

Intro to Generative Art

Noise, Perception, and Learning: Applications in AI Art

IAP 2023

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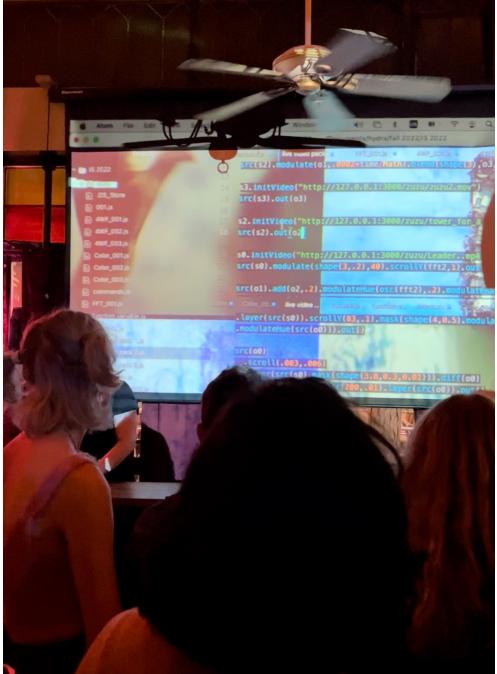
Outline

- Overview of generative art
 - Historical context
 - Examples:
 - Image generation i.e. Processing
 - Sound generation i.e. Live Coding
 - Interactive / collaborative generation i.e. the Brain Opera
- AI Image generation?
 - GANs
 - Diffusion models
- Tools for generative art
 - Processing
 - Stable diffusion

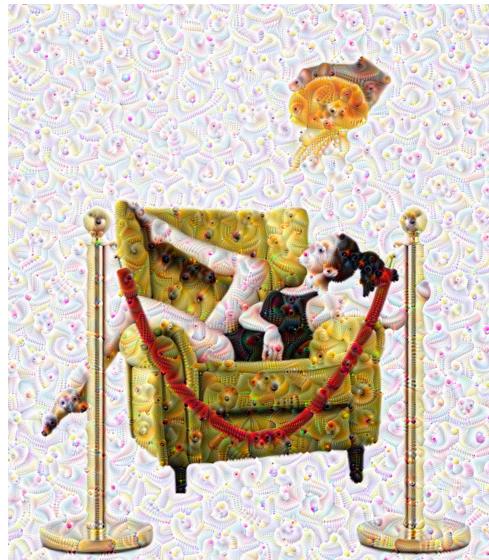
Generative Art

Generative Art

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



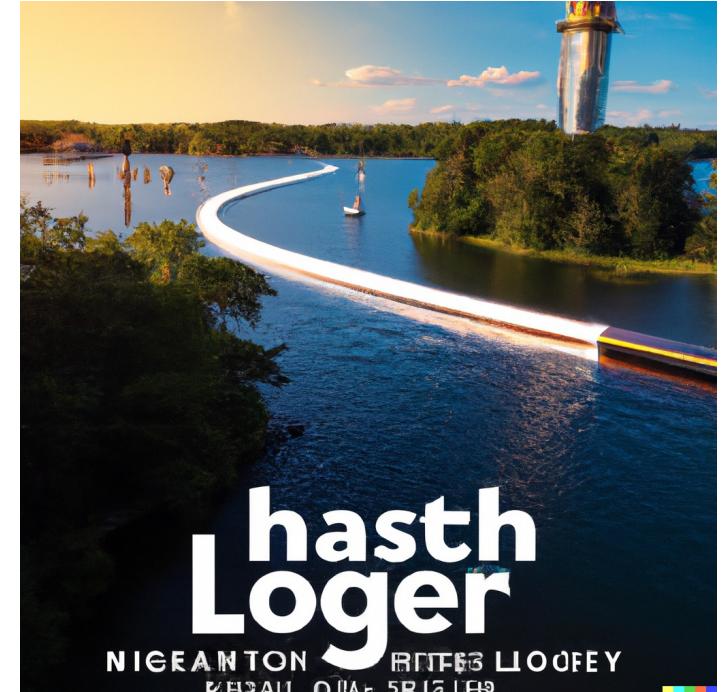
Live Coding



Deep Dream



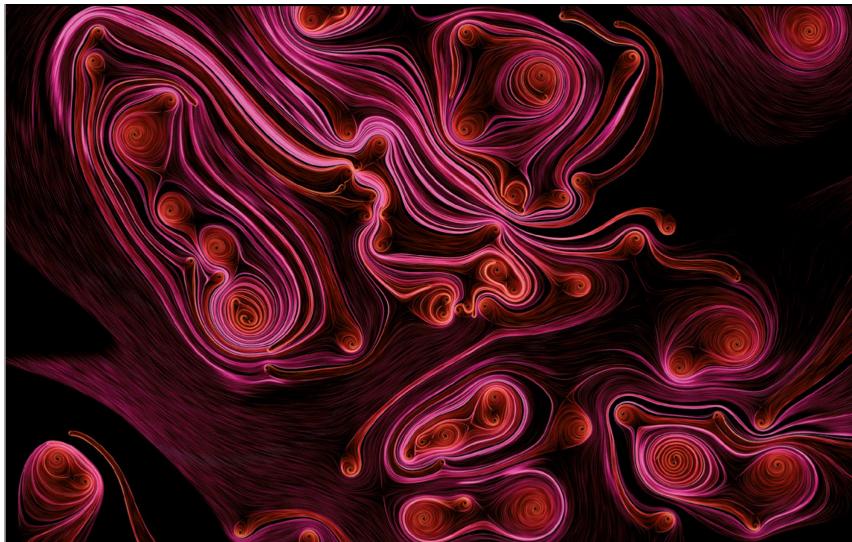
Style transfer



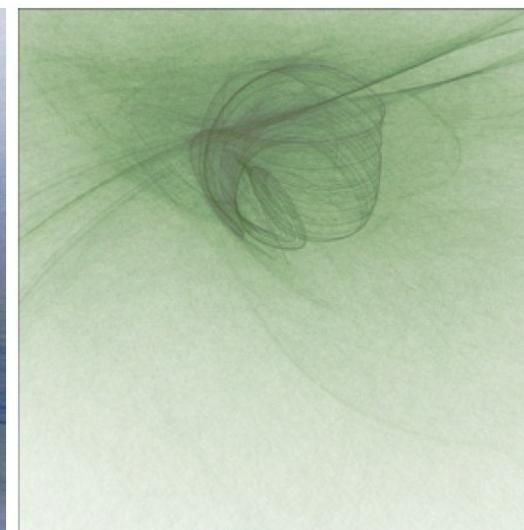
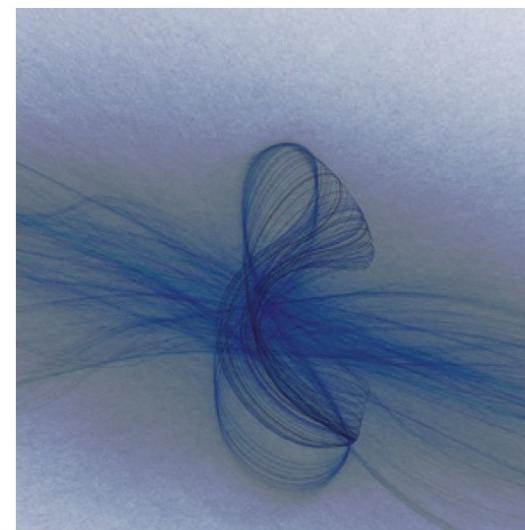
Text-to-Image

Attributes of generative art

- Rules
 - Patterns
 - Games
 - Mathematical functions
 - Algorithms
- Noise
 - Pseudorandom noise generation
 - Complex functions not interpretable by humans



Robert Hodgin, 2010



Matt Pearson, 2010

All 3 pieces created by the same algorithm

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

A History of Algorithmic Art

History of Computer Art

- Generative Systems: Art, Science and Technology at the School of the Art Institute of Chicago in 1969
 - Ended in 1980
 - Used copying techniques
 - Pioneered computer graphic art
- Fred Whipple **Stochastic Painting, 1968**
 - Painted colors and shapes according to a set of pre-determined rules
 - Also a Harvard astronomer known for the “dirty snowball” hypothesis of comets



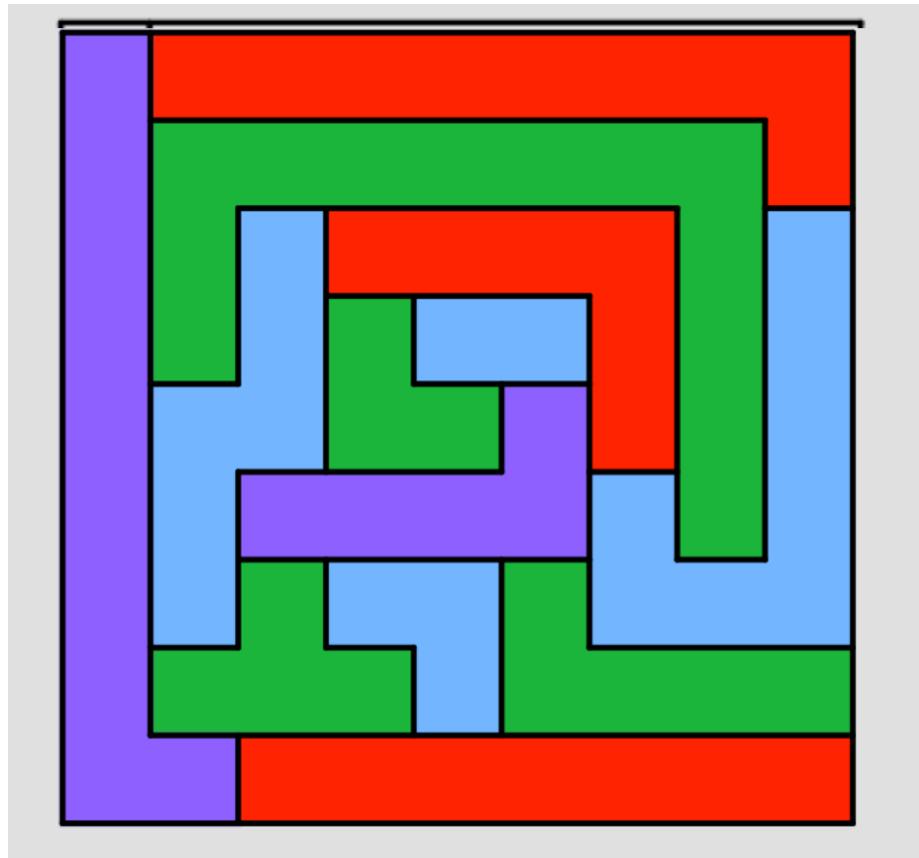
Fred Whipple, **Stochastic Painting, 1968**



George Nees Graphik aus Dreiundzwanzigzackigen 1965

Coloring Puzzles

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



AARON

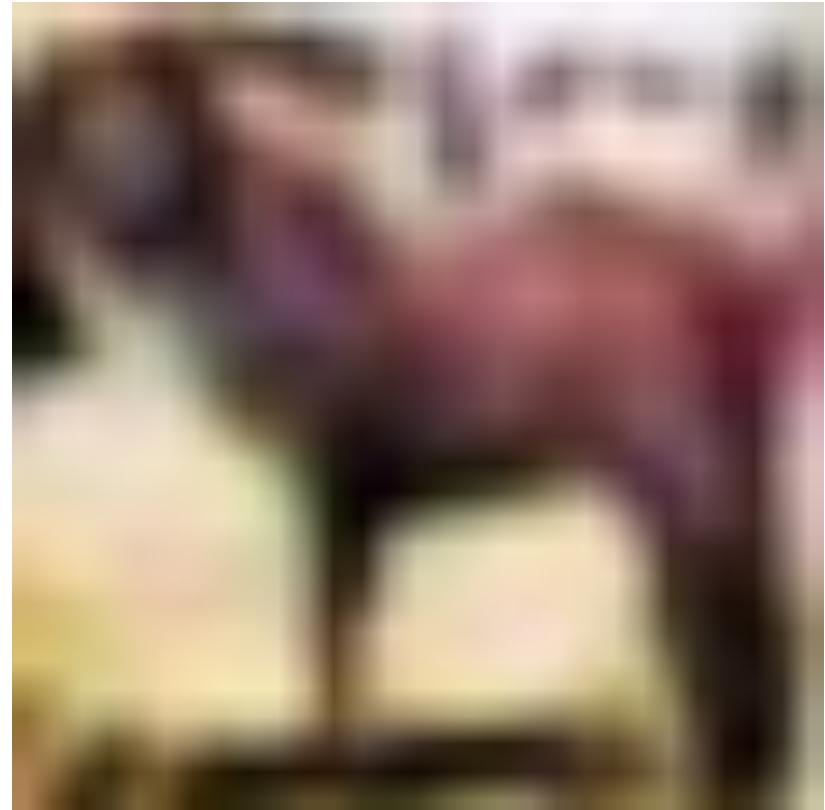
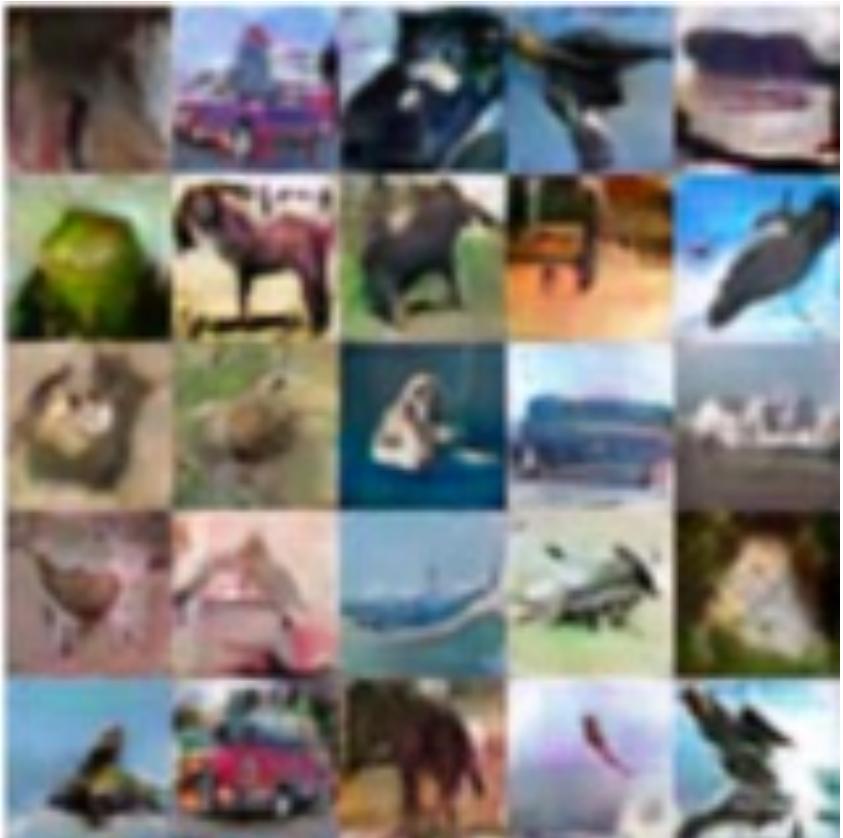
- Programmed in C by Harold Cohen
- 1995 image



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

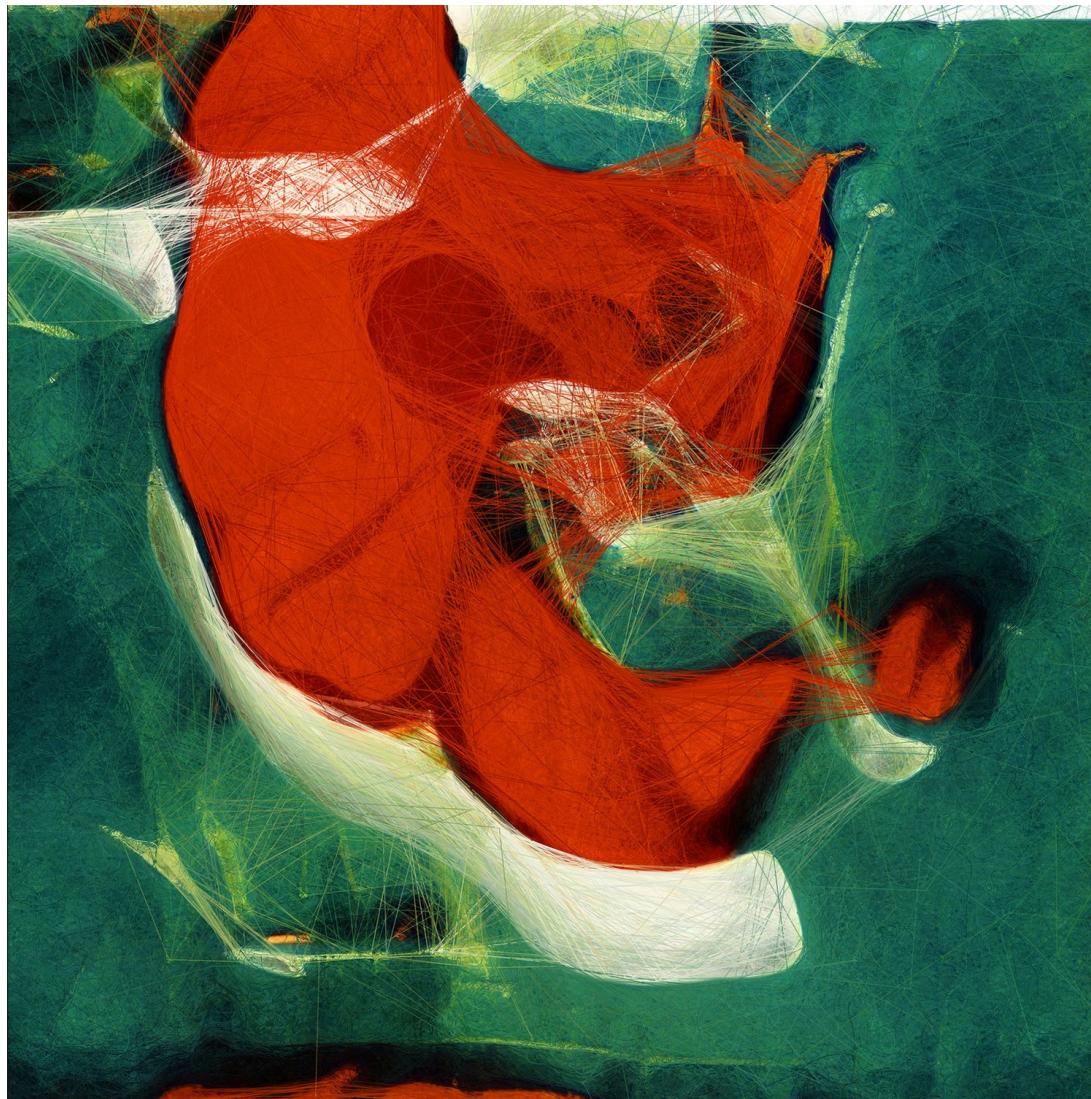
AI Art (state of the art 2015)



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

Types of AI-assisted Image Generation

- Style-transfer
- In-painting and out-painting
- Text-to-image generation
- Image-to-image generation



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

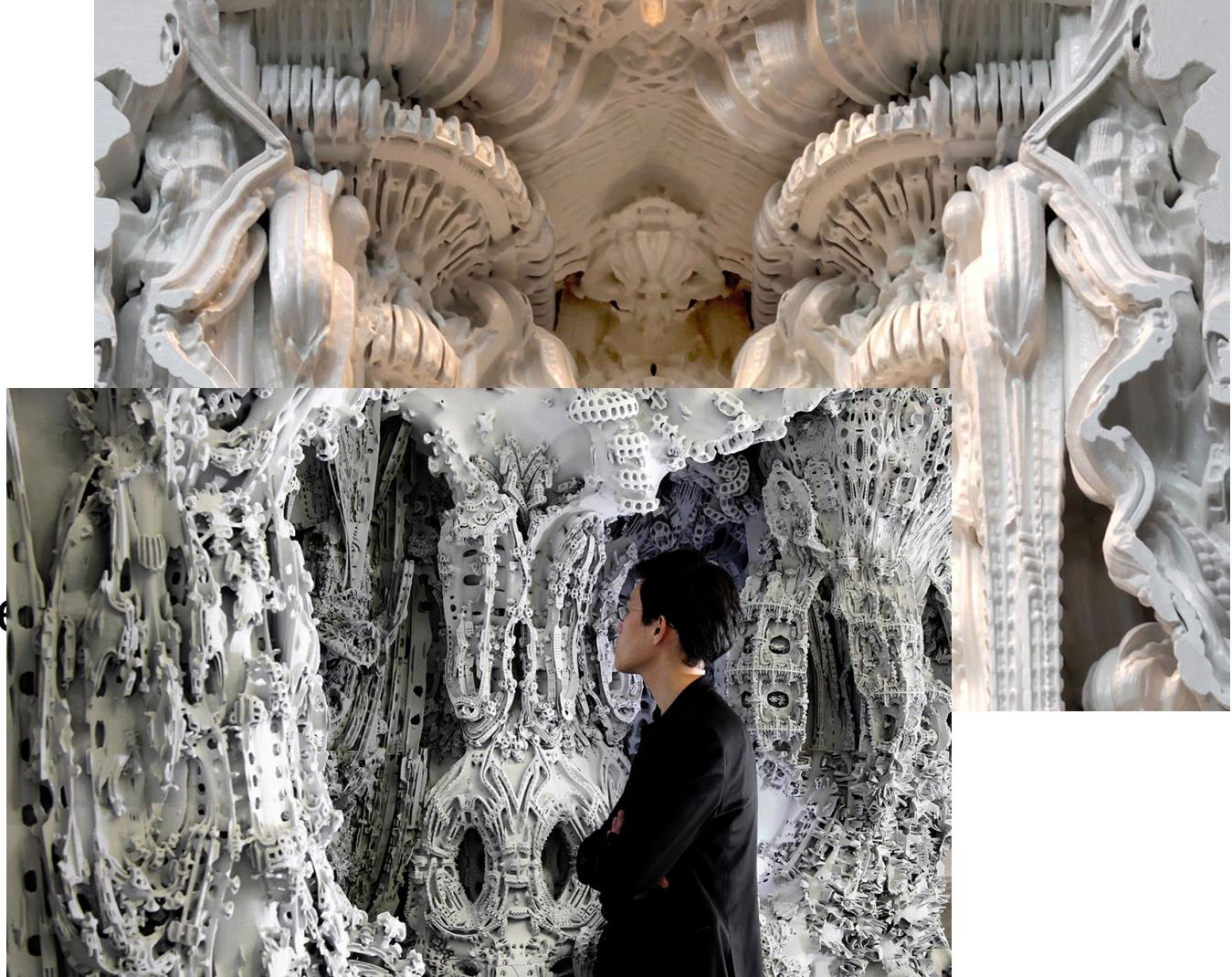
[7] <https://github.com/openai/CLIP> OpenAI 2021

[8] A. Radford, J.W. Kim, et al., ICML 2021 <https://arxiv.org/pdf/2103.00020.pdf>

Aside: Architecture

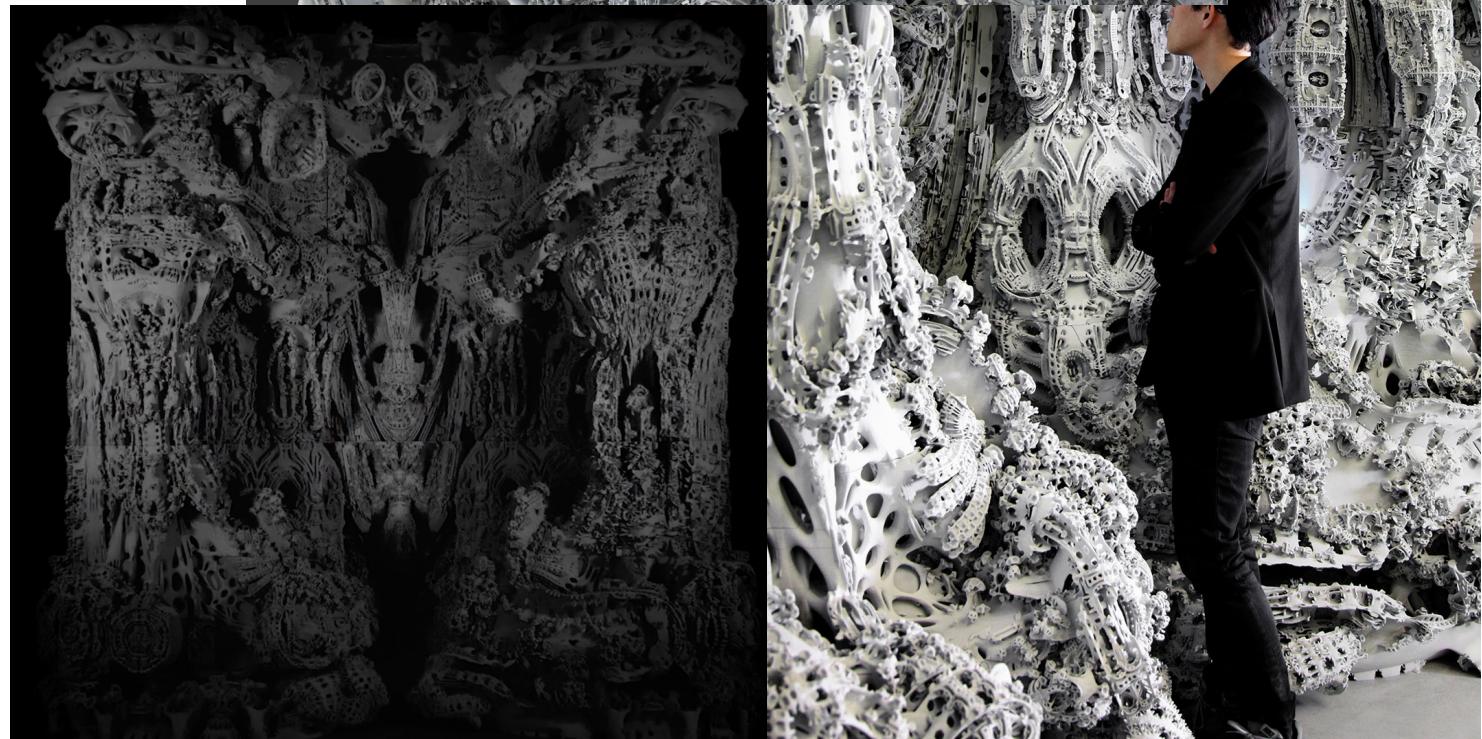
Generative architecture

- Michael Hansmeyer
- Digital Grotesque I
- Made out of 3D printed sand
- Highly articulated surfaces to give the impression of depth
- Generates shapes at many scales



Digital Grotesque II

- Using machine learning this time
- 7 tons of sand



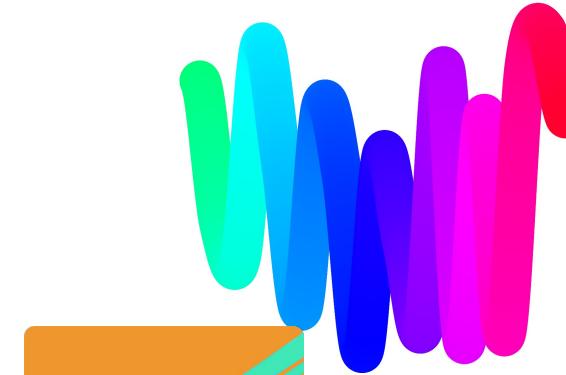
Aside: NFTs

NFTs

1. An artist creates an algorithm that deterministically generates an artwork given some inputs
 1. They may choose how these inputs control how the output looks and operates
2. Artblocks stores code to create generative artworks
 1. These take in a unique seed or hash that controls the variables in the generative code
3. To purchase a
 1. The Art Blocks platform hosts generative projects for the production of verifiably deterministic outputs. A generative script (using [p5js](#) for example) is stored immutably on the Ethereum blockchain for each project. When a user wants to purchase an iteration of a project hosted on the platform, they purchase an ERC721 compliant "non-fungible" token, also stored on the Ethereum blockchain, containing a provably unique "seed" which controls variables in the generative script. These variables, in turn, control the way the output looks and operates.

Blockchain and art

- Matt Kane
 - Gazers – deterministically generated moons that change in time with the moon
- Art Blocks
 - A platform for artists to sell their generative art
 - Headquartered in Marfa TX
- Bored Apes



Memories of Qilin in p5.js by Emily Xie 2022

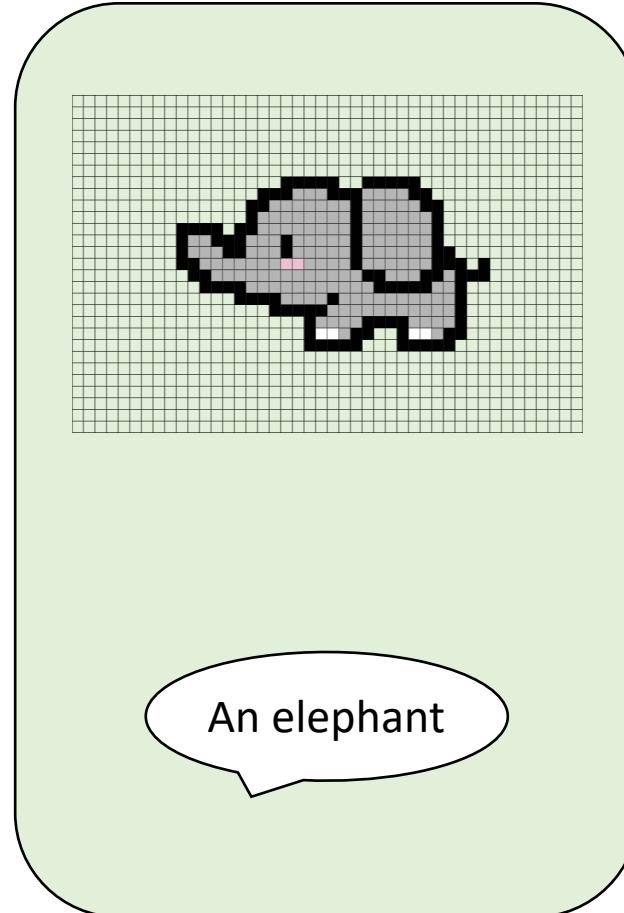
Questions?

Bonus

Cybernetic art

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

Latent Representations



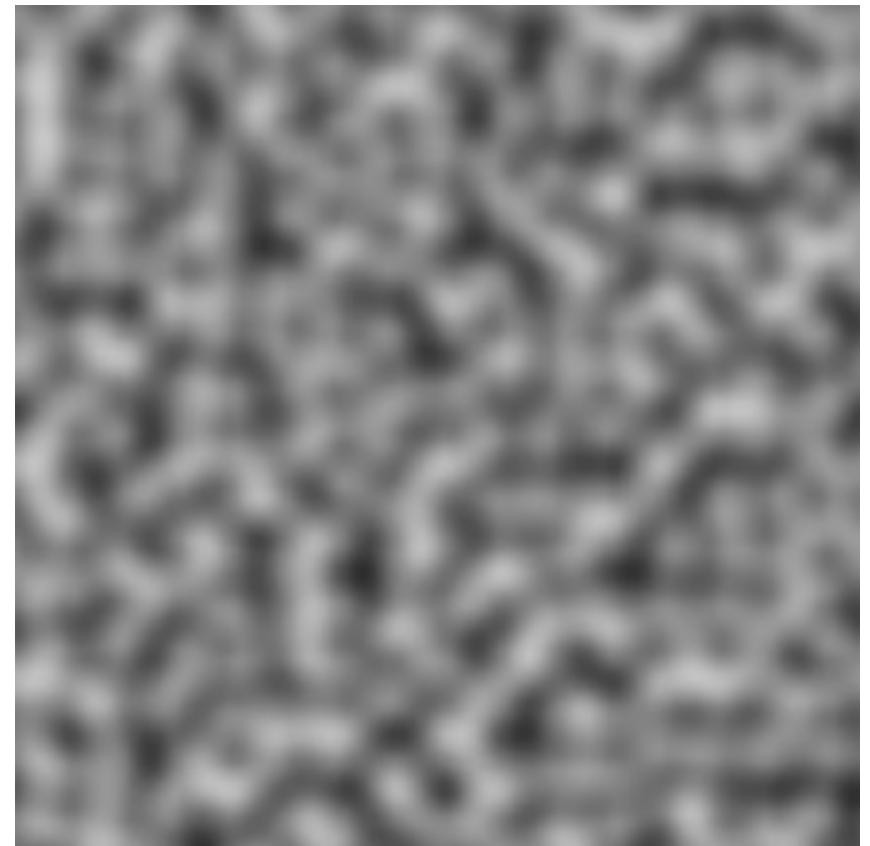
Saliency

Generative art

- Can be precisely understood
- Exactly replicable

Noise

- Perlin Noise
 - Created for Tron
 - More smooth / less random than true random noise



Processing

Datasets

- Mathematical
 - Fractal / madelbrot
- Biological
 - DNA

Ethical concerns with datasets

- Representation
- Graphic imagery



OpenSea

NFT exchange founded in 2017

Jiometory No Compute by Samsy 2021

Gazers by Matt Kane 2021

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 counter-clockwise 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. (See Fig. 1).
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. In Fig. 1 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

Games

- 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 carillonning?