Towards a Symbiotic Future: Art and Creative AI



Fabrizio Poltronieri

Abstract The emergence of new AI systems brings not only technical challenges but also new questions to the realm of art. Even though the use of AI is not a novelty in the art world—Harold Cohen (1928–2016), perhaps the most famous and relevant example, worked on his AARON program for more than four decades—the new scenario, bursting with supervised, unsupervised and reinforced learning techniques make it possible for algorithms to have sufficient autonomous decision-making power to choose paths that hitherto were only available to programmers and artists. It can modify how we creatively use computers. Cohen and AARON actively collaborated with one another. The artist devoted a substantial amount of time employing Symbolic AI techniques to teach AARON to draw and colour in, hard-coding the decisions the system could make. In the later years, the program provided lines and basic abstract compositions for the artist to colour in the spaces, taking the program's input as a starting point. Currently, a growing set of frameworks provide neural networks out of the box, providing the logic for systems capable of learning tasks semi-autonomously by analysing a large amount of data. Thus, we can delegate tasks to increasingly intelligent autonomous systems, including playful and aesthetic ones, the ones that speak to our hearts as humans. Given these circumstances, this chapter reflects on notions such as language, intelligence, abduction, synechism, creativity and the role of aesthetics in a future where our creative relationship with intelligent artificial systems will become one of increasing symbiosis.

Keywords Creative AI · Semiotics · Abduction · Synechism · Creativity

1 Introduction

Over the decades, culture has helped consolidate an imaginary about the role of artificial intelligence that is dark. In the dystopian societies presented by films such as

F. Poltronieri (✉)
De Montfort University, Leicester, UK
e-mail: fabrizio@fabriziopoltronieri.com

© The Author(s), under exclusive license to Springer Nature Switzerland AG 2022

C. Vear and F. Poltronieri (eds.), *The Language of Creative AI*, Springer Series on Cultural Computing, https://doi.org/10.1007/978-3-031-10960-7_2

Metropolis (1927) and *2001: A* Space Odyssey (1968), the role of artificial intelligence systems is to take over and replace humans. More recently, the term singularity has re-awakened fear with the idea that ordinary humans will someday be overtaken by artificially intelligent machines, cognitively enhanced biological intelligence, or both (Shanahan 2015).

While such narratives are compelling as a form of entertainment, my vision as an artist and researcher working with Creative AI for over two decades differs substantially from fiction. I believe in an increasingly symbiotic future, where artificial intelligence and humans play together in real time, sharing transparent processes and decisions, having collaboration as a critical concept. The main objective is to challenge and enhance human creativity and the creativity in computers. I do not think computers will replace human creativity, but they will collaborate even more to enhance our perceptions of, and through creative acts.

Although it still sounds strange to talk about creativity in computers, this text aims to present the theoretical basis of my vision, showing how computers can be types of creative minds. For that, I will use the semiotic and philosophical theories of Charles Sanders Peirce (1839–1914) about the concepts of intelligence and abduction, which is the kind of thinking that is the foundation of creative processes.

The history of the creative use of artificial intelligence brings us significant examples of this symbiotic vision. The British artist Harold Cohen (1928–2016) is a good example, having pioneered the use of Symbolic AI for creative purposes. It is important to note that the differentiation between Symbolic AI—also called Strong AI or GOFAI (Good Old-Fashioned Artificial Intelligence) (Haugeland 1993)—and neural networks is not essential for my argument. In my artistic practice and research, I intersperse the use of both paradigms, as I will demonstrate later in this chapter.

Cohen started exploring Creative AI very early on, reinventing his already well-established career as a painter and aiming to develop an autonomous system that would eventually be equivalent to his creative processes. In the 1950s and 60s, he delved into abstract art, intending to make a painting system that could paint itself. When he encountered his first computer in 1968, the artist could bring this idea to fruition by coding software that somehow emulated human cognition. His aim was that the software could learn what an artist's everyday practice involves, starting from the concrete world of objects to the very abstract levels of computer-generated images.

Cohen started to set up his own Creative AI generator, trying to teach the computer how to make compelling images according to his artistic standards. The artist was not interested in the precision that the computer could offer but in the possibility of designing routines that would enable the machine to make artistic decisions, working together with the human creative process. In its most recent versions, the software—called AARON—began to provide the artist with only basic sets of visual information, such as lines and abstract shapes. Using these basic elements, Cohen would play with the computer, filling the image with additional colours and shapes.[1]

[1] The aim here is not to detail Harold Cohen's vast oeuvre, a topic covered by an extensive bibliography, but rather to point to the fact that the relationship between Cohen and AARON was already

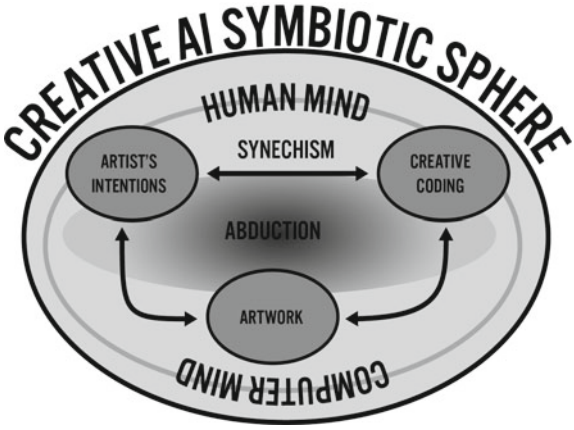


Fig. 1 Creative AI symbiotic sphere

Figure 1 illustrates what I call "Creative AI Symbiotic Sphere", where the artist's intentions (human) are challenged and changed by the creative coding (computer), producing an artwork which challenges and changes both the artist's intentions and the creative coding, in an infinite playful loop, mediated by processes of abduction and synechism. Therefore, if, in practical terms, we observe that Creative AI can play symbiotically with human creativity, what would explain such a possibility? To answer that, it is necessary to understand the concepts of creativity and synechism.

2 Abduction: A Semiotic Approach to Creativity

One aspect that characterizes creativity in Peirce's theory of semiotics is that it can only exist where there is room for chance. For Peirce, creativity has its basis in a type of reasoning that he calls abductive, which is a kind of inference that introduces new elements to already existing arguments. According to Peirce's semiotics, creativity is governed by laws of logical order, in which abductive reasoning reigns.

Creativity can be conceived as a syntactic logic that creates unique recombinations using existing elements, giving rise to new semantics in a process that expands our previously structured set of beliefs. For Peirce (CP 1.383), there is an inner compulsion leading the mind to unite disparate ideas to achieve greater intelligibility of reality through the connections of ideas made by the mind. The creative abductive process is set in motion by perceiving anomalies, surprises and questions regarding what is already known, triggering new mental hypotheses that may solve the questions posed by the newly observed phenomena.

symbiotic. For a more thorough introduction to Cohen's career and work, see Poltronieri and Hänska (2019).

Peirce says that when something we believe in—which he calls "belief"—is embraced as accurate, this something turns into a habit, a source of reliability determined by its predictive nature. The mind is a dynamic system whose main activity is the production of habits. Beliefs are firmly consolidated habits: "For belief, while it lasts, is a strong habit, and as such, forces the man to believe until some surprise breaks up the habit" (CP 5.524). When a behavioural habit starts to show insecurities, showing alterations in its known pattern, an opening for creative opportunities arises. The feeling of surprise generated by the perception of an anomaly is the first step of the abductive reasoning, stimulating the mind to initiate an investigation process until such anomalies disappear, making way for new beliefs.

A dynamic movement towards the adjustment and expansion of pre-existing concepts is necessary to acquire and establish a new set of beliefs. This movement articulates the three logical inferences described by Peirce:

1. the already familiar abduction,
2. deduction and
3. induction.

Although I am focussing solely on abduction in this chapter, it is important to mention that these three modes of reasoning enable the mind to think in a structurally logical and formal manner. Abduction generates hypotheses which must be justified and tested during the development of the two other modalities of reasoning.

For Peirce, the composition of reasoning's cognitive structure is not static but instead formed by layers of processes that gradually gather, establishing a network that relates the inferences of abductive reasoning to empirical conditions. The act of experimenting creatively, that is, abductively, forms the logical basis of any rational process since whenever one acts rationally, one acts according to a conviction guaranteed by an experimental phenomenon (CP 7.337). The creation of new convictions and knowledge starts with abductive reasoning, which triggers experimental processes that test new conditions that may or may not become a reality. Among the three types of logical inference, the abductive one is the most original, as it is the only one capable of generating new hypotheses. As it represents something new, abductive inference cannot guarantee its validity as a general behaviour law. Peirce states that abduction's characteristics are distinct from the other two types of inference in that it is not based on prior knowledge but rather on an experimental process.

Abduction is, therefore, the form that rational thought takes when, for example, the study of new forms of musical composition that have not been previously approached. Abduction involves studying facts and devising a theory or practice to explain them. Peirce presents abductive reasoning as the sole logical operation capable of introducing new ideas, explaining that the mind's creative capacity springs neither from nothing nor an innate ability but rather from its cognitive structure (CP 5.171). It is important to emphasize that creativity, this mental faculty based on abductive reasoning, is linked to the creation, change and expansion of a set of beliefs that form habits. The creative process is triggered when a form of a creative mind is confronted with a problem, causing surprises and uncertainties that initiate the abductive process, which will generate hypotheses to solve the problems in question creatively.

If creativity is something logical, therefore mental, how do we explain the existence of creative computer systems or Creative AI? To address this, we would have to justify that computers are also forms of mind. This is where synechism comes in.

3 Synechism: The Correlation Between the Human Mind and the Computational Mind

In logical terms, if I claim that there is a symbiotic connection, or creatively collaborative essence, between the human mind and AI systems, this means claiming that there is a continuous connection between the human mind and the mind that exists in computational apparatuses. It is necessary to clarify this topic and make it clear why I also attribute a mental form to computers.

To accomplish this task, I will use the branch of Peircean metaphysics called synechism, which deals with continuity, with the connection between mind and matter. The philosophical conception in the foundation of synechism is generous for not separating mind–spirit–body, thereby breaking with the dualist Cartesian philosophical tradition, which seeks to affirm the supremacy of human intelligence over the natural intelligence observed in the cosmos.

In the Peircean conception, the human mind differs from other mental forms because it is the most plastic reality of the known universe, presenting the highest level of malleability. When I use the terms "human mind" and "computational mind", I presuppose that these two mental forms with different levels of malleability (man and computer) can establish effective communication. For Peirce, there is no separation or division, but differences of degree, between nature and culture, between the organic and the inorganic, the physical and the psychic, the natural and the artificial.

The difficulty in understanding and accepting this conception comes from the fact that the semiotic field of signs, from computers to living systems, has often been analysed in terms of dualisms: "tools versus instruments", "instruments versus machines" and above all "machines versus living beings". Rather than confirming such dualisms, Peirce describes this field as a continuum of signs, from the simplest to the most complex semiotic systems. Among the least complex systems are those mediated by instruments or technical devices such as a thermometer, a sundial, a thermostat or an automatic traffic signalling system. The most complex semiotic systems take place in living beings.

Synechism is a crucial concept for understanding Peircean metaphysics, based on the pragmatic idea of continuity and evolution. Therefore, it should be understood as a continuity between mind and matter, the latter also being a form of mind, but more exhausted, especially if placed next to, for comparison purposes, the human mind. This connatural, correlational aspect enables a creative communicational flow between the various mental types we observe in the universe. There is a kind of mind in the work of art, which allows the contemplation of art to be a dialogue, a two-way

street and not just a discourse to be observed. Such an approach explains why the observer contributes to the construction of the work.

The universe and everything that makes it up is a mental form because it has its physical laws derived from psychic models. The great law of the universe can therefore be considered as the law of the mind. For Peirce, all reality is governed by the law of mind, that is, the law to acquire habits, from the purely physical world to the human mind, with the difference that the human mind does not submit to the law in the same rigid way that matter does. Therefore, matter is a mind so closed in habits, so regular that it stops exhibiting the same spontaneous behaviour which is so abundant in the human mind.

Peirce notes that all that we can know, in any way, is purely mental since intelligence can only act upon what is intelligible. Synechism opens the door to an unfettered understanding of the universe since the connaturality between representation and real objects eliminates the nominalist[2] barrier between subject and object, between consciousness and world. This free boundary is already present in Peirce's phenomenology since all phenomena pass undifferentiated through interiority (the phenomena as they really are) and exteriority (appearance). Thus, to understand and use the doctrine of synechism, one must admit that the material universe is provided with habits of conduct in the form of natural laws. In other words, it is a form of mind.

This is, in fact, the central argument of the doctrine that Peirce calls objective idealism. Such doctrine postulates that matter is also a form of mind, but exhausted, transformed into crystallized habits. However, even among minds with a more significant number of crystallized habits, we can observe differences concerning the degree of crystallization presented. In the territory of material artefacts that expand the universe of languages, computers are the most unrestrained mental forms, enabling the fertile emergence of new syntaxes and semantics.

Access to these minds takes place in its most sophisticated degree through metalanguages, such as programming languages, which allow the complete dissolution of one mental form into another, representing a superhighway for the circulation of signs.

4 Exploring the Creative AI Symbiotic Sphere: A Case Study

I have been doing research and artworks with artificial intelligence for over 20 years, almost the same time I had the first contact with Peirce's ideas. The Creative AI

[2] Briefly, nominalism is a philosophical doctrine that holds that things called by the same name have nothing in common except that. This doctrine is usually associated with the thesis that all that exists are particular individuals, and therefore, there are no universals. What all chairs have in common is that they are called "chairs". In opposition to nominalism, Peirce adopts a strong realist position, where nature is self-denominating, independent of human will or languages.

Symbiotic Sphere (see Fig. 1) is a methodology I created and have been improving over these decades. It is not a guide or a model to be strictly followed but a theoretical platform for experimentation, for exploring my restlessness as a researcher and artist, activities that are interconnected for me. I do not see my activity as a researcher as disconnected from my artistic practice. On the contrary, one informs the other.

My first contact with computers happened very early when I was eight years old, and my father returned at home with a mysterious box containing a Brazilian clone of the classic ZX SPECTRUM. Since then, programming has been an activity I do almost every day. During my childhood and adolescence, computers and programming languages were my playgrounds, spaces where I explored creative possibilities and expanded the universe of my languages. I never perceived computers as a substitute for my intelligence or creativity. On the contrary, they were always devices that challenged me, making me a more creative person. I can say that the conception of a symbiotic, mutually beneficial existence with computers and their languages has always been present in my life.

When I started to have contact with Peirce's philosophy more systematically and discovered the concepts of abduction and synechism, it was as if what I had been doing all my life intuitively gained new colours, enhanced by the discovery of a theoretical set that responded perfectly to my practical activity. I had always believed that programming a computer meant, ultimately, accessing a kind of mind plastic enough to allow itself to be reconfigured, reprogrammed. At the same time, I felt contact with the computer-triggered parts of my brain that remained dormant while performing other activities. Later, I discovered that the same thing happened to other people when using computers in a creative context. In a conversation in his studio in Encinitas, California, Harold Cohen told me that when he started using computers, he felt as if parts of his brain that had previously been switched off were being activated.

Computers are ideal apparatuses for the execution of a series of rules. What seems, at first glance, as something limiting is in fact a creative enhancer because nothing says that these rules cannot be subverted or used for the generation of new languages. Furthermore, this is the basis of my symbiotic collaboration model with artificial intelligence:

- I start by delimiting a problem, usually some philosophical uneasiness that I wish to explore aesthetically, in the process of abduction.
- Quickly I start to think algorithmically about what would be the minimal rules for the solution of such a problem; already accessing the computational mind through programming codes.
- This step triggers elements of synechism since the real-time output I get from the computer informs my creative process.
- Next, I am rapidly refining through prototypes the aesthetic language obtained through the communicational game between my mind and the computer's mind, reprogramming it until I reach the result I deem satisfactory.[3]

[3] For a more in-depth description of my working methods see Poltronieri (2021).



Fig. 2 Amigóide

Many times, I delegate this aesthetic judgement to the programming code, letting the computational mind decide if the obtained result is satisfactory or not.

4.1 Amigóide

An example of this process is my automaton *Amigóide*[4] (Fig. 2). It is an apparatus which performs a range of functions in order to search for humans to engage in a friendship. It is an award-winning project initially commissioned in 2010 by the Itaú Rumos Prize, one of the most important art prizes in Latin America.

Two versions (1.0 and 2.0) have been developed, using different AI approaches. The first one (2010–2011) uses GOFAI, whereas version 2.0 (2019) was built utilizing a mix of GOFAI and deep learning, taking advantage of modern machine learning frameworks, which allowed the use of computer vision and image recognition techniques in real time. This case study describes the process behind the automation's design and developments, including the benefits encountered in the transition from GOFAI to a mixed AI approach.

[4] The made-up word *Amigóide* is derived from the Portuguese word "Amigo", which means "friend".

The automaton interacts with people through movements, LEDs, a pre-recorded synthetized voice and demonstrations of digital feelings, which in this case are very simple, with *Amigóide* reacting through its lights when the infrared sensor readings (version 1.0) or computer vision analysis of the camera video stream (version 2.0) indicate whether a human interactor gets close to it or not after a round of interaction.

Once the automaton finds a human, it starts to follow this potential friend, intending to start an endless, flawless friendship. It gets closer to the eminent friend and poses the question: "Fabian, do you want to be my friend?". Fabian is an imaginary friend, a super one, programmed into the automaton's mind. After the initial contact, *Amigóide* tries to conquer the friend through a series of phrases such as "Fabian, what do you search in a friendship?"

Amigóide can be described as a rational agent, i.e. an agent "that acts so as to achieve the best outcome or, when there is uncertainty, the best expected outcome" (Russel and Norvig 2016: 4). Hence, *Amigóide* is a rational agent whose best expected outcome is to establish contact with humans and conquer their friendship. The concept of rational agent (Russel and Norvig 2016) is pivotal to this project because it leaves room for uncertainty, opening a space for abduction to act.

Although deemed successful in the public-facing installation, *Amigóide's* first version had some limitations related to the technological choices employed in its construction. We need to bear in mind that this initial version was designed from scratch in 2010, before the actual wave of machine and deep learning algorithms was widely disseminated and available. These technological constrains had a negative impact on the way version 1.0 behaved and the level of interaction with humans. It was a reflex agent, acting on the basis of its current percept, which informed the series of condition-action rules that handle its behaviour. The major limitations of this approach, however, started to show when I tried to improve many of *Amigóide's* basic capabilities—such as its environmental sensing—and to implement new features, like the ability to perform in any environment, and not only in a special room.

These problems were hard to be defined by a list of formal hard-coded rules. It can be said that the process of synechism was there, as always, but not so efficient due to the fact that the technologies used were not as malleable. We need to remember that the human mind is the most flexible one, and it is part of the symbiotic process to be challenged by the limitations found in less plastic kinds of mind. A proof of this is the fact that these questions proved to be not only technical but rather philosophical ones, intimately related to the approach used to design the automaton.

My attempt to use high-level symbolic, human-readable representations of problems was not flexible enough to provide the level of versatility I needed, at least not at a reasonable cost–benefit level: GOFAI was holding me back, and it took me a long time to realize that. For this reason, and because the history of GOFAI proves that it has been providing a useful experimental framework for the creative use of computers, it is important to have an in-depth discussion about this topic.

According to Haugeland (1993: 112), "GOFAI, as a branch of cognitive science, rests on a particular theory of intelligence and thought – essentially Hobbes' idea that ratiocination is computation". For Hobbes, the reasoning was like numerical computation, in the sense that we add and subtract silently in our heads. GOFAI systems

attempt to implement theoretical basis that emulates human behaviour through the construction of software and hardware, such as *Amigóide* 1.0. Historically, it aims to provide cognitive results at least comparable, and preferably superior, to the expected behaviour of intelligent human beings in similar circumstances, and in all the human cognitive domains, including the abilities to write, read, draw, talk and interact. Thus, a major flaw in GOFAI's philosophical architecture is the very idea of overcoming human intelligence rather than promoting the symbiotic idea of working together to achieve a common goal. According to Floridi (1999), GOFAI tries to achieve its goal by seeking to find a balance between two distinct approaches:

1. A Cartesian one, based on a rationalist dualism, where the presence of intelligence is completely detached and independent of the presence of a body, constituting a complete disembodied cognitive system. It would, at least in principle, be implementable by other disembodied and stand-alone kinds of cognitive systems. However, these notions of intelligence are also completely mind-dependent—mind here meaning the human mind—making it impossible for a machine or even an animal to achieve sophisticated intelligence in this manner.
2. A materialist monistic attitude, which considers that intelligence is solely a complex property of a physical body. In this vision, mental processes play a secondary role, being caused by physical brain processes. This view draws support from the philosophical theories of epiphenomenalism and mechanistic materialism. According to this view, mental events are caused by physical events in the brain but have no effects at all upon any physical events, i.e. mental states or events are by-products of states or events in the brain, necessarily caused by them but exercising no causality themselves. Thus, a thought, belief, desire, intention, or sensation is produced by a specific brain state or event but in no way affecting the brain or the body to which the brain is connected. Hence, this approach would, theoretically, be implementable by other kinds of embodied cognitive systems, including computers and robots.

Facing such paradoxes, where the initial propositions in both philosophical views are favourable, but the outcomes are not achievable, GOFAI implements a form of computational materialism, described in the first half of the materialist monistic approach (item 2 above). Therefore, GOFAI should be possible to be achieved by any brainless, mindless and lifeless general-purpose, symbolic system, deprived of psychological or embodied experience, which is not the case, as Amigóide demonstrates.

In order to implement consistent computational materialism, a GOFAI-based system has to adopt an extreme reductionist and abstract version of computational materialism, assuming the following presupposition:

$$\text{Intelligence} \rightarrow \text{Ratiocination} \rightarrow \text{Symbolic Processing} \rightarrow \text{Computation}$$

Although GOFAI has suffered recurrent criticisms, I am not claiming that it should be abandoned or saying it is no longer relevant. I use GOFAI techniques in combination with neural networks in my experiments and artworks. This mixed approach is supported by several AI front-runners, as highlighted by Ford (2018), and fits very well in my Creative AI Symbiotic Sphere.

4.2 Amigóide 2.0

After years with the 1.0 project shelved, and having worked with deep learning in different artistic contexts in the last few years, I decided to give *Amigóide* another shot, rewriting all the code base with my Creative AI Symbiotic Sphere in mind, meaning to do not fight with technology, but to use it "in the flow", as a continuous extension of my own mind.

Amigóide 2.0 takes advantage of deep learning, which brings a different mindset, a distinct philosophical approach that is beneficial for the field of Creative AI, notably when mixed with GOFAI techniques. In contrast to GOFAI, machine learning—of which deep learning is a subfield—seeks to allow computers to "learn" from experience and come to some understanding about the world in terms of a hierarchy of concepts, where each concept is defined in terms of its relation to other simple concepts (Goodfellow et al. 2016).

The term "learning" can be misleading, as, at the actual stage of development, machines do not really learn. Machine learnt algorithms typically apply mathematical formulas to a collection of inputs—the training data in supervised learning, the most used type of machine learning nowadays—in order to produce the desired outputs. A machine learning model is the result of "brute force" curve-fitting. When the training is successful, the model can map new inputs to the patterns found in the training data. That is the reason why it is expected that these mathematical formulas also generate the correct outputs, or predictions, for most other inputs distinct from the training data, respecting the condition that those inputs are from the same or a very similar statistical distribution as the ones found in training data. It is not proper leaning, in the human sense, because even a slight distortion or change in the inputs is likely to produce completely wrong outputs, what can be interesting for creative and artistic purposes.

The first learning algorithms were intended to be computational models of biological learning, trying to mimic the way learning possibly happens in the brain. According to Goodfellow et al. (2016), deep learning is motivated by two main ideas:

1. That the brain provides a proof by example that intelligent behaviour is possible. From this perspective, a possible path to building real intelligence in apparatuses would be to reverse engineer the computational principles behind the brain, duplicating its functionality.

2. Deep learning models can help us to understand the brain and the principles that underlie human intelligence. These models can shed light on fundamental scientific questions about how the brain works, besides their ability to solve engineering questions and help in artistic and creative ones.

Deep learn as a philosophical concept is much more aligned to synechism than GOFAI. Despite its limitations, by gathering and analysing knowledge from experience, machine learning algorithms do not require human operators to formally specify all the knowledge that the computer needs, as opposed to the GOFAI descriptive paradigm.

As an aesthetic decision, the plastic black cylinder was kept as the main body, making both versions look practically the same. In terms of its inner-logic, the new outputs originated from the deep learning algorithms fed into a simplified GOFAI structure which is similar to the one deployed in version 1.0. The perceived results of implementing this approach in *Amigóide* 2.0 were palpable. Although the core behaviour of *Amigóide* 2.0 was not significantly different from *Amigóide* 1.0, the perceived relationships with it did shift. This, I believe, is because of its continuity of thought through the machine learning models, and the symbiotic connections it engendered in me. More experimentation is to be done here, but as a solution for the issues revealed in *Amigóide* 1.0, the machine learning approach is the correct way forward.

5 Conclusion

While the human mind remains the most plastic mind we find in the universe, the conception that there is a "mind in matter" found in synechism opens new frontiers for exploring creative collaborations between humans and artificial intelligence. Synechism, the doctrine and metaphysical theory that all that exists is continuous, is the view that the universe exists as a continuous whole of all of its parts, with no part being entirely separate, determined or determinate, and continues to increase in complexity and connectedness through semiosis and the operation of an irreducible and ubiquitous power of relational generality to mediate and unify substrates (A Walk to Meryton 2022).

Together with the Peircean theory of abduction, the theoretical basis for the explanation of creative phenomena, we have a robust theoretical and practical arsenal with which to break the Cartesian barrier that prevents the modern world from seeing the multiple possibilities of collaboration existing in a symbiotic universe, where the simple idea that something always replaces another—e.g. artificial intelligence replacing human creativity—gives way to a more complex conception of the universe, where everything is continuously related.

References

A Walk to Meryton (2022). https://aeigenfeldt.wordpress.com/a-walk-to-meryton/
2001: A Space Odyssey (1968) Directed by Stanley Kubrick [Film]. MGM, USA
Floridi L (1999) Philosophy and computing: an introduction. Routledge
Ford M (2018) Architects of intelligence. The truth about AI from the people building it. Packt Publishing
Goodfellow I, Bengio Y, Courville A (2016) Deep learning. MIT Press, Cambridge, MA
Haugeland J (1993) Artificial intelligence: the very idea. MIT Press, Cambridge, MA
Metropolis (1927) Directed by Fritz Lang [Film]. UFA, Germany
Poltronieri F, Hänska M (2019) Technical images and visual art in the era of artificial intelligence: from GOFAI to GANs in ARTECH 2019: Proceedings of the 9th international conference on digital and interactive arts. Article No.: 38, pp 1–8
Poltronieri F (2021) Dreaming of utopian cities: art, technology, creative AI, and new knowledge in the Routledge international handbook of practice-based research In: Vear C (ed) Routledge, London
Russel S, Norvig P (2016) Artificial intelligence: a modern approach. Pearson, Essex
Shanahan M (2015) The technological singularity. MIT Press, Cambridge, MA