On Fitness and Optimization

Nell Tenhaaf, September 2022

Optimization runs as a thread through my time-based works since the late 1990s, drawing on a range of its meanings from the technical to the everyday. This word is generally understood to mean moving toward the best, or as a evolutionary term, selecting for the fittest. It ties in to an overarching theme that has appeared in my works and writings even longer, since around 1989: a skeptical, subjective take on the improvement of our species.

Several of my projects portray optimization through an abstract visual output that contributes to the aesthetic of the work, while also using it as a method for organizing the action that takes place as the work unfolds. For example, I first used optimization as a topic in a 1999 work called ***UCBM (you could be me)***. *UCBM* is a user activated video installation that explores viewers' adaptation to empathizing in an entirely computer mediated scenario. It uses a verbal test and an evolutionary algorithm (aka genetic algorithm) to assess a participant's willingness to relate. The topic of the test, artificial empathy, is set up like this: *UCBM* portrays a quasi-real personal interaction through an image sequence that shows someone in their personal space as if mirrored in an online forum. Participants' collective behaviour in this scenario is optimized in the sense that their more "fit" actions and choices are fed back into the genetic algorithm that will assess the next interaction. Each participant also generates an LED pattern that is personalized, based on the algorithm's processing of their input. It's tongue-in-cheek though, the test and the assessment are in no way scientifically based and don't give many clues as to what responses will lead to higher fitness.

These days the genetic algorithm has become a core artificial intelligence (AI) method for processing datasets so as to find optimized solutions to complex questions. The general meaning of optimization in AI is based on algorithmic procedures that are executed iteratively so as to compare various solutions until an optimum one is found (e.g., for design problems, or detecting trends of various kinds). A refinement of this idea comes out of Machine Learning, or ML: "a learning algorithm adjusts a model so as to improve its performance… over a dataset".[i] ML is behind the now familiar tracking, sorting and optimizing of the huge amounts of data captured from daily life, with outcomes that are deployed for everything from shaping our buying behaviour to predicting the weather.

Speaking more broadly and using the term in a more colloquial sense, optimization is a feature of adaptation that is useful and necessary when it comes to getting rid of things that run counter to the overall welfare of a living or non-living system. Nature works that way, in a whole systems approach, unless human intervention narrows it down to specific goals that are meant to benefit only us. So optimization doesn't have to be thought of as only an AI manoeuvre that is now infiltrating our lives in a quasi-threatening way.

But what about optimization in art? There are artists who use AI to generate unexpected images or experiences from familiar ones, notably (or perhaps notoriously) the crowd

who are convinced that computation can optimize to artistic beauty[ii]. There are much more interesting artists who use ML methods based on datasets to change system behaviours slowly over time, developing a theme or a kind of narrative. But these are not the areas of interest in my art practice. Operating in the zone of reciprocal exchange between humans and artificial entities, my works play with the idea of revealing the inner workings and machinic logic of a programmed system, in which optimization is a behind-the-scenes procedures.

An underlying philosophical conundrum in the concept of optimization is the reason that *UCBM* is so layered: in a system that is going to computationally test, judge or improve behaviour, I wanted to present an assessor with obvious bias, one who might mirror my own thoughts and aspirations. The idea was to reveal that in any system that appears neutral there is always a bias built in from the designer. This covers the calibration of the system, or what standard it uses to measure by, as well as outputs that only the system builder can decode. In *UCBM*, the working system has two visible manifestations: the speaking woman in a lab coat and the silent self-observing woman sitting at a screen, shown in the image sequence of the interface box. But the system itself is ultimately a more significant player in the action than these overt characters, it works as a kind of artificial entity. The system is the machinic power behind the scenes.[iii]

Some participants saw this as menacing, standing in for the threat of technoscience, which *UCBM* is understood as critiquing. But I was interested in evoking such a presence just for itself, as a reality that we live with and have to negotiate with, possibly even find some empathy for. One key source for these ideas was the social intelligence branch of AI that is focused on how computational systems or robots can more accurately mimic and also interact with human factors – including the subtle issue of bias. I read a 1997 paper that inspired the title of *UCBM*, "I Could be You: The Phenomenological Dimension of Social Understanding".[iv] The author explores how both a human observer and the designer interacting with a system/robot are embodied agents who bring in intentionality and subjective explanation as biases, and how these agents set up empathy as an aspect of the exchange.

In 1999, I didn't use the word optimize itself, but looking back, in *UCBM* I wanted to make a basic form of optimization accessible and readable through image and concept. I also didn't know that the genetic algorithm like the one deployed in *UCBM* would play an important role in the algorithmic methods of ML. But I had already become interested in the GA for its capacity to model an adaptive system, as well as the way that it generates captivating two-dimensional patterns. In *UCBM* the GA is used both to produce an "adaption pattern" in LEDs, and as a method for assessing how one's empathy factor compares to that of others who try the test.[v] Each participant's actions are assessed when the GA takes their empathy score, derived from their speed of approach and from their answers to three questions, and calculates it as a set of artificial genes (lists of integers) that mutate and crossover to form offspring. These are compared to fit genes that I programmed in to the system. As noted above, there is a lot of irony here in the notion of better answers and actions.

In a rudimentary way, *UCBM* improves the system's model of itself by storing and comparing participants' input. Viewers with adaptive offspring that result from better performance pass their genes into the gene pool that subsequent viewers interact with. In this way the recombinant action of the GA links together a population of nine viewers before resetting. Fitness in the group of nine usually climbs up, because of the passing on of adaptive numerical genes, and this is made visible for each participant in a graph. The GA itself as it is calculating generates the participant's adaptation pattern displayed in the LEDs.

I wondered about two interrelated things: how people would perceive the personification of assessment by a non-human agent, and how people would read an abstract representation of the GA itself. What would they think about the conceptual distance between these two things: listening to the female tester intensely focused on her inner life, and interpreting the abstract machinic pattern of the GA? The clue given by *UCBM* is that the assessor claims to decode this pattern herself when she gives each participant a performance score, in a rather teasing way. So she stands in for the system in all of its ruminations, calculations and manifestations.

The idea of showing some of the interior state changes of a working system applies equally in a 2021 reworked version of ***Flo'nGlo***, which was originally made in 2005. A particle swarm optimizer (PSO)[vi] is a subtle but key element that changes for each iteration as the work plays out, again in the form of an abstract pattern. The optimizing procedure of the PSO is different from the GA, in that there are no agent-elements that are eliminated while others succeed. It operates as a comparison between neighbouring particles instead, so it throws the emphasis less toward adaptation and more toward overall population health. In *Flo'nGlo* the PSO is displayed as a pause in the interaction between the two figures, a rumination by Glo when Flo throws input its way. The optimization pattern is unique to each cycle of the narrative.

This is how it works: the Flo character generates a word; the PSO uses the word as its "target" for optimization (it uses a numerical version of the word, with the value of each letter converted to 8-bit binary, then decimal, and added together, e.g. optimize has the cumulative value 881). Then Glo riffs off the word with a new one that it passes to Flo. The PSO is visible via an LED pattern in the centre of Glo's display. It takes a variable amount of time to optimize.

Flo'nGlo are two artificial entities that become one thing when conjoined in a conversation. This does not make the entities humanoid, in fact *Flo'nGlo* is *anti-anthropomorphic*. It considers a very machinic form of conversation in a lo-fi format that borrows from human language, and so it aims at some kind of reconciliation between us and our technological artifiacts. *Flo'nGlo*'s conversation shows how phenomena can become interconnected in lo-fi format. For example, a very simplified pixelated view on an organic movement is very much like a synthetic one, and vice versa. Things seem to be more ordered, or ordered in a different way, when visible and audible information is pared down.

TV Breeder mixes TV signal into image composite "parents", which then produce very low-resolution video "offspring" using crossover and mutation functions of genetic programming (the GA, as in *UCBM*). This is a collaborative project by NSF (nous sommes fragiles), the duo of John Kamevaar and myself. The *Breeder* offspring are meant to be childlike: they are displayed in LED boards that show simple patterns of lights, monochrome and very lo-res in the first itertion of the work in 2013, and in colour but still lo-res in a later version. The offspring emit a chirpy sound when they are deemed fit by the programming enivironment. The fitness function that the GA optimizes to, i.e., what each of the thirty offspring in a generation is compared to, is derived from a few minutes of TVOntario broadcast, a Canadian educational network available in our area. The earlier iteration used broadcast signal via a wire coat hanger antenna, switching channels periodically; the later iteration used online TV, mostly CNN. *TV Breeder* is a machine that uses signal as input and manipulates it to play on its fitness in the media world.

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[i] "A machine learning algorithm can thus be summarized as follows. Given a certain kind of task (supervised, unsupervised, reinforcement learning), a learning algorithm adjusts a model so as to improve its performance (measured using an evaluation criterion) over a dataset. While this is roughly true across all fields of applications of machine learning, there exist many variations within the kinds of techniques that are suitable for each of these components." Sofian Audry, *Art in the Age of Machine Learning* (Cambridge and London: The MIT Press, 2021), p. 10.

[ii] See Audry Chapter 2, Optimizing Art. Like Audry, the thing I have against computational creativity (and this applies also to much of the generative art area) is the deeply conventional, reductive idea about art that it tends to call on.

[iii] I heard a terrific talk on ML and designer bias by Ramon Amaro in Vancouver Art Gallery's *Speculative Futures Symposium*, April 2022. His book is *The Black Technical Object: On Machine Learning and the Aspiration of Black Being*, 2022.
See also Audry Chapter 11, Watching and Dreaming on inductive biases.

[iv] I adapted the title in conversation with the author, Kerstin Dautenhahn. "I Could be You: The Phenomenological Dimension of Social Understanding" in *Cybernetics and Systems: An International Journal*, 28:417-453, 1997.

[v] The GA Max/MSP objects in *UCBM*, which I still use, are from artist Bill Vorn's LifeTools (1996-2008).

[vi] The PSO is again the basic idea of a computational method that optimizes a problem by iteratively trying to improve a candidate solution. The population of candidate solutions

here are particles that move around in the search-space, each influenced by its own local best known position and that of its neighbouring particles. As Jim Kennedy first described it to me, unlike other fitness algorithms no element has to die in the PSO. The PSO Max/MSP object in *Flo'nGlo* was written by artist Ben Bogart for the 2005 version. See James Kennedy and Russell C. Eberhart, *Swarm Intelligence* (San Francisco: Morgan Kaufmann Publishers, 2001).