Intro to Generative Art

Noise, Perception, and Learning: Application in AI Art
IAP 2023

Overview

01 WHAT IS GENERATIVE ART?

02 EARLY GENERATIVE ART

03 TRY IT YOURSELF

04 MODERN GENERATIVE ART

05 AI ART

06 CLASS OVERVIEW

The Instructors

Sarah Muschinske

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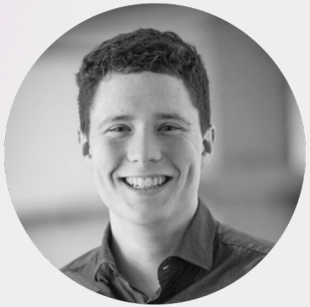


Logan Engstrom

Chandler Squires

Mikey Fernandez

01

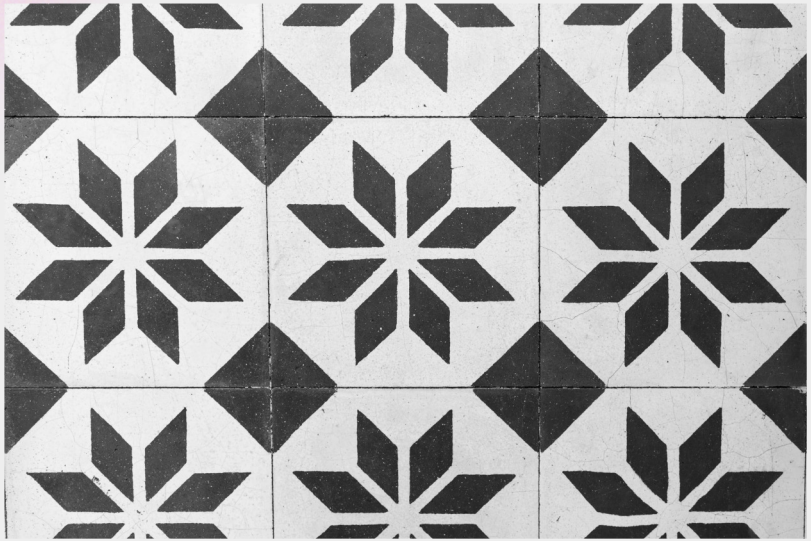
What is Generative Art?

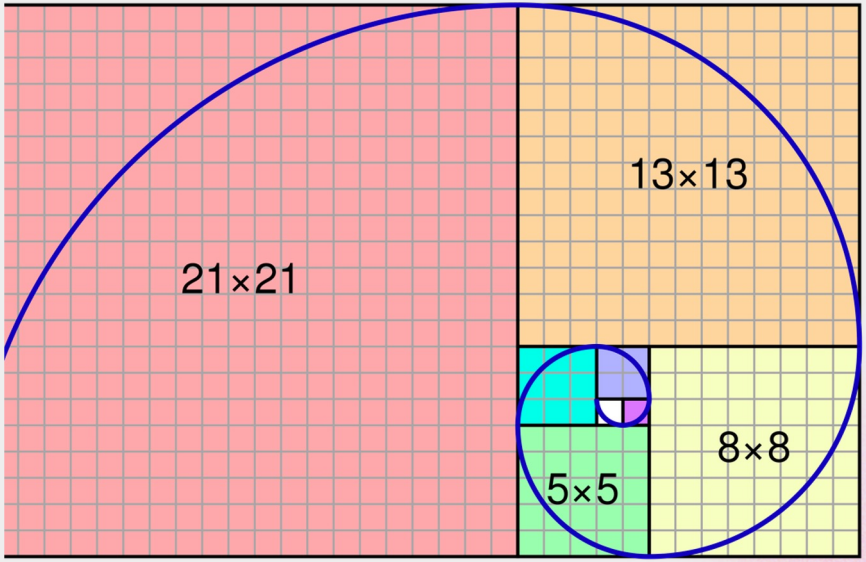
Art that in whole or in part has been created with the use of an autonomous system

Attributes of generative art

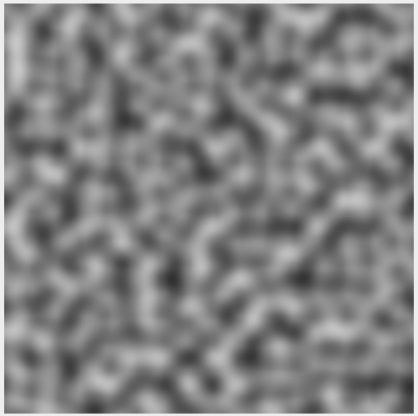
- Generated using basic rules such as:
  - Games
  - Patterns
  - Mathematical functions
  - Algorithms
- Can Introduce “Randomness”
  - Pseudorandom noise generation
  - Complex functions not interpretable by humans

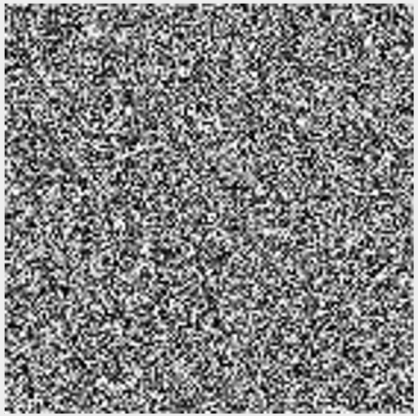
Rules





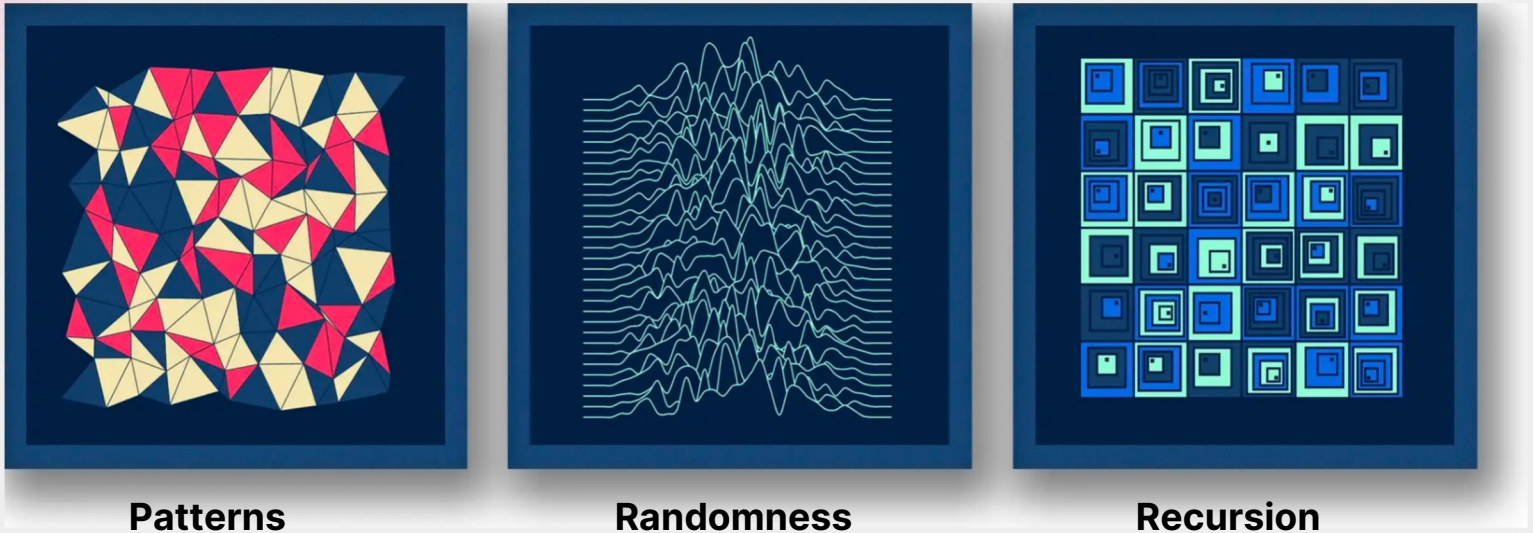
Noise





- White Noise
  - Flat frequency content
  - Maximum entropy
- Perlin Noise
  - Created for Tron
  - More smooth / less random than true random noise
  - Also called Simplex Noise

Examples with Generative Art



Patterns **Randomness** **Recursion**

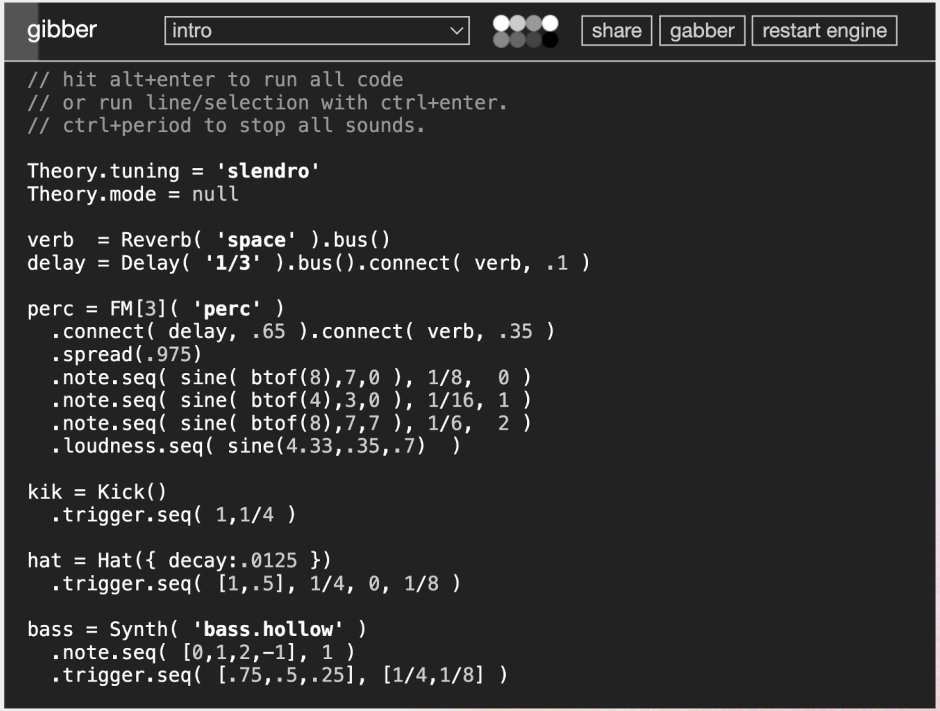
https://levelup.gitconnected.com/generative-art-3-fundamental-concepts-to-get-you-started-44205dae167b

Games

- Game of Life
- Musical dice games
  - Roll a dice and play a sound according to rules
- Fugues
- Brian Eno

What is an algorithm?

- Is all music algorithmic
- What about carilloning?



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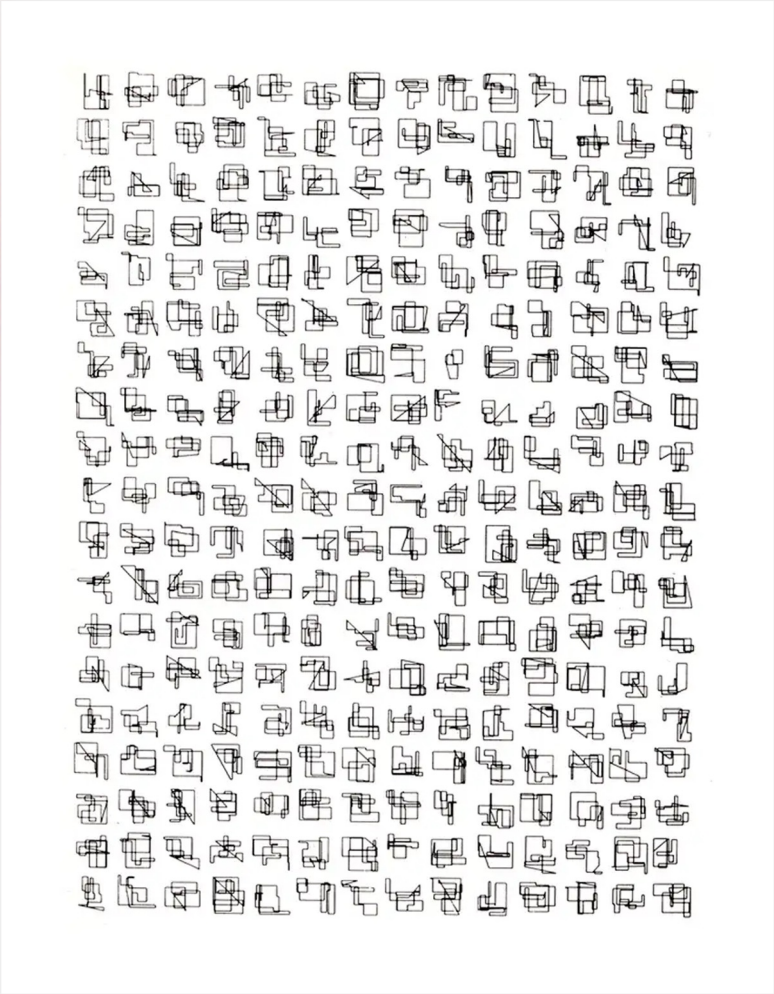
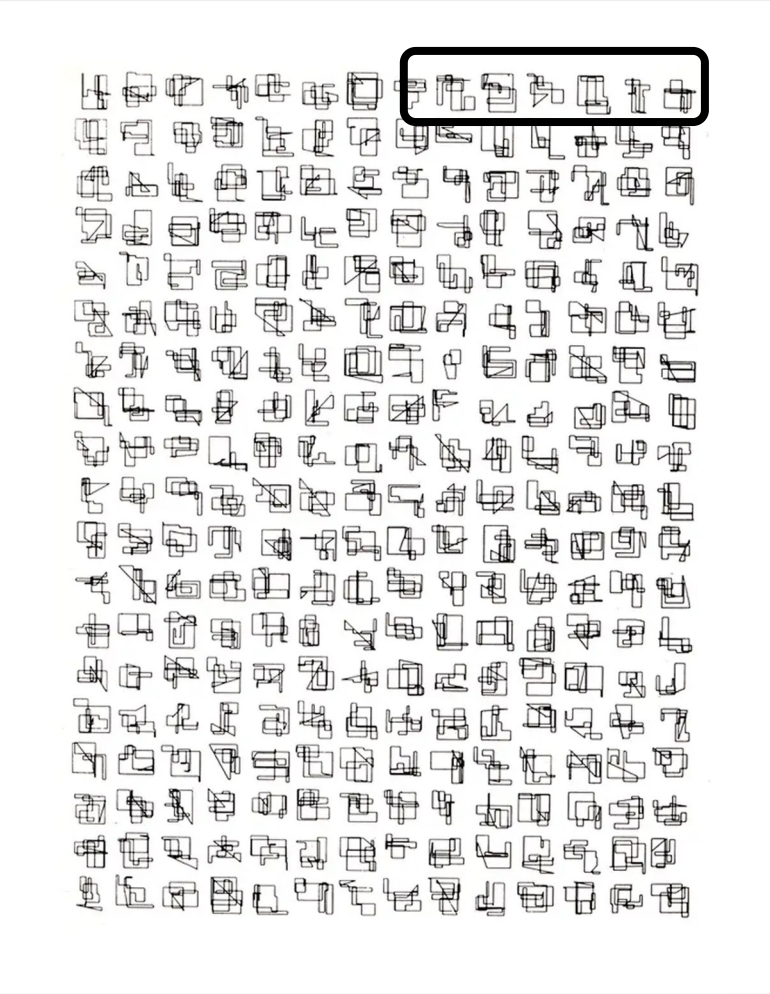
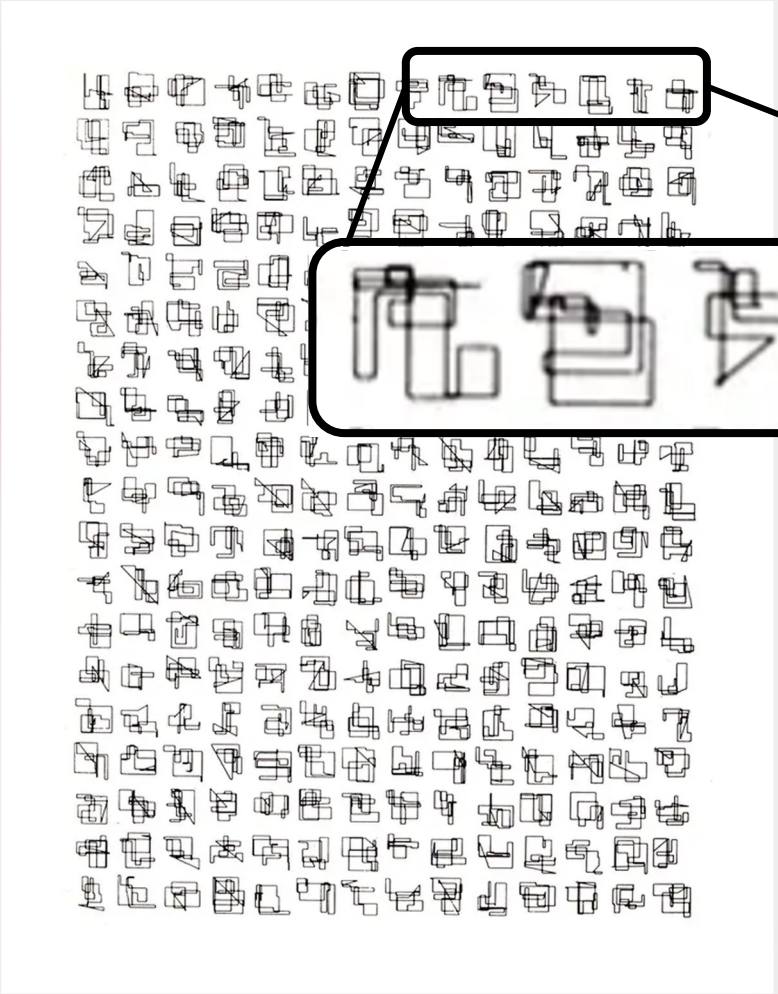
Early Generative Art



Polygon of 23 vertices, George Nees 1965



Polygon of 23 vertices, George Nees 1965



Polygon of 23 vertices, George Nees 1965

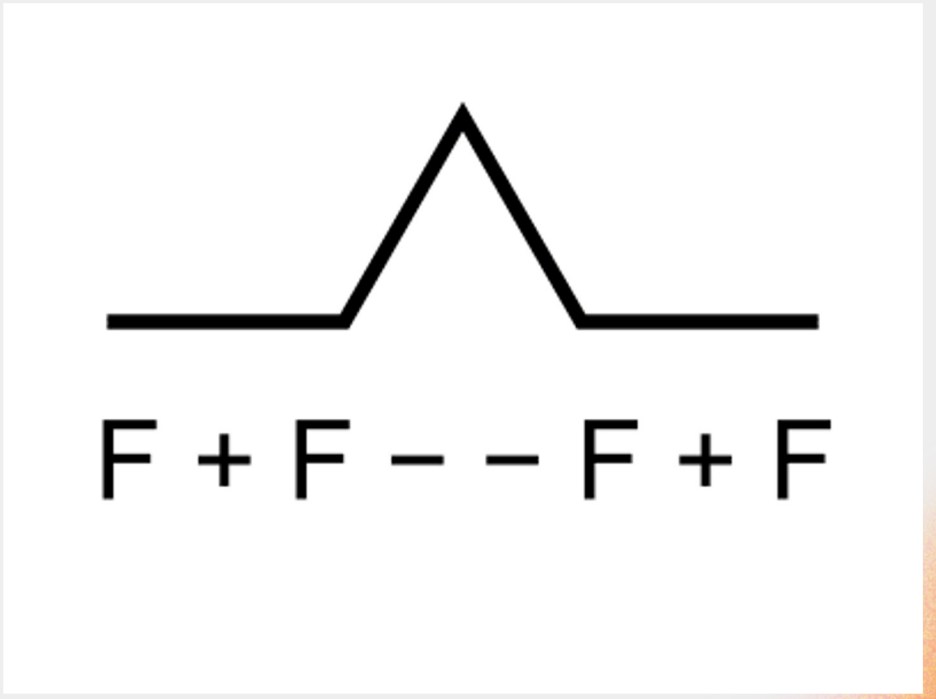
Are these the result of:

- Patterns
- Games
- Mathematical functions
- Algorithms

Transformation de carrés concentriques,
Vera Molnar 1976

Before computers, there were plotters


?REPEAT 20 [REPEAT 180 [FD 1 RT 2] RT 1→
8]
?HT
?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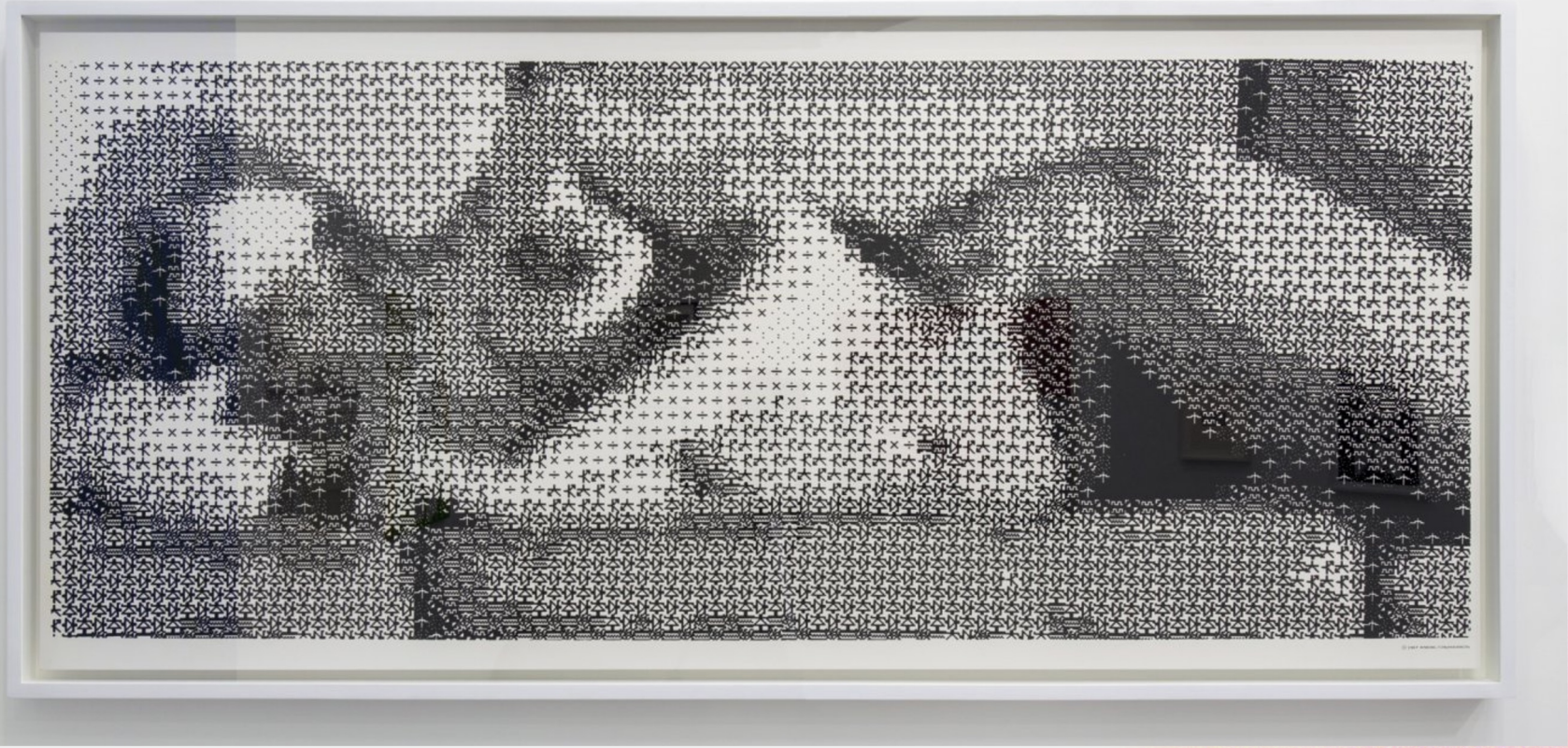

Ken Knowlton and Leon Harmon, Computer Nudes: studies in perception, 1967

Fred Whipple, Stochastic Painting, 1968

Stochastic Painting Rules

1. The first pair give x and y on a canvas coordinate system for the starting point.

2. The first of the second pair, taken as a decimal of 360°, gives a direction from the starting point; the second, multiplied by a unit distance, say a centimeter or half an inch, measures a distance in this direction.

3. From the end of the first line the first number of the next pair measures a distance; the second, multiplied by 15°, measures an angle turned counterclockwise from the tip of the previous line.

4. Successive lines are developed by successive number pairs from the ends of the previous lines or from the outer sides of closed areas.

5. We now must have a rule for closing the areas. I first tried a rule that produces areas that are all triangles or polygons with no internal angles greater than 180°. I chose to join the figure at the end of a line when any projection of a line was pointed towards the originating side of the polygon. This leads frequently to several lines radiating from a point, which gives some sense of three-dimensionality to the final painting.

6. At the edges of the canvas I first adopted the simple rule of extending the line by equal-angle reflection.

7. When the canvas is completely covered, the choice of colors can be made by successively numbering each closed area by a number taken in sequence from a random-number table. The nature of the painting can be quite affected by ruling that contiguous areas may or may not receive the same color. I chose to eliminate contiguous areas of the same color thereby ending up with colored areas all of polygonal character.

8. If the tubes of paint are numbered successively, in any order, ten random numbers distribute the ten colors among the numbers from 0-9.

9. The remainder of the operation, as in any number painting, permits the painter to choose textures and shades at will. Or, if he wishes, he can mix a certain amount of white with the paint for each area

Fred Whipple, Stochastic Painting, 1968

Are these the result of:

- Patterns
- Games
- Mathematical functions
- Algorithms

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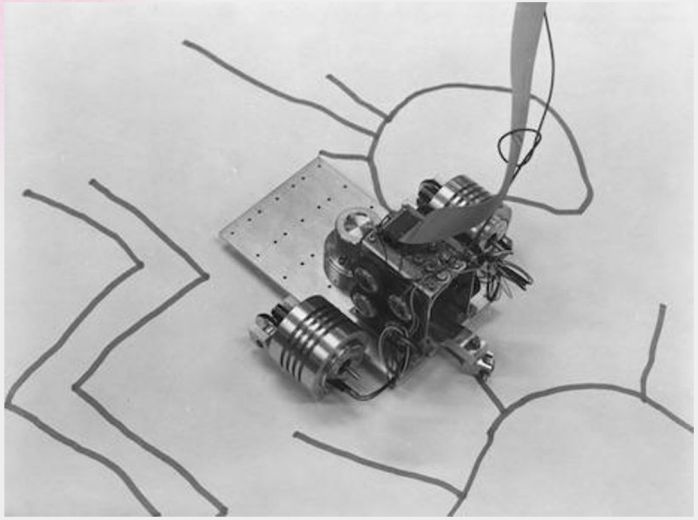
PLS71994/PLM47399
00:09:23

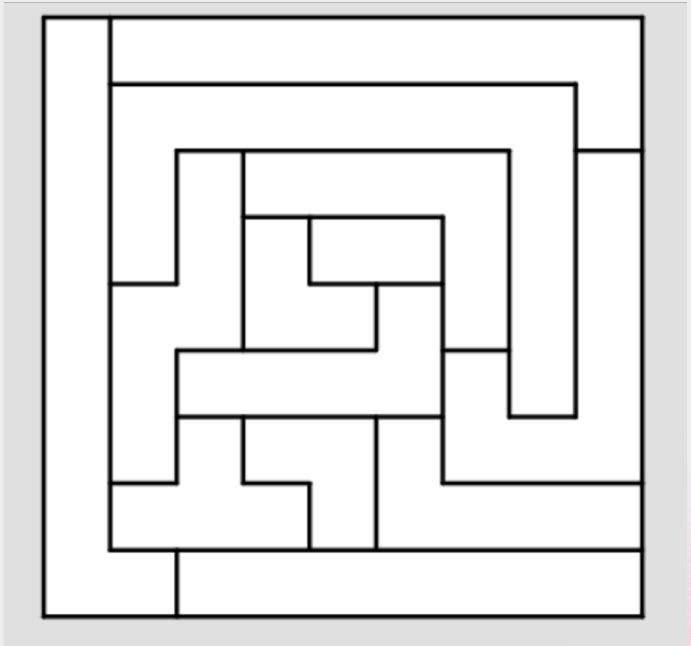
AARON, 1995,

programmed in C



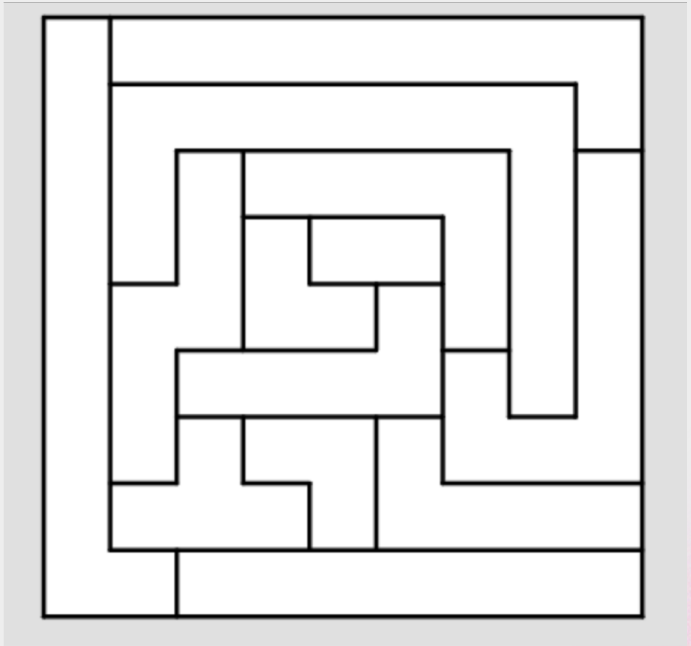
Coloring Puzzles

- Coloring puzzles
  - Using only 4 colors



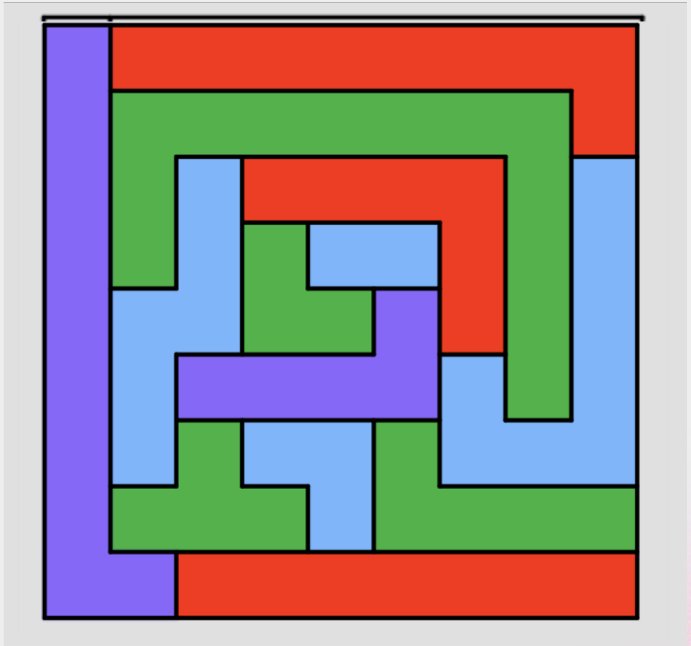
Coloring Puzzles

- Coloring puzzles
  - Using only 4 colors
    - No adjacent shape can have the same color



Coloring Puzzles

- Coloring puzzles
  - Using only 4 colors
- Scratch
  - Visual coding for kids
  - Made by the media lab in 2003



LET'S DO IT OURSELVES!

Grab a paper and some coloring tools.

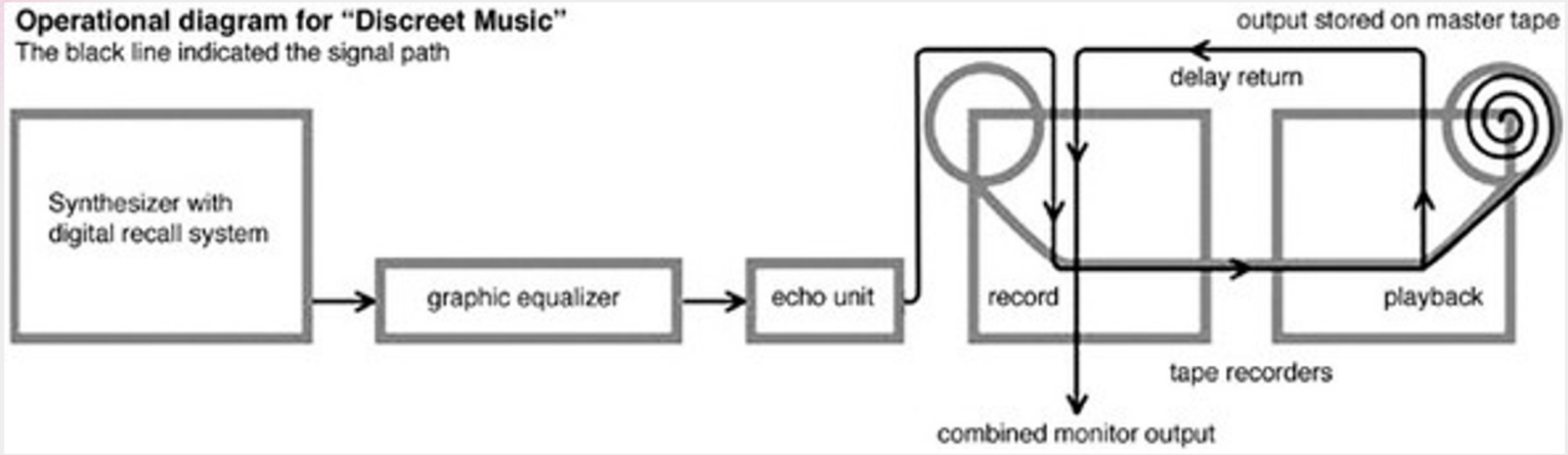
03

And generative art is not just visual!

Generative Music

https://gibber.cc/

Brian Eno's Discreet Music 1975



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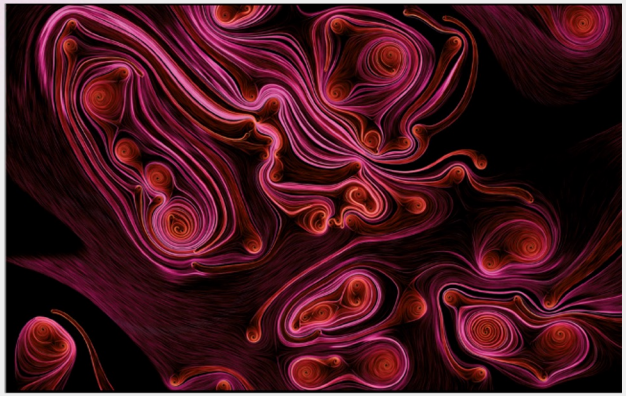
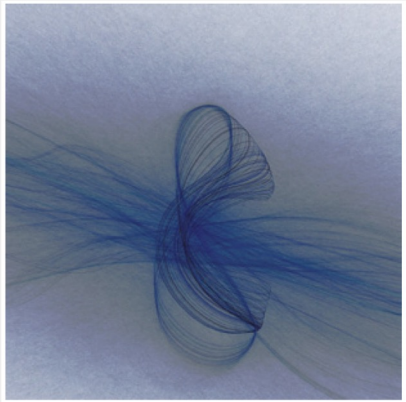
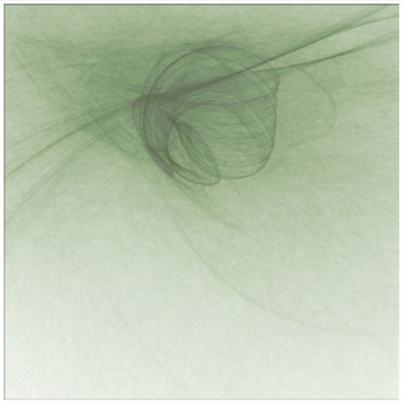
Modern Generative Art

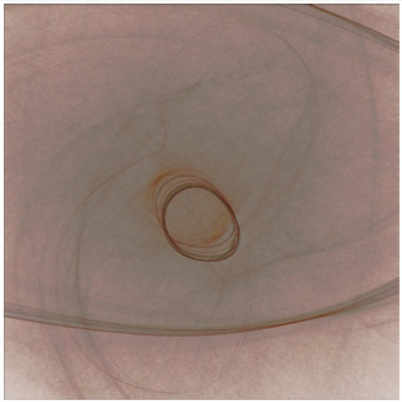
Generative Artworks



Robert Hodgin,
2010





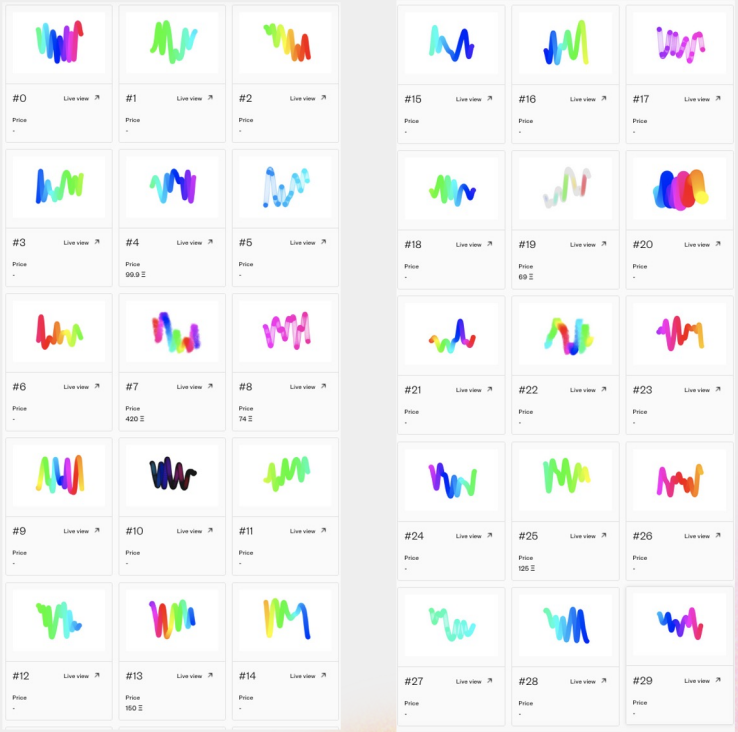


Matt Pearson,
2010

All 3 pieces created by the same algorithm

Blockchain and Generative Art

- Used to provide proof of ownership of many types of art
  - Art not stored on chain
- Generative art applications
  - Code stored on chain
  - Takes a hash input that decides the unique output

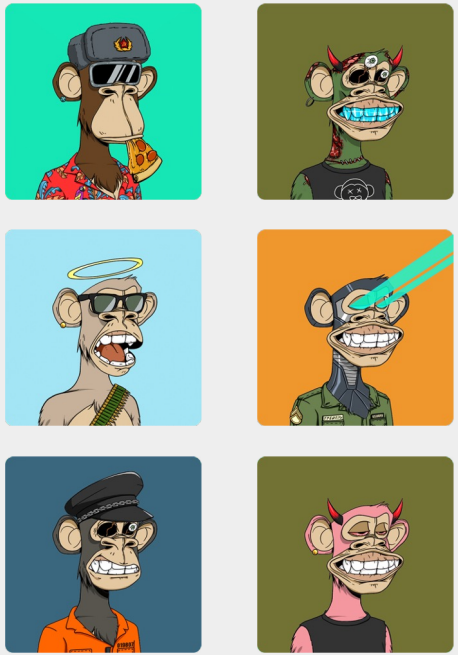


OpenSea

NFT exchange founded in 2017

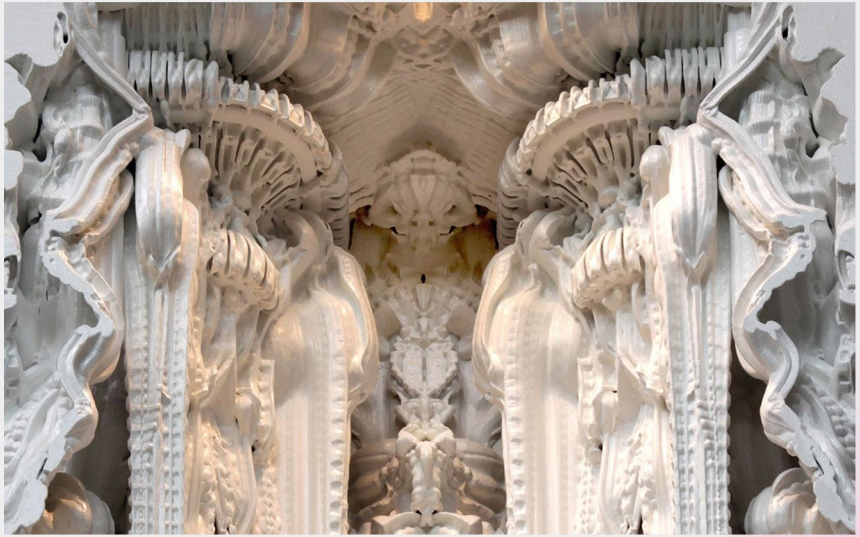
Art Blocks

Memories of Qilin in p5.js by Emily Xie 2022



Bored Ape Yacht Club 2021

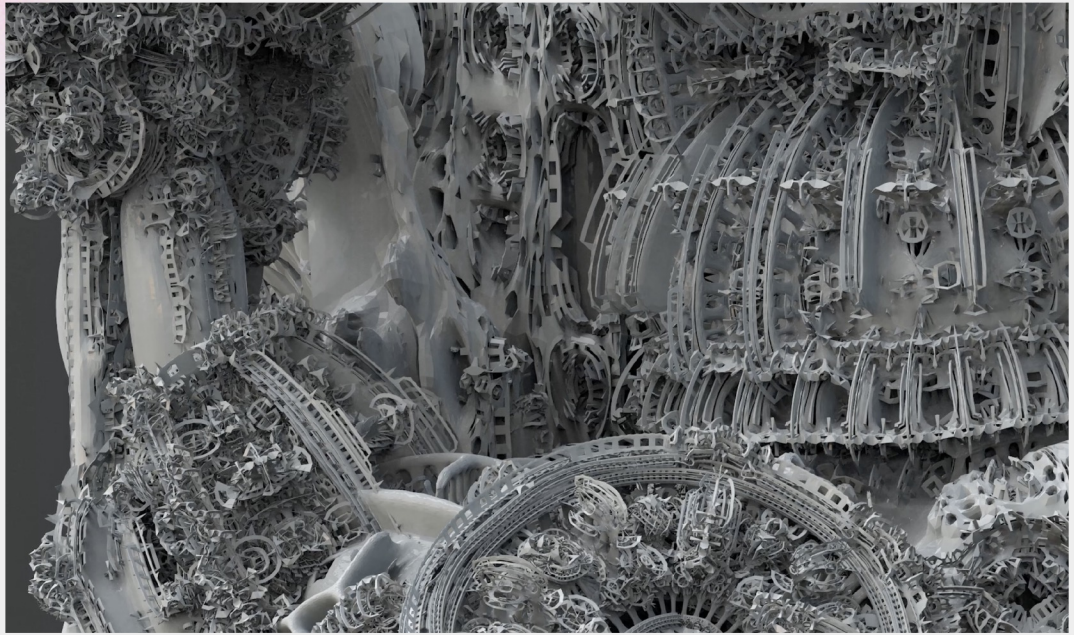
Generative architecture



Michael Hansmeyer Digitial Grotesque I , 2013

Digital Grotesque II

Digital Grotesque II



Generative art tools

- Processing
  - Its own language with Java-like syntax
  - Javascript library p5.js
  - Python module
- Cinder
  - C++
- Openframeworks
  - C++ toolkit
- Nodebox
  - Node-based w/ GUI & Python options

Saturazione, Stefano Contiero, Processing, 2021

- Nannou
  - In Rust
- vvvv
  - Visual language
- OpenRNDR
  - In Kotlin / Java

Processing

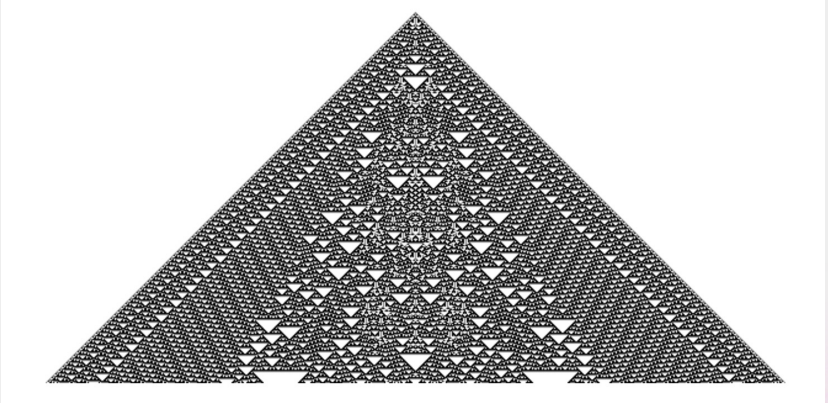
```
from p5 import *

def setup():
    size(100, 100)

def draw():
    text_size(64)
    fill(0, 140)
    text("8", (0, 60))
    text("8", (15, 65))
    text("8", (30, 70))
    text("8", (45, 75))
    text("8", (60, 80))

if __name__ == '__main__':
    run()
```

Cybernetic art

- Any kind of feedback-driven art
- Crowdsourced data
- Interactive art exhibits

Cellular Automata

- https://math.hws.edu/eck/js/edge-of-chaos/CA.html
- Uses a set of rules to decide the next state
- On the edge of stability and chaos
- Can create complex patterns or simple repetitions
- 88 unique elementary cellular automata
  - Binary, 1D, based on the state of a cell and its nearest neighbors
- Asynchronous vs synchronous updating
- Stochastic (random) cellular automata or locally interacting Markov chains



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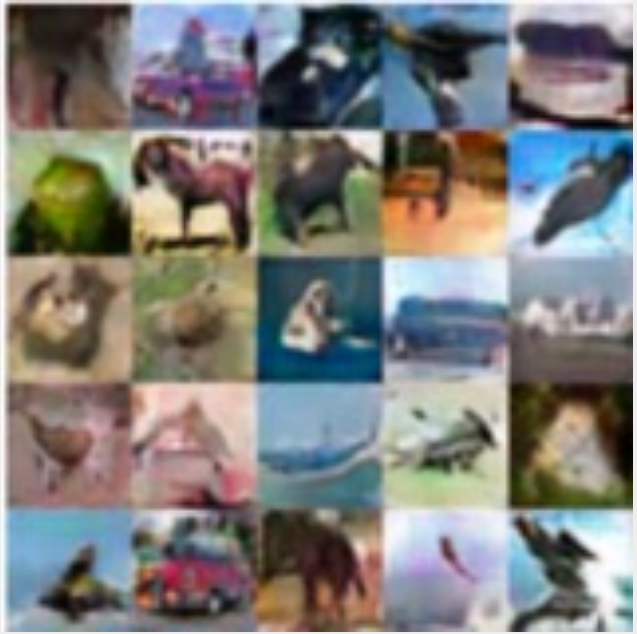
AI Art

AI Art (state of the art 2015)



https://thegradient.pub/the-past-present-and-future-of-ai-art/

Unsupervised, Refik Anadol 2022
Trained in 200 years of MoMA exhibitions – currently in the MoMA

Text-To-Image GUIs

- Stable diffusion, Sept. 2022 [1, 2]
- DALL-E 2, April 2022 [3]
- Latent diffusion (precursor to Stable Diffusion), April 2022 [4, 5]
- Tools these use:
  - GPT-3 [6]
  - CLiP [7, 8]

[1] https://huggingface.co/spaces/stabilityai/stable-diffusion
[2] https://github.com/CompVis/stable-diffusion
[4] https://github.com/CompVis/latent-diffusion
[5] R. Rombach, A. Blattmann et al, CPVR '22 Oral, https://arxiv.org/pdf/2112.10752.pdf

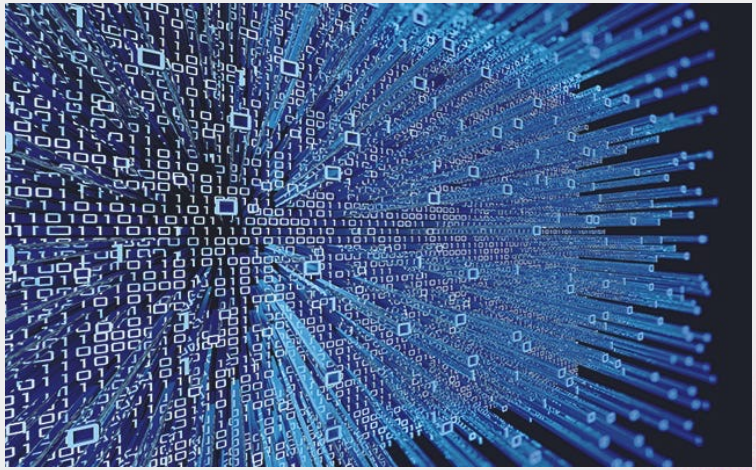
[6] https://arxiv.org/pdf/2005.14165.pdf OpenAI 2020
[7] https://github.com/openai/CLIP OpenAI 2021
[8] A. Radford, J.W. Kim, et al., ICML 2021 https://arxiv.org/pdf/2103.00020.pdf

Ethical concerns with datasets

- Representation
- Graphic imagery

Why hasn't AI Art Always existed?

- Too small of data sets
- Unlabeled data
- Long processing / training times



06

Questions?