What is Generative Art?

Gordon Monro
www.gommog.com

I describe myself as a *generative artist*. Generative art is not a widely known practice, so in this article I describe it, give examples from my own practice, and close with a few questions and my answers.

What is generative art?

Here is a widely used definition:

> *Generative art refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art.*
>
> Philip Galanter, "What is Generative Art?", 2003

The generative artist is working at one remove: the artist composes the system, and the system generates the work.

Generative art has a long history. Wind chimes and aeolian harps (wind harps), both known in ancient times, have been claimed for generative art. A more substantial body of art is the extraordinary geometric art made in the Islamic world, particularly in religious contexts. The best-known example is the Alhambra in Spain (13th-14th century). Much of the geometric work is based on 6-, 8- or 10-sided figures arranged in a systematic manner. A more contemporary example of geometric generative art is Sol LeWitt's wall drawings (1968 on), carried out according to simple written instructions.

With the spread of computers generative art expanded enormously in scope. The earliest computer art was necessarily generative, as there were no tools like Photoshop; getting anything out of a computer required writing a program. The first music composed by a computer program was the *Illiac Suite*, by Lejaren Hiller and Leonard Isaacson (1956). This was in the form of a score for string quartet. The first computer-generated visual art was shown in three exhibitions in 1965, by Georg Ness, Michael Noll and Frieder Nake. Since that time computer-based generative art has spread out in a number of directions. The first interactive sculpture controlled by a computer is claimed to be *The Senster* by Edward Ihnatowicz (1970); it moved in response to sound and people's movements in front of it. Generative design and generative architecture have become recognised practices.

An idea that has played a significant role in generative art is evolution, as in nature: animals produce offspring that are not exact copies of the parents, due to mutation and shuffling of genes in mating, and natural selection occurs: some animals have better chances of survival than others. This idea was used for scientific purposes from the 1960s, where the idea was to have a population of potential solutions to some problem (in the form of mathematical formulas and the like), subject them to breeding and mutation, allow the better solutions to survive, and repeat the process. In the late 1980s and early 1990s artists picked up on this idea to "breed" images; pioneers were William Latham and Karl Sims. In art there is no clear-cut problem to be solved, and the artist may steer an evolutionary process by viewing and selecting images that will be the parents of the next generation.

My own engagement with generative art

I began to make generative music in early the 1990s, mostly sound files generated sample by sample, such as *Peer Pressure* (2000-1), which was inspired by the mechanism that causes fireflies to flash in unison. I also wrote a few pieces for acoustic instrument and computer-generated sound track, including *The Voice of the Phoenix (2)* (1997), for bass or contra-bass flute and sound track. The sound track was generated a program that used chaotic oscillators; I composed the flute part intuitively.

I started to make generative video works in the early 2000s. One was made by a physical construction consisting of a Lego robotics kit, two laser pointers and a box lined with mirrors (*Red Grains*, 2003-4). I programmed the robotics controller to move the laser pointers, with feedback from some light dependent resistors, set the apparatus going, and used a video camera to record the moving dots of light. My other videos have been made frame by frame, generating images completely synthetically in the computer. One of these was *Triangular Vibrations* (2007), based on a mathematical model of a vibrating drum. I followed this up with a real-time interactive installation *Cloud Drum* (2008) based on the same idea.

I have made one generative sculpture, as part of a piece called *Exiguous Cubes* (2008). I wrote a computer program that generated arrangements of Lego blocks according to rules that I set up and displayed them on screen. I also made one actual sculpture from Lego blocks that was exhibited next to the computer display.

My first work based on evolutionary ideas was a real-time installation *Evochord* (2005). This generates a continually changing musical chord that is trying to evolve towards harmoniousness. More recently I have been making digital prints showing the outcome of evolutionary processes. The series *Difference Engine* (2009-2012) shows a large number of small patterns that evolved under the pressure to be different from one another, with no interference from me. For the series *Shaping Evolution* (2011) I generated a large number of images autonomously, letting the computer evolve them using simple criteria such as symmetry, and then picked ones

I liked from the final output. For both series of prints I showed a visualisation of the "DNA" along with the generated images.

What are generative artists doing exactly?

For me the key word in Galanter's definition is "autonomy". A generative artist sets up a process and then hands control over to the process. As Galanter is careful to indicate, the output of the process may be only part of a bigger work. However, in the generative part of the work the artist is composing the *process*; that is what generative artists do. Composing a process is iterative: set something up, see what it does, think about how the result could be improved, modify the process, see what it does now. and so on.

So a generative artwork typically has two sides: the visible or audible outcome, and the system or process behind it. It is an aesthetic and practical decision for the artist as to how much of the process behind the visible work should be revealed, and in what form.

From one point of view the hidden aspect of a generative work is unusual, and possibly disturbing. However, many traditional artworks are not properly comprehensible without external knowledge, for example knowledge of the other works of the artist, of incidents in the artist's life, of works of literature that the artwork references, and so on.

Does generative art always use randomness?

No, for example the Islamic art mentioned above does not. However, much generative art does use randomness or variation, through the use of a random number generator in a computer, through environmental input (for example wind speed) or through the interaction of people with the work.

This indicates another way in which generative art has a hidden aspect: the system the artist sets up may be capable of producing a huge volume of output; it is again an aesthetic and practical decision as to what to exhibit.

Do generative artists need to have studied science/mathematics/computer science?

The short answer is no. Sol LeWitt studied art and graphic design. The computer artist and graphics pioneer Charles Csuri, whose computer-generated work *Random War* (1967) remains significant, trained as a painter, as did Harold Cohen, creator of the unique "computer artist" *Aaron*. William Latham studied art and made his first evolutionary artworks without a computer; he then teamed up with mathematician and computer scientist Stephen Todd.

The longer answer is in two parts. Firstly, since generative artists are composing systems and processes, an interest in systems and processes is fundamental. This need not come through formal study, and need not be expressed through computer programs.

Secondly, if you are looking to make generative art using a computer, you need some way of getting the computer to carry out the processes you design, and that means computer programming or scripting. However, there are a number of frameworks or environments that help. The free system *Processing* (processing.org) is a stand-out, and there are commercial programs such as Adobe's Flash. As with any art practice, time and effort are needed to become competent, but getting started is much easier than it used to be.

Is it art? Where is the creativity? Where is the hand of the artist?

Generative art is art, by any reasonable definition. It is shown in galleries and museums, and the people who make it in large part identify as artists (not scientists or computer professionals). Generative art, like other art, can be political, or not; it can comment on its own means of production, or not; it can be very much about surface appearance, or not; and so on. The questions around generative art are artistic questions.

The creativity in generative art is in the design and refinement of the systems or processes. Frieder Nake has expressed this well: "I am the creative one, and I remain the creator. However, the stuff of my creation has changed from material to semiotic, from particular to general, from single case to all cases."

Where is the hand of the artist? Painting is not the only art form. There have been a host of developments, of which photography is only one, that have overturned the idea that art depends on the hand. I once heard someone say that what matters is the mind of the artist, and, as a generative artist, I agree.

Further information

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