

tion in individuals of the population. Snapshots of these block assemblages reveal little information, but as soon as they are animated, one can see an obvious lifelike sense of purpose in their motions. This is the outcome of a long line of generations in which the population had adapted to the Darwinian pressures set up by Sims in his simulations.

These kinds of computer animated characters are not designed in the strict sense. They are evolved. Which is not to say there is no Art in their creations. The programmer has unlimited choice in how to represent the scheme for which genes are expressed as body and motion. The programmer also has unlimited choice in how to set up the environment, which kind of physics within which to imbue the creatures, and what the evolutionary pressures will be for survival. In terms of expressivity and narrative potential, this technique is a far cry from classical character animation, in which the artist has very much control of the subtle nuances of movement in a character. But it suggests some new techniques for making virtual characters do some remarkable things without telling them exactly how, and letting their personalities and “body language” evolve, through Darwinian encouragement. It is an art of crafting evolutionary dynamics, of setting up the degrees of freedom for motion and parameters for anatomical variation, and of crafting genotypes and their expressions into phenotypes. My efforts in bringing some of the expressivity and humor of classical animation to this new techniques resulted in an interactive artifact which I call “Disney Meets Darwin”¹⁴.

Grown Art

The American school of Action Painting signifies an art of *act, process* and *emergence*. The painter would engage in an energized gestural dialogue with the canvas. Each stroke (or dribble) the painter made spoke back—dictated what the next stroke should be. The continual iteration of the painter’s evolving vision, as it interacted with paint and canvas, brought forth a grown form - an expression of a process, something emergent. This may be said also of painters who use an “automatist” approach, and some abstract surrealist styles, in which, as the artist assumes an altered state of mind, the forms semi-automatically emerge from the canvas. These styles of painting emphasize the organic, and they often bring forth biomorphic forms. Why?

Process

Harold Cohen’s lifelong, continually evolving computer program “Aaron”, was conceived originally as a means for Cohen to encode his drawing methodology, to represent it algorithmically in the form of an artificial intelligence work or art. Aaron tirelessly generates unique, one-of-a-kind artworks, all of which bear the unmistakable signature of Aaron’s master (Cohen himself)¹⁵. Cohen has made a whole years-long art project of representing the *process* of his artmaking. Which is the real art of Harold Cohen, his brainchild Aaron, or the thousands of works that Aaron has generated, and will continue to generate when Cohen is no longer alive?

The use of evolutionary computation techniques, such as genetic algorithms, suggests new approaches to a familiar notion: art is process. Art and design creations evolve in the maker’s mind as well as in the work itself (and they also build upon the evolved visual language which is its cultural context). In the evolution of a creative work, visions, ideas and methods emerge in the maker, prior to, and simultaneous with the act of crafting them. They change, mutate, some die off, many live on, reproduce, and merge with others. The act of creating is partly an evolutionary act—a bit of bottom-up emergence and serendipity with a bit of top-down design and planning. The evolutionary mind is like a microcosm of nature. Richard Dawkins’ term, “memes” denotes the ideological equivalent to biological genes in nature¹⁶. A powerful meme (highly *fit* in the Darwinian sense) can spread like wildfire from mind to mind, reproducing and combining with other powerful memes. Even within one individual, a mind full of memes, and the context within which the individual is situated, can serve as the ecosystem in which a creative work is born. Thus, I believe that specialized genetic algorithms designed to aid in the creative act (“memetic algorithms”) could be designed and would become useful tools as apprentices to some artists and designers.

ARTIFICIAL LIFE MEDIA

The science of artificial life has begun to trickle down from the ivory towers in Santa Fe and elsewhere, and into popular print media, animation studios, computer game factories, and art galleries. And the notion of using computational evolution and autonomous agents in our technologies is becoming more commonplace. Top-down Design and bottom-up Evolution may merge in our technological future. The Made and the Born, as Kevin Kelley suggests, will merge into hybrid forms.

Computer Games That Play You

The experimental interface agents designed by Pattie Maes and other researchers at the Media Lab can evolve to learn about a user’s interests and adapt to his/her style of doing work, like sorting out email messages, for instance. Likewise, the characters and other behavioral objects in a computer game can adapt to a player’s skill level and style of playing, as the game is being played, or over the span of many games.

In computer games, behavioral entities—moving sprites, warships, race cars, pong balls, cartoon characters—which were already designed to live in a microworld—can be made to adapt to their worlds, through some automatic optimization schemes, like quick genetic algorithms or fast-adapting neural nets. They can become successful in their *niche*, able to deal with gravitation or any other particular attributes of the world within the game, and to respond to the actions of humans and other entities in predictable, interesting, or entertaining ways. Here is an arena in which artificial life techniques can, and already have begun, to be used. For instance, Craig Reynolds (inventor of the flocking and schooling “boids”, and other autonomous entities), is currently applying his techniques towards an entertain-