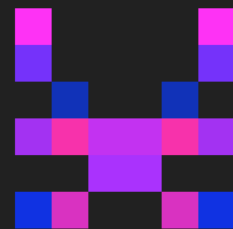
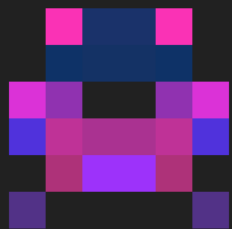
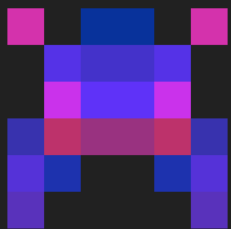


generative art

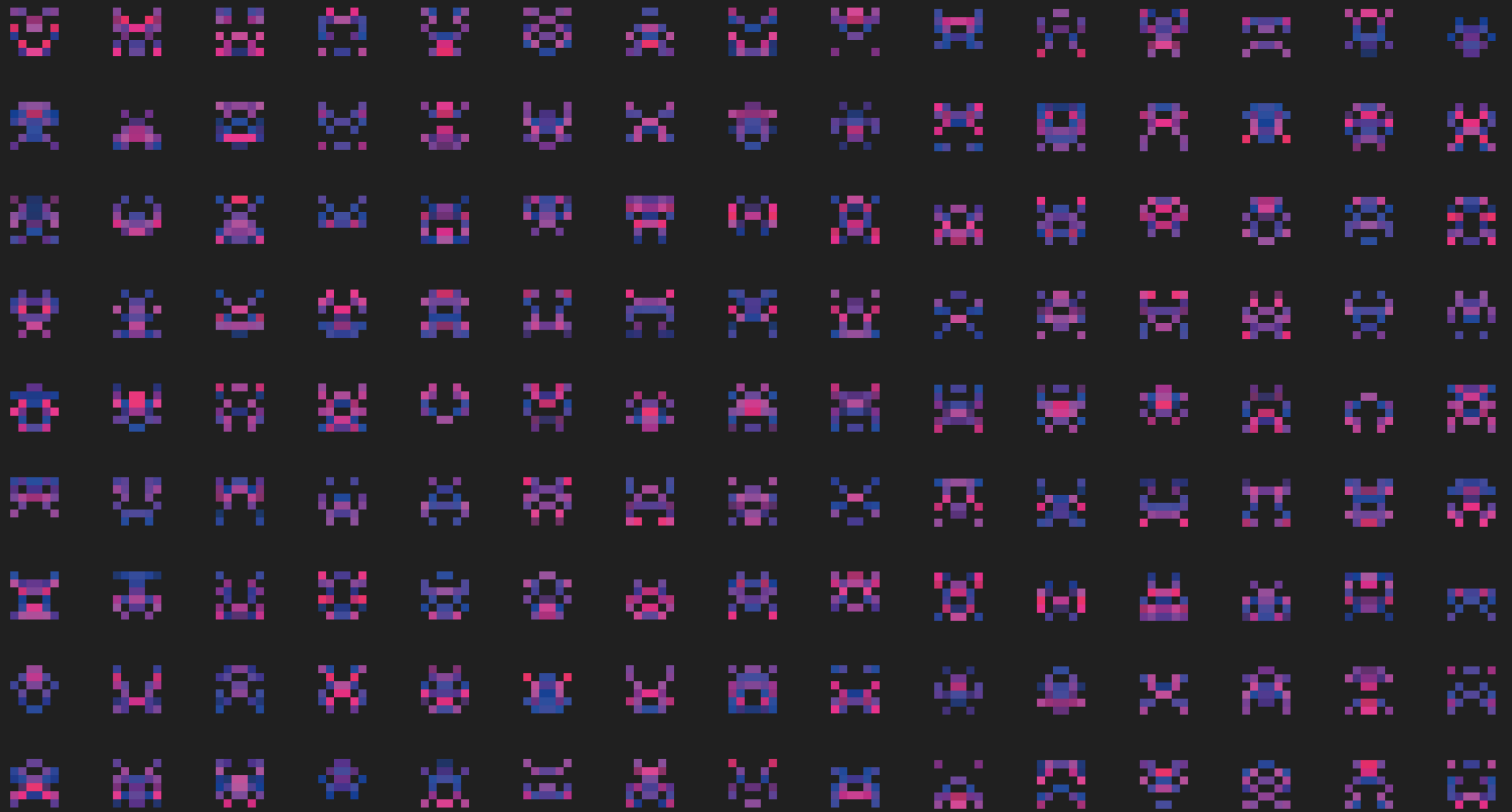
WHAT IS

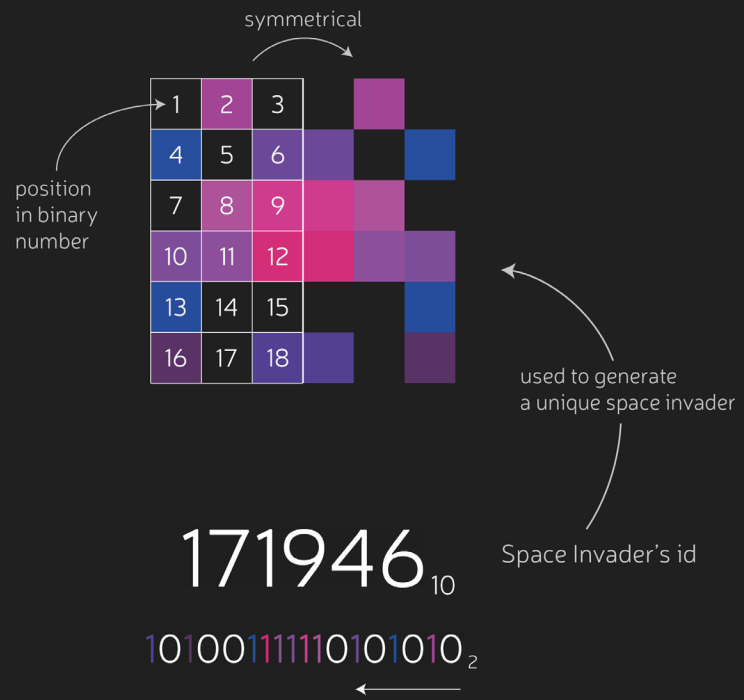
generative art











# Generative art

“Generative art refers to any art practice in which the **artist cedes control to a system with functional autonomy** that contributes to, or results in, a completed work of art.

Systems may include natural language instructions, biological or chemical processes, computer programs, machines, self-organizing materials, mathematical operations, and other **procedural inventions.**”

(Galanter 2008)



Mozart, Bach, Kirnberger

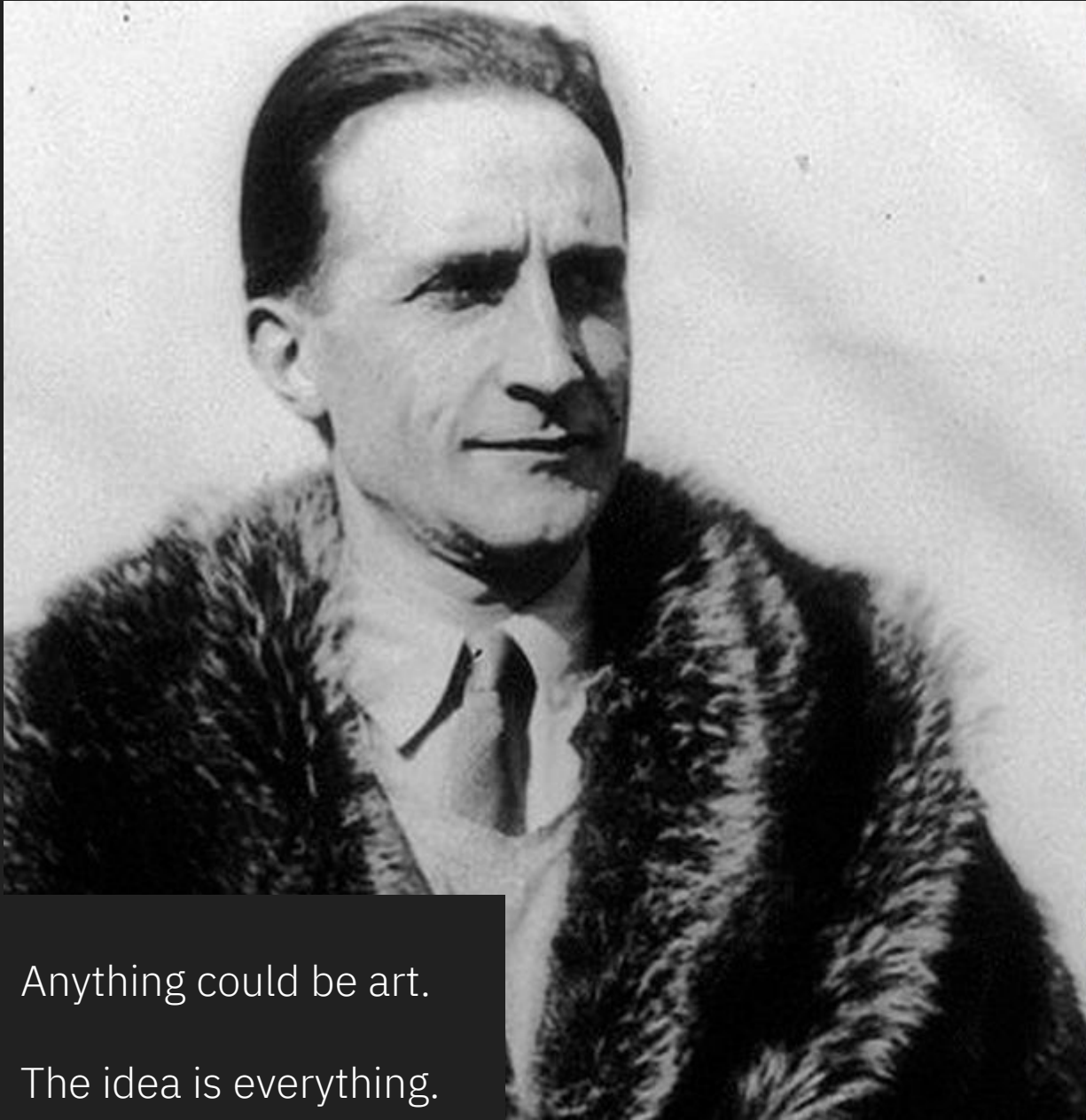
**Music Dice Game**

18th century

The idea was to create a minuet by cutting and pasting together prewritten sections, making selections according to the roll of a die.

<https://youtu.be/9Zdg6Ec4mVw?t=125>





Anything could be art.  
The idea is everything.



Marcel Duchamp  
**Fountain**  
1917

# Conceptual art

new approach in art significant in 1960s and 1970s

“In conceptual art **the idea or concept is the most important aspect of the work.** ... It means that all the planning and decisions are made beforehand and the execution is a perfunctory affair. **The idea becomes the machine that makes the art.**”

Sol LeWitt (1967)

Sol LE WITT  
Born 1928, Hartford, Connecticut  
Lives in New York

PROPOSAL FOR WALL DRAWING, INFORMATION SHOW

Within four adjacent squares,  
each 4' by 4',  
four draftsmen will be employed  
at \$4.00/hour  
for four hours a day  
and for four days to draw straight lines  
4 inches long  
using four different colored pencils;  
9H black, red, yellow and blue.  
Each draftsmen will use the same color throughout  
the four day period,  
working on a different square each day.

→ IMAGE

## Proposal for wall drawing

Sol LeWitt

For LeWitt this often meant creating instructions and diagrams for large scale wall drawings that could be carried out by others.





Yoko Ono

## Instruction Paintings

### CLOUD PIECE

Imagine the clouds dripping.  
Dig a hole in your garden to  
put them in.

1963 spring

### FLY PIECE

Fly.

1963 summer



BEAT PIECE

Listen to a heart beat.

1963 autumn

CITY PIECE

Walk all over the city with an empty baby carriage.

1961 winter

PAINTING FOR THE WIND

Cut a hole in a bag filled with seeds of any kind and place the bag where there is wind.

1961 summer

MAP PIECE

Draw a map to get lost.

1964 spring

TRAVEL PIECE

Make a key.  
Find a lock that fits.  
If you find it, burn the house that is attached to it.

1964 spring

BOX PIECE

Buy many dream boxes.  
Ask your wife to select one.  
Dream together.

1964 spring

The key element in generative art is the use of an **external system** to which the **artist cedes partial or total control**.

With generative art, the autonomous system does all the heavy lifting; the artist **only** provides the instructions to the system and the initial conditions.

Who is then the **creator of the piece**?

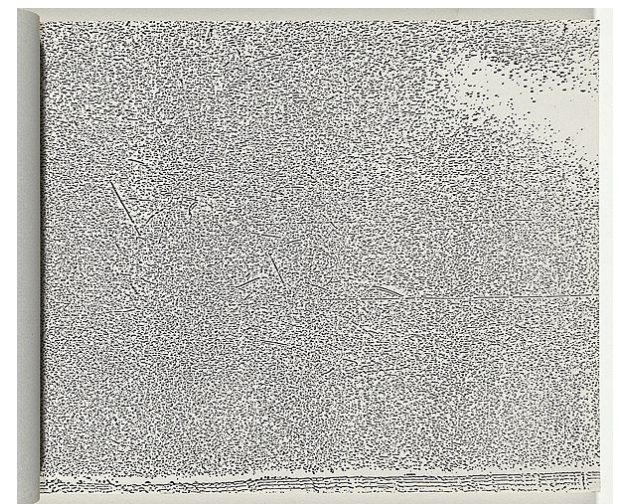
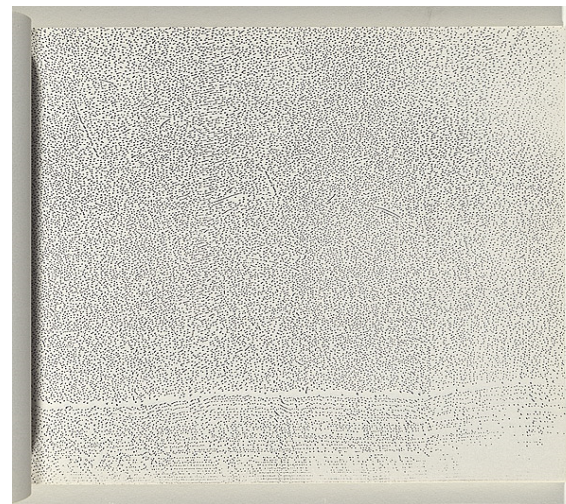
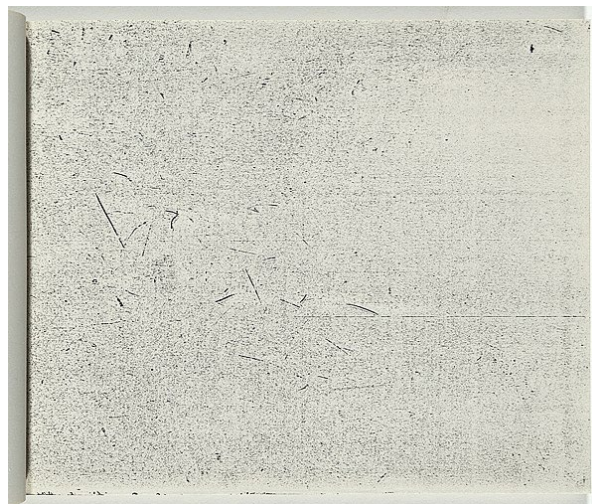
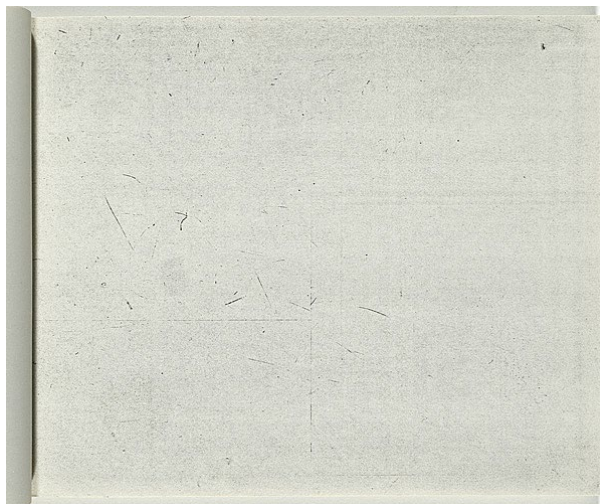
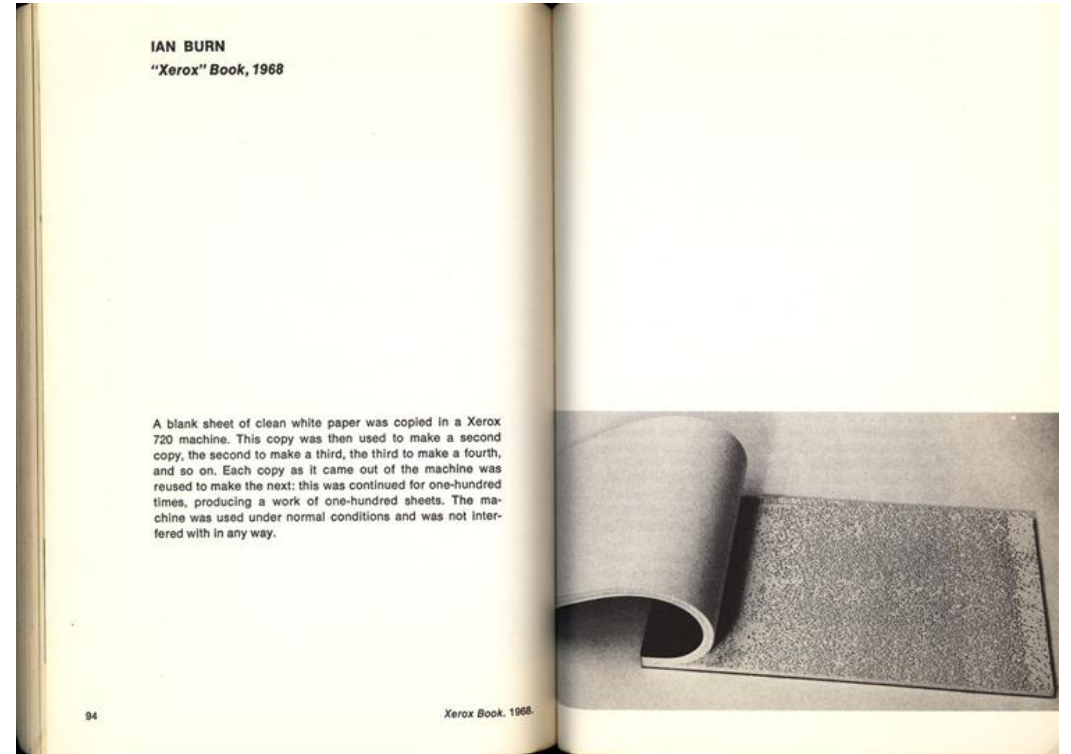


→ IMAGE

## "Xerox" Book

Ian Burn, 1968

Documentation is often how we come to know about conceptual art.



→ SOUND

**4' 33"**

John Cage, 1952

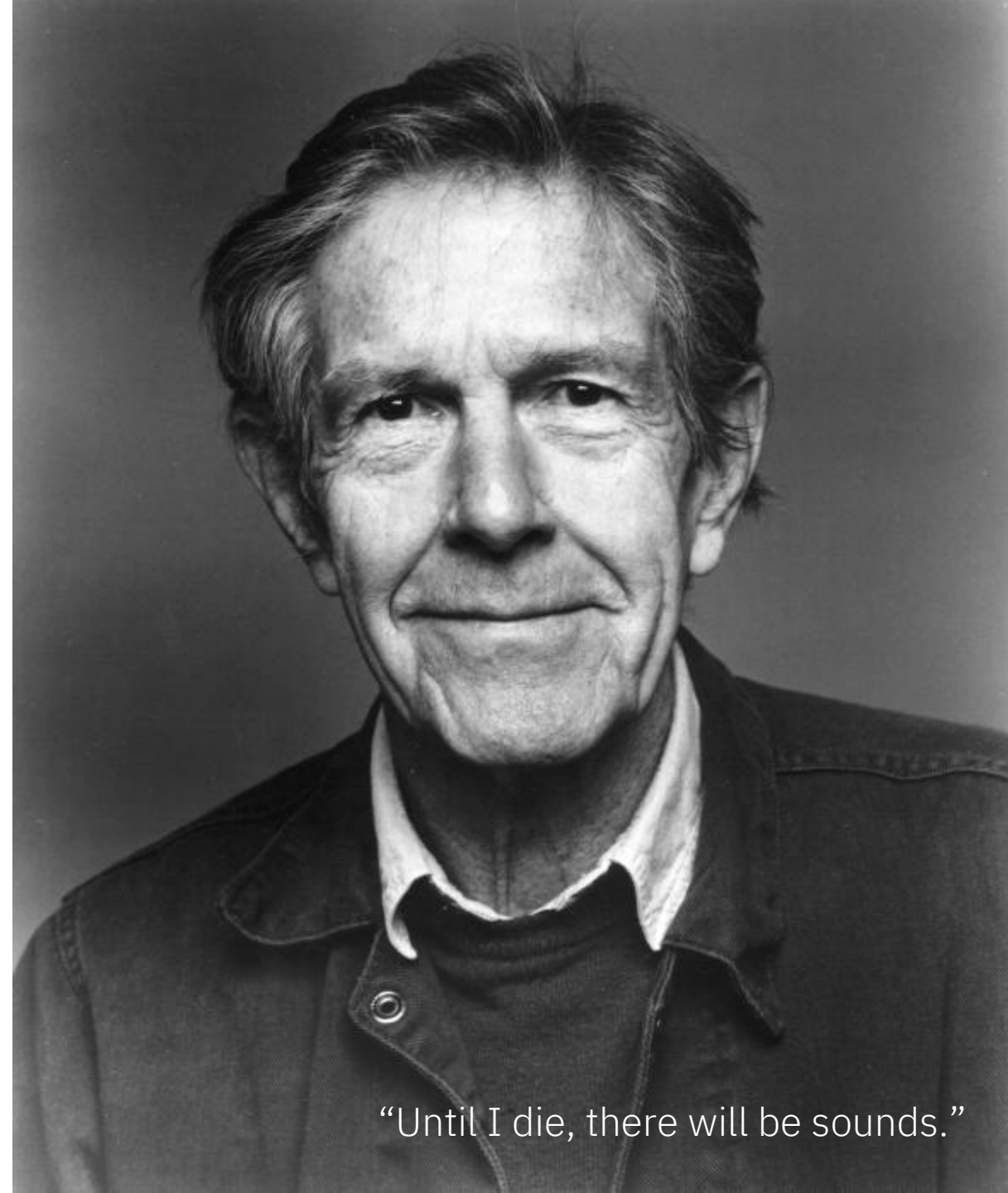
**4'33"**  
(CM Level 10 Solo Piano Arrangement) by John Cage (1912-1992)  
arr. Nate Kang

Moderato  
♩ = 100

*scherzo pizzicato*

The musical score is presented in five systems, each with a grand staff (treble and bass clefs).  
System 1 (measures 1-16): Starts with a piano (*pp*) dynamic, followed by a fermata over measure 8, and then a crescendo leading to a mezzo-forte (*mf*) dynamic.  
System 2 (measures 17-32): Features trills (*tr*) and a fortissimo (*sf*) dynamic, followed by a decrescendo to a mezzo-piano (*mp*) dynamic.  
System 3 (measures 33-47): Includes a tremolo section, a *poco a poco accelerando* section, a *subito* section with fortissimo (*sf*) dynamics, and an *a tempo* section with a crescendo (*cresc.*).  
System 4 (measures 48-63): Shows fortissimo (*ff*) dynamics, a mezzo-piano (*mp*) dynamic, fortissimo (*fff*) dynamics, and a fortissimo piano (*fp*) dynamic.  
System 5 (measures 64-65): Ends with a fortissimo (*f*) dynamic.

<https://www.youtube.com/watch?v=JTEFKFiXSx4>



“Until I die, there will be sounds.”



→ SOUND

# Discrete Music

Brian Eno, 1975

Procedural methods of composition, where music is defined by a set of rules or conditions.

A 30-minute piece created by a tape-loop feedback system. A synthesized melody was recorded onto a tape machine, the output of which was fed into a second tape machine. The output of the second machine was then fed back into the first machine and the overlapping signals recorded.

## "DISCREET MUSIC"

Side One  
"DISCREET MUSIC"  
Recorded at Brian Eno's studio 9.5.75.

## Side Two THREE VARIATIONS ON THE CANON IN D MAJOR BY JOHANN PACHELBEL

- (i) "FULLNESS OF WIND"
- (ii) "FRENCH CATALOGUES"
- (iii) "BRUTAL ARDOUR"

Performed by The Cockpit Ensemble conducted by Gavin Bryars (who also helped arrange the pieces).  
Recorded at Trident Studios 12.9.75.  
Engineered by Peter Kelsey.

Produced by Brian Eno.

Since I have always preferred making plans to executing them, I have gravitated towards situations and systems that, once set into operation, could create music with little or no intervention on my part.

That is to say, I tend towards the roles of planner and programmer, and then become an audience to the results.

Two ways of satisfying this interest are exemplified on this album. "Discreet Music" is a technological approach to the problem. If there is any score for the piece, it must be the operational diagram of the particular apparatus I used for its production. The key configuration here is the long delay echo system with which I have experimented since I became aware of the musical possibilities of tape recorders in 1964.

Having set up this apparatus, my degree of participation in what it subsequently did was limited to (a) providing an input (in this case, two simple and mutually compatible melodic lines of different duration stored on a digital recall system) and (b) occasionally altering the timbre of the synthesizer's output by means of a graphic equalizer.

It is a point of discipline to accept this passive role, and, for once, to ignore the tendency to play the artist by dabbling and interfering. In this case, I was aided by the idea that what I was making was simply a background for my friend Robert Fripp to play over in a series of concerts we had planned. This notion of its future utility, coupled with my own pleasure in "gradual processes" prevented me from attempting to create surprises and less than predictable changes in the piece. I was trying to make a piece that could be listened to and yet could be ignored... perhaps in the spirit of Satie who wanted to make music that could "mingle with the sound of the knives and forks at dinner".

In January this year I had an accident. I was not seriously hurt, but I was confined to bed in a stiff and static position. My friend Judy Nylon visited me and brought me a record of 18th century harp music. After she had gone, and with some considerable difficulty, I put on the record. Having laid down, I realized that the amplifier was set at an extremely low level, and that one channel of the stereo had failed completely. Since I hadn't the energy to get up and improve matters, the record played on almost inaudibly. This presented what was for me a new way of hearing music - as part of the

ambience of the environment just as the colour of the light and the sound of the rain were parts of that ambience. It is for this reason that I suggest listening to the piece at comparatively low levels, even to the extent that it frequently falls below the threshold of audibility.

Another way of satisfying the interest in self-regulating and self-generating systems is exemplified in the 3 variations on the Pachelbel Canon. These take their titles from the charmingly inaccurate translation of the French cover notes for the "Erota" recording of the piece made by the orchestra of Jean François Paillard. That particular recording inspired these pieces by its unashamedly romantic rendition of a very systematic Renaissance canon. Paillard plays the piece at somewhere near half its notated tempo, and I have made the tempo slower still in deference to the evident wisdom of his decision.

In this case the "system" is a group of performers with a set of instructions - and the "input" is the fragment of Pachelbel. Each variation takes a small section of the score (two or four bars) as its starting point, and permutes the players' parts such that they overlay each other in ways not suggested by the original score. In "Fullness of Wind" each player's tempo is decreased, the rate of decrease governed by the pitch of his instrument (bass = slow). "French Catalogues" groups together sets of notes and melodies with time directions gathered from other parts of the score. In "Brutal Ardour" each player has a sequence of notes related to those of the other players, but the sequences are of different lengths so that

the original relationships quickly break down. I have attempted to emulate Paillard's lush and opulent string quality as far as possible in the recording and mixing of these pieces.

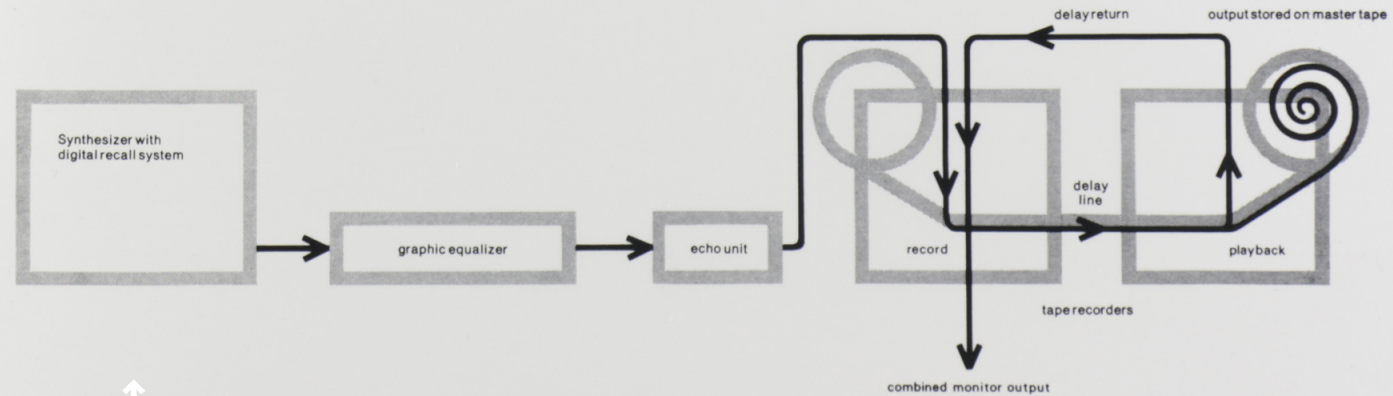
## Brian Eno

Born in Woodbridge, Suffolk on May 15th, 1948.  
1964-69 attended Ipswich and Winchester Art Schools, studying with Tom Phillips, Roy Ascott, Christian Wolff, Anthony Benjamin, Noel Forster and George Brecht. 1968 performed 90 minute rendition of "X for Henry Flynt" by La Monte Young; built two large versions of George Brecht's "Drip Event."  
1969-70 joined Scratch Orchestra briefly and Portsmouth Sinfonia. Produced both Sinfonia albums.  
1971 to present, was a founder member of Roxy Music for two and a half years and has since worked with Robert Fripp, John Cale, Kevin Ayers, Nico, Robert Wyatt, Robert Calvert and Phil Manzanera.  
Records to date include 3 solo albums and 2 collaborative albums with Robert Fripp. Published "Oblique Strategies" with Peter Schmitt.  
Founded and produced Obscure Records.

Design by John Bonis of CCS

## Operational diagram for "Discreet Music"

The black line indicates the signal path



↑  
score



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→ SOUND

## **Random Access**

Naum Jun Paik, 1978



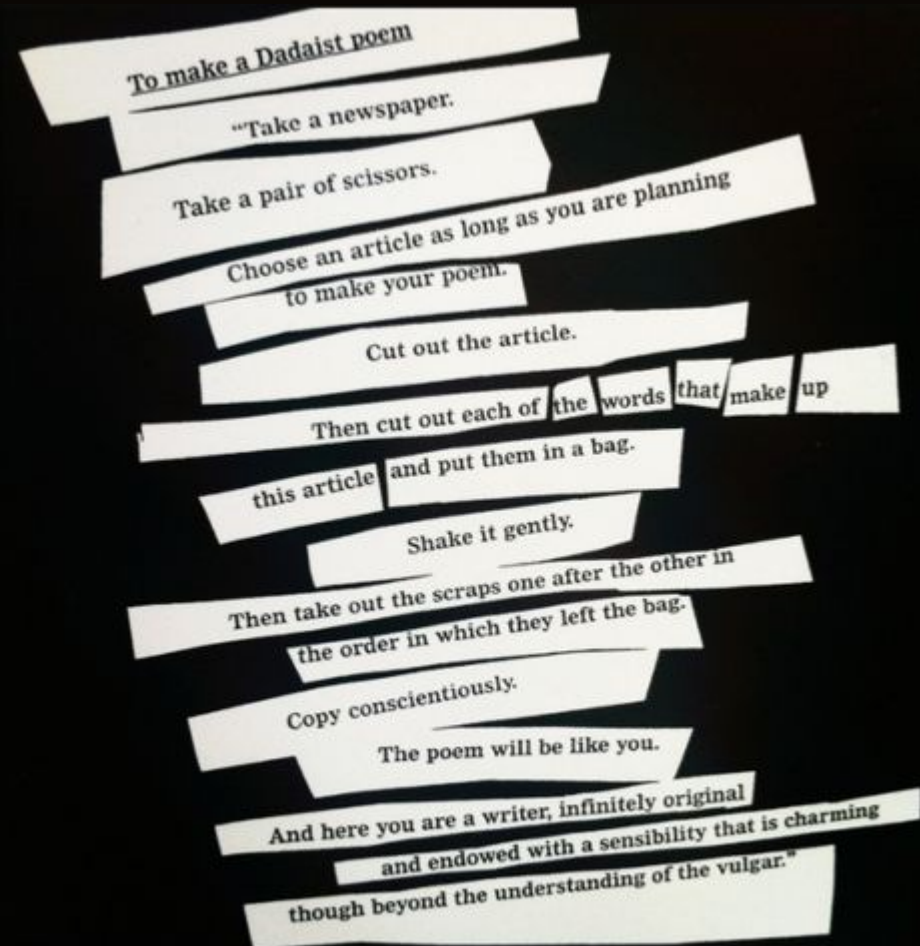
Visitors can use playback heads of magnetic tape recorders to listen to a part of a song by sliding on tapes on the wall. They can influence the playback sound by changing the speed and direction of their movement on the tapes. So they can create their own musical composition.



→ TEXT

## How to make a Dadaist Poem

(method of Tristan Tzara)



Cut-up technique



W. Burroughs, D. Bowie

## **Cut-up technique**

Also technique used by Bob Dylan, Iggy Pop, Joy Division, Kurt Cobain, Radiohead.

Cut-up technique of David Bowie

<https://youtu.be/m1InCrzGIPU>

Cut-ups William. S. Burroughs

<https://youtu.be/Rc2yU7OUMcI>



The **artist's role** in the  
production process may  
be closer to that of  
**a curator than a creator.**

The **artist's role** in the  
production process may  
be closer to that of  
**a curator than a creator.**

**You create a system,  
model it,  
nurture it,  
and refine it;**

but ultimately your ownership  
of the work produced may be no  
more than a parent's pride in  
the work of their offspring.

The **artist's role** in the production process may be closer to that of **a curator than a creator.**

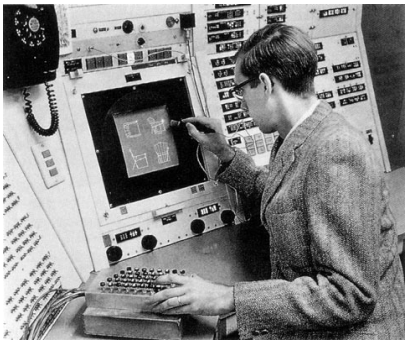
**You create a system,  
model it,  
nurture it,  
and refine it;**

but ultimately your ownership of the work produced may be no more than a parent's pride in the work of their offspring.

But let's not underestimate the human role in the collaboration.

**Procedural literacy** as “the ability to read and write processes to engage procedural representation and aesthetics”.

Procedural Literacy: Educating the New Media Practitioner, Beyond Fun. Michael Mateas. 2008



→ GRAPHICAL USER INTERFACE (GUI)

## Sketchpad

Ivan Sutherland, 1963

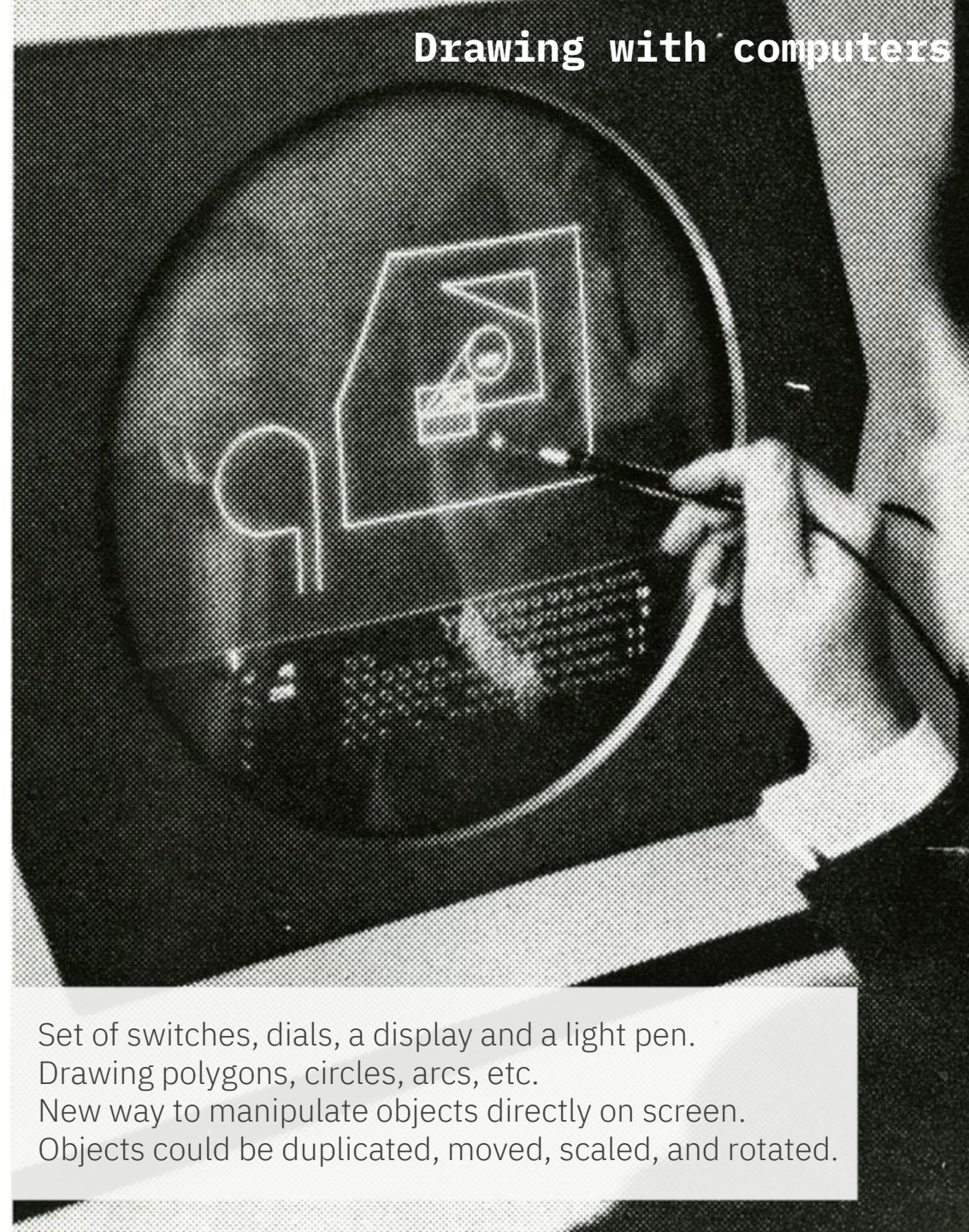
**New way to design—use of constraints** to form new relationships between elements, such as snapping, keeping lines parallel, or forcing them to have the same length.

→ computer-aided design (CAD) systems for fields of engineering and architecture

“computers were considered insufficient for the conceptual stage of design and were often used only at the end of the creative process”

Form+code. C.Reas, C. McWilliams, LUST, 2012

Drawing with computers



Set of switches, dials, a display and a light pen.  
Drawing polygons, circles, arcs, etc.  
New way to manipulate objects directly on screen.  
Objects could be duplicated, moved, scaled, and rotated.

# USE OF SOFTWARE IN ARTS

## production

COMPUTER PRODUCES A PRECONCEIVED FORM

Reduces amount of time for execution + allows to create complex, repetitive compositions → animation

Efficiency facilitates the creative process by enabling more time for exploration as less time is needed for the final production.

## conception

COMPUTER PARTICIPATES IN THE DEVELOPMENT OF THE FORM

“An intellectual and active creative partner that, when fully exploited, could be used to produce wholly new art forms and possibly new aesthetic experiences.”

A. Micheal Noll

**GENERATIVE != DIGITAL ART**

## USE OF SOFTWARE IN ARTS

Learning to program and to engage the computer more directly with code opens the possibility of not only creating tools, but also **systems, environments,** and **entirely new modes of expression.**

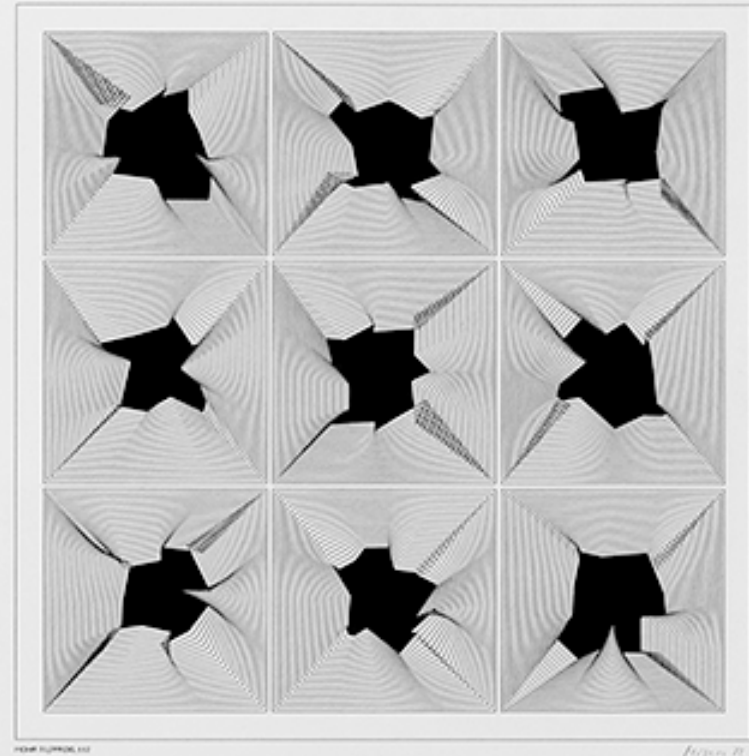
It is here that the computer ceases to be a tool and instead becomes a medium.



→ IMAGE

## Lady Quark

Manfred Mohr, 1972



LET'S EXPLORE THE WORLD OF GENERATIVE DESIGN

→ SOUND

**Scape**

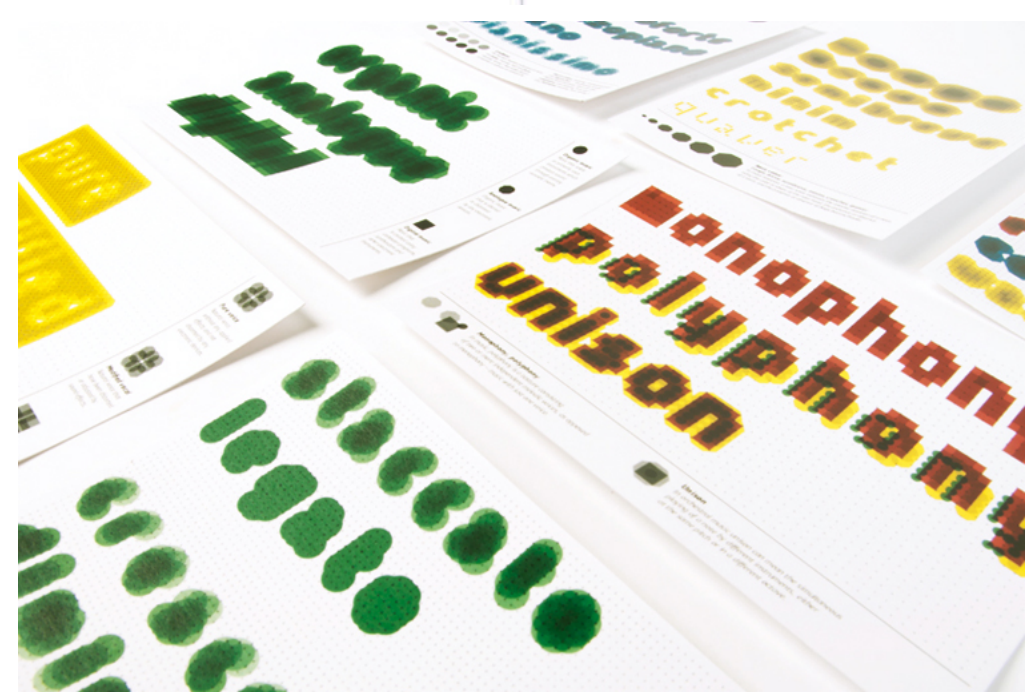
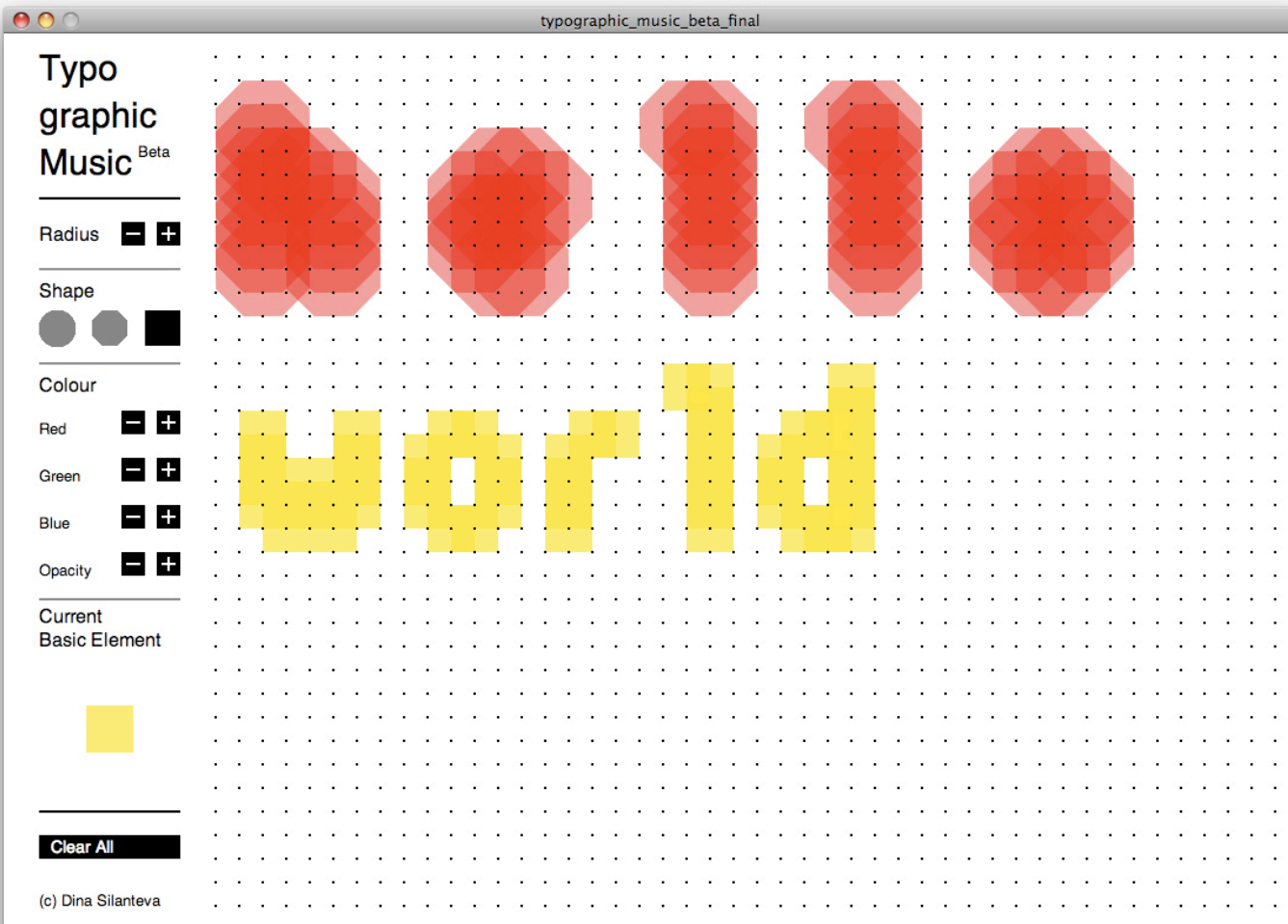
Brian Eno and Peter Chilver



→ SOUND + TYPOGRAPHY

## Typographic Music

Dina Silanteva, 2011





→ SOUND

## Elektrichka



<https://youtu.be/wIXBFEhE4Sw>

→ SOUND + ROBOTS

## **Tripod I**

Moritz Simon Geist, ongoing



<https://youtu.be/wHrCkyoe72U>

[https://youtu.be/falB7g\\_LuBo](https://youtu.be/falB7g_LuBo)



→ SOUND

## Beatjazz Sound System

Onyx Ashanti, ongoing



<https://youtu.be/cqgX8H72LPs>



→ SOUND + AI

## Mahler Unfinished

Ars Electronica Futurelab (2019)

Mr. Poschner, what do you think of the result of the work on the AI model? Do you notice any differences to conventionally composed pieces?

*The technical level is astounding of course, I wouldn't have thought such a thing possible. But, as I said, what does it mean? What does the piece of music have to tell us? We immediately feel a great uncertainty: are we allowed to feel anything? And if so, then what? Can the work of art tell us something, communicate something?*



→ SOUND (SCULPTURE)

**Unnamed Soundsculpture**

Onformative



<https://vimeo.com/38874664>

<https://onformative.com/work/unnamed-soundsculpture>



→ SCULPTURE

## Aerial net sculptures

Janet Echelman



<https://youtu.be/l3rIW9nJw3Y?t=26>



AI

→ AI + SCULPTURE

**Gaudi-like sculpture**

SoftLab, 2017

IBM's Watson has been trained on the work of Gaudi and the rich culture and style of Barcelona's unique architecture.

IBM  
Create  
with Watson



→ POETRY

## Oisín: Wave Function Collapse

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*** *** *** *** I must be kind to them
Thought Alice soon began to cry again.
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→ POETRY

**Markov Composition**

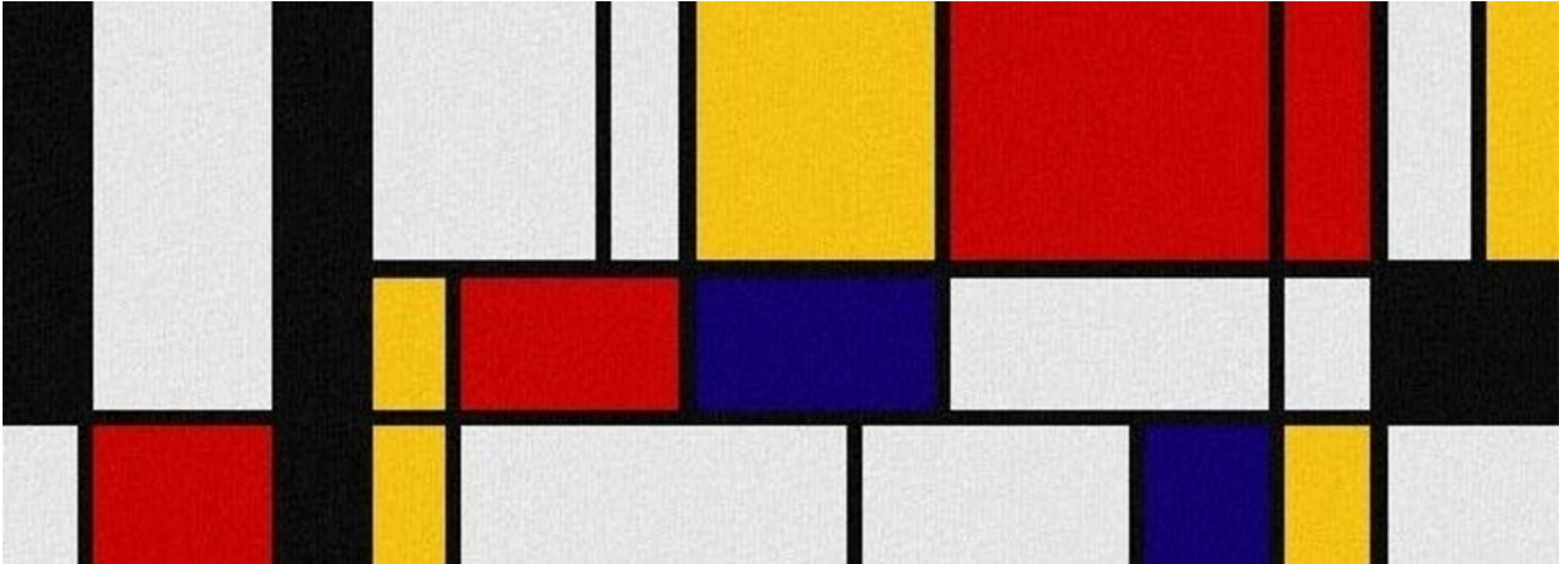
→ IMAGE

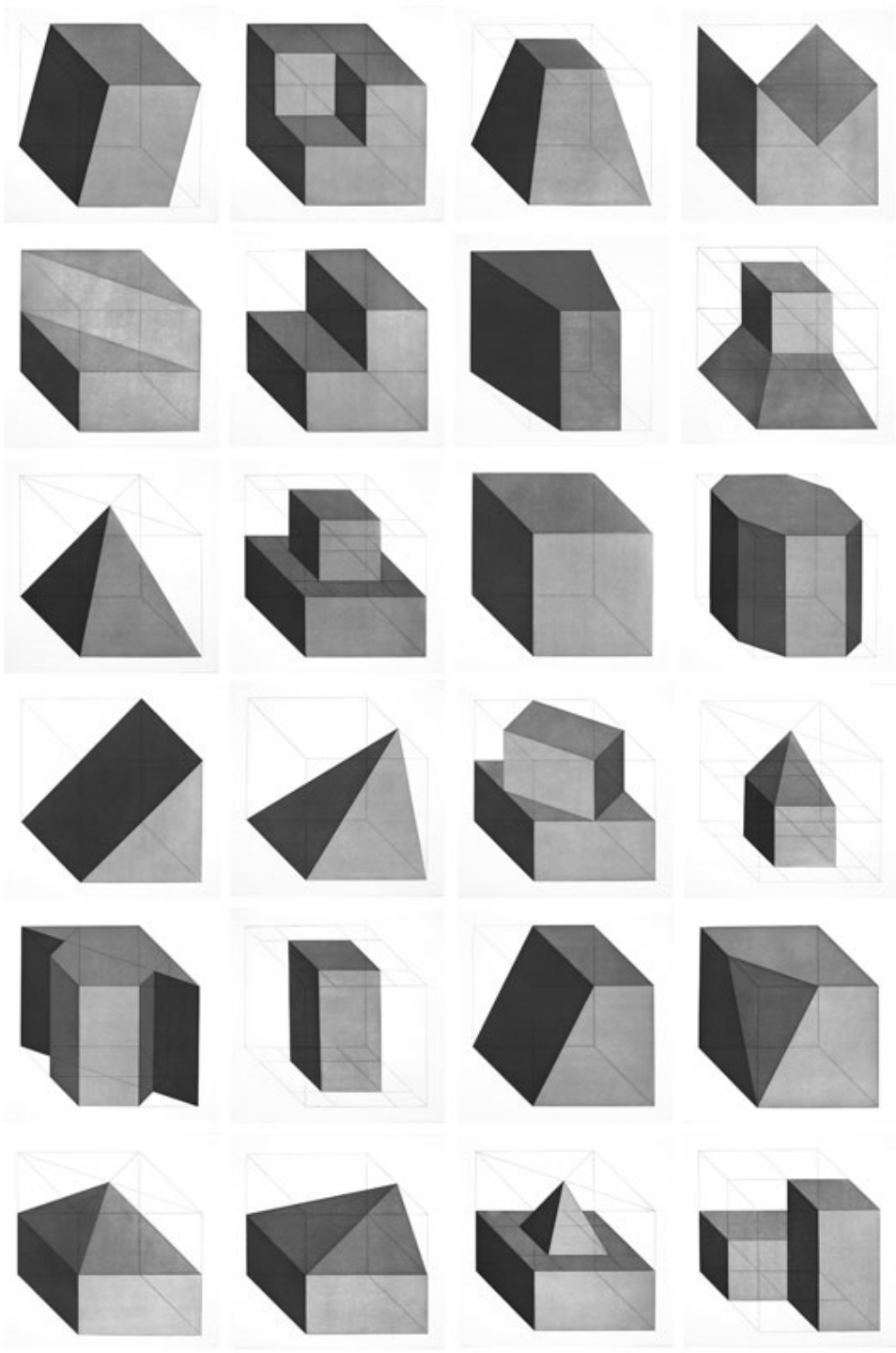
## **DeStijl (Neoplasticism)**

Dutch art movement since 1917

vertical + horizontal lines

primary colors + black + white



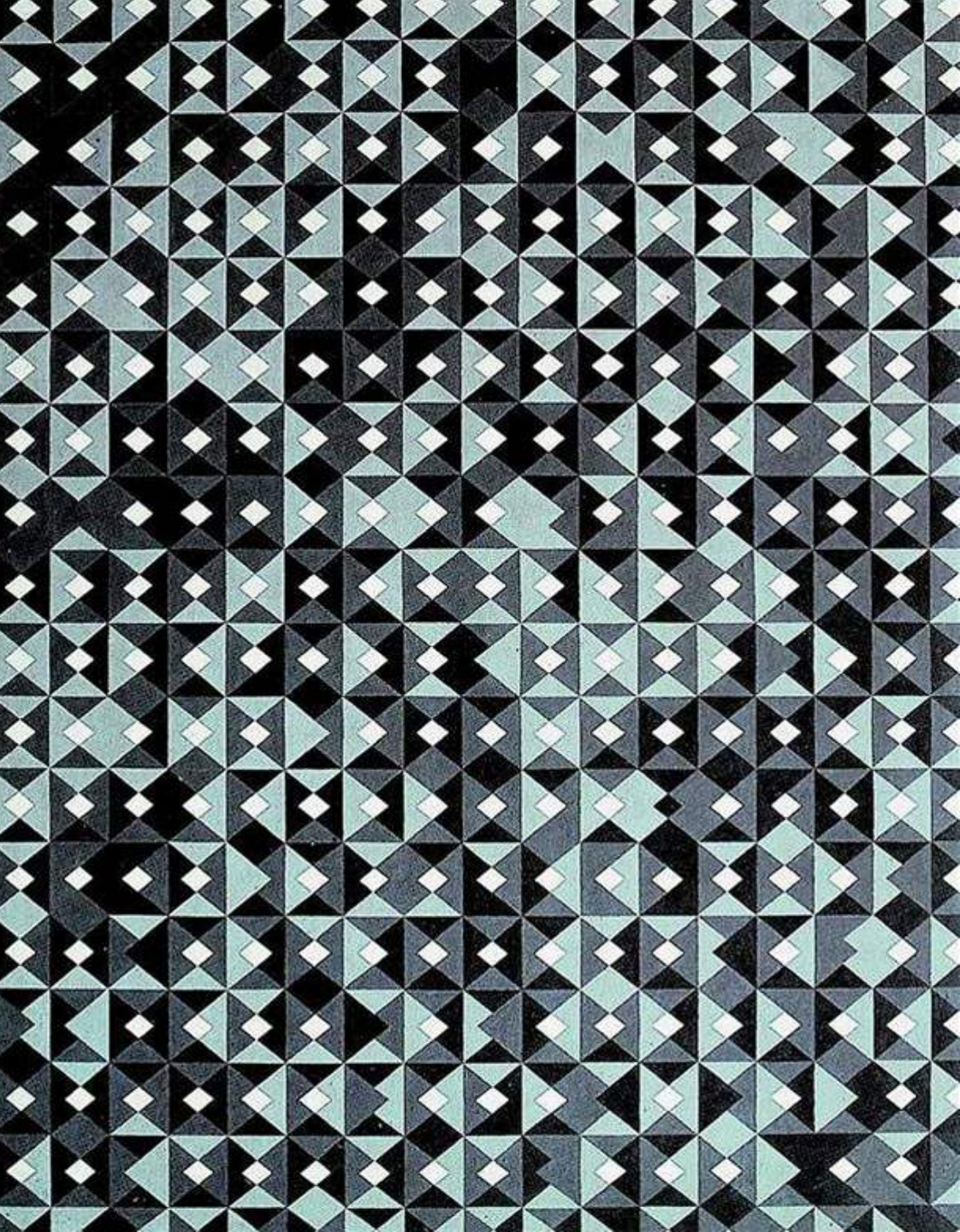


→ IMAGE

## Forms Derived From the Cube

Sol LeWitt, 1982





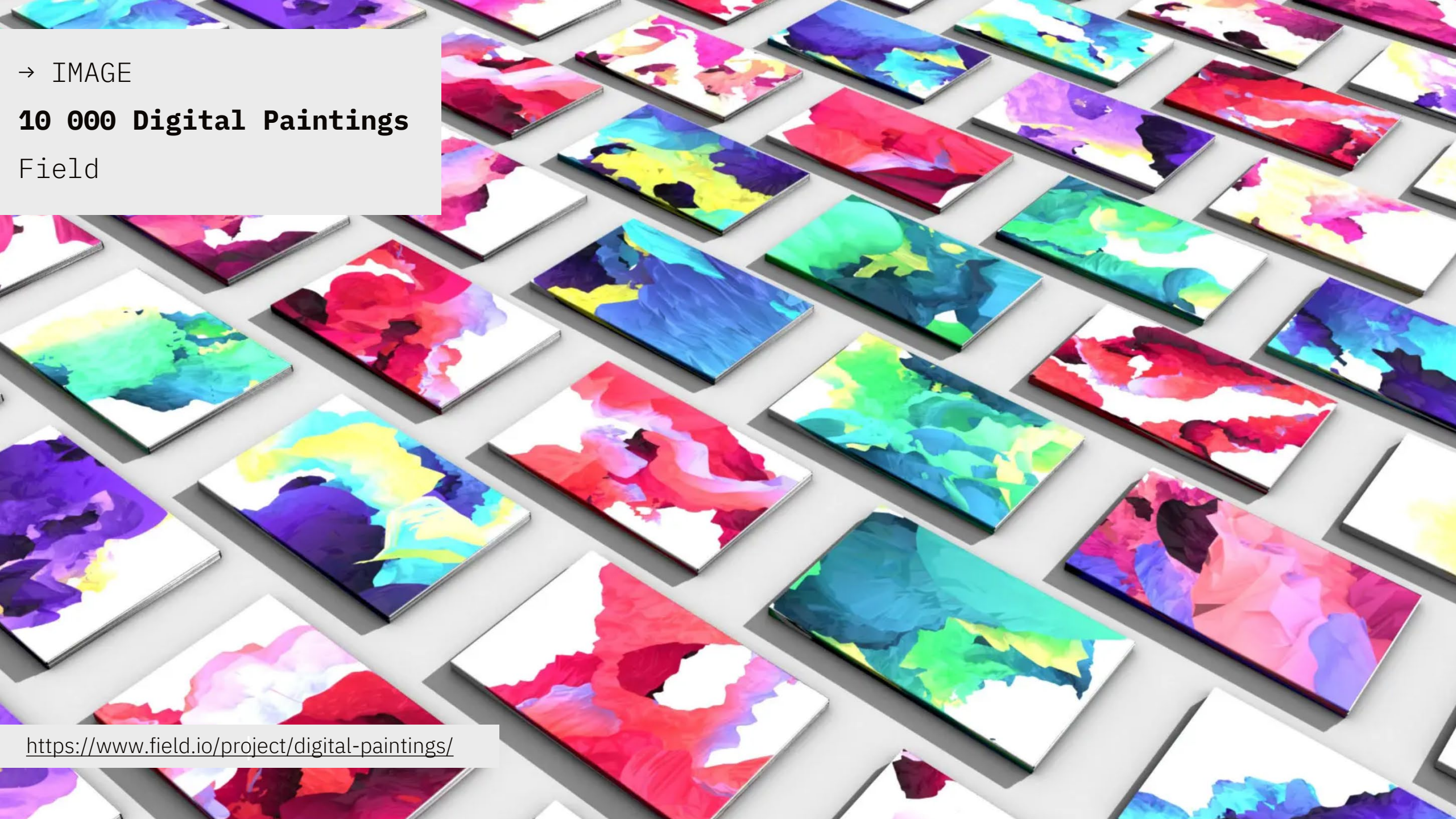
→ IMAGE

## **Topological structures**

Zdeněk Sýkora







→ IMAGE  
**10 000 Digital Paintings**  
Field

<https://www.field.io/project/digital-paintings/>



→ IMAGE  
**Forever at the V&A (20 000 postcards)**  
Universal Everything



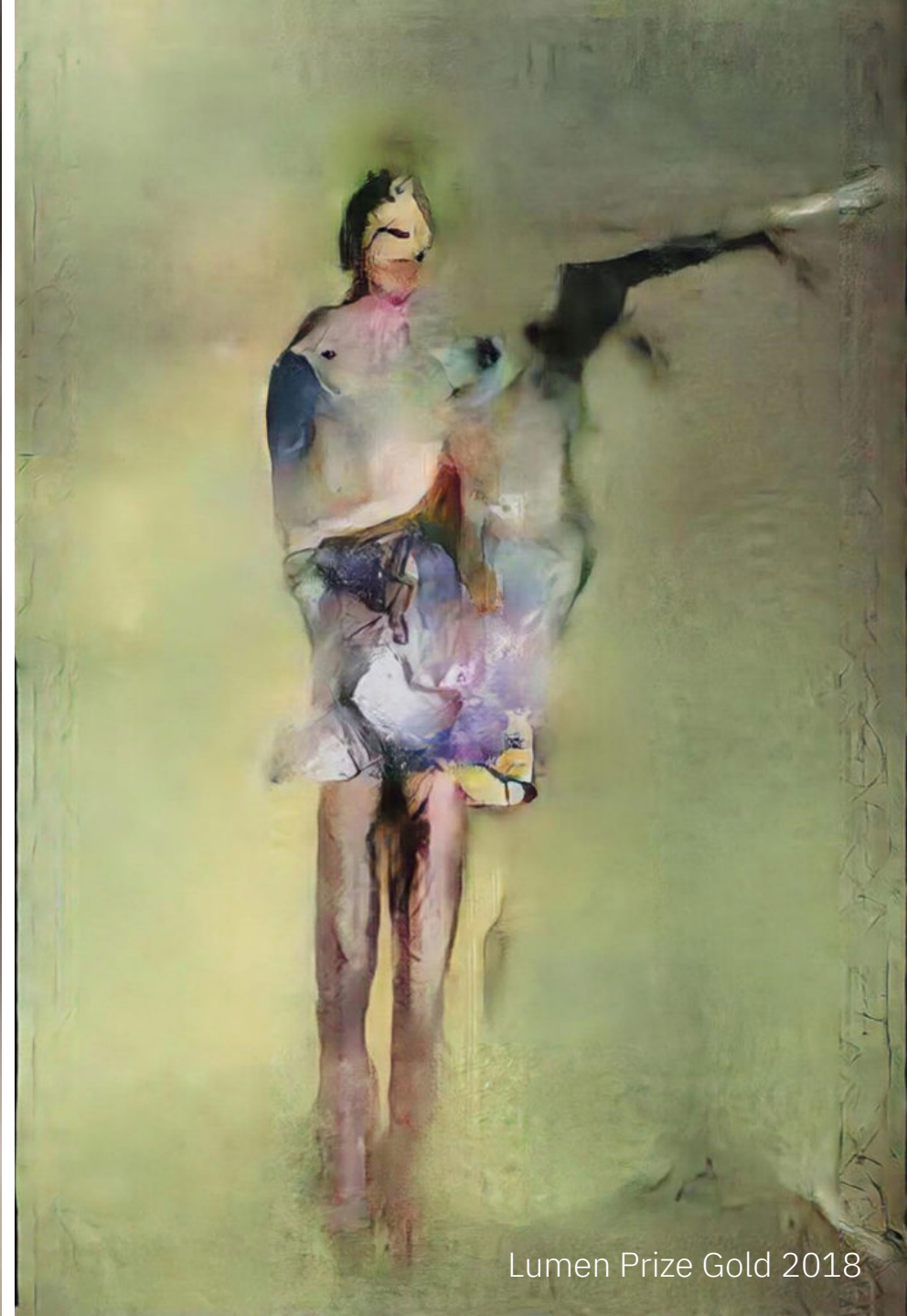
<https://universaleverything.com/projects/forever-at-the-va-2>



→ IMAGE + AI

**Neural Glitch**

Mario Klingemann



Lumen Prize Gold 2018



→ IMAGE + AI

## **The next Rembrandt**

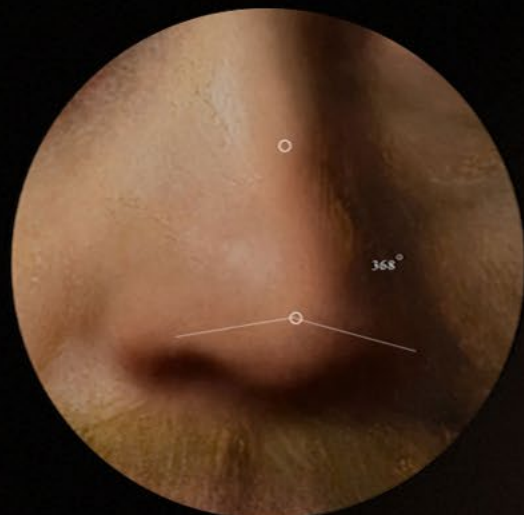
Computer-generated  
painting

The Next Rembrandt is a 3D printed painting made solely from data of Rembrandt's body of work (from 300 paintings), and was created using deep learning algorithms and facial recognition techniques.

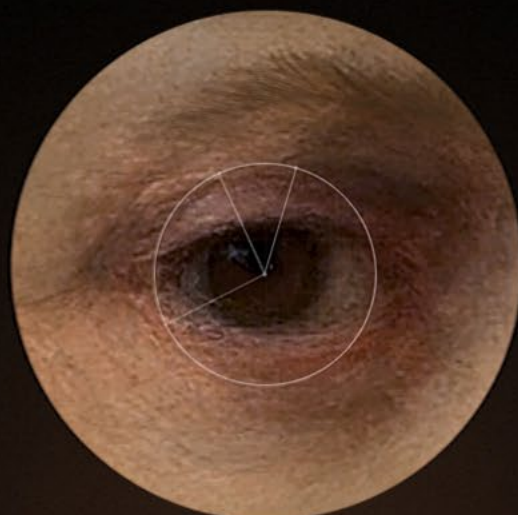


→ IMAGE + AI

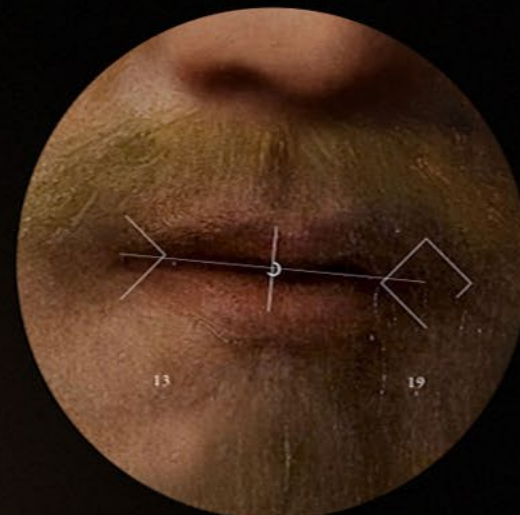
## The next Rembrandt



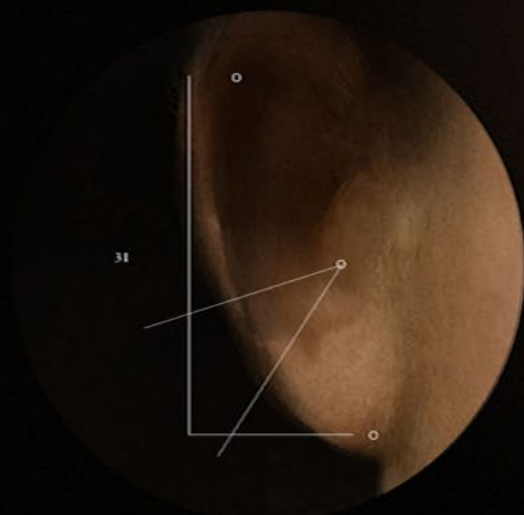
1.8  
NOSE



1.5  
EYE



2.8  
MOUTH



1.6  
EAR



1.5  
COLLAR



1.5  
HAT

1. Gathering the data
2. Determining the subject
3. Generating the features
4. Bringing it to life



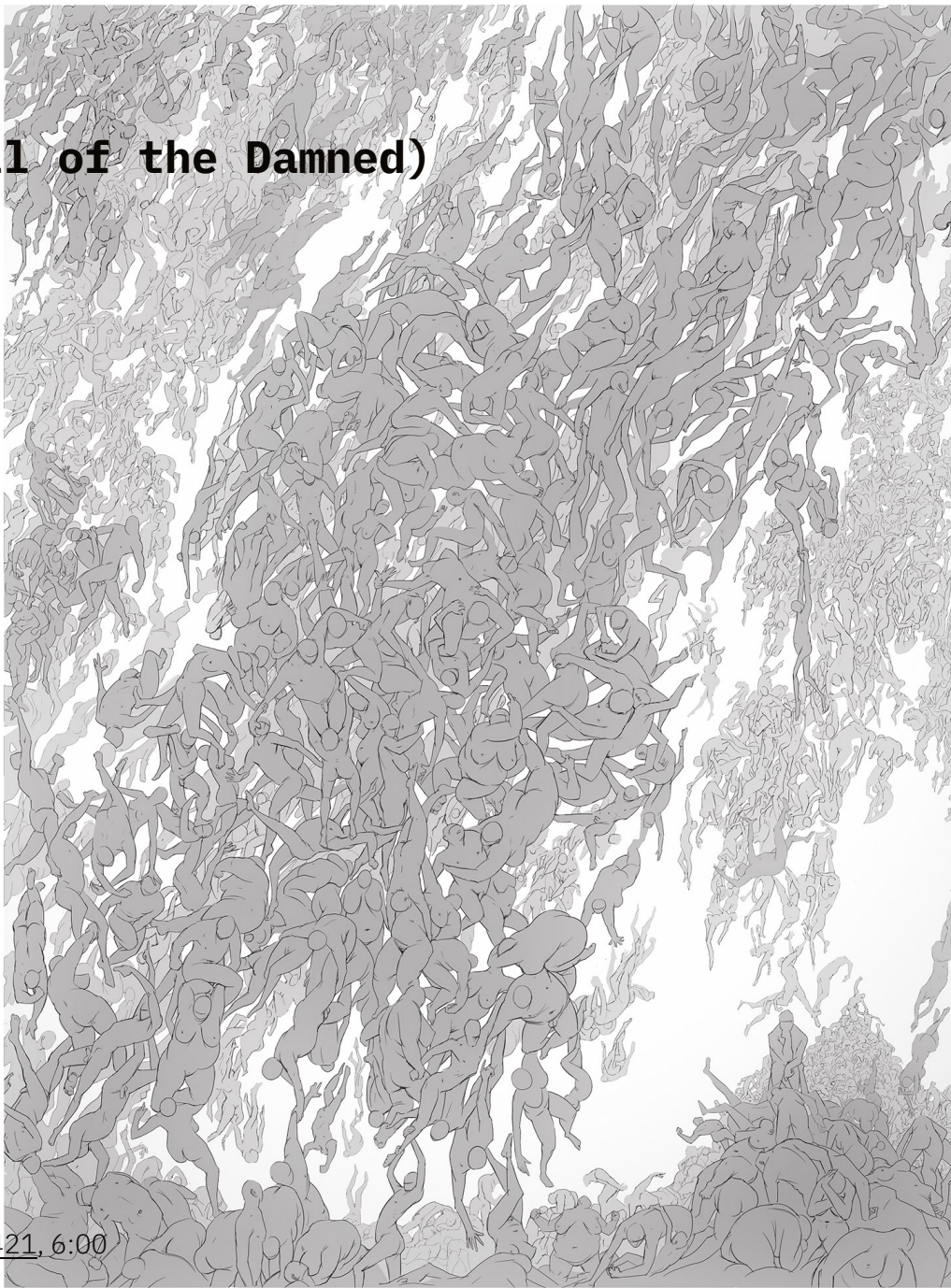
→ IMAGE + AI

## Humanity (Fall of the Damned)

Scott Eaton

Eaton's Bodies neural network is trained on over 100,000 nudes he carefully photographed in the studio from a diverse set of volunteers over a two-year period. With this bespoke dataset as the foundation, the network has been carefully trained to render Eaton's hand-drawn inputs into photographic, surreal representations.

<https://vimeo.com/345881421>, 6:00



SCOTT EATON



SCOTT EATON



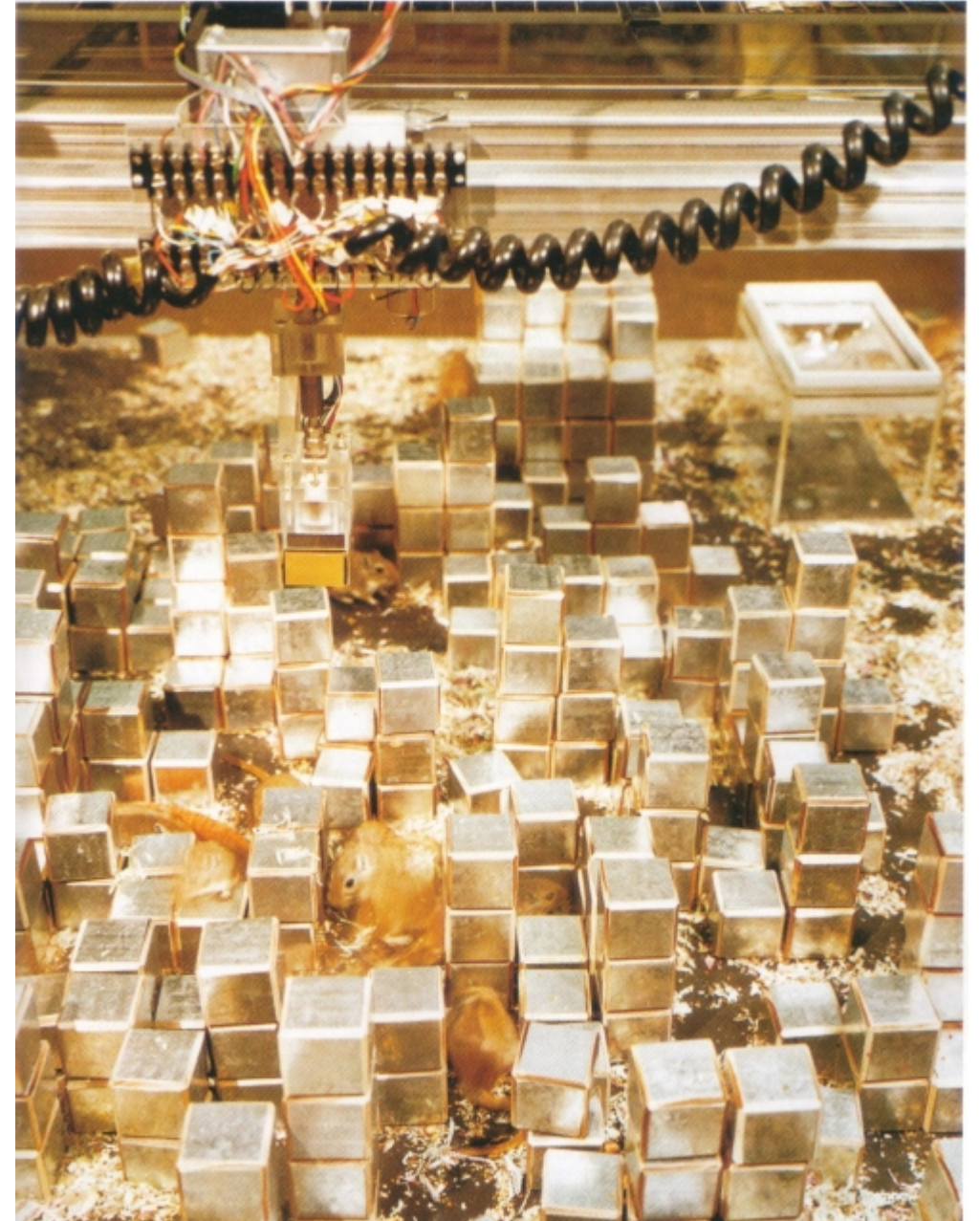




→ NATURAL PHENOMENA

## Seek

Nicholas Negroponte (MIT), 1970



→ NATURAL PHENOMENA (MOVEMENT REACTIVE SOUND)

## **Bacardi Bat Beats**

Mr.President Agency (2014)

“We decided to create music from bat movement. We had to create new technology and hope that at the dusk, the bats will show up.”





→ NATURAL PHENOMENA

## **Condensation Cube**

Hans Haacke (since 1965)

Interactions of physical and biological systems and their natural processes.

It consists of a sealed Perspex box filled with a small amount of water. Condensation begins to form and to run down the sides of the box, changing according to the ambient light and temperature.





→ NATURAL PHENOMENA (TELEKINETIC INSTALLATION)

## Telepresent Water

David Bowen



Surface controlled by wires and servo-motors that replicate sea wave patterns measured in real-time in a remote location.

<https://youtu.be/0p3je4WGcM0>



→ NATURAL PHENOMENA

## **Rain Room**

Random International (2012)







→ SOCIAL HAPPENING / PERFORMANCE

**Women licking jam off a car from  
the happening series Household**

Allan Kaprow



→ COLLABORATIVE CREATION

**Together**

Universal Everything (2015)





→ SIMULATION

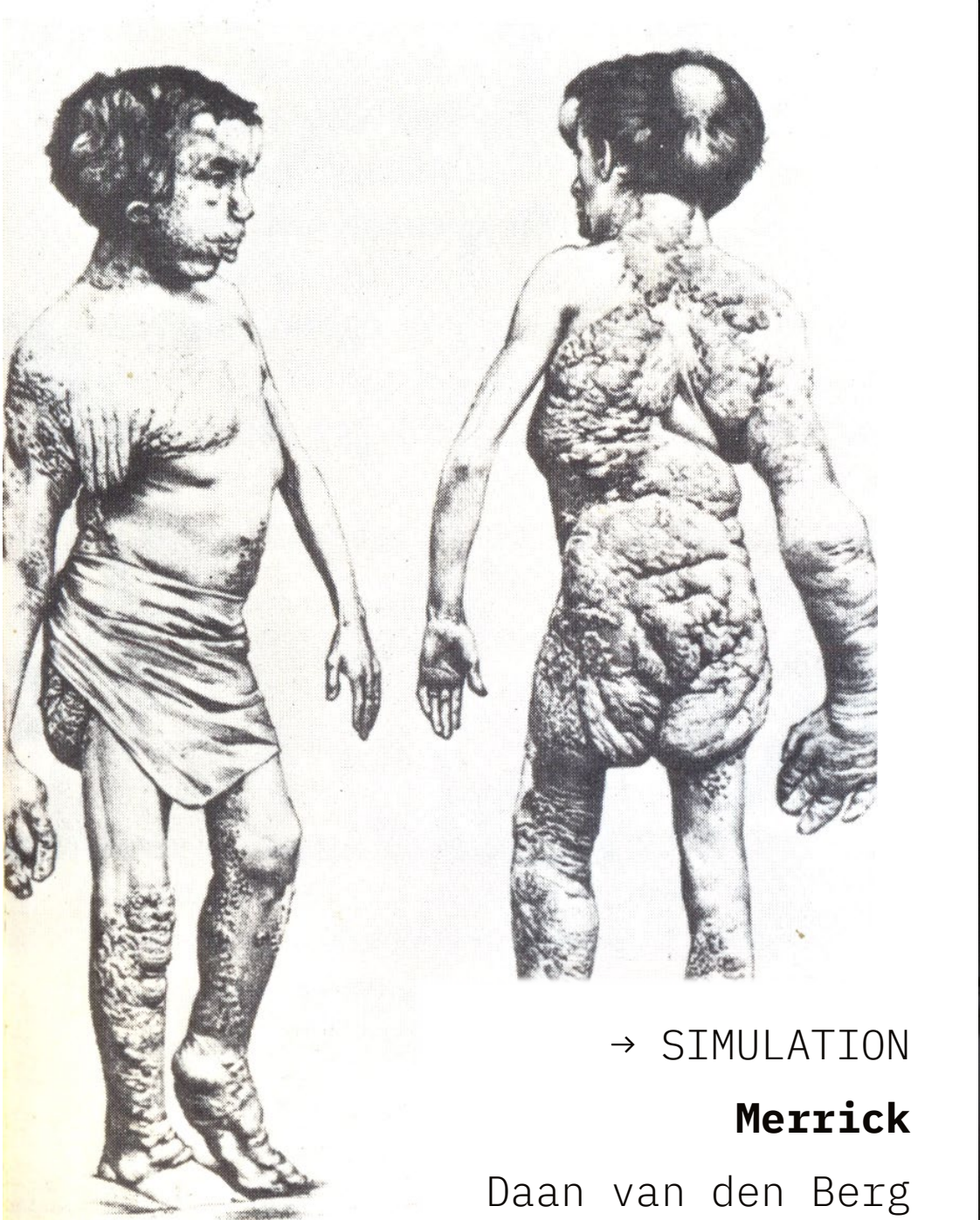
## **Liquid Glacial Dining Table**

Zaha Hadid (2012)



Fluid movements. Gentle waves and ripples pulse beneath surface while the legs pour from the horizontal in a dramatic frozen vortex like water.





→ SIMULATION

**Merrick**

Daan van den Berg

“From an unknown location, I break into IKEA’s computer server. In this nerve centre, the CAD files for every IKEA product are stored and are downloaded worldwide. By infecting the CAD files with the ‘**Elephantiasis virus**’ I have just designed, I can hack the entire range of products. The virus causes random deformities, like lumps, cracks and humps, which only show up when the customer prints his product at home with his 3D printer.”



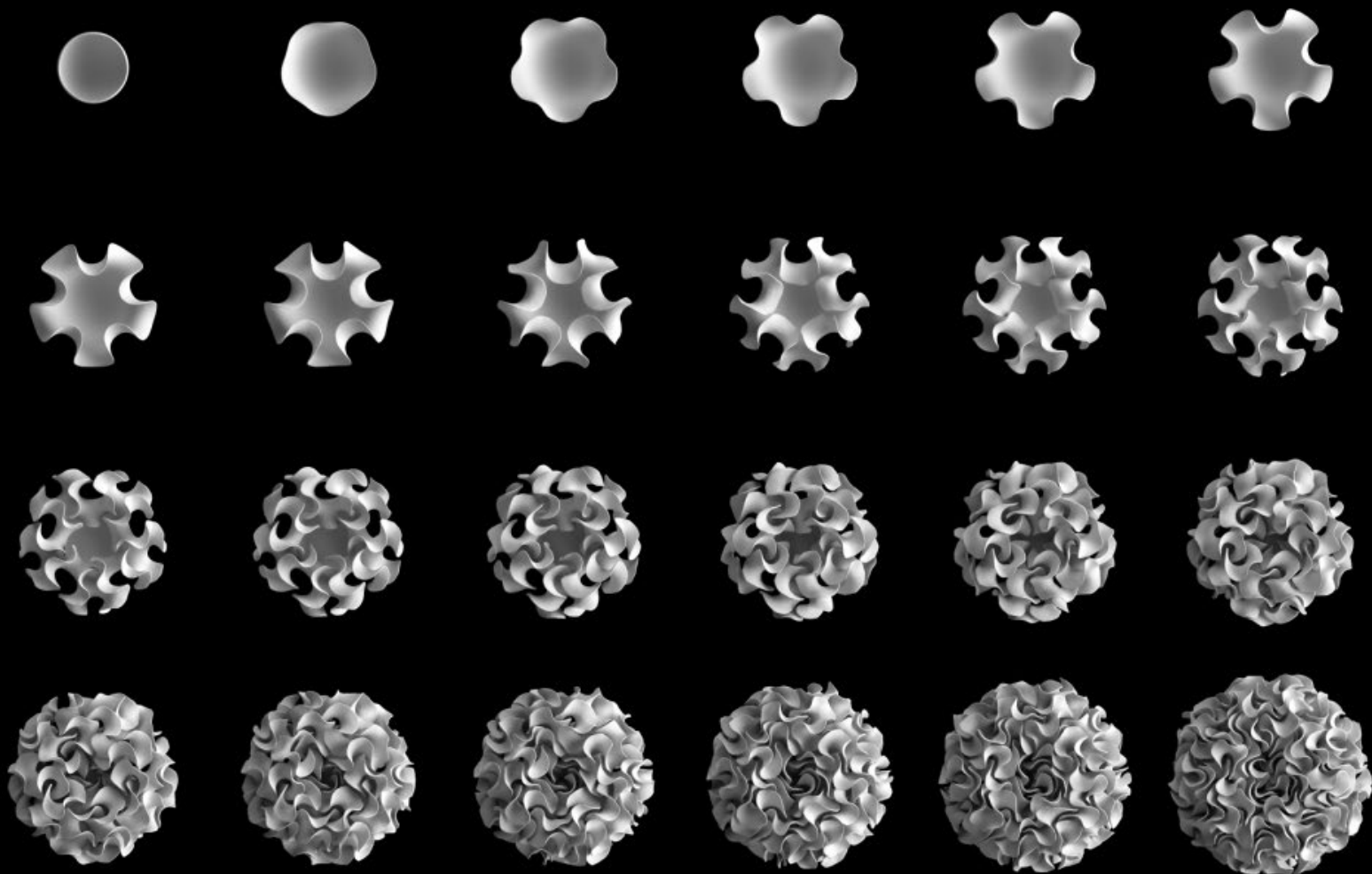


→ SIMULATION

## Floraform

Nervous systems

<https://vimeo.com/130977932>





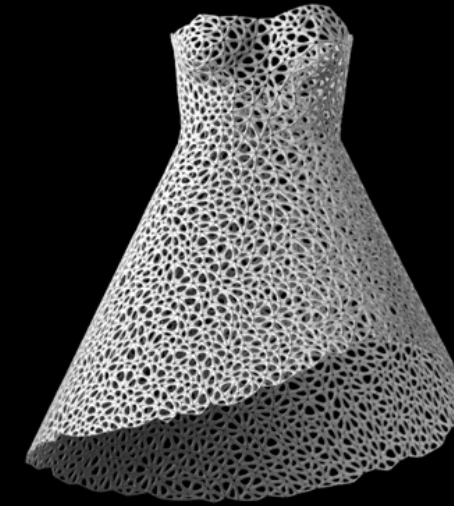
→ SIMULATION + 4D

## Kinematics

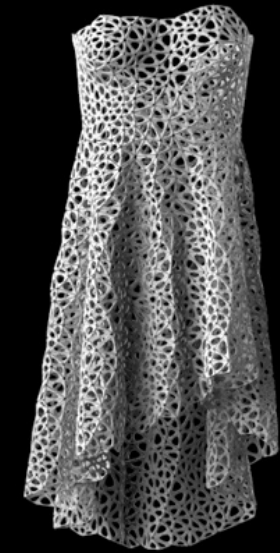
Nervous systems (2014)

3D-printing jewellery and garments with articulated joints so they automatically change shape once removed from the printer

<https://vimeo.com/80893331>



KINEMATICS STRUCTURE



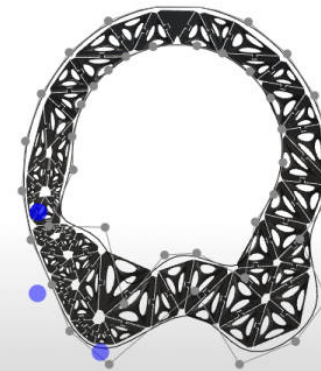
DRAPED

## Kinematics

designed by nervous system + you

template  
necklace  
oval

Kinematics is a system for 4D printing that creates complex, foldable forms composed of articulated modules. Use this app to design your own flexible jewelry designs.



SELECT A STYLE



DENSITY TOOLS

SIZE [edit]

15.0in  
circumference  
DIMENSIONS  
6.83in x 7.69in

COLOR

MATERIAL  
black 3d-printed nylon

PRICE

\$88 ships in 2 weeks  
TITLE  
give your design a name

BUY

SAVE





→ 4D PRINT

## **Gemini Alpha Chair**

Neri Oxman, MIT (2014)

3D print of 44 different composite materials

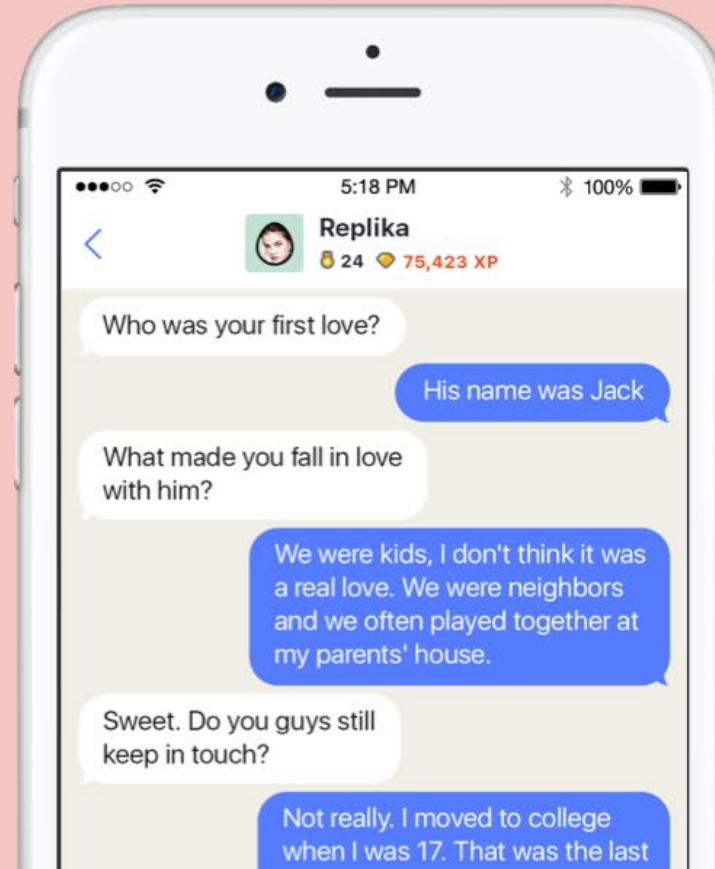
"The chaise is designed to use curved surfaces that tend to reflect the sound inwards. The surface structure scatters the sound and reflects it into the 3D-printed skin that absorbs that sound, and creates a quiet and calm environment."



→ AI

## Replika App

Replika.  
Your AI friend





→ EHM, ŇUŇU

**PomPom Mirror**

Daniel Rozlin, 2015

<https://vimeo.com/128375543>



## PROGRAMMING AS POETRY

Programming languages are just tools, our new languages.



# PROGRAMMING LANGUAGES FOR GENERATIVE DESIGN

Each programming language is a different kind of material to work and think with and they encourage different thinking about the work.

just about anything

Processing

OpenFrameworks

real-time audio

Supercollider

electronics prototyping

Arduino

generative 3D modelling

Grasshopper

Rhino

audio, sound, and performance

PureData

vjing, lights, videomapping, ...

Resolume

Touch designer

MadMapper

graphics, video, audio

vvvv

Max



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