PV259

Generative Design Programming

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Some of the presented slides are from the previous teacher, Kristína Zákopčanová. Thank you for teaching this and providing them!

Intros

What is this course about?

Why do creative coding?

To build programming and mathematics skills ... with less suffering.

Use algorithmic thinking in the design world, and design thinking in algorithmic world.

Upgrading your designs with generative process will make them 100% futuristic and special.

It’s always pretty satisfying to make your own software without limitations of the existing one.

Even more if people smile at it. Did you ever exhibit your own artwork?

Organizational information

Officially, we have **seminars and lectures**, but we don’t distinguish between them. We will have interactive lessons.

We will be programming using **Javascript** and **P5.js** (Processing) library. No prior Javascript knowledge is required.

All learning material will be published after lessons in **interactive syllabus in IS**.

We’ll have a **Discord** server for quicker communication and to help you anytime.

Organizational information

Moved to interactive syllabus in IS.

What is expected of you

Attendance
You are expected to attend both lectures and seminars. You can miss 2 weeks without excuse.

Creative coding homeworks
There will be 3, every two weeks. You will be asked to upload them and shortly present to others.

The final project
We'll spend quite some time on your final projects. We'll discuss these regularly and we'll hold an exhibition at the end of the course (before Christmas).

70 hours
Is roughly the average reported by last year students.

Final project

In 8th week
You'll begin working on final projects, and we'll give you the details and examples.

In 11th week
You will give a very short (~2 min) presentation of your artwork-in-progress to gain feedback.

Meanwhile, we'll consult with you, and do some activities to help you ideate and develop your project.

We'll hold an Exhibition at FI before Christmas. (probably 15. 12.)

If you are super hyped, look at previous year's projects: **generativedesign.cz/projects**

Course units

Week

1 21. 9. Generative design & art, definition and overview. Introduction to drawing with P5.

skipped class on 28. 9. - holiday

3 5. 10. Geometric patterns. Transformations.

4 12. 10. Randomness. Noise.

5 19. 10. Custom shapes. Curves.

6 26. 10. Graphic design. Type. Fonts.

7 2. 11. Multi-agent systems.

8 9. 11. Image processing.

9 16. 11. Audio-reactive art. Final project assignment

10 23. 11. Interactive art installations. Final project ideation.

11 30. 11. AI in art - lecture. Final project proposals presentations.

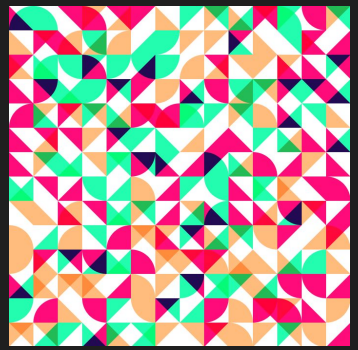
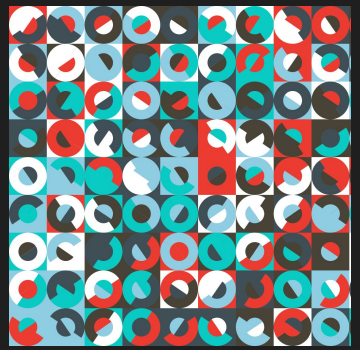
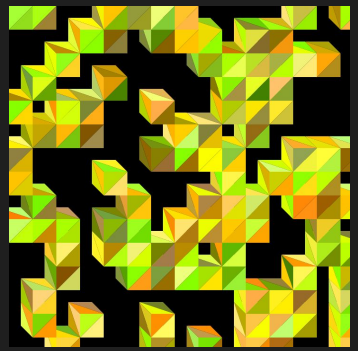
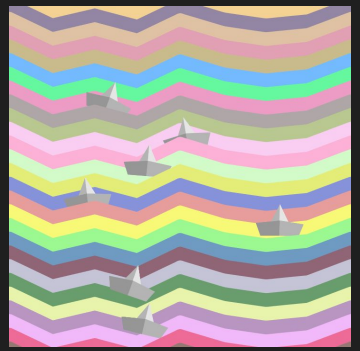
12 7. 12. Final project consultations.

13 14. 12. Finalization of projects.

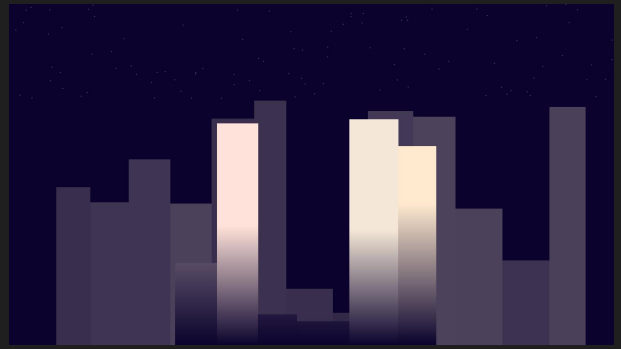
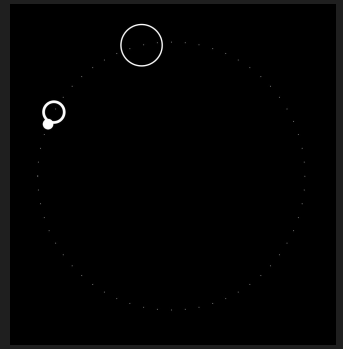
Exhibition - 15. 12. (to be discussed)

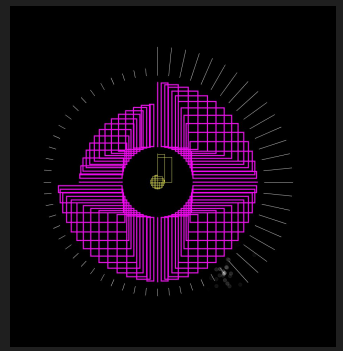
Examples from class

Geometric patterns

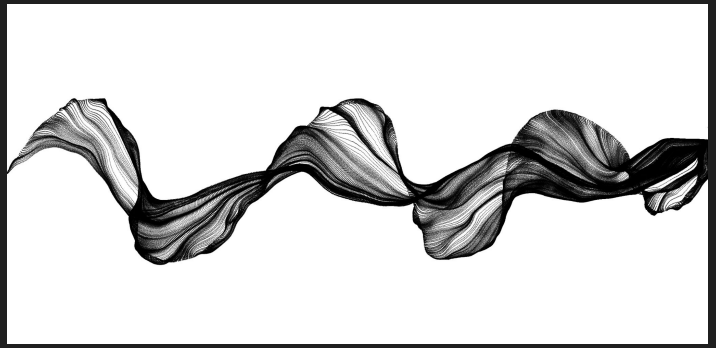
Clock

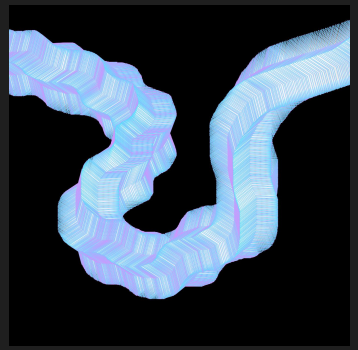





Examples from class

Brush





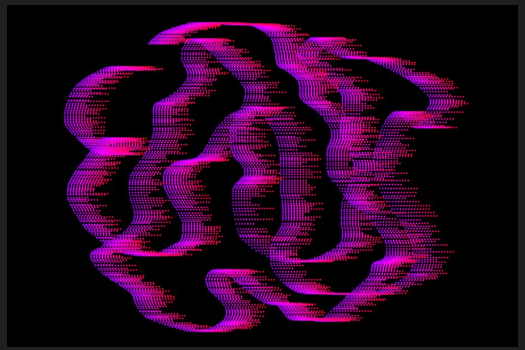


Image processing

what is generative design?

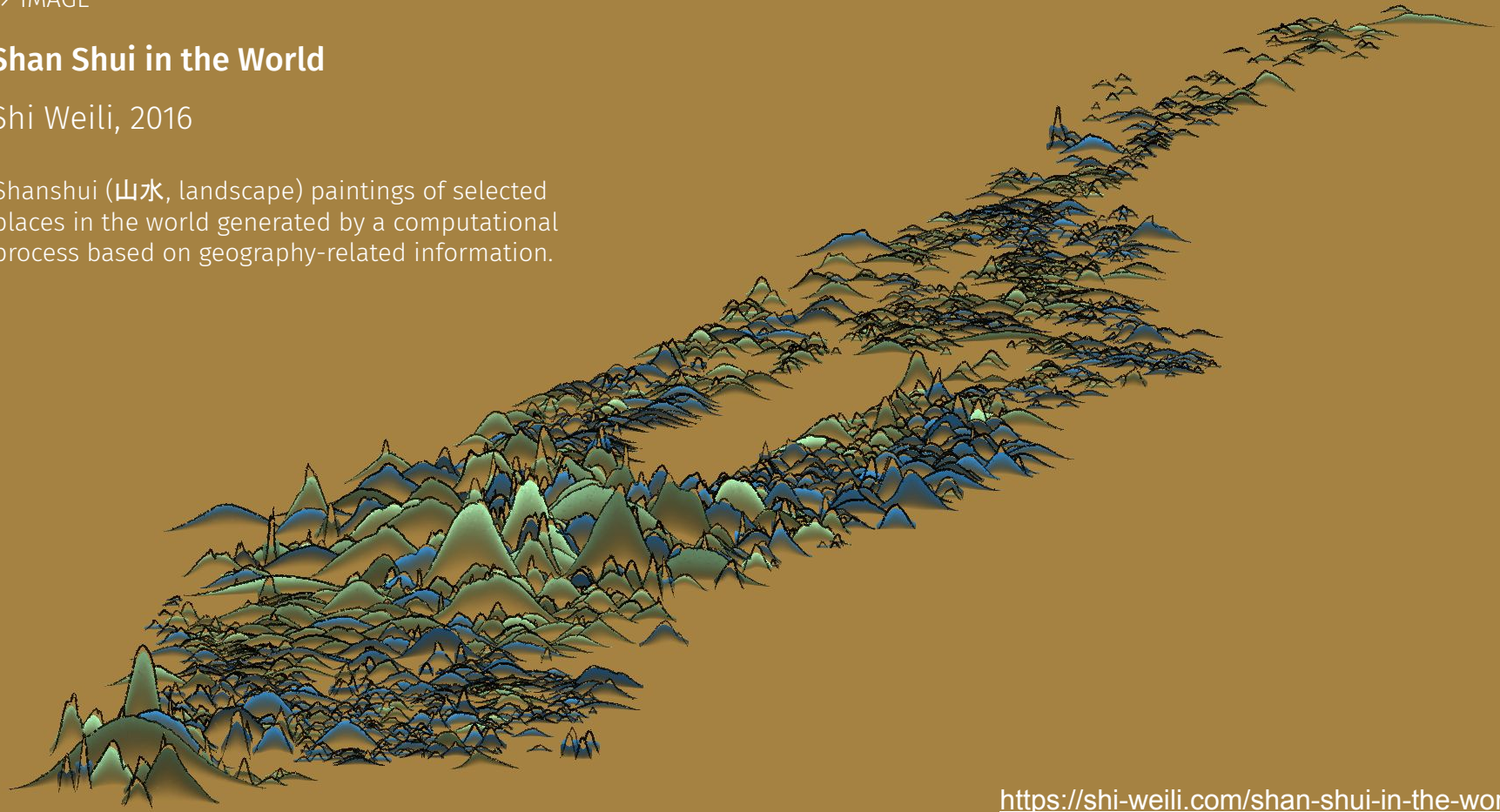
a methodology, a process

→ IMAGE

Shan Shui in the World

Shi Weili, 2016

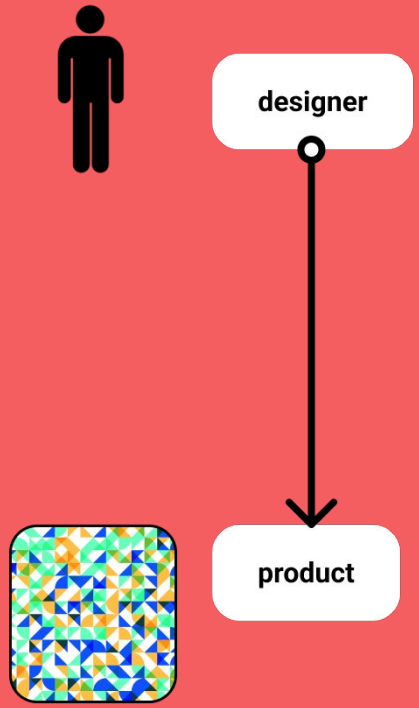
Shanshui (山水, landscape) paintings of selected places in the world generated by a computational process based on geography-related information.



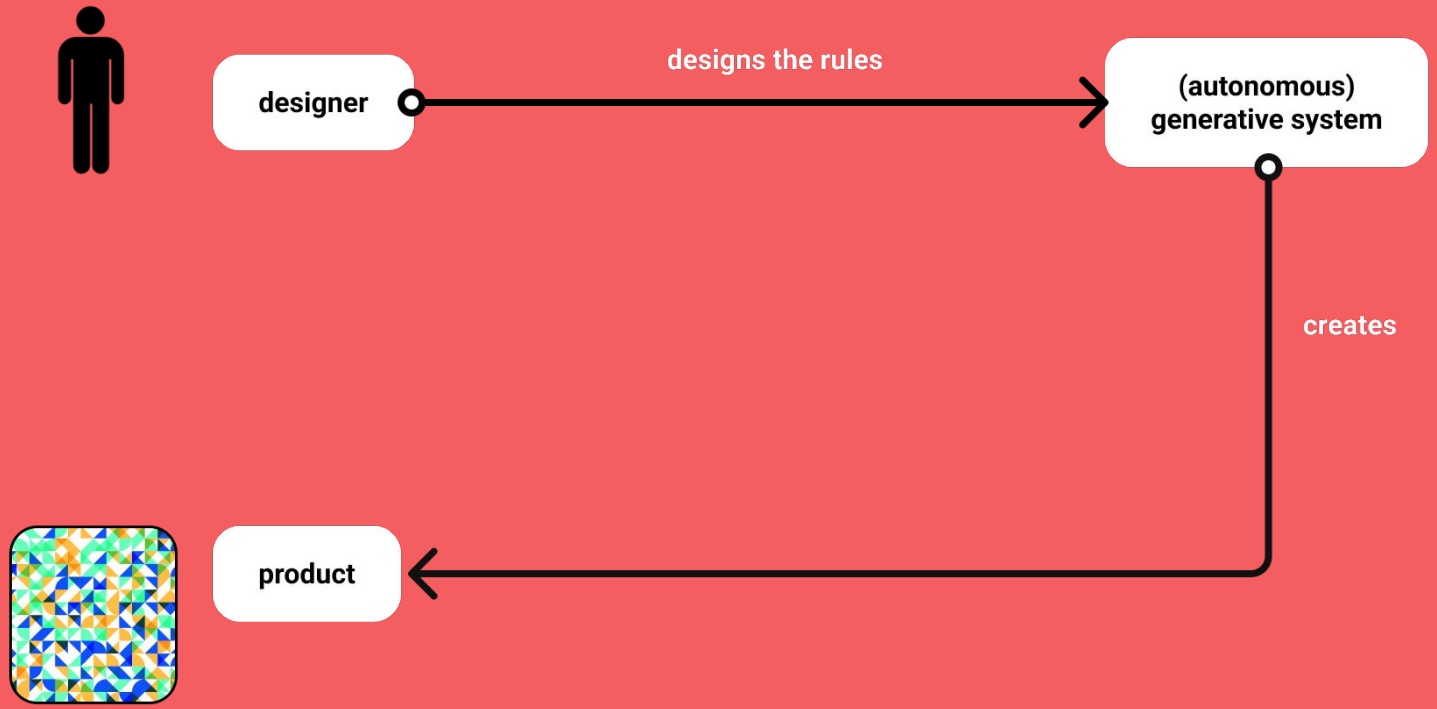
https://shi-weili.com/shan-shui-in-the-world/

Traditional vs. generative design

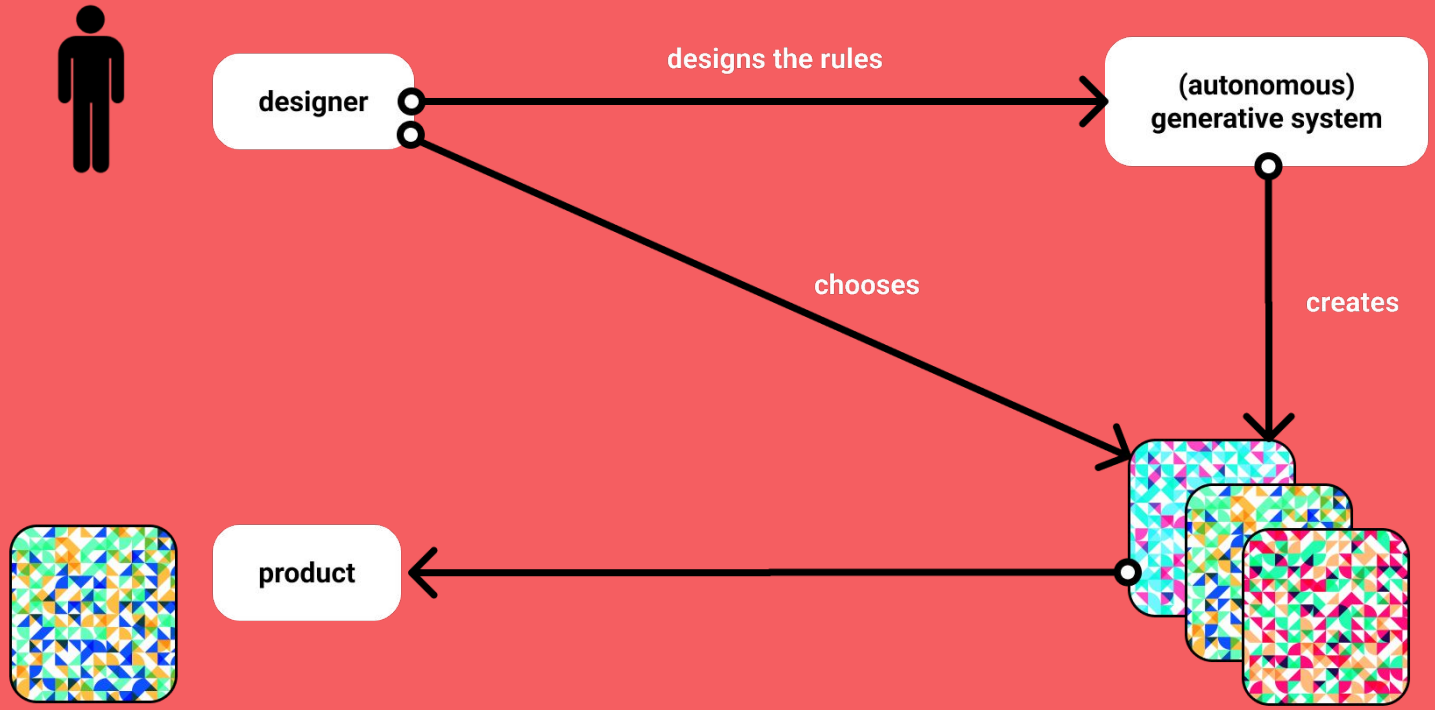
In traditional design, we directly create the product.



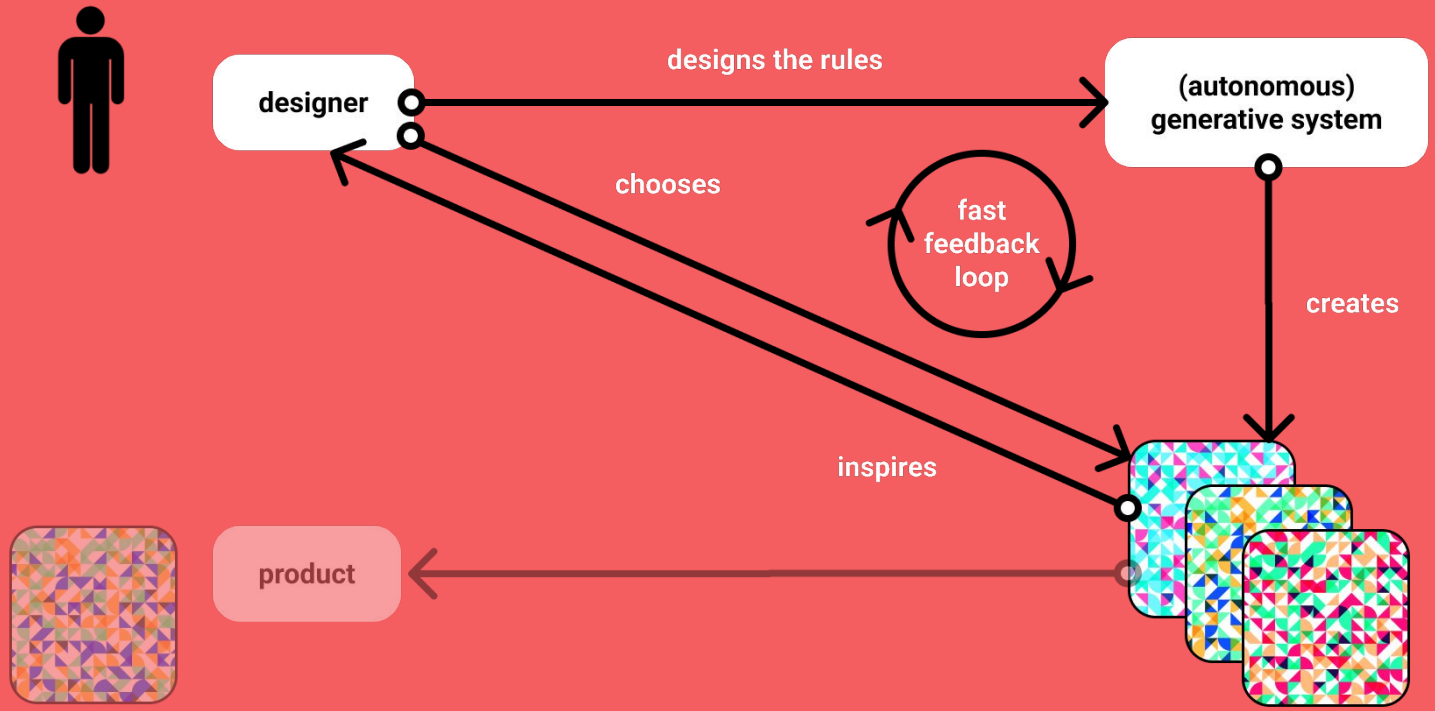
The process becomes generative, if we let something else create the output.
We don't directly interact with the materials and the product.



Actually, the system can create **endless variations** of the product. We then choose the best one.



It allows for quick **iterative experimentation**: we tweak the rules, the system generates new products, we evaluate them, and then, we either select the best one, or again, tweak the system towards what we like.



Potentials of generative design

It can **boost creativity** by inspiring ideas and concepts which designers would not necessarily have considered (when variability=randomness in the designs is introduced).

Computer generating the designs results in **faster iterations, faster work process.**

We can generate shapes or compositions which are **hard to impossible to do by hand**.

When we create **generative tools** with sufficient genericity, they can be passed on to other designers (with or without programming skills) to be used for similar design problems.

Herr, Christiane & Fischer, Thomas. (2001). Teaching Generative Design

One flaw

In general, computers are not capable of selecting good designs. Generating the variations is easy; rating them based on **usefulness and beauty** requires a good amount of knowledge, and is mostly performed by humans.

How do we know what is a good design? Can we compute it?

Can we compute what is a good design?

Yes, if...

the selection process of the best design can be formalized using scientific parameters:

- using mathematical optimization, Airbus designed parts of the A320 plane + the whole factory
- we call this **parametric design** - with software such as AutoCAD

No, not yet...

for example when dealing with art. How to compute whether an artwork/graphic design is aesthetic?

- **computational creativity** is a new research area trying to formalize creativity
- especially evaluation of aesthetics by AI. My opinion: we will be seeing a growth in tools for automated layouting in graphic/web design, video making, etc; with development of more powerful AI models.

what is generative art?

art created by a generative system

Generative art definition

"Generative art refers to any art practice in which the **artist cedes (podstoupí) 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)

Generative art definition: notes

- **generative art is simply a reference to how the art is made**, and it makes no claims as to why the art is made this way or what its content is.
- generative art is **uncoupled from any particular technology**. Generative art may or may not be “high tech”.
- system that moves an art practice into the realm of generative art must be **well defined and self-contained enough to operate autonomously**

Galanter, Philip. (2003). What is generative art? Complexity theory as a context for art theory.

GENERATIVE

doesn’t mean

DIGITAL

→ MUSIC

Music Dice Game

Mozart, Bach, Kirnberger, 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.

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.

73

→ IMAGE

Proposal for wall drawing

Sol LeWitt, 1969

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

GENERATIVE

can mean offloading your work to other people

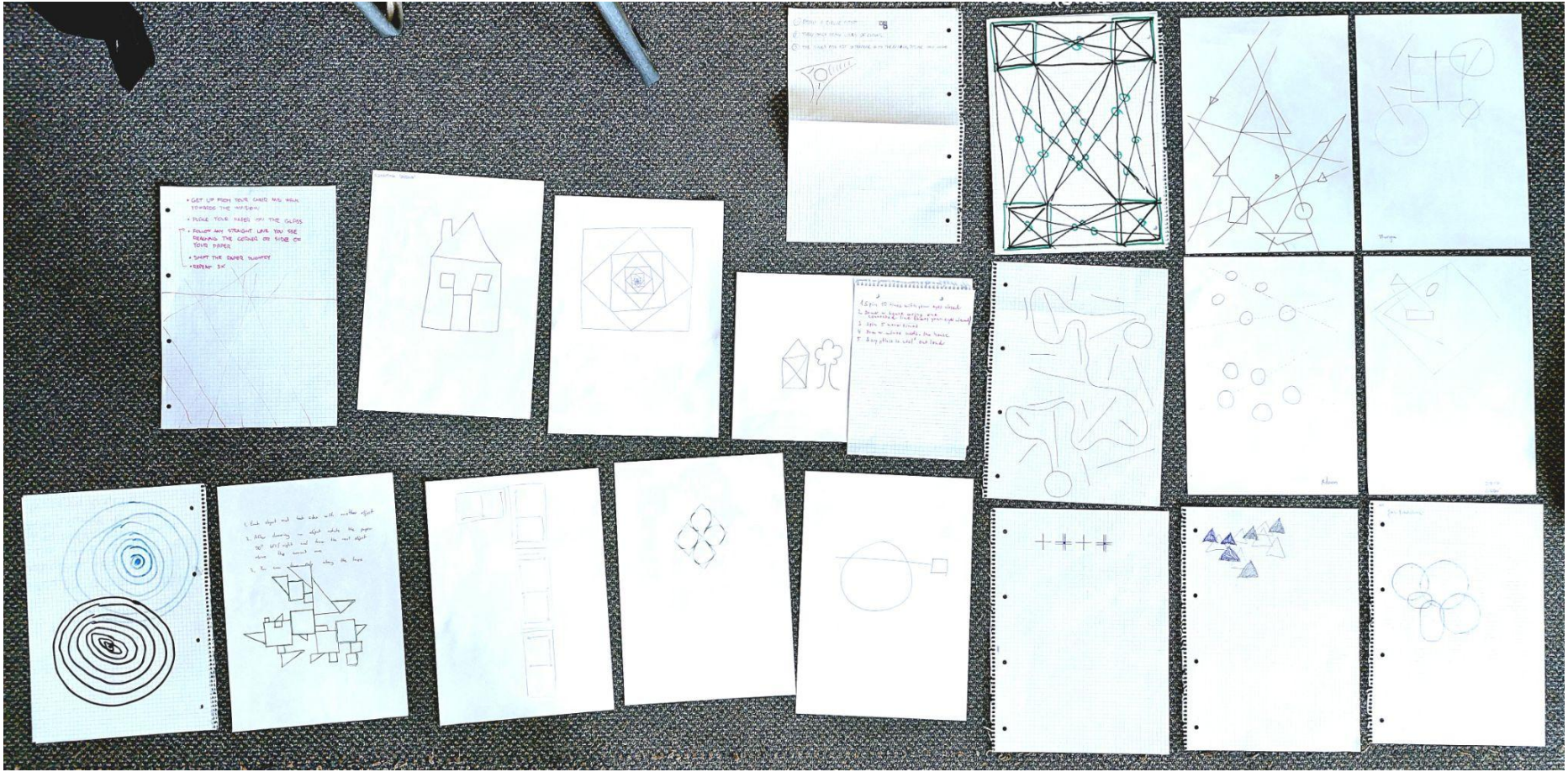
Lewitt exercise

Write a simple art plan for drawing.

At least 3 rules. Don’t be strict - allow randomness. Write the rules on the top of a paper.

Exchange plans with a partner.

Draw each other’s plan, below the rules (so we can see both the rules and the drawing).


• GET UP FROM YOUR CHAIR AND WALK TOWARDS THE WINDOW.
• PLACE YOUR HANDS ON THE GLASS
• FOLLOW ANY STRAIGHT LINE YOU SEE REACHING THE CORNER OR SIDE OF YOUR PAPER
• SHIFT THE PAPER SLIGHTLY
• REPEAT 3X

If the autonomous system does all the heavy lifting and the artist **only** provides the instructions to the system and the initial conditions...

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

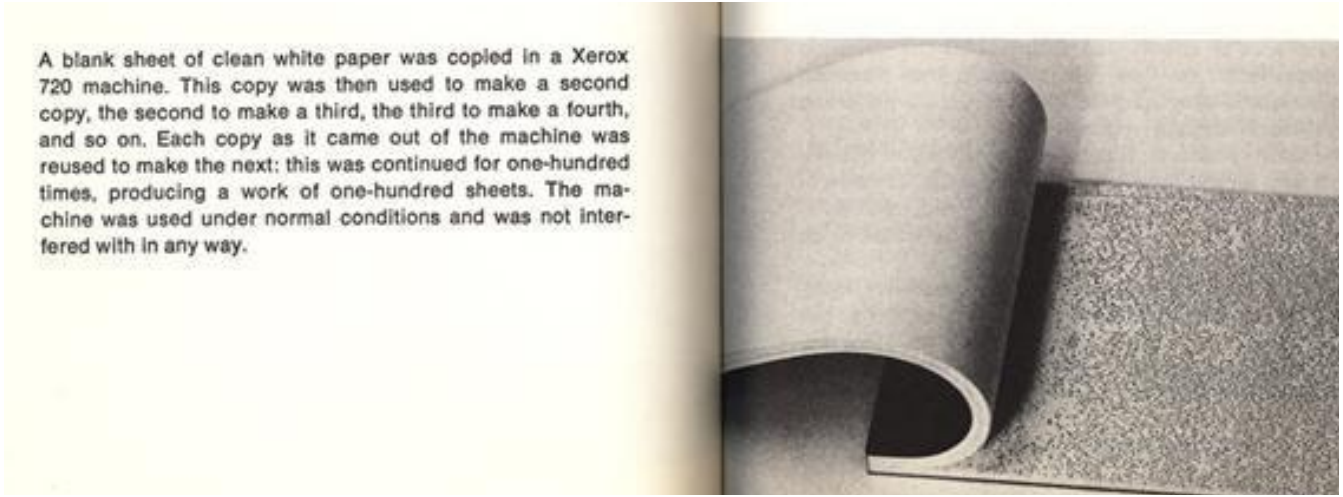
Other interesting questions ->
McCormack: Ten Questions Concerning Generative Computer Art (2012)

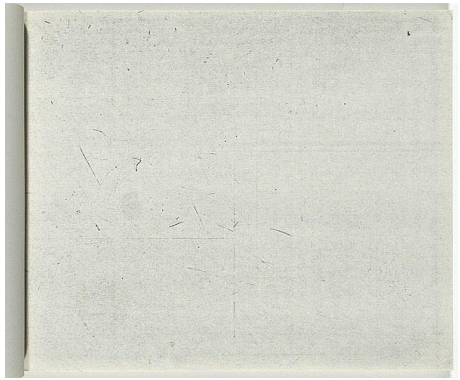
→ IMAGE

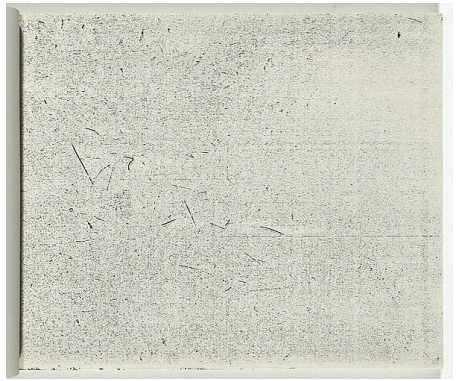
“Xerox” Book

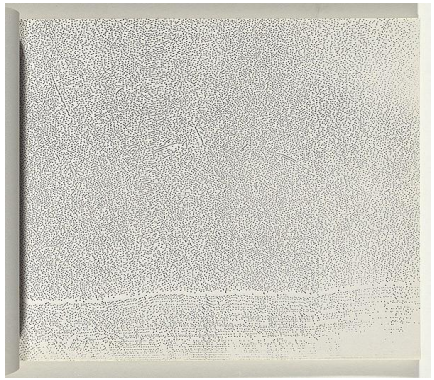
Ian Burn, 1968

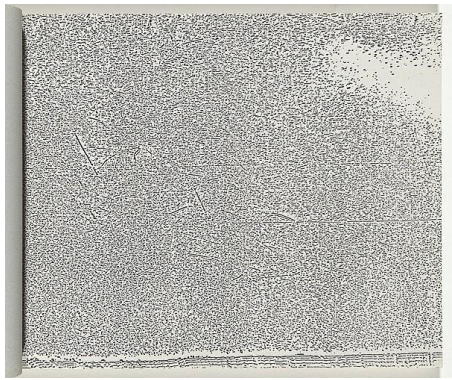
Documentation is often how we come to know about conceptual art.







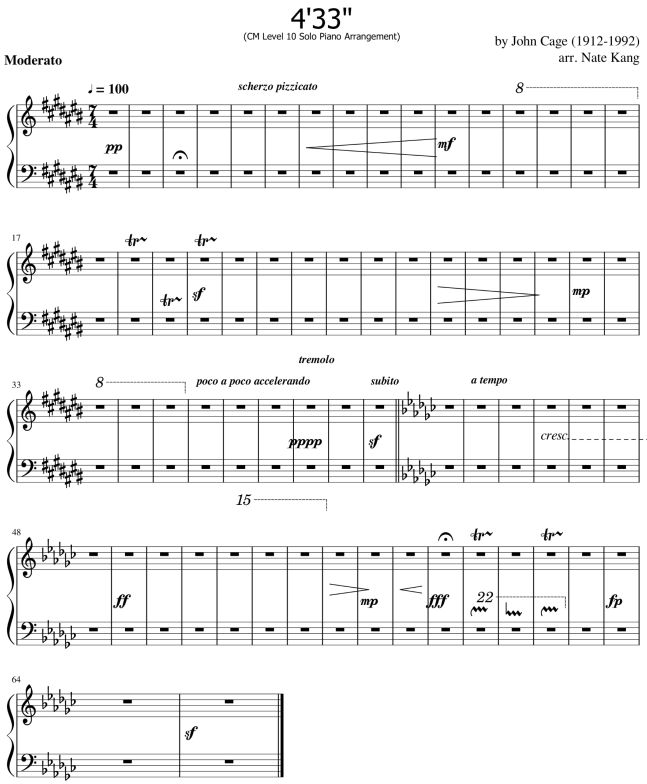


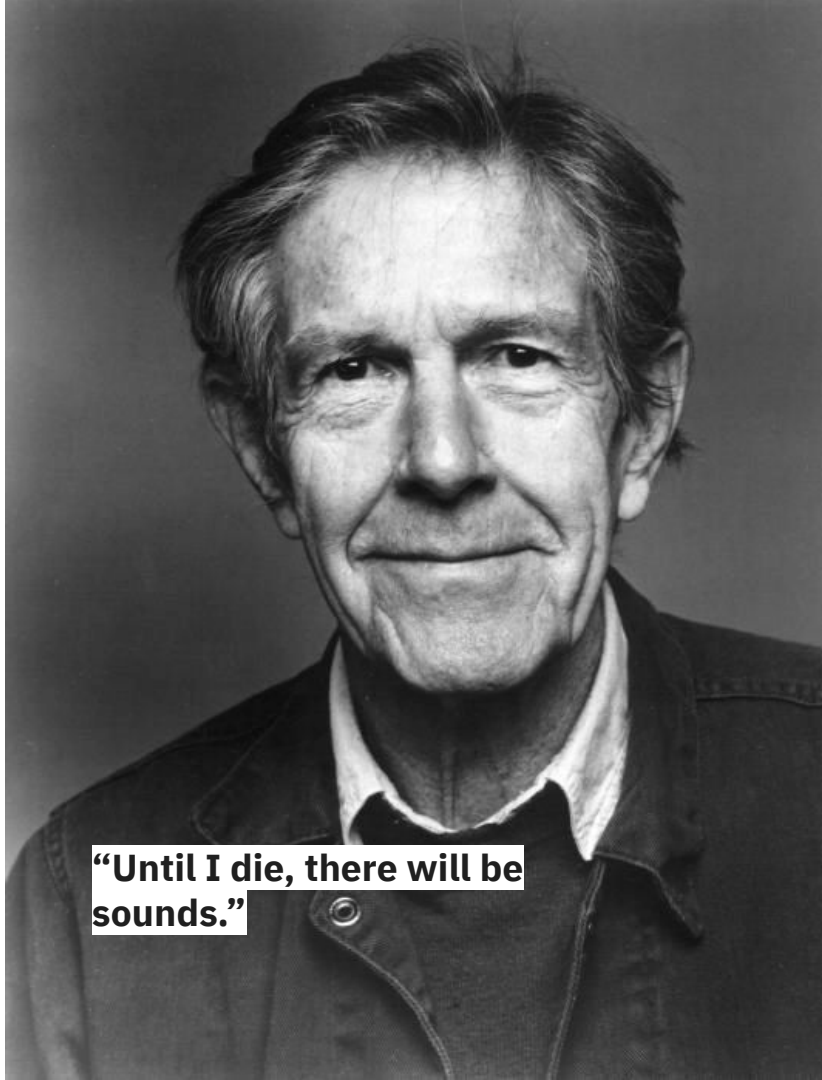


→ SOUND

4’33”

John Cage, 1952





→ SOUND + VISUALS

Scape

Brian Eno, Peter Chilvers; 2015

Ipad application.

→ 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.

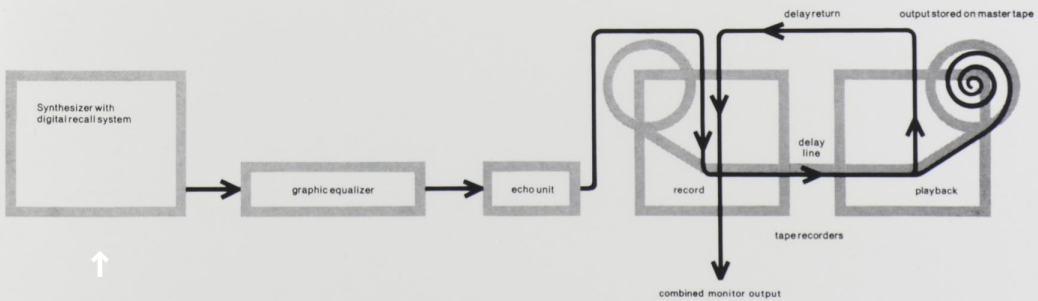
In this case the "system" is a group of performers with a set of instructions – and the "input" is the fragment of Pachelbel. Each variation takes a small section of the score (two or four bars) as its starting point, and permutates the players' parts such that they overlay each other in ways not suggested 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 Schmidt.
Founded and produced Obscure Records.

Design by John Bonis of CCS

Operational diagram for "Discreet Music"
The black line indicates the signal path



↑
score

ENOLP5

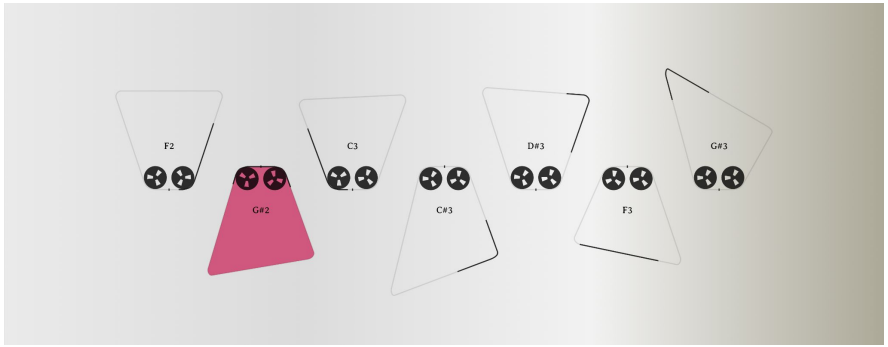
→ SOUND

Music for Airports

Brian Eno, 1978

Interactive visualization of the system: https://teropa.info/loop/#/airports

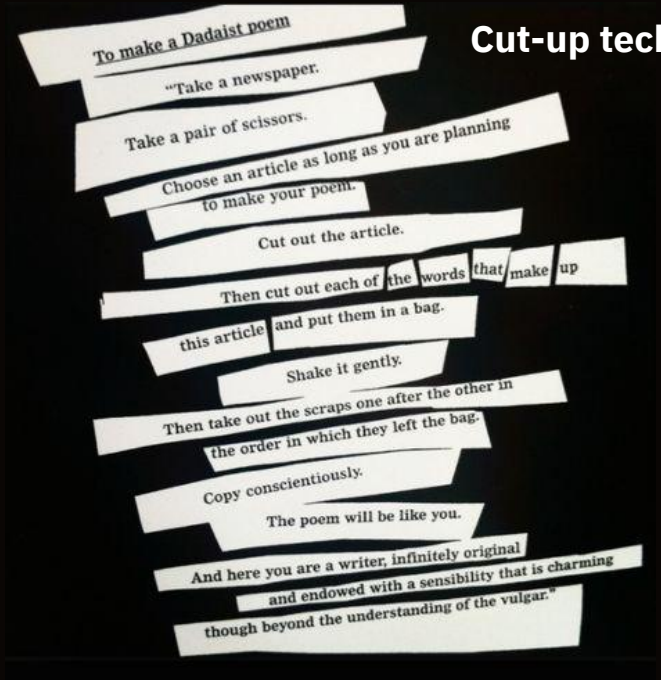
“The thing about pieces like this is that they are actually of almost infinite length. They simply don't reconfigure the same way again. This is music for free in a sense. The considerations that are important, then, become questions of how the system works and most important of all, what you feed into the system.”
- Brian Eno, Generative Music, 1996



→ TEXT

How to make a Dadaist Poem

(method of Tristan Tzara)



Cut-up technique

Cut-up technique

W.Burroughs, D.Bowie

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

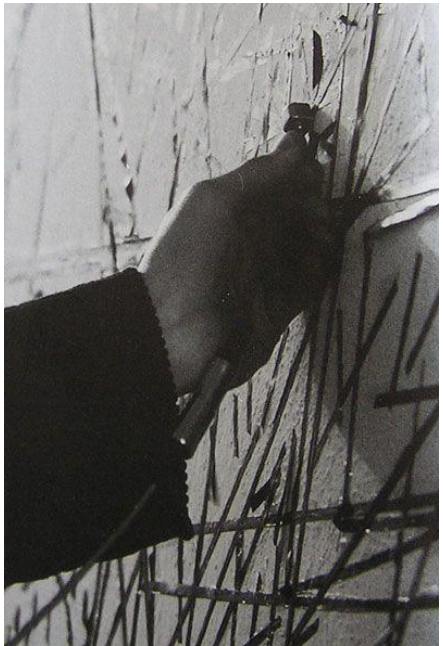
Cut-up technique of David Bowie

Cut-ups William. S. Burroughs

→ SOUND

Random Access

Naum Jun Paik, 1978



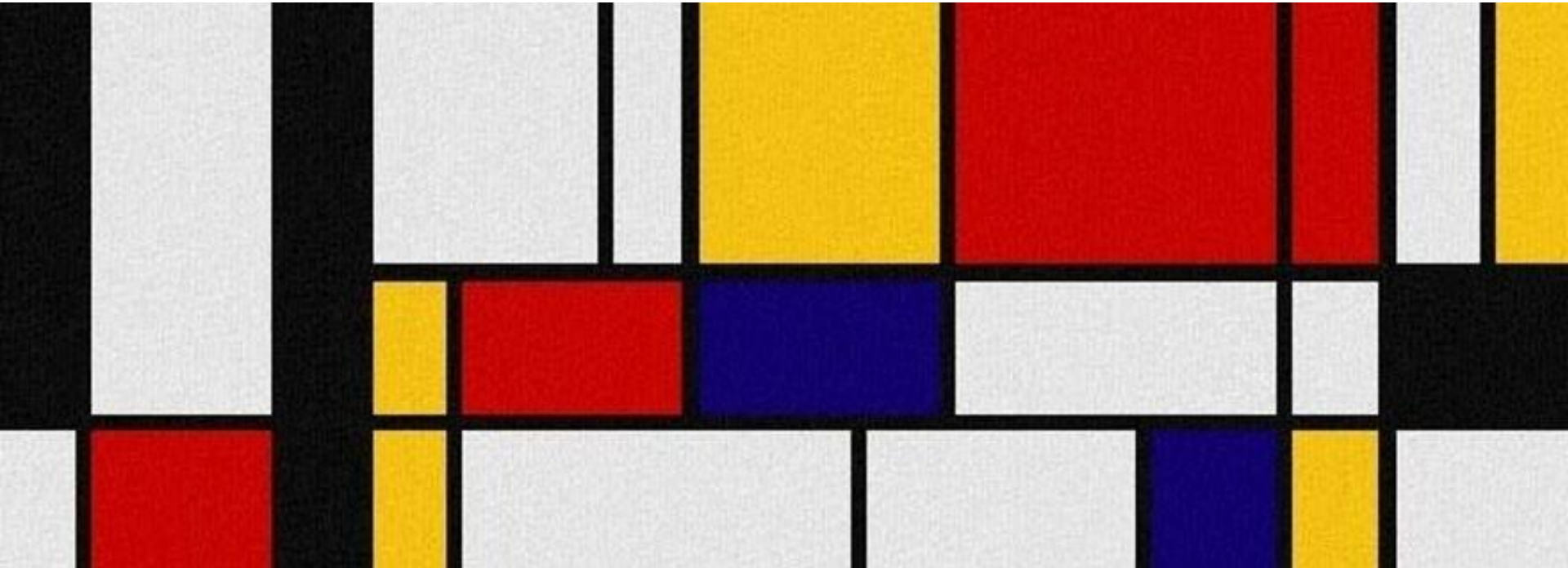
Visitors can use playback heads of magnetic tape recorders to listen to a part of a song by sliding on tapes on the wall. They can influence the playback sound by changing the speed and direction of their movement on the tapes. So they can create their own musical composition.

→ IMAGE

DeStijl (Neoplasticismus)

Dutch art movement since 1917

vertical + horizontal lines
primary colors + black + white



→ PERFORMANCE

Women licking jam off a car from the happening series Household

Allan Kaprow, 1964

participative project - viewers are actively engaged, creating the art piece

→ IMAGE

Topological structures

Zdeněk Sýkora, 60’s and 70’s

→ NATURAL PHENOMENA

Seek

Nicholas Negroponte (MIT), 1970

From “Software” exhibition

Article

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

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.

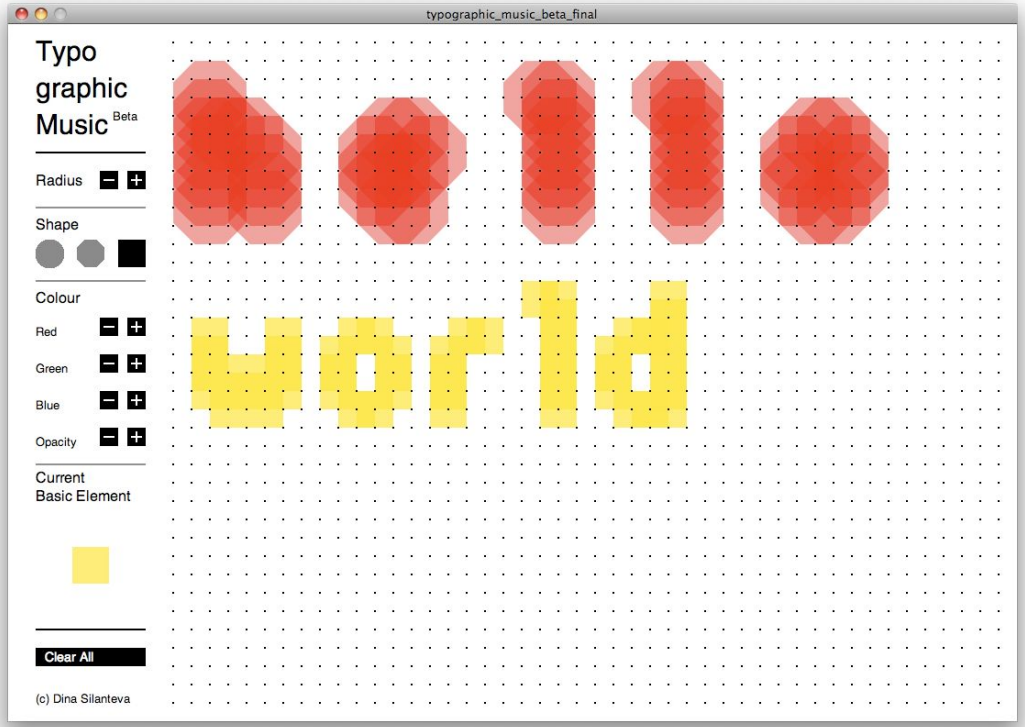
Form+code. C. Reas, C. McWilliams, LUST, 2012

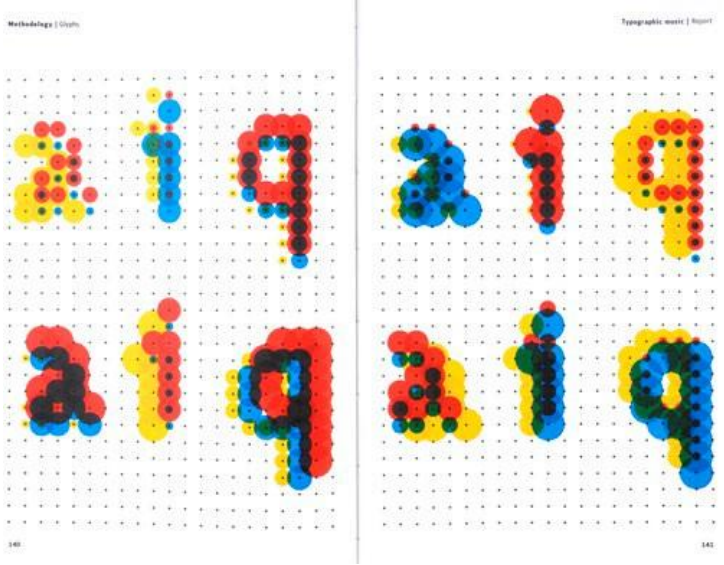
LET’S EXPLORE THE MODERN WORLD OF GENERATIVE ART

→ SOUND + TYPOGRAPHY

Typographic Music

Dina Silanteva, 2011





→ PERFORMANCE

Measuring the Universe

Roman Ondák, 2007-now

Article (Tate modern)

→ SOUND + HW

Tripod I

Moritz Simon Geist,
ongoing

https://youtu.be/wHrCkyoe72U https://youtu.be/falB7g_LuBo

→ 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?

→ ??

Unnamed Soundsculpture

Onformative

Dancer interpreting a song with the movement of her own body. 3 depth cameras.

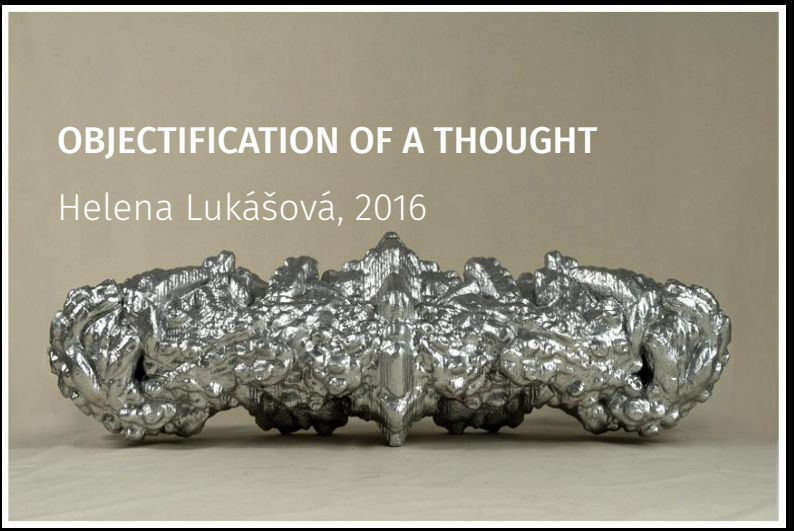
https://vimeo.com/38874664

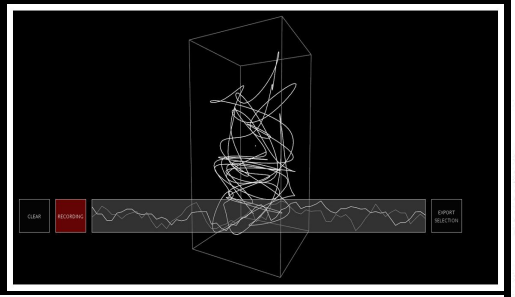
https://onformative.com/work/unnamed-soundsculpture

→ SCULPTURE

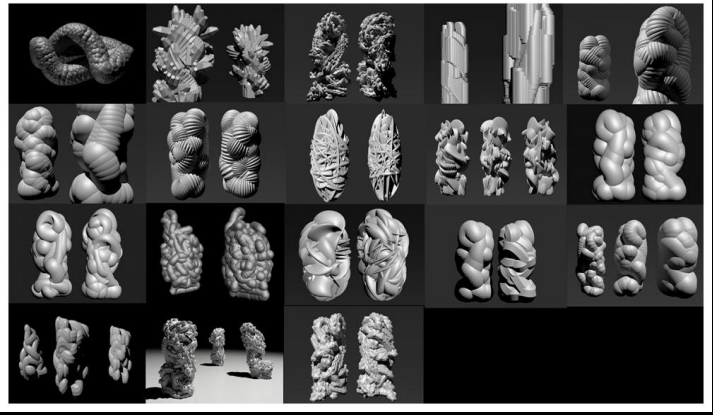
Aerial net sculptures

Janet Echelman






```
  @Override
  public void mouseDragged() {
    if (!seeking && !clearHover && !recordHover && !exportHover) {
      rotX += map(mouseY - pmouseY, 0, height, 0, -PI);
      rotY += map(mouseX - pmouseX, 0, width, 0, TWO_PI);
    }
  }

  @Override
  public void mouseWheel(MouseEvent event) {
    zoom = zoom * pow(1.05f, -event.getCount());
  }


  /// EXPORT ----------------------------------------------------------------
------

// Penize
// telo prodas
// dusi prodas
// zdravi nekoupis
// nakonec se zblaznis

// Money
// you sell your body
// you sell your soul
// you won't buy your health
// and you go mad, that's all


  static DateTimeFormatter formatter = DateTimeFormatter.ofPattern("yyyy-
MM-dd_HH-mm-ss");

  static void exportObj(PApplet applet, float[] coords, int coordCount) {
    String dateTime = LocalDateTime.now().format(formatter);

    OutputStream s = applet.createOutput("export\\path_" + dateTime +
".obj");
    PrintStream out = new PrintStream(s);

    String v = "v %.2f %.2f %.2f";
    String f = "f %d %d %d";

    out.println(String.format(v, 0.0f, -200.0f, 0.0f));

    int count = 1;
    for (int i = 0; i < coordCount/3; i++) {
      float x = coords[3 * i];
      float y = coords[3 * i + 1];
```



https://helenalukasova.com/OBJECTIFICATON-OF-A-THOUGHT

→ POETRY

Oisín: Wave Function Collapse

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

https://github.com/mewo2/oisin

Markov Composition

http://mariechatfield.com/markomposition/

→ 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

https://www.markrobert.nl/project/the-next-rembrandt

→ IMAGE + AI

The next Rembrandt

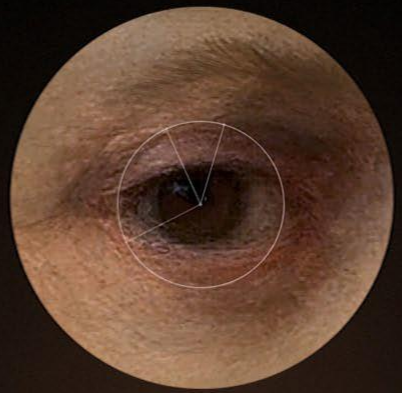
Computer-generated painting

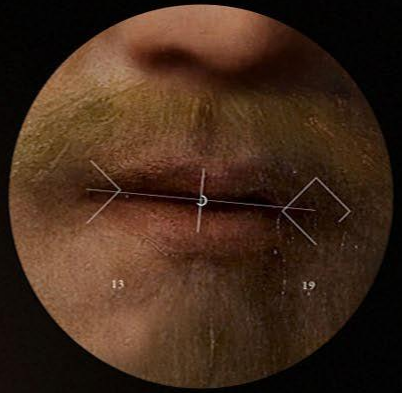
The Next Rembrandt is a 3D printed painting made solely from data of Rembrandt's body of work (from 300 paintings), and was created using deep learning algorithms and facial recognition techniques.

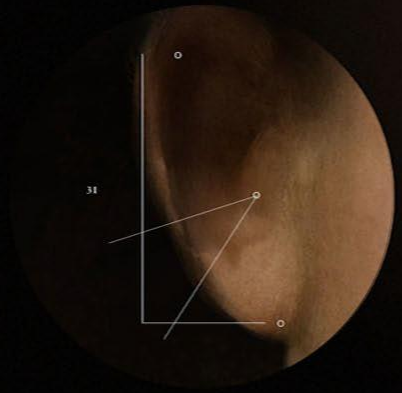
→ IMAGE + AI

The next Rembrandt

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







→ NATURAL PHENOMENA / TELEKINETIC / DATA ART

Telepresent Water

David Bowen

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

→ NATURAL PHENOMENA

Rain Room

Random International,
2012

→ COLLABORATIVE CREATION

Together

Universal Everything, 2015

https://vimeo.com/106589895

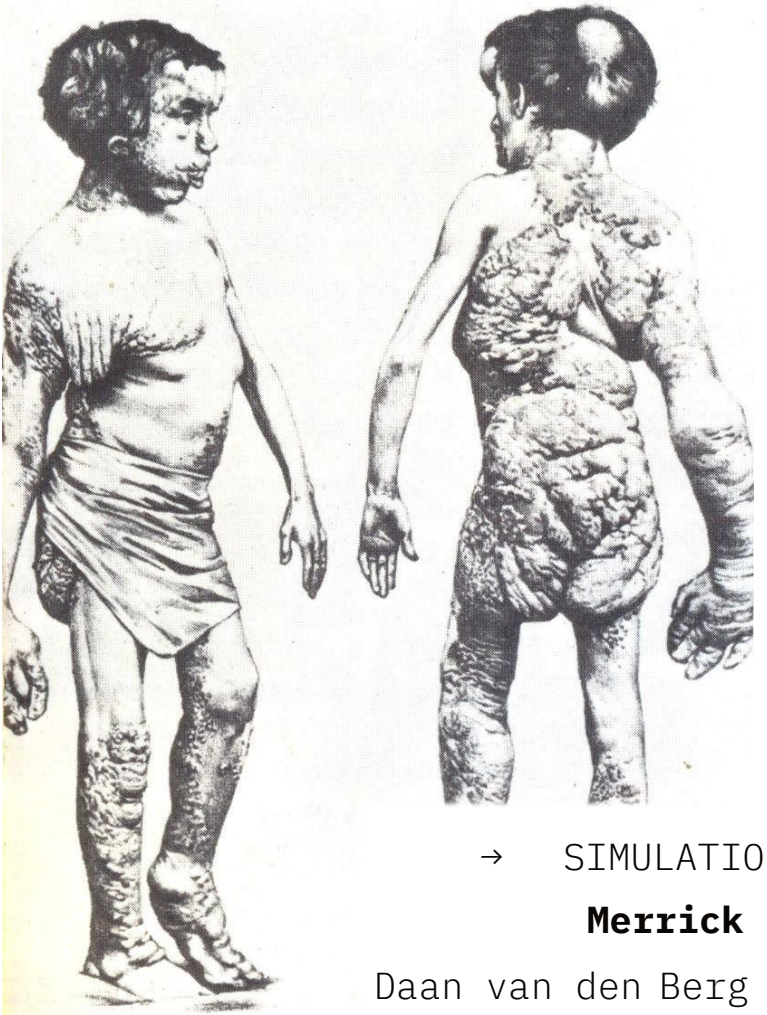
→ Visualization

Facebook Tree

Onformative Studio (2014)

Data visualization for Telekom flagship store.

http://www.onformative.com/work/4010-facebook-tree/



→ 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."

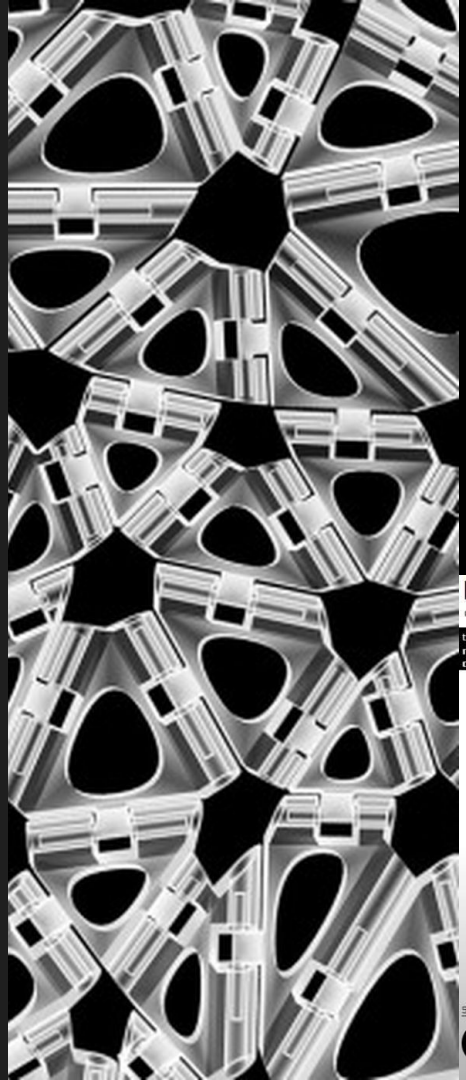
→ SIMULATION + 4D

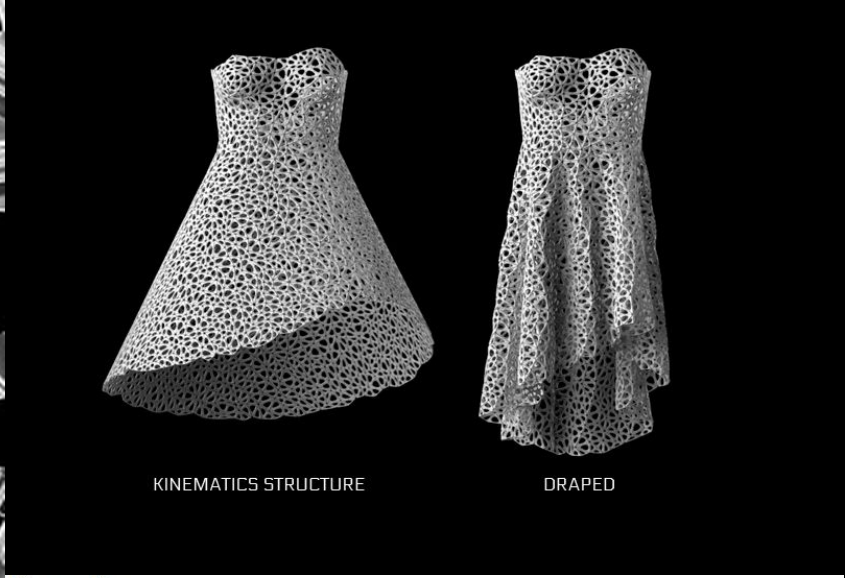
Kinematics

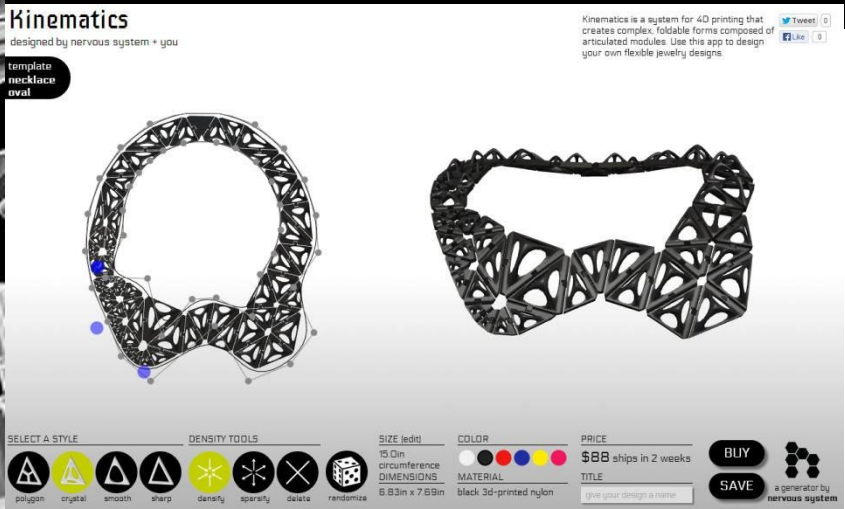
Nervous systems, 2014

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

https://vimeo.com/80893331







Yoko Ono

Instruction Paintings

Ono gives instructions, but ultimately, we are doing the performance - can it be considered generative?

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

Which artworks did you like?