Southwestern University

Picbreeder : The Evolution of Art Inside of a Computer

Lauren Gillespie
Southwestern University

Introduction

Evolutionary computation is a powerful tool for optimization and problem-solving and also has the power to create novel and diverse works of art. Picbreeder is a program that combines the power of evolutionary computation with human ingenuity to create unique and diverse images[1].

Much like the diverse traits that have come from generations of selective breeding seen in domesticated animals, users are able to harness and direct the powerful process of evolution with images, using Picbreeder. By combining a human's ability to discern and appreciate unique patterns and images along with computational evolution's ability to evolve new and novel images, an initial population of plain, simple images can be evolved into striking art quickly and easily.

Picbreeder demonstrates how evolution can create novel, beautiful forms without having any specific starting goal in mind; computational evolution creates new art and the human user acts as the filter, thus influencing but not dictating what is created in each new generation. The beauty of Picbreeder is that it allows anyone to create art, whether it be random or inspirational.

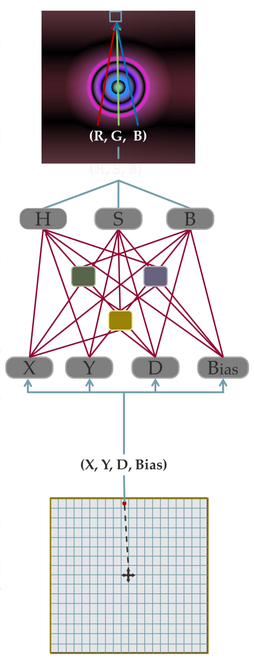
Networks Composing Patterns

This research uses Compositional Pattern-Producing Networks (CPPNs), a form of neural network that can take advantage of the geometry of the input space and encode spatial intelligence[2].

The CPPN takes x and y coordinates from a grid space, the distance from the center of the grid space and a constant input of 1.0, a bias, as inputs. These values then propagate through the CPPN to produce three output values: hue, saturation and brightness. The corresponding color is then painted at the given location on the grid space. This process repeats over and over to create the image.

CPPNs can create such diverse patterns because they have multiple activation functions across the nodes of the network. These functions represent a variety of symmetric and repeating patterns, leading to the wide variety of images that can be produced.

Images are encoded by CPPNs with infinite resolution, which means that the network can paint a picture as small or as large as the user desires. Because the coordinates of the grid space are scaled down to a preset range, as few or as many rows/columns across this range as they desire because the space can be broken down an infinite number of times.



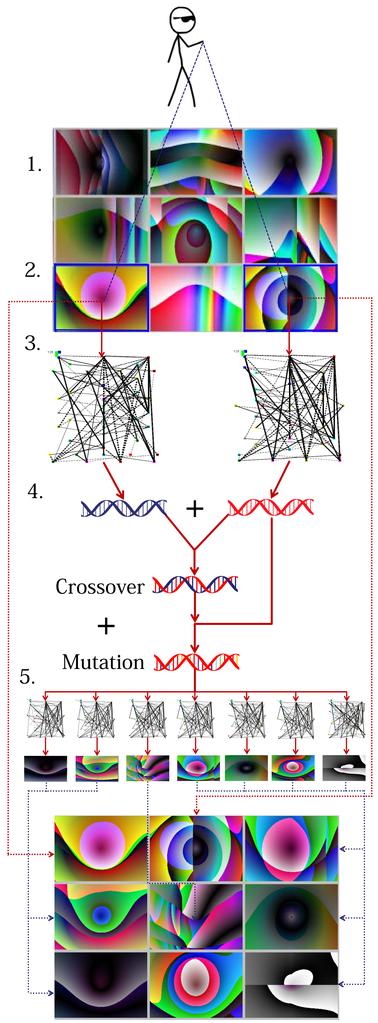
Evolving Art

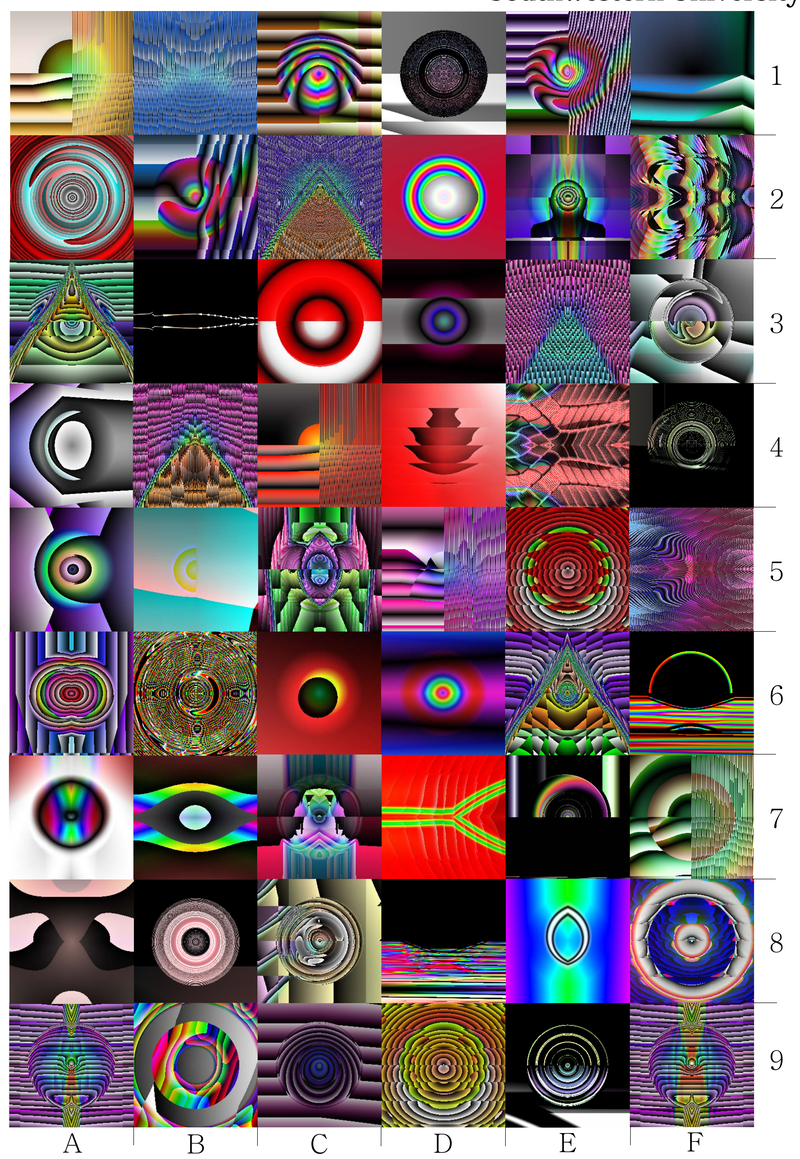
Picbreeder blends art and science into one. Unlike traditional art, the computer is in charge of the creative process. The human instead acts as a filter for the art created by the computer and helps the computer to discover unique and creative images.

Picbreeder evolves images via selective breeding, and it is through this process that the computer is able to realize creative forms[1].

1. First, the computer creates an initial random population of genotypes
2. These genotypes encode CPPNs which paint the initial set of images.
3. The user then picks his or her favorite images from the set.
4. Creation of the next generation of images occurs via repeated crossover and/or mutation of the chosen parent genotypes. Both sexual and asexual reproduction are mimicked.
5. The newly created genotypes encode a new population of CPPNs which are then used to paint the next generation of images

This process repeats over and over, as many times as the user wishes. Part of the beauty of Picbreeder is that there is no preset stopping point. One could continue to evolve images indefinitely and get unique results every time.





References

[1] Secretan, J., N. Beato, D.B. D'Ambrosio, A. Rodriguez, A. Campbell, and K.O. Stanley. Picbreeder: Evolving Pictures Collaboratively Online. *Proceedings of the Computer Human Interaction Conference*, Association of Computational Machinery, New York, 2008.
[2] Stanley, K.O. Compositional Pattern Producing Networks: A Novel Abstraction of Development. *Genetic Programming and Evolvable Machines Special Issue on Developmental Systems*, New York, 2008.

hhmi Howard Hughes Medical Institute