



# THE ARTIST IN THE MACHINE— THE WORLD OF A.I.-POWERED CREATIVITY

Over 2,000 years ago Plato, in *Meno*, pondered the origins of new knowledge, that is, how new concepts can emerge from those already established in the brain. How can a system produce results that go far beyond the material it has to work with? This is the problem of creativity.

My studies of highly creative people have led me to define creativity as a two-step process: the production of new ideas and objects from what already exists, accomplished by problem-solving. This definition applies equally to the brain as an information processing system and to the computer. It takes into account both the final product and the process of producing it.

But what drives the creative process? What are the dynamics of creativity? Among the characteristics of creativity which have emerged from my studies of highly creative people are: perseverance, inspiration, a high degree of competitiveness, unpredictability, being 'out there' in the world and having worldly experiences, problem discovery and finding connections between apparently disparate concepts. Can machines have these characteristics of human creativity and thus be creative like us? The answer is yes, I contend. Machines running algorithms such as AlphaGo, DeepDream, Generative Adversarial Networks and Creative Adversarial Networks have already shown glimmers of creativity. But they will only be truly creative when they have evolved emotions and consciousness.

## A.I.-CREATED ART

Today computers are creating an extraordinary new world of images, sounds and stories such as we have never experienced before. Gerfried Stocker, the outspoken director of Ars Electronica in Linz, says provocatively, "Rather than asking whether machines can be creative and produce art, the question should be, 'Can we appreciate art we know has been made by a machine?'"<sup>1</sup>

Alexander Mordvintsev's DeepDream algorithm sees things we don't and conjures up images merged in extraordinary and, to the human eye, sometimes nightmarish ways. Ian Goodfellow's Generative Adversarial Networks (GANs) provide a way for computers to assess their creations without human intervention. As he puts it, they give A.I. a form of imagination. Computer scientist Ahmed Elgammal's Creative Adversarial Network (CAN) creates art styles that are not only definitively new but appealing to human eyes. Pix2pix—creating fully developed images from an outline—and CycleGANs, merging two photographs, have created images never seen or even imaginable before.

Throughout history, when an artist breaks boundaries, creating art that cannot be classified within established styles, it sparks a brand new school, as Picasso did with Cubism. Computer art too does not fit within any of the traditional styles. It pushes the frontiers of art forward. “Computers are changing the way human artists paint,” says Alberto Barqué-Duran, an artist and performer who uses artificial neural networks in his work.<sup>2</sup>

#### A.I.-CREATED MUSIC

In music, Google's Project Magenta created the first melody composed by a computer which had not been programmed in any way to do so. Artificial neural networks, such as Magenta's NSynth, explore new sonic vistas, producing sounds never heard before. Presently there is a huge difference between music created by an artificial neural network, which teaches itself with minimal programming, and music created by computers which have been programmed to do so along with huge data bases of music (rule-based or symbolic machines). At the moment the rule-based approach produces melodic music of complex structure and is more efficient at helping musicians play and compose music.

#### A.I.-CREATED LITERATURE

Computer-generated literature is even more of a frontier. The question of whether and how machines can have and express emotion throws the problems into stark relief. Most difficult of all is the complex human facility of humour. Even at the most basic level, like Knock Knock jokes, machines don't know they are joking. They don't have awareness, though this does not detract from the fact that they sometimes do the charming and unexpected which—to human eyes—hints at a personality, such as when the A.I. which wrote the script for the film *Sunspring* (created by Ross Goodwin and Oscar Sharpe) suddenly said, “Call me Benjamin.”

At the moment rule-based machines tend to generate more sophisticated plots and stories than those created by more autonomous artificial neural networks. But this gap is being closed by the artificial neural network GPT-3, the most powerful language model produced to date.

While most programmed—i.e., rule-based—systems have constraints to prevent them from producing text that doesn't work in the way we expect language to

work, artificial neural networks generate poetry and prose which frequently pass over into that realm, such as the script for *Sunspring* and the image-inspired poetry of Goodwin's word camera.

Poets like Nick Montford and Allison Parrish use algorithms to tread the fine line between sense and nonsense in their explorations of semantic space, the space of meaning. Parrish looks into the question of what nonsense actually is: is a word nonsensical simply because we've never heard of it? Thus with the help of computers they are able to expand our horizons, our sense of what is and is not acceptable and interesting.

How we interpret such gnomic prose can provide hints on how we will respond to computer-generated prose of the future, prose written by a machine, which is after all an alien life form. In future we can expect computers to produce literature different from anything we could conceive of. Our instinct will be to try to make sense of it. But when a new form of writing appears, generated by sophisticated machines, we may not be able to.

For the moment the great stumbling block is that computers cannot appreciate the art and music they themselves produce and are unaware of the quality of the moves they make in chess and Go. Basically they lack awareness.

### INTO THE FUTURE

In art, literature and music, we would like machines to produce extraordinary new artefacts beyond anything we can imagine. This will only be possible if they develop creativity. Computers already show creativity when they play games, in particular Alpha Zero which plays Go, chess and shogi and is being used for medical research as well. There are also glimmers of creativity in A.I.-created art, literature and music. Project Magenta is trying to accomplish this with end-to-end training, with the computer teaching itself and being programmed as little as possible. The alternative—a great deal of programming and a huge database in a symbolic machine—is, so its proponents claim, closer to the way the human brain works, accumulating information and building up ways to handle it from experience.

Computers already exhibit some of the characteristics of human creativity. In the future they will possess all of them, which will require them to have emotions and consciousness. The neuroscientist and psychologist Michael Graziano suggests a way to generate consciousness in a computer, in parallel to the way we use attention to develop awareness by processing information. Along with consciousness will come emotions such as happiness and suffering, which computers will one day perhaps become able to experience and use as inspiration. Machines already exhibit the very human trait of competitiveness.

In time there will be computers capable of entertaining each other and us. Some people might even come to prefer computer generated art, literature, music.

1 Gerfried Stocker, author interview, September 7th, 2017.

2 Quoted from his presentation, *My Artificial Muse*, at the A.I. Meetup, London, July 2nd, 2018.

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