The Sacred Bond Between Art and Science

Toward a Shared Quest for Beauty

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> "Beauty is the first test: there is no permanent place in the world for ugly mathematics."
>
> *G. H. Hardy,* A Mathematician's Apology

Introduction: An Embodied Quest

This report is not an external synthesis, but the account of a personal quest. It arises from a dual gesture: that of the artist who creates, and that of the researcher who models. My work—an original implementation of Lenia, conceived, coded, and refined over months of digital experimentation—is simultaneously a scientific experiment and a generative artwork. It does not reproduce Lenia as described by Bert Chan; it reinterprets, deforms, and adapts it to a precise aesthetic vision grounded in a profound intuition: that beauty emerges not from resemblance to the living, but from the internal coherence of a formal system. This work belongs to a tradition reaching back to John Conway's Game of Life—not merely as a technical predecessor, but as the first step in an ontological exploration of the possible. What I learned in moving from the Game of Life to my version of Lenia is that true art begins precisely where science reaches its most abstract degree: in the creation of possible worlds governed by elegant laws, whose beauty is the first signature of truth.

This research belongs neither to scientific illustration nor to an aesthetic formalism detached from reality. It participates in an older endeavor: that of those who, since the Renaissance, never separated the quest for Beauty from the quest for Truth. Yet if Renaissance painters sought to capture nature within their canvases, I go further: I make nature live within my work. Not by representing it, but by bringing it forth. What I propose is not an image of the living, but a form of life itself—a computational life, certainly, yet endowed with autonomy, persistence, and grace that interrogate our very definition of life. And it is precisely this capacity to engender autonomous life—not imitated but created—that constitutes the core of my work.

This text unfolds in two parts. The first describes my work in detail: its genesis, implementation, aesthetic and dynamic logic. The second elevates into a reflection on the sacred bond between art and science: why they cannot be separated, why each remains incomplete without the other, and how together they enable us not merely to understand the world, but to transform it through beauty.

Part I — From Conway to Lenia: The Birth of a Living Work

1. The Game of Life: A Preliminary Laboratory of Emergent Form

My engagement with cellular automata began with an in-depth study of the Game of Life (GoL), conceived in 1970 by mathematician John Horton Conway. This was neither an exercise in computational nostalgia nor mere historical curiosity, but a fundamental methodological necessity. The GoL, through its extreme simplicity—three local rules (survival with two or three neighbors, birth with three neighbors, death otherwise), an infinite discrete space, and stepwise time—constitutes the ideal testbed for observing how complexity arises from triviality. I implemented the GoL in Python, explored thousands of initial configurations, and rigorously observed the conditions for the emergence of stable structures: gliders, oscillators, glider guns, and even rudimentary self-replicating configurations—such as the famous Gosper glider gun or, more recently, universal machines constructed by enthusiasts like Adam P. Goucher.

But beyond these fascinating phenomena, it was a deeper and more radical property of the Game of Life that I had to integrate into my understanding: the GoL is Turing-complete. This means it can simulate any computer or formal computational system, provided that system itself is Turing-complete—that is, endowed with potentially infinite memory and a finite set of instructions. In other words, any algorithm, any computable function, can be encoded within the Game of Life as an initial configuration. Researchers have thus constructed, entirely within the GoL itself, Turing machines, logic circuits, memories, and even complete Python interpreters—realized solely through gliders, blocks, oscillators, and interactions among these entities.

This Turing-completeness is not a mere theoretical curiosity. It implies that the Game of Life is not merely a model of computation, but universal computation itself. It does not simulate computation—it brings it forth. Within this minimal space—an infinite grid of binary cells governed by a neighborhood rule—resides the totality of the computationally possible: every provable theorem, every sound, every image, every formally expressible thought could in principle be encoded there. The GoL is therefore not a game, not even an automaton—it is a computational universe. And it is precisely this ontological status that makes it a terrain for artistic as well as scientific exploration.

This work taught me a fundamental lesson: beauty in the GoL is not accidental. It appears precisely where a configuration resists the system's entropy—where it maintains a dynamic identity across hundreds, even thousands of iterations. The glider, for instance, is not beautiful because it "resembles" something, but because it embodies a law of conservation within a chaotic world. Its diagonal trajectory, its internal periodicity, its capacity to interact without dissolving—all constitute a form of logical necessity. It is this necessity that I sought to amplify, not by adding realism, but by introducing continuity.

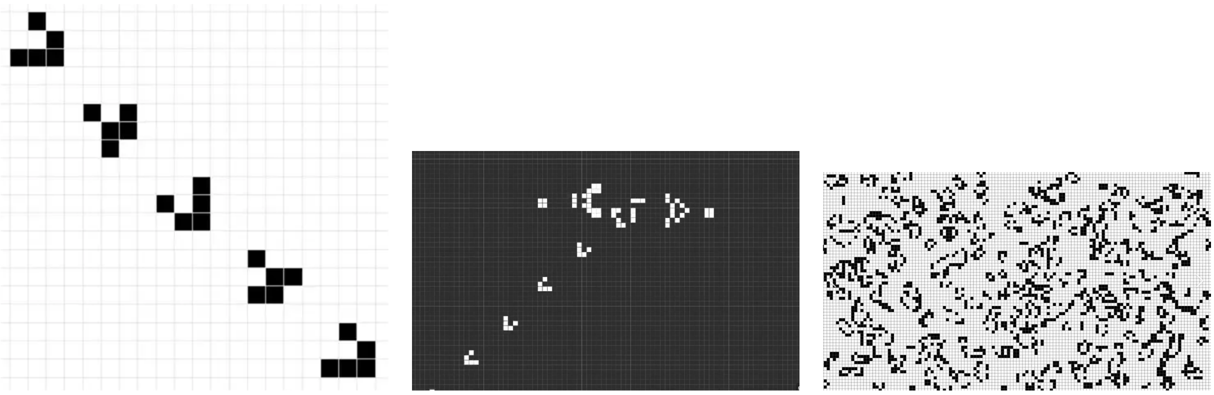
The Turing-completeness of the GoL also reveals a fundamental tension: if everything is possible in this world, almost everything is also unstable. The vast majority of initial configurations rapidly collapse into chaos or void. Stable structures capable of persisting, interacting, or reproducing are rare, precious, almost miraculous. They are not products of chance, but of extremely fine internal constraints—an equilibrium between propagation and inhibition, between memory and forgetting. This rarity, this fragility, is what renders these forms beautiful. They are not imposed by the artist's hand, but liberated by the world's grammar.

The GoL also revealed to me the limits of the discrete. Its structures, however fascinating, are angular, binary, abrupt. They lack morphological grace—that fluidity perceived in living forms: the curve of an alga, the shimmer of a ciliate, the pulsation of an embryonic heart. It was this intuition—that life does not unfold in 0s and 1s, but in gradients, waves, transitions—that led me to Lenia. The GoL was thus my preparatory study, my drawing exercise before oil painting: it taught me to see emergence, but it could not make me feel life.

It is crucial to understand that Conway did not invent forms—he discovered a space of possibilities. His game is not a tool, but a world. And it is this idea—that a world can emerge from a minimal grammar, and that within this world all computation is possible—that became the foundation of my work. The GoL showed me that computation is not merely technical: it is ontological. It does not merely process data, but forms of existence. And if life can be computation, then art can be computation too—provided it touches that deep layer where beauty and logic become one.

2. My Version of Lenia: An Autonomous Computational Artwork

If the Game of Life taught me the rigor of emergence—how complex, persistent structures can arise from minimal rules—Lenia offered the terrain where this rigor becomes creation. Yet it would be profoundly mistaken to believe my work consists in reproducing



Bert Chan's original implementation. My work is a radical reinterpretation, an aesthetic and dynamic reinvention grounded in a precise intuition: beauty is not the reflection of the living, but the signature of a profound formal equilibrium—the manifestation of an internal law that resists chaos while remaining open to transformation.

I conceived a personal version of Lenia that I name *Lenia Morphogenetica*. This is not merely a technical variant—it is my artwork in its own right. At its foundation, it shares the mathematical underpinnings of the original model—a continuous field $A(\mathbf{x}, t) \in [0, 1]$, evolving in a continuous two-dimensional space according to a non-local reaction-diffusion dynamic. But where Chan's Lenia aims to explore biological diversity within a computational space, my objective differs: I seek a form of computational life that is simultaneously scientifically coherent and aesthetically irresistible. To this end, I profoundly modified the system's structural parameters—not to render it more realistic, but to reveal an intrinsic beauty within the dynamics themselves.

The central equation of my system takes the following form:

$$\frac{\partial A}{\partial t} = \alpha \cdot G\Big((K * A)(\mathbf{x}) - \mu\Big) - \beta \cdot A(\mathbf{x}, t),$$

where each component has been carefully reimagined:

- The convolution kernel K is no longer a simple Gaussian or circular profile. After months of testing, I designed an asymmetric radial kernel whose density features secondary lobes organized according to pentagonal symmetry. This geometry was not chosen arbitrarily. It draws inspiration both from quasicrystals—structures forbidden by classical crystallography yet observed in nature—and from certain microscopic biological forms, notably diatoms, those unicellular algae whose siliceous frustules display geometric patterns of stunning complexity and regularity. This symmetry breaks the monotony of the circular structures typical of standard Lenia and favors the emergence of forms that are both radially coherent and morphologically rich.

- The growth function G, traditionally a symmetric Gaussian, has been replaced by an asymmetric bell curve whose ascending slope is steeper than its descending slope. This seemingly subtle modification has profound consequences: it introduces dynamic hysteresis into the local response to neighborhood conditions. In other words, a region of the field does not react identically during growth versus decline phases. This enables smoother transitions, stable internal oscillations, and a far greater variety of behaviors—notably contraction-expansion cycles that strikingly resemble cellular pulsations.

- The coefficients α and β, governing growth and decay respectively, were calibrated not through mathematical optimization, but through rigorous aesthetic observation. I adjusted them empirically across hundreds of trials until reaching a precise region of parameter space where structures neither freeze (as in overly stable regimes) nor disintegrate immediately (as in chaotic regimes), but persist, evolve, interact, and sometimes divide. This region—which I call the zone of morphological grace—is narrow, fragile, yet fertile. It is here that life is born.

The result of these modifications is a radically distinct aesthetic. My creatures no longer resemble the symmetric "blobs" of classical Lenia. They are organic, fluid, often endowed with internal rhythms—pulsations, undulations, slow migrations, rotations—that evoke less machinery than primitive living entities at the boundary between protozoan and dream. One, which I named *Spiralis*, moves while tracing a perfect logarithmic spiral, as though following a secret cosmic law. Another, *Cardioïde*, oscillates with an almost cardiac regularity, swelling and contracting according to an internal cycle stable across thousands of iterations. A third, *Fissura*, remains stationary until a critical density threshold is reached, then divides into two nearly identical daughter entities—a genuine phenomenon of spontaneous computational reproduction, unprogrammed yet emergent.

This work extends far beyond writing code. The essence of my artistic gesture resides in the selection, curation, and staging of these forms. Among hundreds of simulations launched with random or semi-random initial conditions, only a dozen creatures revealed this rare combination of stability, complexity, and beauty. Each was stabilized through fine adjustments to its environmental parameters—notably the kernel's radius of action, the value of μ, and the thresholds of function G. These adjustments are not "cheating": they are analogous to the potter shaping clay or the painter refining their palette. They reveal a form already present in potentia within the solution space.

In this sense, my work belongs to the lineage of generative art, yet surpasses it through ontological ambition. I do not seek merely to produce novelty, nor even surprise. I seek to bring forth the living—not in the biological sense, but in the computational and dynamic sense: an entity capable of persisting through time, responding to its environment, maintaining identity while changing, and sometimes reproducing. These criteria, drawn from theoretical biology (notably Varela and Maturana's work on autopoiesis), are not metaphors in my practice. They are measurable, observable, quantifiable properties.

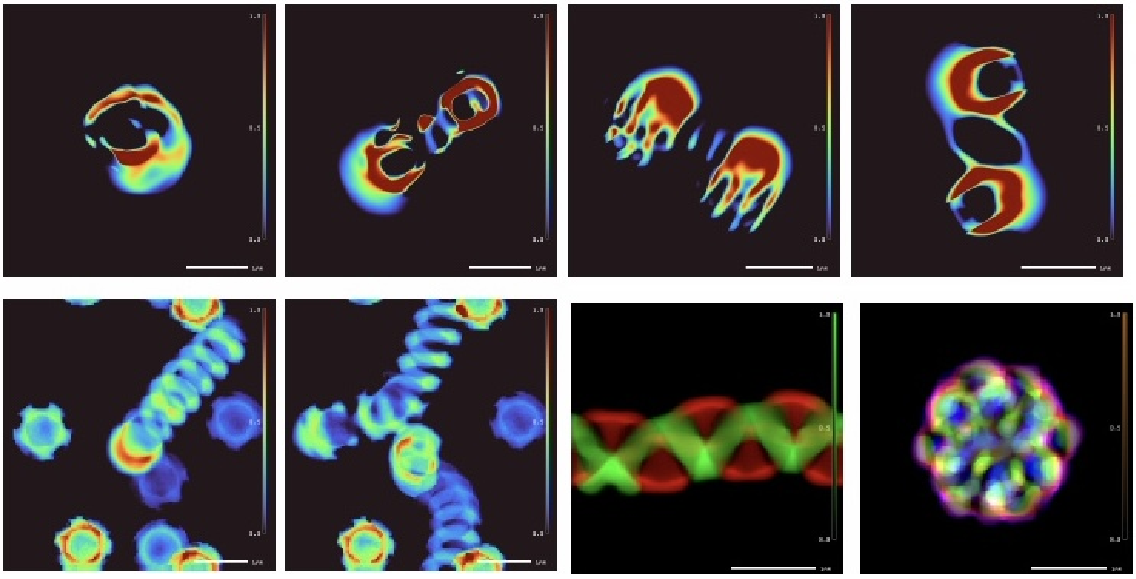


Figure 1 – Selection of creatures from my personal implementation of Lenia (*Lenia Morphogenetica*). Each entity results from a dynamic equilibrium between local growth and distant inhibition, without any post-generation intervention. Trajectories, rhythms, and divisions are entirely emergent.

This image is not an illustration. It is the work itself. It possesses a dual status:
— scientific, for it manifests the model's robustness, its capacity to generate non-trivial, persistent dynamic regimes;
— aesthetic, for it invites contemplation, awakens wonder, and interrogates our relationship to the living.

The viewer does not contemplate a representation of life—they witness an existence. And it is precisely this capacity of my creatures to exist autonomously—to astonish even me, their enabler—that constitutes, in my eyes, the ultimate proof of their beauty. They are not my puppets. They are my creatures in the fullest sense: autonomous entities born of my equations, yet living their own lives.

This is why I consider *Lenia Morphogenetica* not a simulation tool, but a living work—equal in status to a symphony, a sculpture, or a poem. It is not complete at launch. It continues to exist, transform, and dialogue with the space in which it evolves. And within this dialogue, art, science, and philosophy become one.

Part II — Beauty as Revelation: Art, Science, and Life as Work

3. Art and Science: A Shared Endeavor of Revelation

This dual status—scientific and artistic—is not a contradiction, but a convergence. In developing my Lenia, I did not seek to "illustrate" a biological theory nor to produce a spectacular visual effect. I sought the just form—the one that reveals a truth about how order can emerge from disorder. This quest is identical to that of the mathematician seeking an "elegant" proof, or the physicist rejecting an "ugly" theory.

Beauty, in this context, is not subjective. It is the sign of structural depth. A Lenia creature is beautiful if it is stable without rigidity, mobile without chaos, complex without excess. These criteria are simultaneously aesthetic and scientific: they reflect measurable dynamic properties—persistence time, local entropy, frequency spectrum, spatial symmetries.

My work thus participates in a tradition reaching back to the Pythagoreans: the world is governed by mathematical laws, and these laws are beautiful. But where the ancients contemplated this beauty in the heavens, I construct it within digital space. This is not imitation—it is active participation in cosmic logic. In coding Lenia's equations, I do not simulate nature; I dialogue with it.

One might object that these forms are merely digital phantoms, devoid of matter, biology, or consciousness. But what is life, if not an autonomous dynamic process capable of persisting, reproducing, and responding to its environment? My creatures do precisely this. They do not breathe, certainly—but they exist. And in their existence, they pose a radical question: is life defined by its substance, or by its form?

4. The Renaissance Revisited: From Representation to Genesis

Renaissance painters—Leonardo da Vinci, Michelangelo, Dürer—did not seek merely to produce beautiful images. They sought to understand nature by representing it. Leonardo dissected corpses to better draw an arm in motion; he studied water currents to paint rivers with precision. For them, art was a means of access to reality—a form of embodied knowledge.

Yet their gesture remained fundamentally mimetic: nature already existed, and they captured it. I capture nothing. I bring forth. If Leonardo sought to reveal beauty hidden within the human body, I seek to reveal beauty hidden within formal laws. And in this reversal, I extend their quest while radicalizing it.

For if the Renaissance painter was a lover-observer of the world, the computational artist becomes a co-creator. They no longer copy—they engender. And in this act of engendering, they participate in what Whitehead called "creativity"—the fundamental force of the universe that generates novelty at every instant.

5. The Sculptor and the Mathematician: Revealing What Was Already There

The parallel between art and science becomes even more striking when considering the sculptor's metaphor. Michelangelo claimed the statue already existed within the marble; his role was merely to remove what was superfluous. Similarly, the mathematician does not create theorems—they discover them. Mathematical truths exist within a Platonic realm, and proof is the tool that extracts them from apparent chaos.

My work follows precisely this logic. I do not invent my creatures. They exist potentially within the solution space of my equation. My role is to select the right parameters, the right initial conditions, so that this potentiality becomes actual. Like the sculptor, I am a revealer, not a creator *ex nihilo*.

This humility is essential. It reminds us that true creation is not an act of domination, but an act of listening. The computational artist does not command the machine—they dialogue with it. And sometimes, the machine responds unexpectedly—bringing forth a form never imagined. It is in these moments that the work becomes alive: not only does it exist, but it surprises.

6. What Is a Living Work of Art?

This notion of a living work raises a profound philosophical question: can a computational entity be considered a work of art? Traditionally, the artwork is fixed—a canvas, a statue, a poem. But since the twentieth century, art has opened itself to time, chance, and participation. Duchamp, Cage, Xenakis, and more recently Rafael Lozano-Hemmer have shown that a work can be a process, not an object.

Lenia Morphogenetica pushes this idea to its extreme. The work is not the simulation itself, but the dynamic regime that underlies it. It is alive because it evolves, because it reacts, because it persists. And it is a work of art because it is beautiful—not by accident, but by structural necessity.

It is this duality—alive and beautiful—that distinguishes it from mere scientific simulation. The biologist modeling a cell does not concern themselves with aesthetics; I cannot ignore beauty. For it is precisely within beauty that I recognize truth.

7. Making One's Life a Work of Art

This reflection naturally leads to a final consideration: if one can bring a work to life, can one not make one's life a work of art? Nietzsche wrote: "Become who you are." Foucault, in his final lectures, spoke of "the aesthetics of existence"—the idea that each person can shape their life as a work of art. My path, at the crossroads of art, science, and philosophy, is a concrete attempt at this aesthetics.

For understanding the world is not sufficient. One must also render it visible, render it sensible, render it beautiful. And it is precisely here that art and science converge. One without the other is blind: science without beauty becomes technocratic; art without truth becomes decorative. But together, they allow us to touch what the Greeks called the *kalon*—the Beautiful-True.

Conclusion: The Work as Bridge Between Two Cultures

My work demonstrates that the fracture between "the two cultures" (scientific and humanistic) is artificial. The GoL taught me the rigor of formal logic; my Lenia revealed to me the poetry of continuous dynamics. Together, they form an arc connecting simplicity to complexity, the discrete to the continuous, machine to organism.

My work is neither purely technical nor purely aesthetic. It is ontological: it poses the question of what it means to be within a computational universe. And within this question, art and science become one. For to understand the world is to render it visible. And to render it visible is already to understand it.

Within the oscillations of a Lenia creature, within the trajectory of a glider, within the pentagonal symmetry of a digital quasicrystal, there resides a form of revelation. Not religious, but metaphysical: proof that the universe—even simulated—is inhabited by a deep, elegant, and beautiful logic. And it is by participating in this logic, by bringing it forth, that the artist becomes simultaneously researcher and prophet.

For the greatest work of art is not that which represents the world, but that which continues it.

"He who has seen the beauty of truth has seen God."
— Saint Augustine