

INTERACTIVE EVOLUTION

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The most fascinating and complex entities in our world are still those that have occurred naturally. Life itself, the human mind, language, and many other phenomena have all emerged from natural biological processes without the presence of a purposeful designer.

Many of these same natural processes can be performed in simulation on computers. As more and more powerful computers continue to be built, we can expect many intriguing and complex artificial results to emerge from these simulations. Whether the emerging virtual entities will qualify for the category of "life" or not, is subject to debate, but in either case these simulated life-like processes give us new methods for the creation of complexity. In some ways, like life itself, the complexity arising from these simulations can surpass what we are capable of designing with traditional tools or even understanding.

Much of my work involves the simulation of a specific natural process: evolution. Evolution consists of a simple cycle. The most "fit" entities in a population survive and reproduce. The resulting offspring are copies or combinations of their parents but often with random alterations or mutations. Some offspring may be improvements on their parents, and as only the most fit of each new generation of offspring continue to reproduce, the population as a whole can slowly improve.

In simulation, fitness can be provided interactively by a human observer at each step of the cycle — those that are selected as being most aesthetically interesting, survive and reproduce. Images, virtual worlds, or even animations can be interactively evolved in this way with the user imposing survival criteria in a god-like manner. This is a method for creating and exploring complexity that does not require human understanding of the specific processes involved.

Fragments of computer code are the chromosomes that describe the growth process of these virtual entities. The computer code, like DNA, is the genotype, and the virtual result, like an organism, is the phenotype.

A "genetic language" is defined which is composed of a set of primitive mathematical functions that can be assembled into complete genetic growth instructions. Mutations alter these coded instructions and can sometimes cause new functions and parameters to be included, potentially increasing the resulting level of complexity.

A nearly infinite number of genetic codes and corresponding results are possible, and these evolutionary simulations can essentially "invent" new types of equations and methods for generating images or other virtual entities.

This is an unusual collaboration between humans and machine: the humans supply decisions of visual aesthetics, and the computer supplies the mathematical ability for generating, mating, and mutating complex virtual entities. The user is not required to understand the technical equations involved. The computer can only experiment at random with no sense of aesthetics — but this combination of human and machine abilities permits the creation of results that neither of the two could produce alone.

