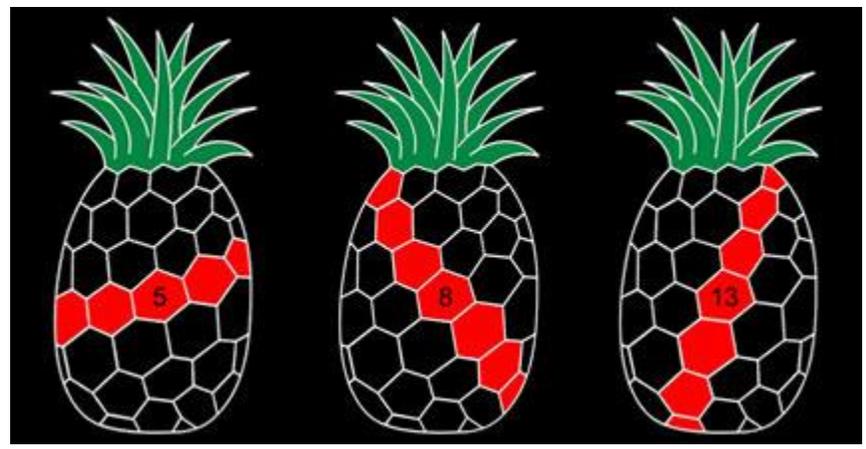




# Fibonacci in Nature

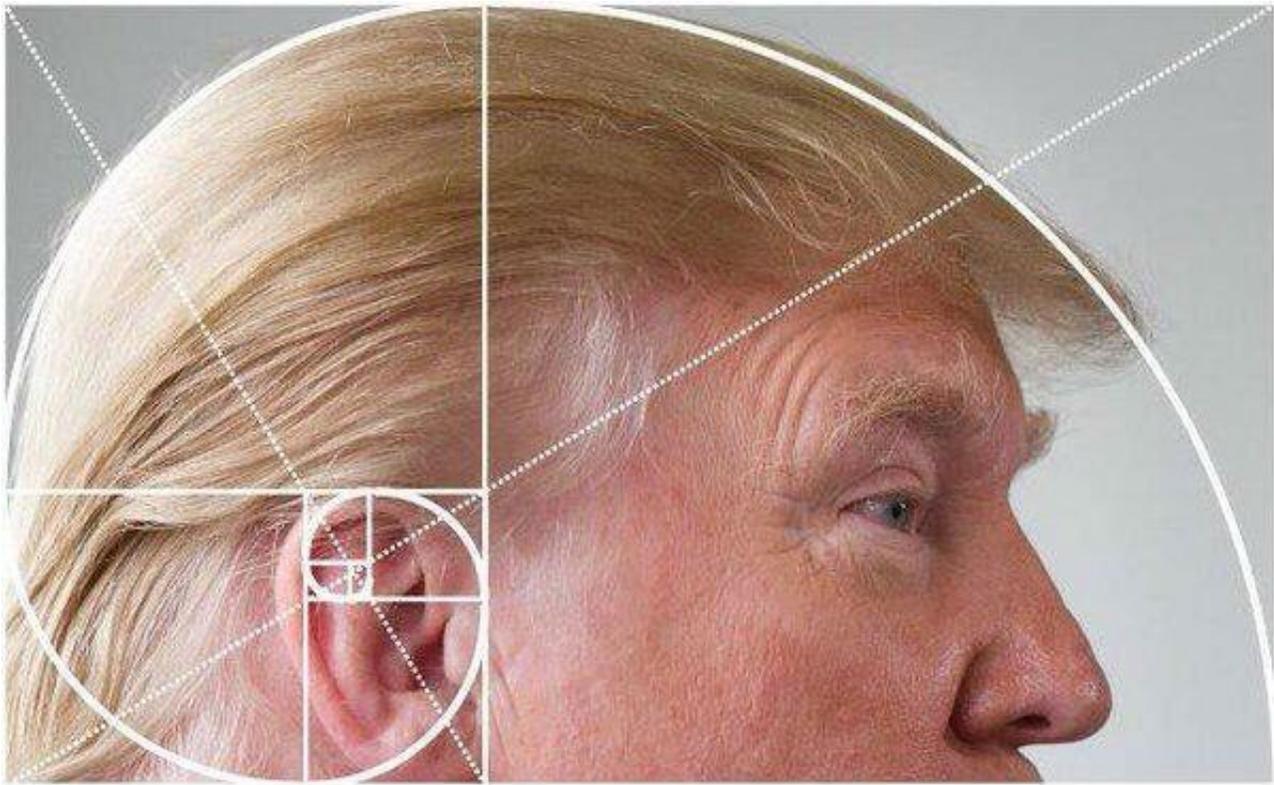
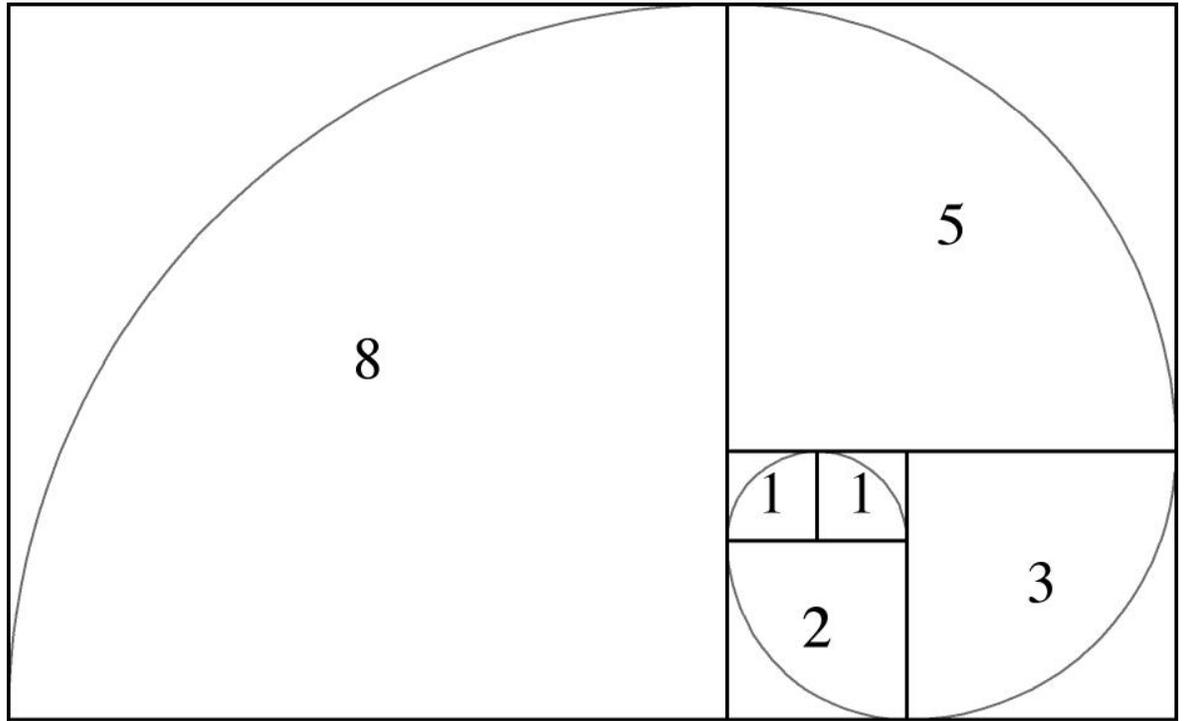
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Spirals



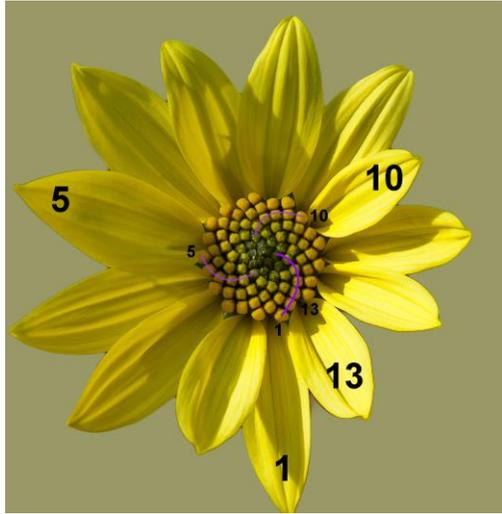
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Fibonacci Spiral

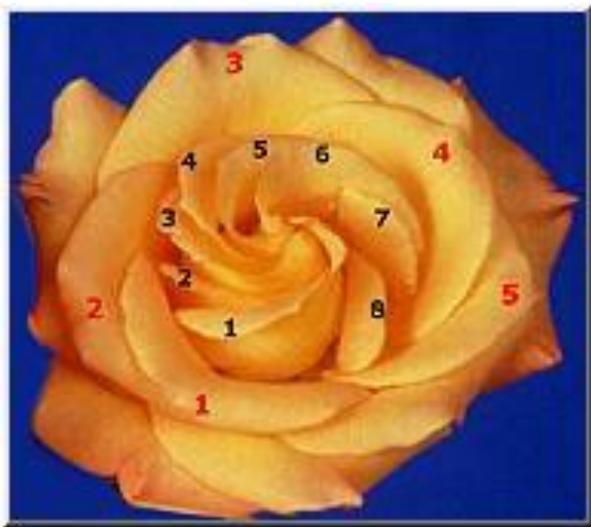


1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Flower petals

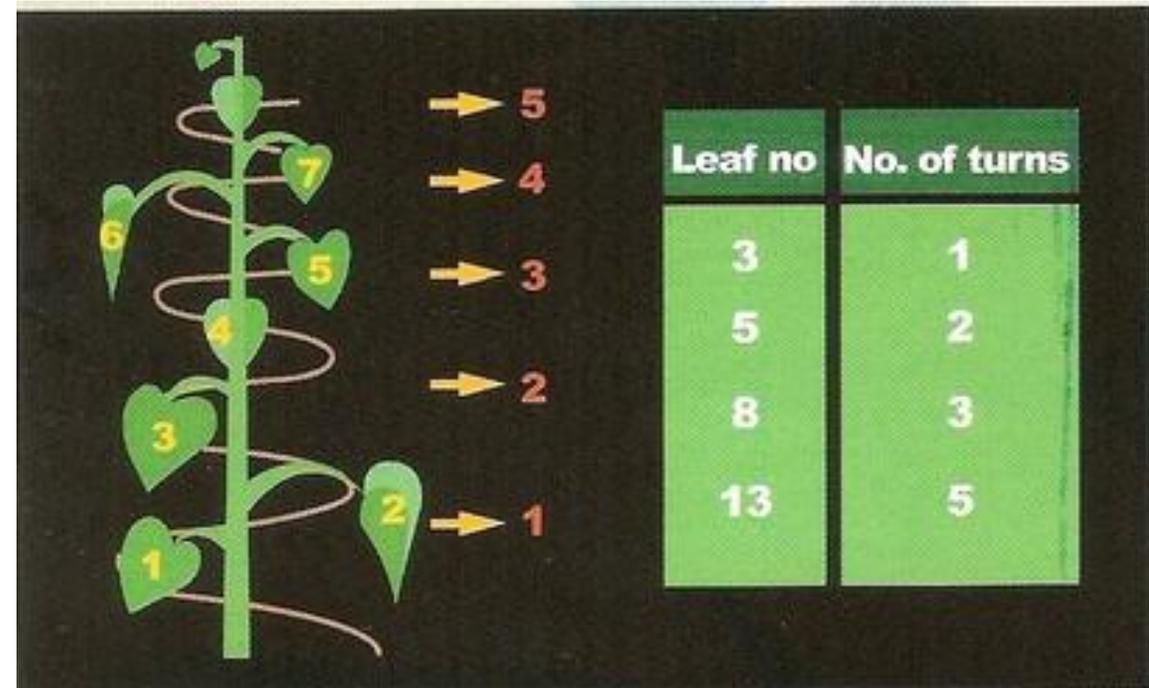
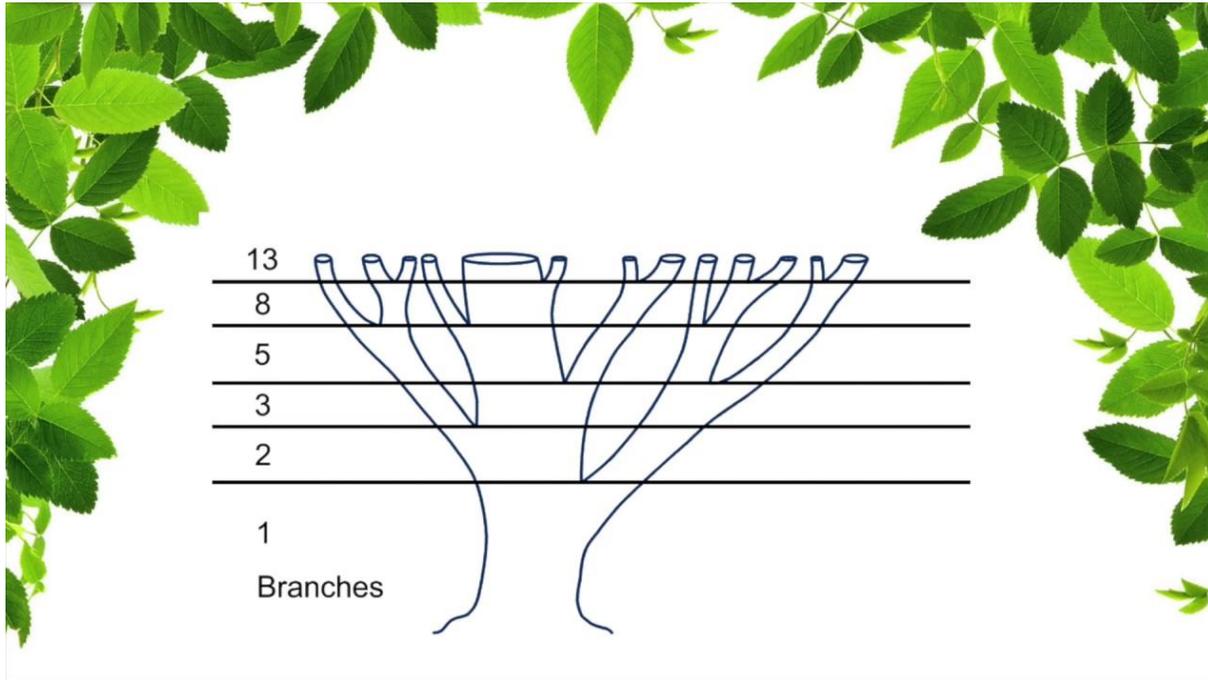


LUCKY CLOVER!



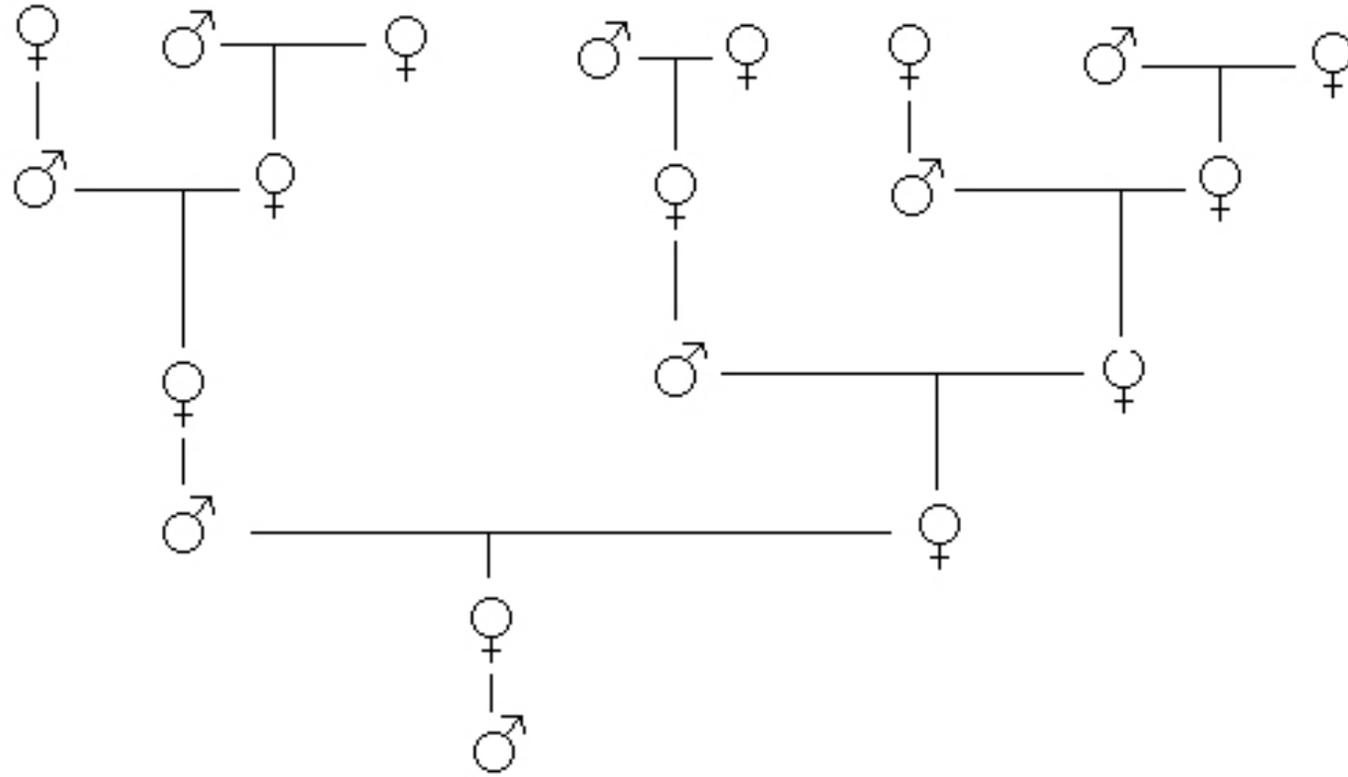
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Trees and Plants



1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

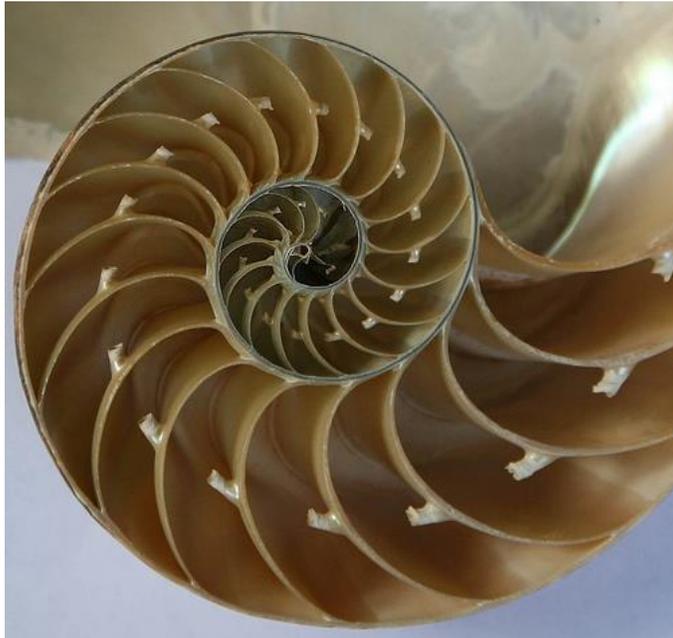
# Honey Bee Genealogy



8  
5  
3  
2  
1  
1

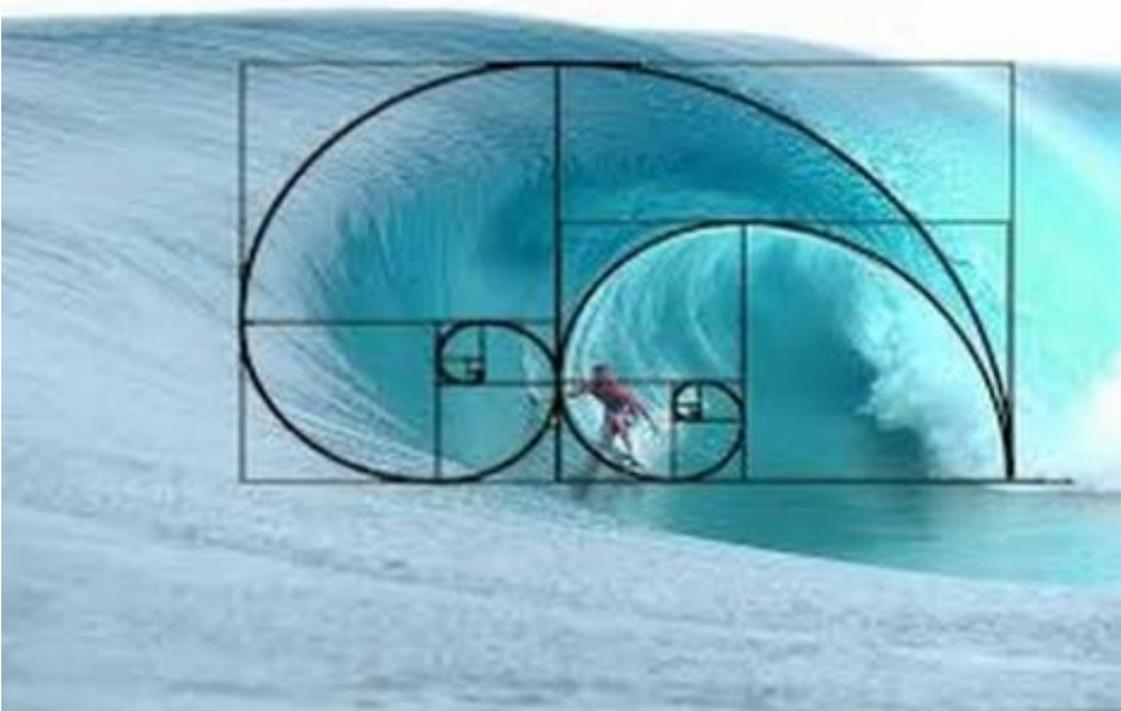
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Ocean Life



1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Ocean waves



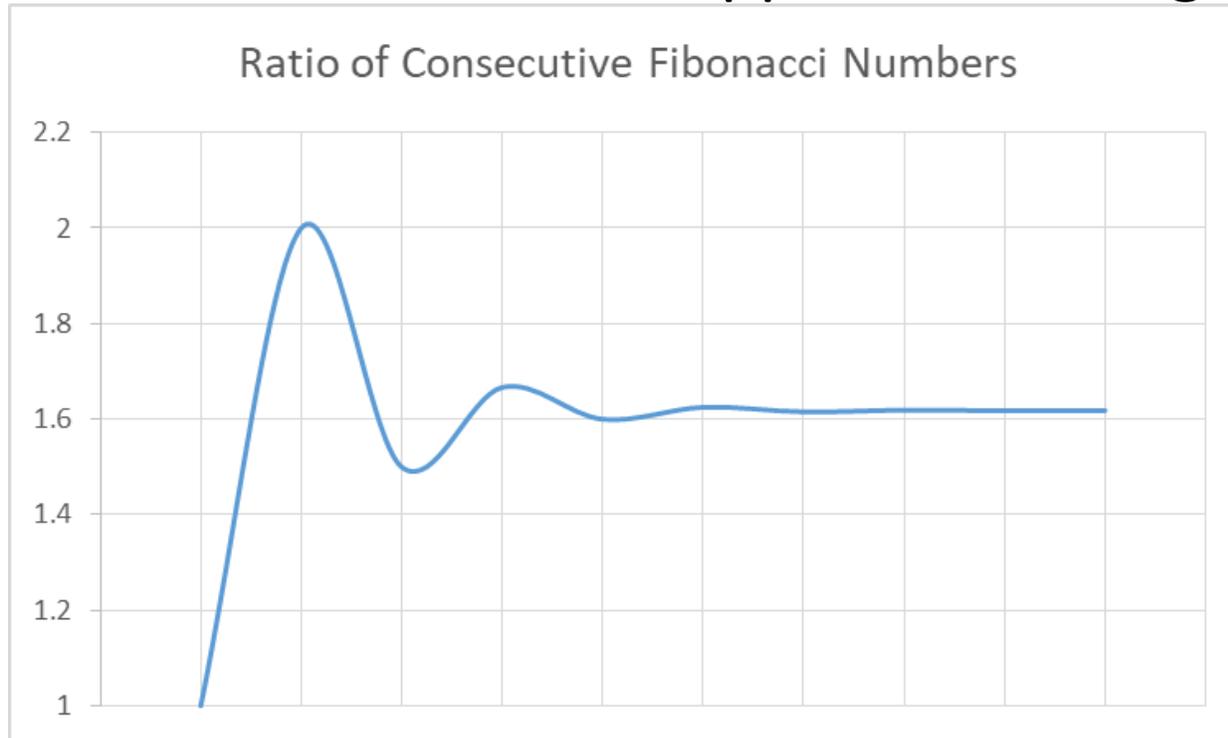


# Fibonacci in Art

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# The Golden Ratio

- The further you go out in the Fibonacci sequence, the ratio of consecutive numbers approaches the golden ratio (called  $\phi$ )



The Golden Ratio

$$\phi \approx 1.618$$

$$\phi = \frac{1 + \sqrt{5}}{2}$$

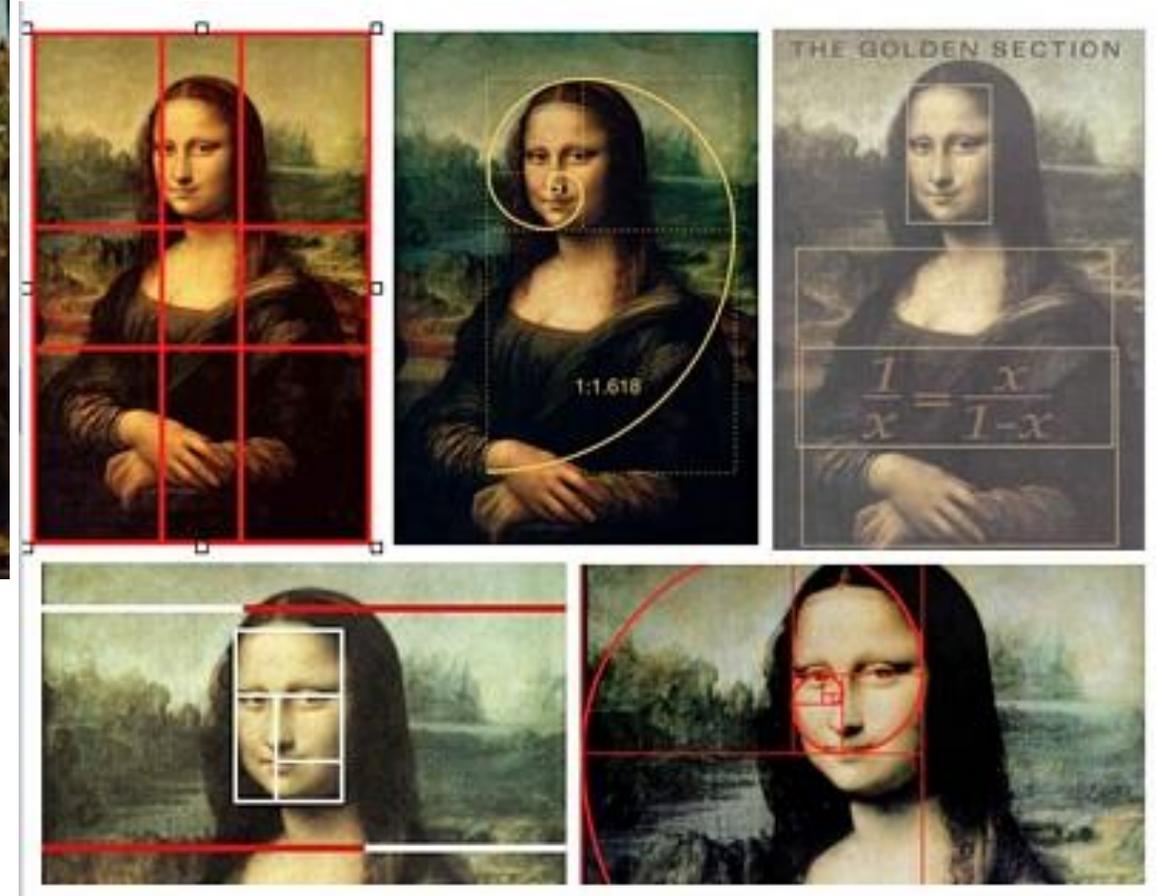
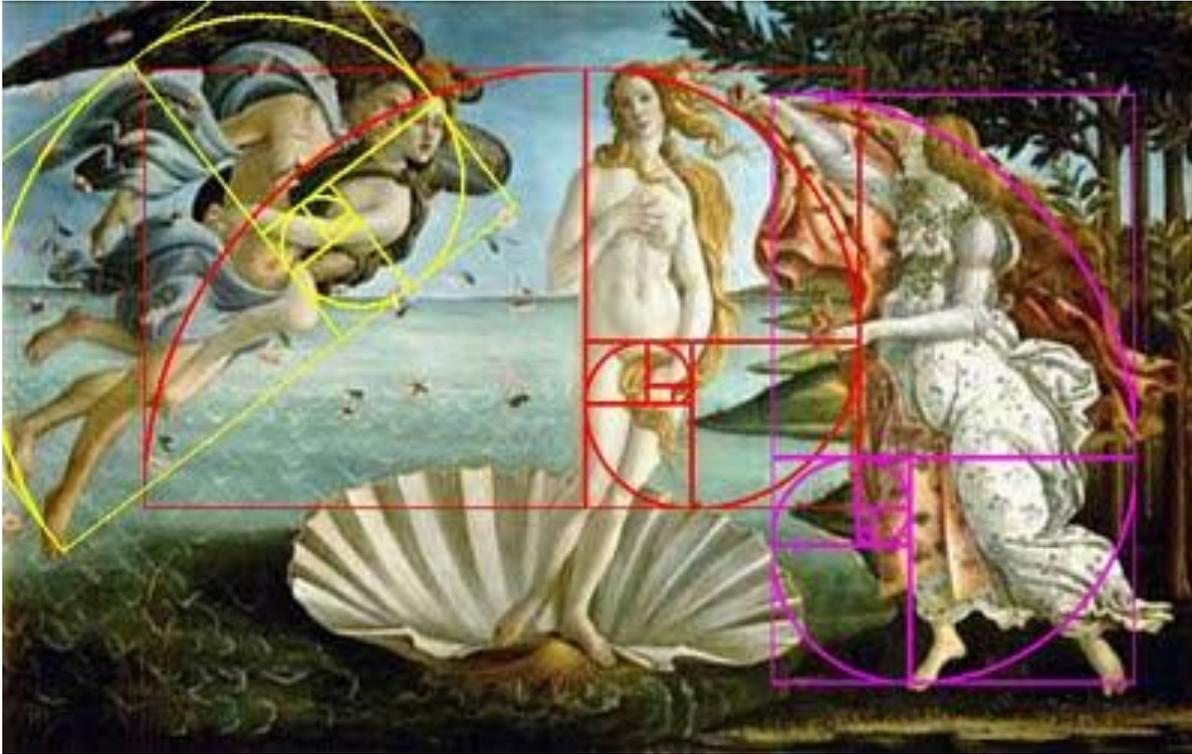
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# A Golden Rectangle

- A rectangle with length and width consecutive Fibonacci numbers is called a golden rectangle.
- Artists and Architects knew this was an aesthetically pleasing shape and it was incorporated in ancient art and architecture.

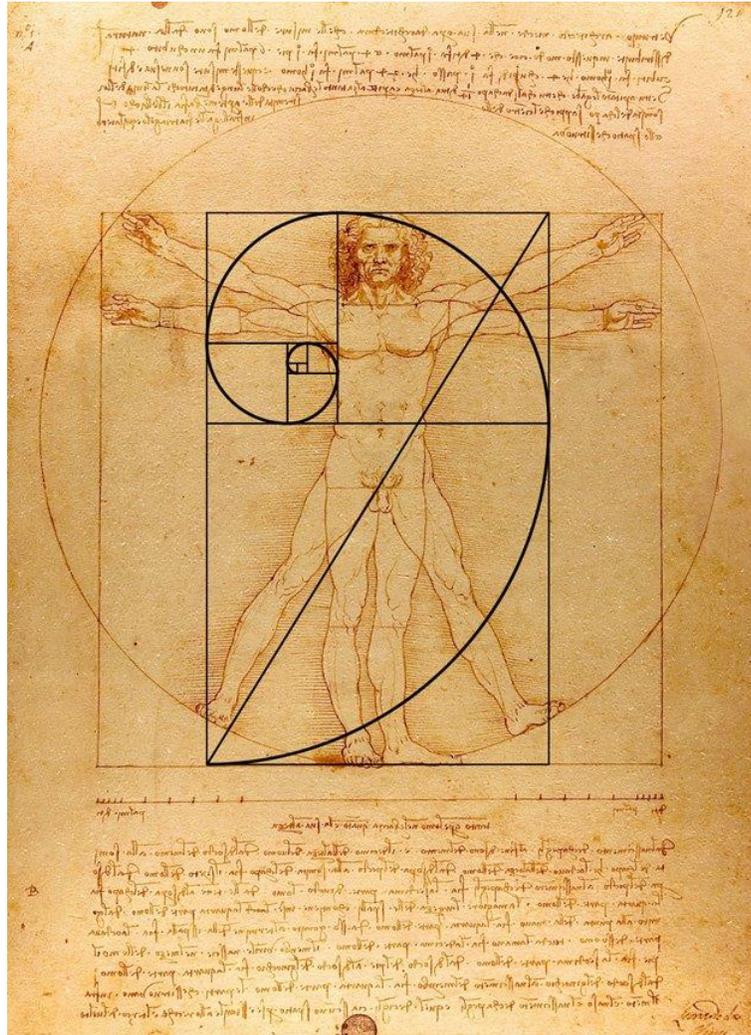
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Art



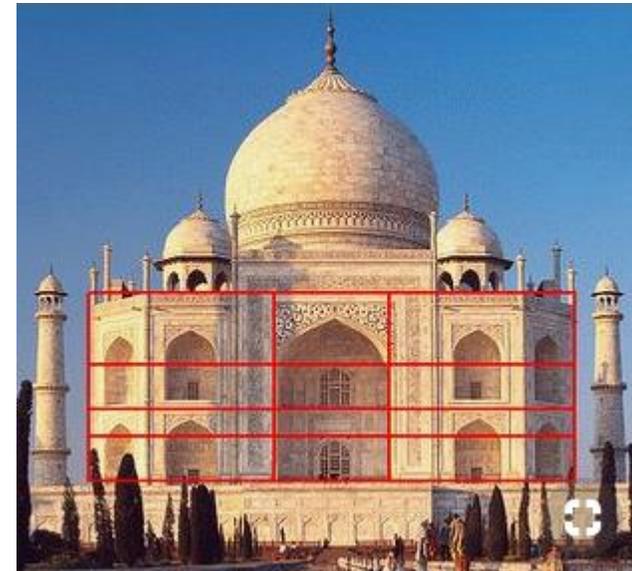
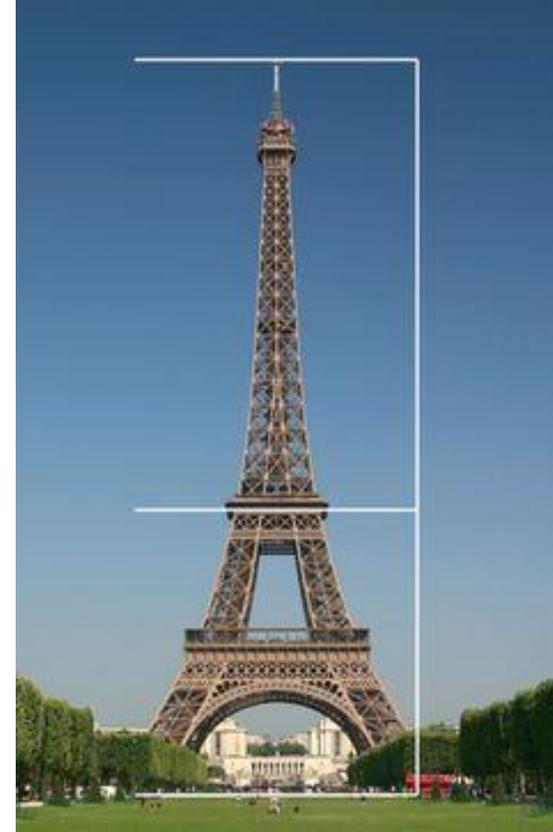
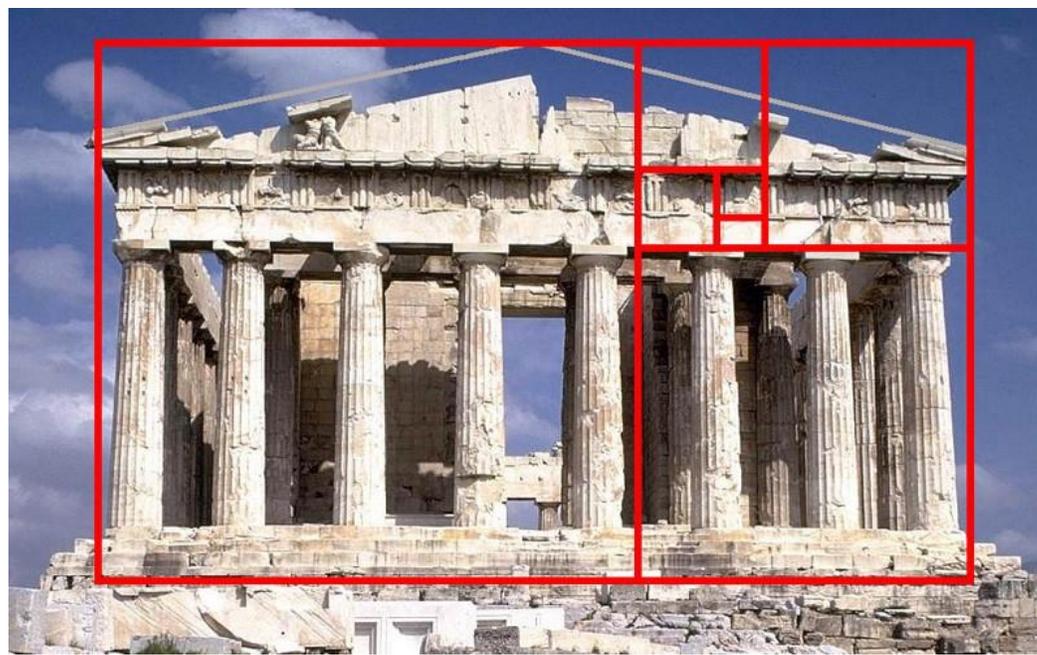
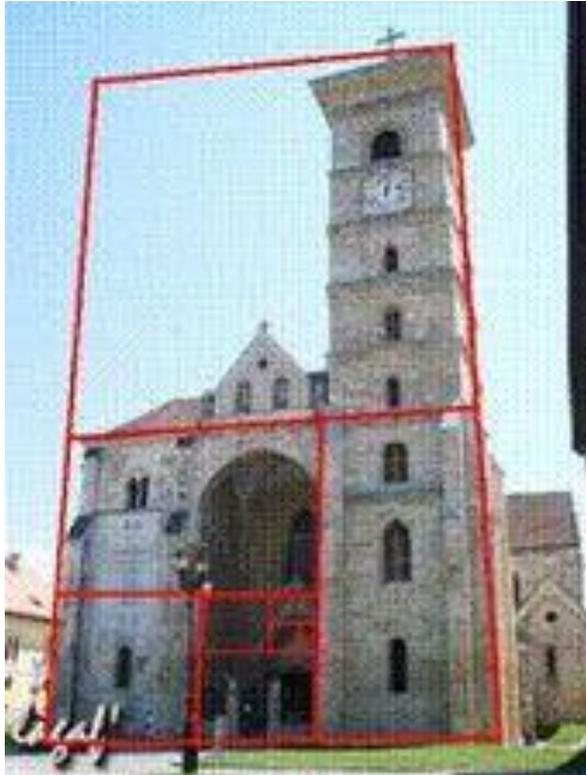
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Art

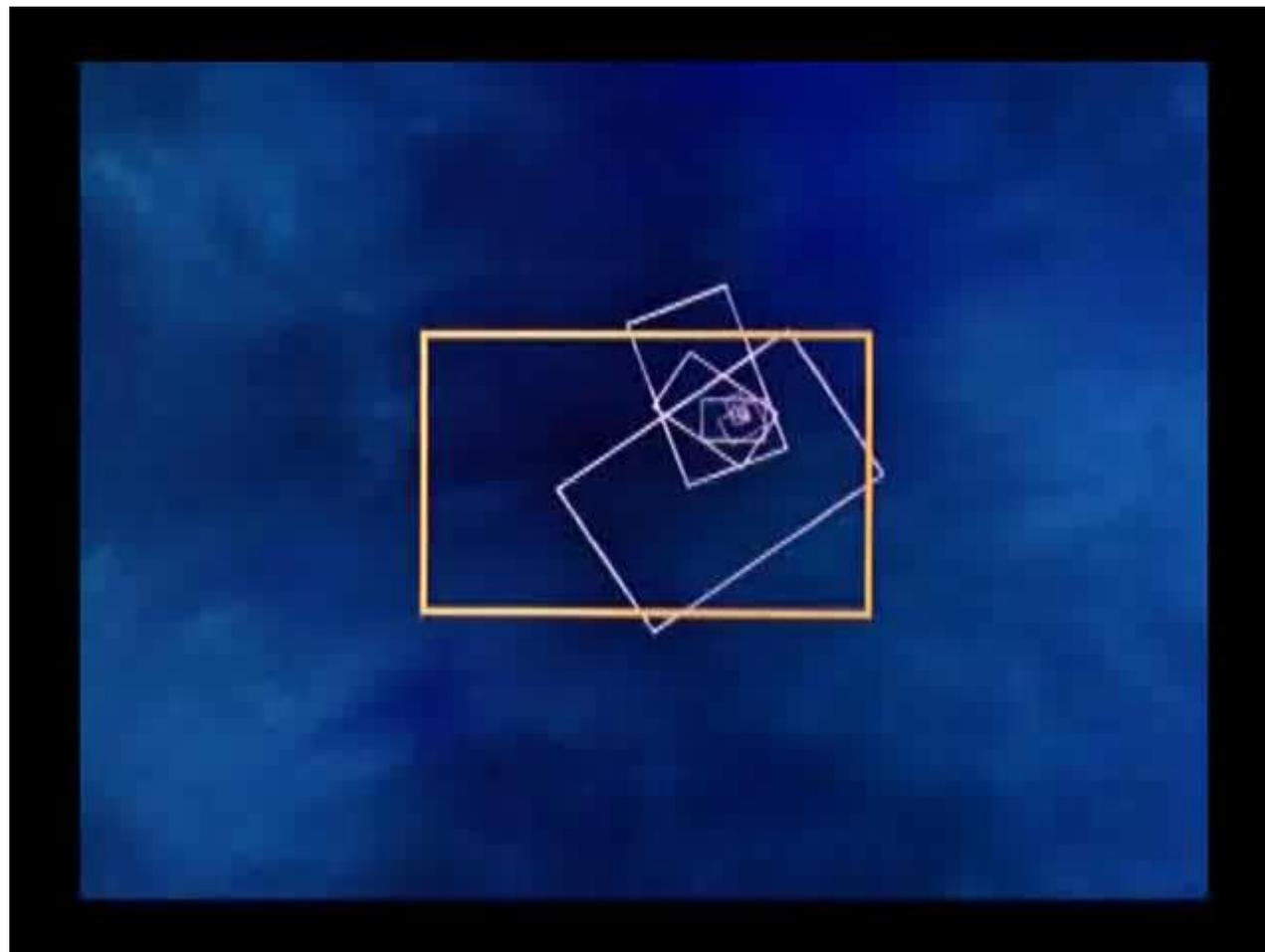


1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Architecture



# Donald in Mathemagicland 1959



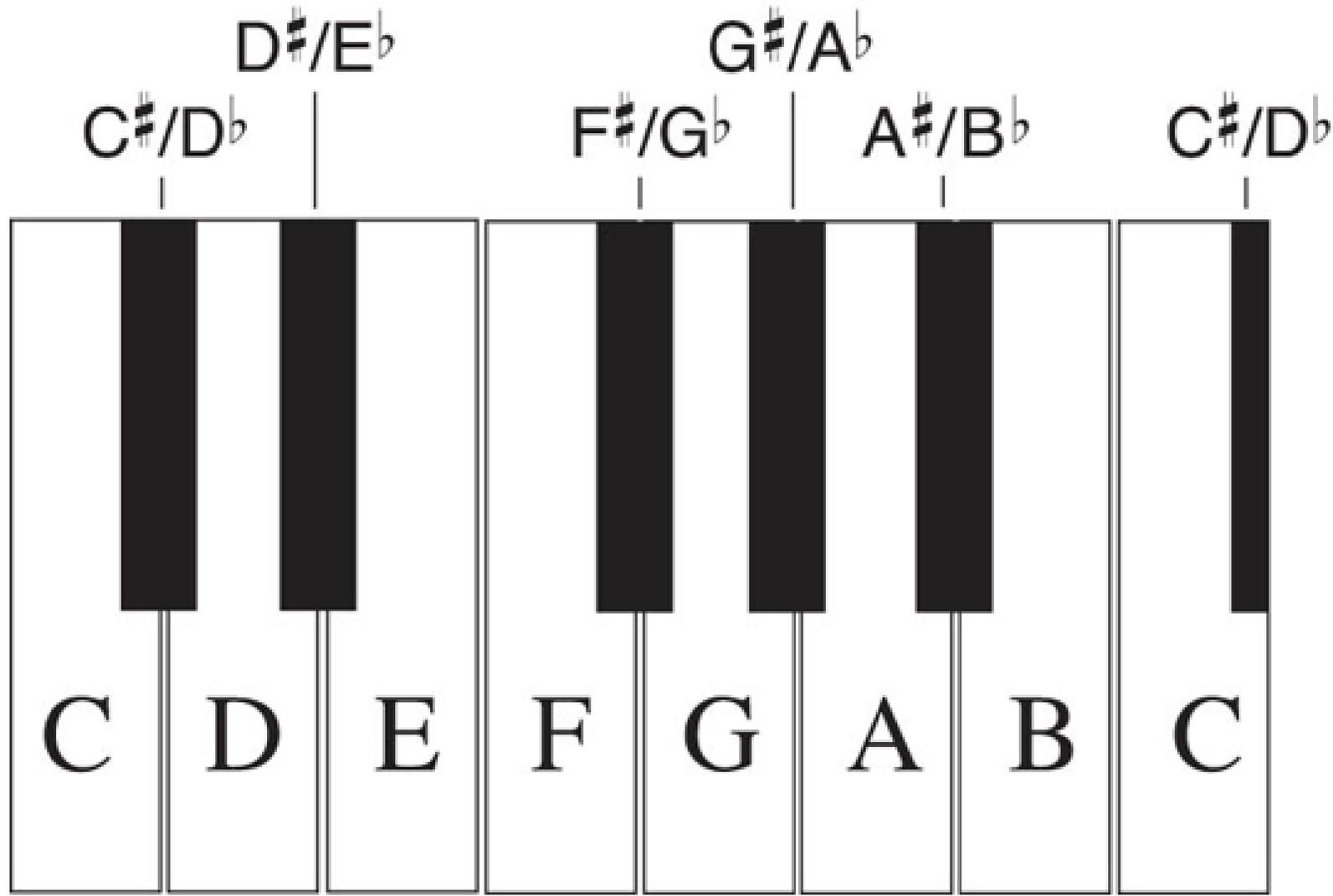
# Fibonacci in Music



1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

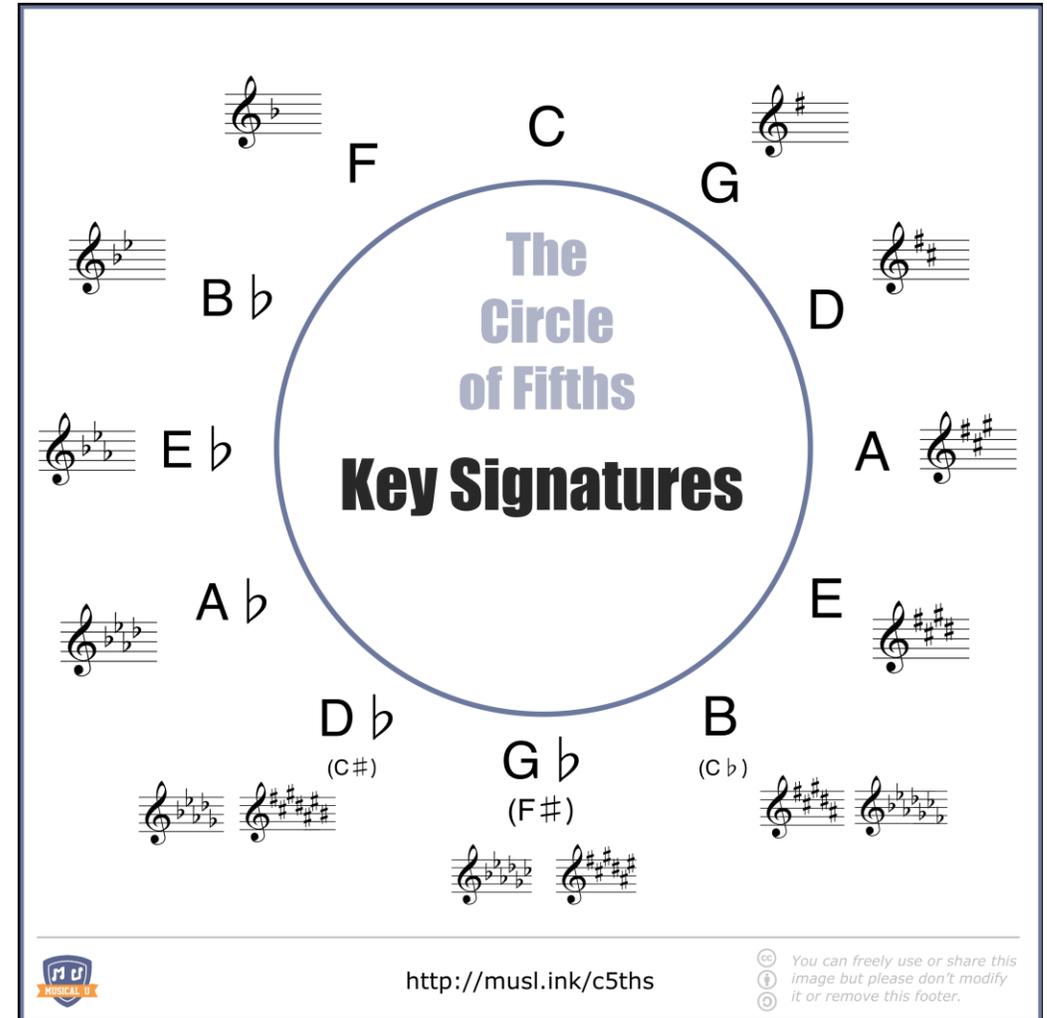
# Keys on a Piano

- 1 octave
- 2, 3 (groups of black)
- 5 black keys
- 8 white keys
- 13 keys total
- 5<sup>th</sup> note in a major scale is dominate, it is the 8<sup>th</sup> note of the 13 in the octave



# Consonance and Dissonance

- “Consonance is associated with sweetness, pleasantness, and acceptability; dissonance is associated with harshness, unpleasantness, or unacceptability” (Wikipedia).
- Fifth is most consonant sound in music.
- Circle of fifths used to compose, harmonize, and build chords



1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Intervals in Music

Fibonacci Ratio	Note in Major Scale	Musical Relationship
1/1	A	Root
2/1	A	Octave
2/3	D	Fourth
2/5	F	Aug. Fifth
3/2	E	Fifth
3/5	C	Minor Third
3/8	E	Fifth
5/2	C#	Third
5/3	F#	Sixth
5/8	C#	Third
8/3	D	Fourth
8/5	F	Aug. Fifth

It is interesting to note that the fourth is sometimes considered consonant and sometimes dissonant and the sixth is called an “imperfect consonance.”

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Types of Scales

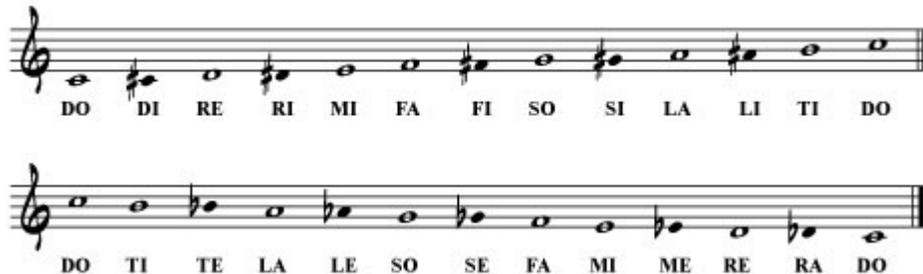
- Pentatonic – 5 notes (folk tunes and rock music)



- Diatonic Scale – 8 notes (many classic melodies)



- Chromatic Scale – 13 notes (symphonies and contemporary music)



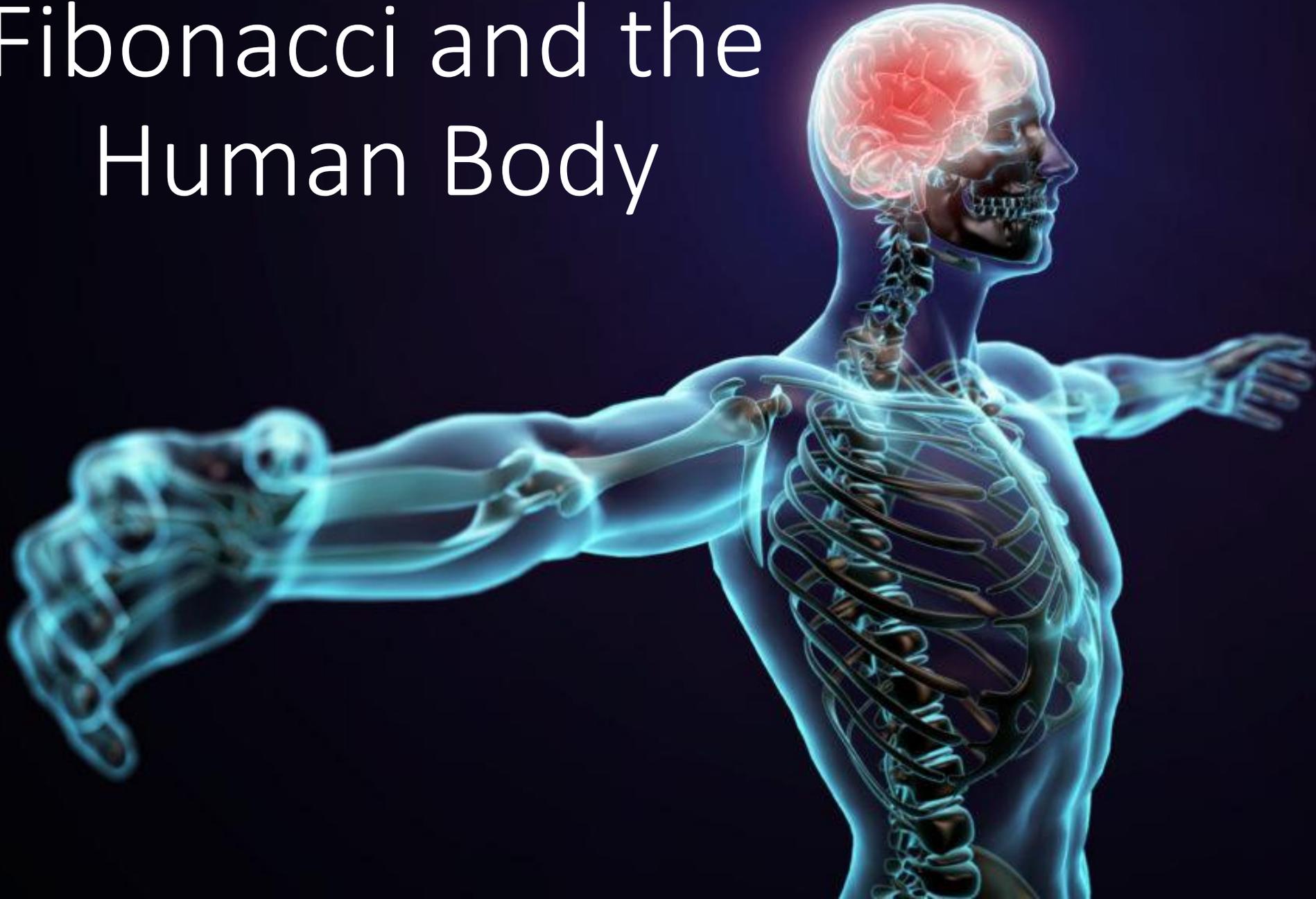
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Composers

- [Bach Little Fugue in G minor](#)
- Why is this piece so pleasing to the ear?
- Some of the best composers know and use intervals of Fibonacci Numbers
  - Theme 34 measures
  - Slow, soft 55 measures ( $55/34 \approx \phi$ )
  - Fast, loud 21 measures
  - Repeat of theme 34 measures ( $34/21 \approx \phi$ )



# Fibonacci and the Human Body



# Human Beauty

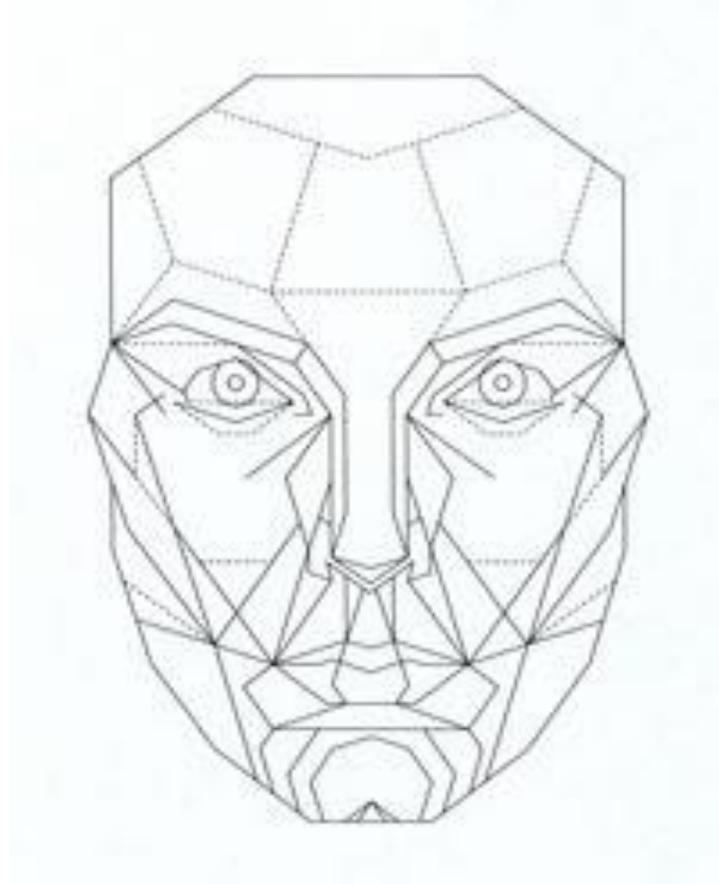


Brad Pitt



Danny Devito

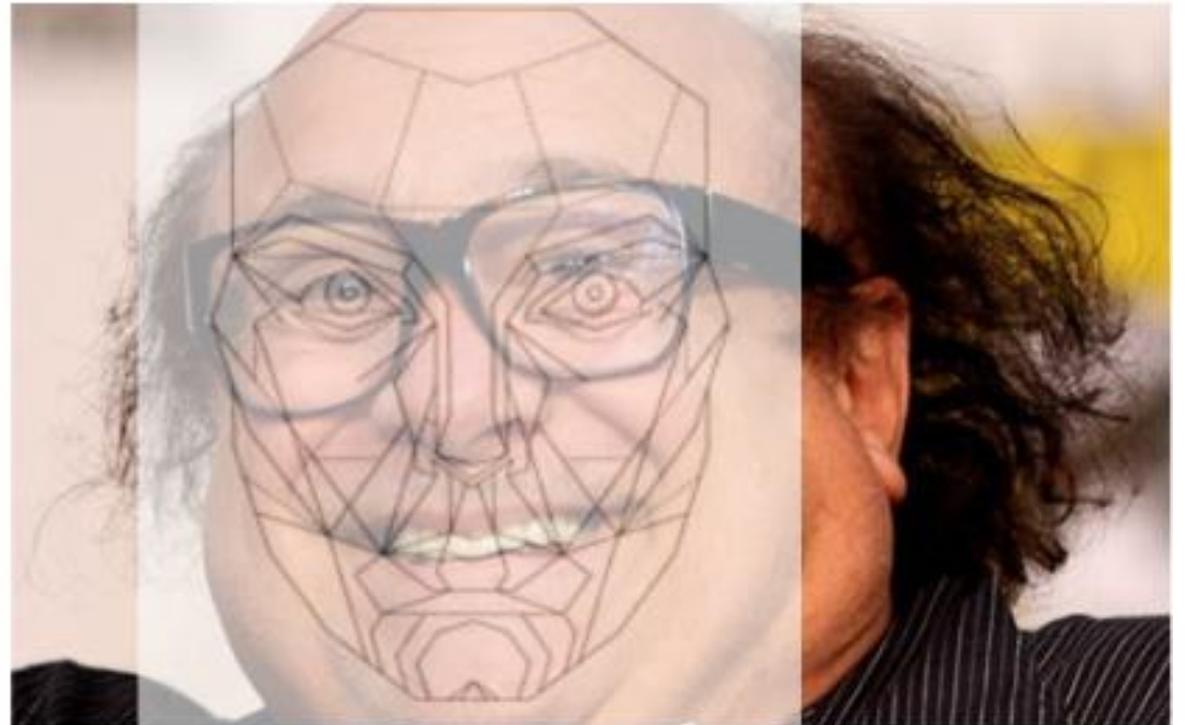
# Human Beauty



# Human Beauty

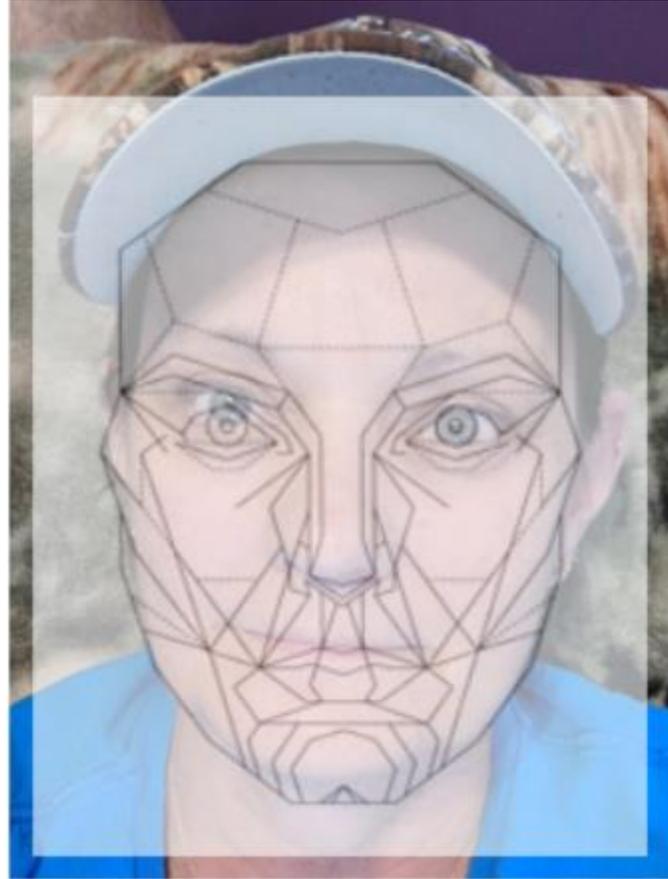


Brad Pitt



Danny Devito

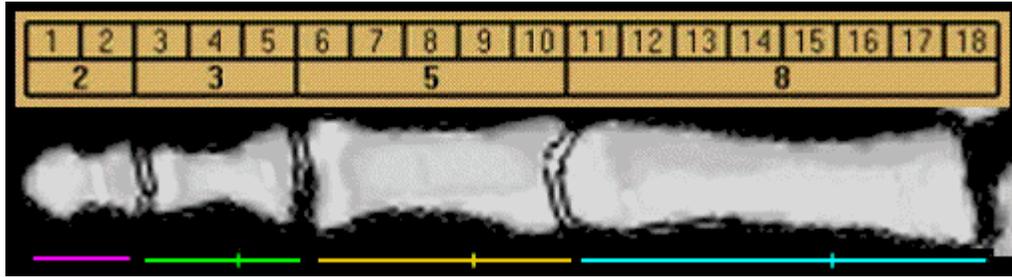
Me



I may not be Brad Pitt, but I'm not Danny Devito either!

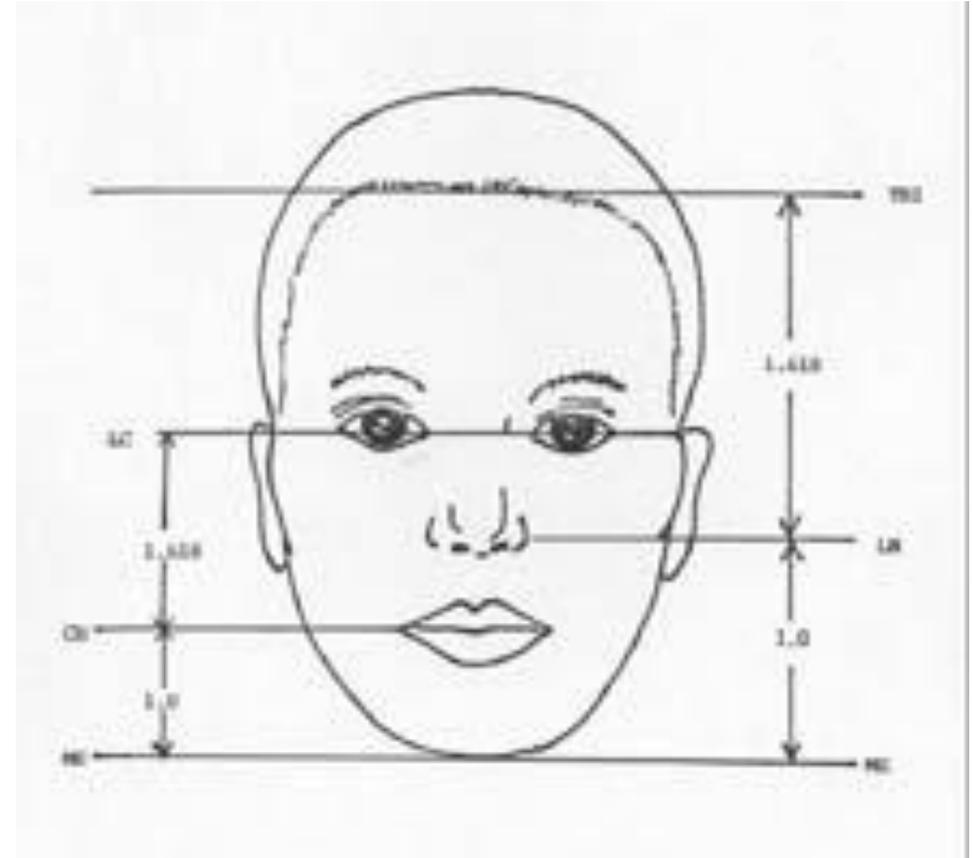
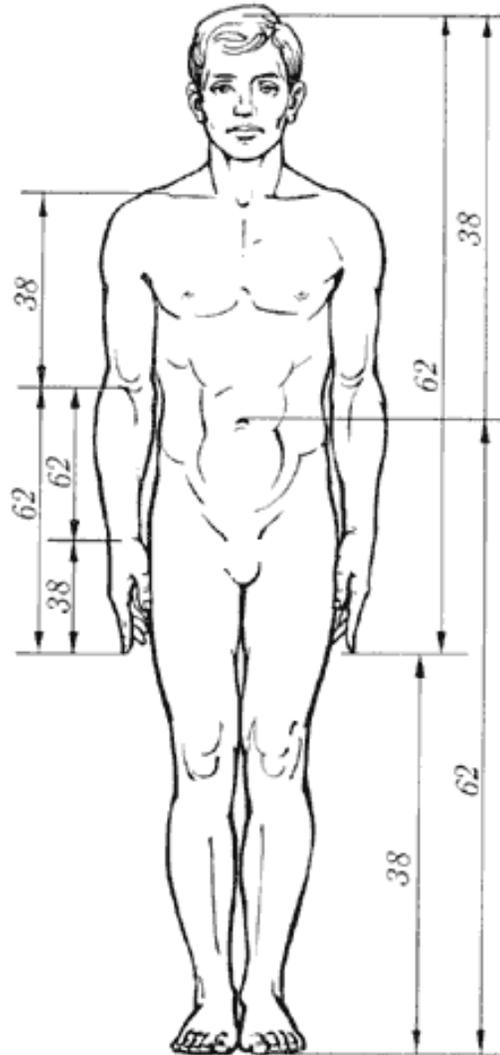
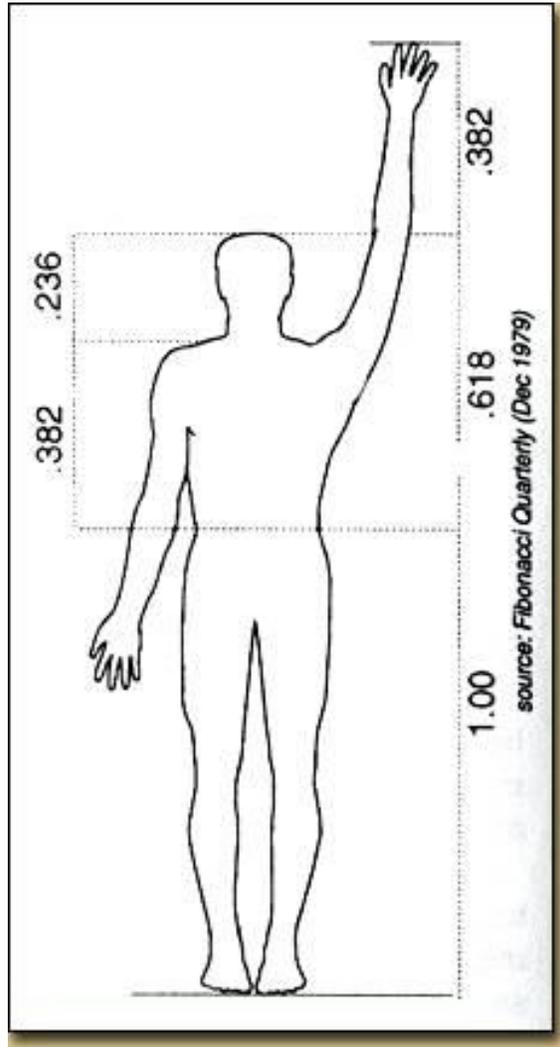
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Fingers and Arms



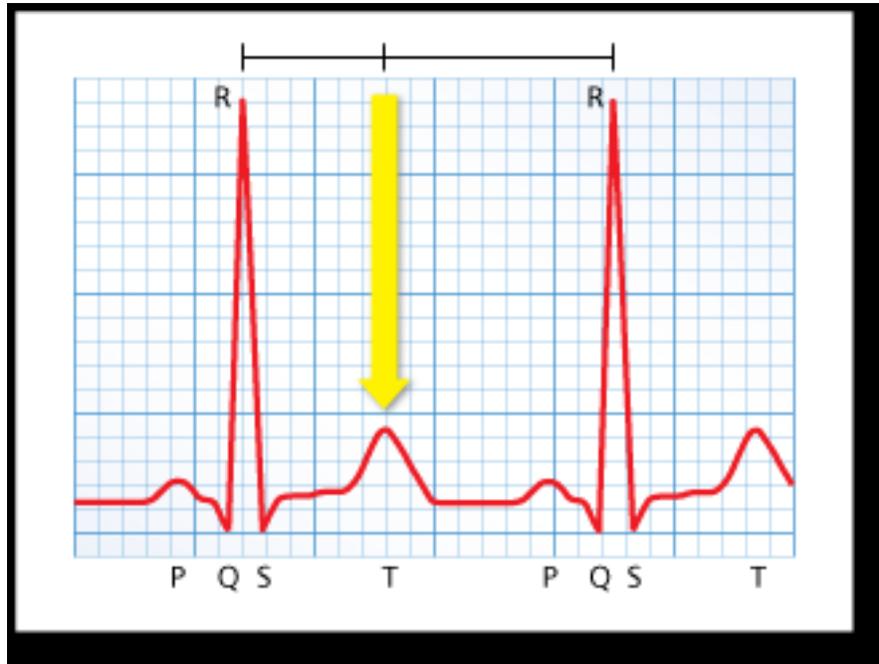
1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Body and Face Proportions



1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

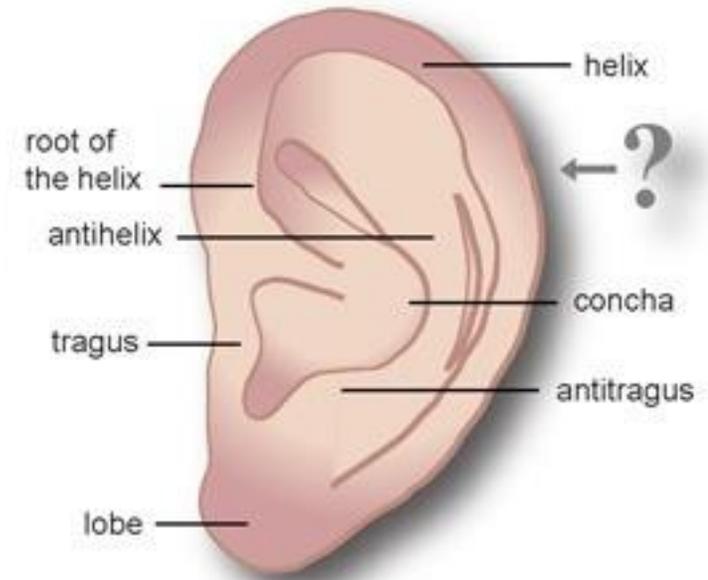
# Heartbeat and Ears



Fibonacci Double Spiral



Outer Ear Double Helix





1, 1, 2, 3, 5, 8, 13, 21, 34, 55, ...

# Other Places Fibonacci is Found

- Weather



- Fractals



- The list goes on, but my time does not!

THE END