


Finding
companionship
in a
digital
age

In Japan, forlorn teenage girls weep over the deaths of their Tamagotchi toys and send them to official graveyards for burial. In Europe, elf-like virtual pets are bred like racehorses and traded over the Internet. In the U.S., digital Dogz and Catz live on computer desktops. Have we found a new best friend?



We have embarked upon a new era of virtual pet in which our computers have become backyards for our digital pals, and the fertile ground for our own imagination. In some cases, people are relating to pretend pets not unlike the way they would to a fish, lizard, or bird. They are obsessing about their pets' care, becoming hysterical when they die, and generally responding to them like they are more than bits and bytes of coding. The line between how we treat actual and artificial life appears to have blurred. The question is: Why? Have virtual pets dramatically evolved, or does this new trend reflect our own evolution? Do these pets deserve our affection and attention? What does this newfound attachment to virtual pets — and their popularity in general — portend for software developers, and the gaming industry in particular?

Finally, the emergence of these pets raises a question that is trickier to answer than it might first appear: Are some of these pets actually alive? Their creators say it deserves serious consideration, since some of the virtual pets are constructed using Artificial Intelligence. Mind you, this is not the soup-thin AI that game developers have employed for years, but bona fide bottom-up software coding that, if the pets' creators are to be believed, enables the creatures to learn and act autonomously. In other words, creators contend these pets display not only Artificial Intelligence, but artificial life.

Take the furry woodland Norns, for example, which were developed by a British AI

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living things [exhibit] — such as that they excrete, require energy, carry a reproductive code, and so on," Cliff said. "In the case of most software agents — Sonic the Hedgehog or Super Mario, the answer is no to all of the features. In the case of the Norns, the answer is yes to a surprising number."

The Norns aren't the only creatures

on the threshold of a new gaming era. From this day forward, he presumes, players will begin to develop emotional relationships with animated entities, and the entities will be sophisticated enough to deserve our nurturing attention. Ultimately, Bates and others believe this generation of virtual pets will give rise to a whole new level of

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Dogz and Catz from PF Magic were among the first digital pets



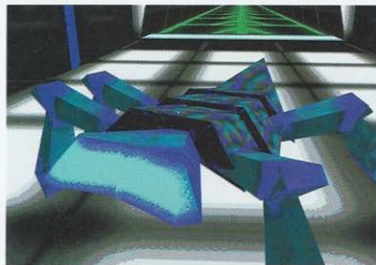
to lay claim to the "artificial life" moniker. Fujitsu Interactive contends that Fin Fin, a half dolphin, half bird that hit the U.S. market this spring, is the most sophisticated use of AI ever in a game. According to its creators, Fin Fin is a semi-autonomous creature programmed to develop an emotionally based relationship with its owner. The object of *Fin Fin* — talk and sing to the virtual pet through a microphone and nurture a friendship with the easily frightened creature.

Meanwhile, Anark Inc. is set to release *Galapagos* with its autonomous protagonist named Mendel. Mendel uses a new proprietary

technology called Non-stationary Entropic Reduction Mapping (NERM) that permits it to learn from mistakes and adapt to the environment, with or without explicit instruction from the player. "There's a new breed of companies coming forward," said Anark President Stephen Collins. "Our characters are not preprogrammed."

Whichever version of AI is the most sophisticated, Joseph Bates, artificial life expert from Carnegie Mellon University believes we are

interactive gaming. Thousands of players will be able to compete online, not just with one another, but with digital creatures that act unpredictably, but plausibly. Imagine, if you will, adventure games in which a town's bartender, gatekeeper, and even evil monsters react, learn, and adapt. "In my view, this is the purpose of games. This is the destiny of games," Bates said. "This is not about the concept of AI that's been bandied about before. This is about building games around characters that have a range of emotions, and give the impression of life."



Anark's *Galapagos* features a mythical creature that learns from its mistakes via a technology called NERM

company called CyberLife Inc. CyberLife constructed the underlying software coding to mimic biology, including copying basic chemical and genetic processes. The creatures eat, sleep, reproduce, get sick, have a survival instinct, and even evolve — leading some researchers to credit CyberLife with a damn healthy imitation of real life. "It's an extraordinarily impressive piece of work," said Douglas Adams, author of *Hitchhiker's Guide to the Galaxy*. "It's phenomenally primitive, but it'd be very, very hard to say — except for the environment they inhabit — that this life is artificial and some other life form is not."

Dr. David Cliff, an AI lecturer at Sussex University and a consultant on the Norn project, said the Norns are a major leap forward from existing gaming software. "Basic biology texts will list like 12 features that

It may not look like it, but Dr. Bruce Blumberg and his students at MIT are conducting a serious experiment with Silas, a cute and cuddly virtual dog

His name is Silas, and his virtual yard is a 16-by-16-foot area at the MIT Media Lab. There, Silas, a dog-like creature, is projected by a computer into a three-dimensional space, where kids can play with his animated image as if he were more ghost than virtual pet. Silas may also present a glimpse into the future of virtual playthings.

Silas was created by Dr. Bruce Blumberg and other students at MIT. He works like this: The creature is generated on a computer, then his image is projected into the virtual playpen. When a person interacts with Silas' image, the person's gestures are picked up by a camera, and fed back into the computer so that Silas can react to them. Blumberg refers to the experience as poor man's Roger Rabbit. "Using vision techniques, the dog can respond to your gestures," Blumberg said, adding that, like other virtual pets, Silas is programmed in a way that he needs to satisfy certain drives. "At every instant, he's trying to figure out what to do. There are little self-interested agents fighting for control — is his motivation to play with you or to pee?"

Blumberg said that Silas, in fact, has a less sophisticated brain than some other virtual pets, such as Dogz by PF Magic. Still, kids who compare the two often find that Silas is more "real" and more "alive," and researchers think they know why. It turns out that Silas has a quality that is thought to be an increasing component of artificial life, namely, he is emotionally accessible and thus, people think he has lifelike qualities. "If they have expressiveness, people will give the benefit of the doubt to creatures and read more into them than there is," Blumberg said.

This effort to create emotional characters rather than purely intelligent characters represents a radical shift in recent years in AI and A-life research. For many years, the goal was to create purely intelligent entities — mathematically based systems — such as chess-playing machines that could play chess far better than even their programmers. In spirit, though, the latest efforts fit nicely with the original definition of Artificial Intelligence, as conceived by British defense department scientist Alan Turing in the middle of the century. The Turing Test for Artificial Intelligence, simply put, states that if you cannot tell the difference between a man and a



The emotionally based Silas has proved especially effective with kids

machine, then the machine deserves the same respect you would afford the man.

This emphasis on emotional intelligence began in the mid-1980s, when another MIT scholar, Rod Brooks, wrote a paper called "Elephants Don't Play Chess." His point was that animals, while they lack pure intellect, do a great job in making sense of the world. Brooks ultimately was the founder of a school of thought called Behavior-based AI, which said that biology, not math, should be the inspiration. That thinking has permeated Stanford University, Carnegie Mellon University, and the Media Lab, the three centers of AI the government helped fund in the 1950s. All three continue to thrive today, and each is, directly or indirectly, contributing to the field of entertainment and game software.

One of the basic questions that researchers are still trying to answer is: What is the definition of Artificial Intelligence? "There's not a good answer," said Dr. Joseph Bates, professor of computer science and fine arts at Carnegie Mellon. "It's what constitutes intelligence, what constitutes human-ness, and what constitutes life, and none of those have easy answers. All of this stuff is in the eye of the beholder."

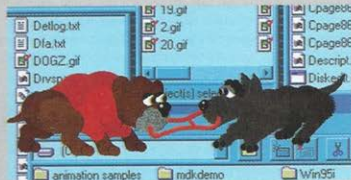
To illustrate his point, Bates tells a story about a day he walked into a lab at the University of Chicago. He looked up and, to his momentary alarm, saw that he was being watched — and followed around the room — by a television camera



eye attached to a robotic arm. "All I can say is that it made me very uncomfortable," Bates said. "It raises the key question, which is, 'What makes a person think that a machine is alive?'"

At Carnegie Mellon, Bates and his team are working on research designed to create digital entities that are perceived as alive, whether or not they exhibit classic intelligence. For example, they are trying to figure out how to create a videogame creature that will care about itself. Said Bates: "You have to believe that if you rip the head off a creature, it cares. You have to have characters with a rich range of emotions."

Barbara Hayes-Roth, director of the virtual theater project at Stanford University, said virtual pets, notably Fin Fin, don't exhibit particularly intelligent behavior. "If you want a pet," she said, "get a dog." At the same time, Hayes-Roth thinks of the creatures as more than a game. And she sees substantial potential for the computer medium to create far more sophisticated creatures that increasingly will approximate life forms. Even more so than what books or movies or television have been able to do. "What's really wonderful and distinctive about computer-controlled media — and what is more like life — is that they can be deeply interactive," she said. "It offers an opportunity for a person's behavior to have a noticeable impact on the other side. When we master this, the entertainment market is going to be huge."



In terms of AI, Silas is still less sophisticated than Dogz

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Korea and Japan have banned the toys not just because of the incessant beeping, but because children are becoming overly excited or grief-stricken about the fate of their pets. There is at least one reported case of a teenage girl committing suicide over the death of her

didn't really start the virtual pet craze, particularly for computer-based pets. That honor belongs to PF Magic, which for three years has been marketing *Dogz* and *Catz*. Brook Boynton, contributor to the original *Dogz* project and marketing manager for the San

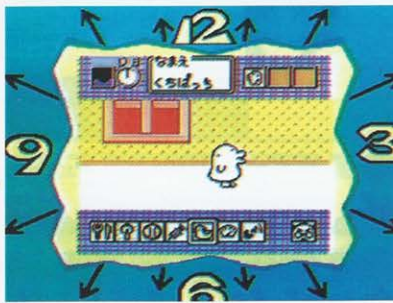
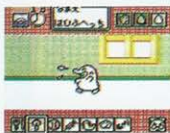
Schools in Korea and Japan have **banned the toys not just because of the incessant beeping, but because children are becoming overly excited or grief-stricken about the fate of their pets**

My friend the little chicken

Regina Wiedel, a legal secretary from San Francisco, was at the Farmer's Market recently when she got an urgent page. The page was from Wiedel's sister, who was concerned about the health of her son's Tamagotchi, and didn't know whether it needed affection, food, or discipline. "I know this is really silly," she said, "and I know you'll think I'm stupid, but I don't know what to do. I don't want to kill it."

Created by Bandai, the Tamagotchi is the most popular virtual pet of all time. Your job, as a Tamagotchi owner, is to care for the pet by pressing tiny buttons to feed, discipline, and clean it, as well as give it affection and check its health status. Keeping your pet happy is no small task — it beeps frequently to demand attention or food, or to let you know it is under the weather. Initially, Bandai designed the pets to appeal to teenage girls, and to give them a taste of what it is like to care for children. Their popularity has spread far beyond that demographic, though. Bandai put the Tamagotchis on sale in November of 1996, and by June of 1997 had sold 1.3 million in Japan, creating such a demand that it gave rise to a black market.

Affection for the Tamagotchis developed far beyond the company's expectations. Schools in



Bandai's remarkably successful Tamagotchi has inspired countless imitations and variations

Tamagotchi. The fascination with these pets is particularly heightened in Japan and elsewhere in Asia. That may be because the region has less physical room for live pets, so children put their affection and nurturing skills into artificial life. It may also be because Japan is very densely populated and, as a result, fads spread very quickly.

Tamagotchis have gotten under our skin in the U.S. as well, though, as Wiedel's story illustrates. Wiedel initially got her Tamagotchi from a friend. The reason? The friend was going on a trip to Hawaii and asked Wiedel to babysit. "They were planning to go scuba diving, and they didn't know what they would do with it while they were underwater," Wiedel said. At the same time, Wiedel doesn't take the creature that seriously. She said she played with it for a while at work, then gave it to her nephew. "We had a Tamagotchi, now we've got a cat," Wiedel said of her and her husband, who accidentally overfed the Tamagotchi and caused it to die in its sleep. "We're working our way up to having a kid."

Despite their popularity, Tamagotchis

Francisco company, said, "Everybody has been talking about virtual pets and it's like, hello, we've been here since 1995." Not only has the company been around for two years, it has sold one million copies, far exceeding sales of other computer-based virtual pets.

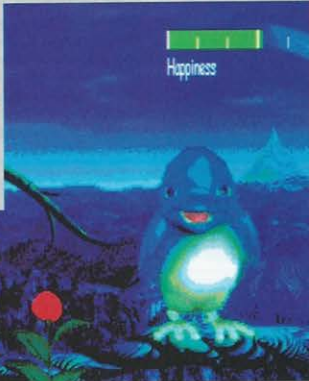
The company is set to release the second generation of *Dogz* and *Catz*, which are far more sophisticated than the hand-held Tamagotchi. Like the *Norns*, *Dogz* and *Catz* are PC-based and feature a neural network, which dictates very basic drives, such as fetch, beg, or catch. The pets eat, sleep, play with toys, demand attention, howl at the moon at night, get fat when they are overfed, and sad when they are under-loved. To be sure, *Dogz* and *Catz* can elicit some strong responses. Ryan Ramirez, a 25-year-old music and sound engineer with Front Line Productions in Campbell, California, said he initially played with his dog *Darth* for about an hour a day. When he brought it home, his girlfriend took a real liking to it. "She won't let me squirt it with water," Ramirez said. "The dog squeals when you squirt it, and [my girlfriend] gets really angry."



The Tamagotchi phenomenon has created a new class of virtual parents in kids and adults

As the dust begins to clear from the initial virtual pet craze, companies like Fujitsu are beginning to experiment with different aspects of the technology such as voice control

Here Fin Fin.
Here Fin Fin.
Come out to play. Fin Fin, come here and I'll give you a treat.
Fin Fin, if you don't come here, I'll make you into a handbag.
Fin Fin, get your scrawny butt out here before I turn you into dolphin pâté.



Fujitsu's Fin Fin is a cross between a dolphin and a bird and responds to the specific tone of the user's voice

Then, suddenly, Fin Fin appears on the horizon and flies to a nearby tree branch. The creature, half dolphin, half bird, perches and looks out warily through the monitor. My virtual pet has arrived. In theory, Fin Fin has emerged because I have enticed it with my friendly advances and dulcet tones. That is the ostensible secret to a friendship with Fin Fin: Say nice things in a pleasant way into the microphone, and Fin Fin will respond by becoming your friend and performing tricks for your amusement.

In reality, it doesn't matter what you say to Fin Fin, just how it is said. If you said, in dulcet tones, "Come out here, Fin Fin, so I can skin and make you into soup," Fin Fin would fly forward happily and possibly begin singing. "It's keying off of the pitch and volume of the voice. It's an animal that responds to you sort of cooing and calling, rather than yelling," said Mike Pontecorvo, director of technology for Fujitsu Interactive, creators of *Fin Fin: On Teo, the Magic Planet*. "If you yelled, it wouldn't know what you are saying, but it would respond differently."

While Fin Fin may not understand the words you use when calling him, he nevertheless can serve as a barometer of your emotional state. And thus Fin Fin has come to serve as something of a virtual mood ring, particularly in Japan. Executives there have been known to use Fin Fin as a source of relaxation — when they have succeeded in calling out the creature, they know their tone of voice has calmed down, and they, in turn, are more relaxed. At the same time, Fin Fin has been known to go nuts, and go into hiding, when the creature is loaded onto a computer in a loud, tense office surrounding. *Fin Fin* went on sale in Japan in June 1996, and as of June 1997, 30,000 copies sold for \$150 U.S. *Fin Fin* went on sale this spring in the U.S. for a different price and different target market — \$59 targeted to kids and young teenagers.

Fin Fin exists on the Planet Teo, which, like Earth, has 24-hour days, 365-day years, days and nights and weather changes. In addition to Fin Fin, the world has birds, insects, mammals, amphibians, fish, and Fin Fin's natural enemy — a creature called a Vale, a cross between a woolly mammoth and a sloth.

The object of the game is quite simple: The more time you spend with Fin Fin, and the friendlier you are to him, the more the creature will emerge in one of three settings — the Happy Amile Forest, the Enchanting Tsabu Woods, or the Water Hole of the Secret Inlet. When Fin Fin feels comfortable, he will perform tricks, including swimming, diving, and playing with the Lemo Fruit.

If you yell or speak harshly to Fin Fin, he will not emerge as often, although he eventually will develop a tolerance to strident talk and respond to it less fearfully. No matter how you talk to Fin Fin, though, you cannot absolutely control whether he will respond. In this respect, "Fin Fin is more like a wild animal than a pet," Pontecorvo said. A bio-scan meter clues you in to how Fin Fin is feeling, whether he is hungry, scared, or happy. Other features of the game allow you to call Fin Fin with a special whistle, feed him Lemo fruits, and take snapshots of him with a camera. Fujitsu Interactive said it spent \$350 million and more than five years developing Fin Fin. It advertises the game as the "most advanced form of artificial life available in entertainment technology today." That remains a matter of debate among artificial life experts.

What the experts will grant Fin Fin, though, is that the product has made a marked foray into a relatively new area of Artificial Intelligence known as emulation. Emulation is an effort to reproduce not pure intellect, but cognition and emotion. The concept is to convey a feeling, which increasingly is considered a major component of intelligence, and certainly of life. A simple way to think of emulation is to think about the impact that Disney animations have on

writers — the animations are not alive, but they are able to display and evoke emotion, according to AI researchers. "You look at what people care about in animals or animations or many of their friends ... Can they see emotion, can they see purpose, can they see goals," said Joseph Bates, director of Project Oz at Carnegie Mellon University. "It's not something scientists know, it's something that animators and artists know. If you want characters that are personality rich, that are interactive living characters, listen to the writers, artists, and animators. They should be the boss," added Bates, who is the unusual combination of professor of fine arts and computer science.

Pontecorvo envisions that emulation efforts will eventually be used together with more traditional mathematical AI to create products that better define the entire definition of intelligence. For instance, Pontecorvo said, you might soon be able to ask your search engine how it is faring on an Internet search. The engine could respond with a smile, a shrug, or a look of confusion if perhaps it has reached its limit. "We want to add a more emotive, human dimension to things," he said.

Comparing *Fin Fin* to *Creatures*, Joe Morici, vice president of sales and marketing for Fujitsu Interactive, said, "Theirs is more evolutionary, ours is more emotion based. The more time you spend with him, the more you become a very close personal friend of Fin Fin and he becomes a close personal friend of yours," he said. "We're trying to create this lovable creature in your computer. Eventually, this creature or a creature will be able to do what your keyboard and mouse do for you."

Emotional Intelligence?

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kids weaned on television, who have become invested in nonexistent creatures on TV. "It's sad when people's lives are so sterile that they search for real human companionship in digital entities," Stoll said, adding that virtual pets in turn do nothing to teach children real responsibility because they can be turned off or "rebooted" when they die. "People are lazy. They like what is easy to get a hold of and what gives them enjoyment

starts when a player visits the hatchery, selects an egg, and takes it to the incubator. The Norms, which are a cross between an elf, a dog, and a deer, are hatched exhibiting basic behaviors — they play with toys, walk around, show curiosity, all with varying degrees of enthusiasm, depending on their digital genes.

Beyond that, the player can't force the Norm to do anything, but can attempt to teach it by

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Clifford Stoll, author

I'm OK, my pet's OK

Researchers, philosophers, and game makers suggest a handful of possible reasons that people are responding to virtual pets with emotion. Sherry Turkle, an MIT professor who has extensively studied the feelings children have toward their virtual pets, Tamagotchis in particular, said that kids are redefining their concept of "life" to incorporate digital entities. Turkle said that this has been happening for 20 years, as computers became more ubiquitous, but that it has intensified in the last two years.

Turkle said that since virtual toys appear to display a sense of independence, they elicit nurturing feelings in children — and adults — who want to feel needed and take care of something that cannot entirely fend for itself. "This is buried very deep within our nature," said Turkle, author of *Life on the Screen: Identity in the Age of the Internet*. "Kids are redefining what is lifelike to include the nonbiological," she said, adding that they are not alone in the age of the ubiquitous computer. "It's what our whole culture is struggling with: how to feel attached to a thing."

Another theory used to explain the popularity of virtual pets is that they merely are an extension of our comfort level with television, movies, and videogames. We are accustomed to seeing characters digitally, in two dimensions, and giving ourselves over to them emotionally. As a result, it isn't a big leap to treat virtual creatures with the affection one might ordinarily reserve for a living thing.

At least one prominent author is very troubled by this concept, though, and about what it may say of our culture. Clifford Stoll, author of *Silicon Snake Oil*, believes the popularity of virtual pets demonstrates a continued sterilization of our culture, which he said puts too much emphasis on technology and not enough on solving real problems impacting real people.

He said that the popularity of these pets is further evidence that we are raising a generation of

without the least responsibility." Despite his concern, Stoll said he believes the virtual pet fad will pass, just as the pet rock did 20 years earlier. "It's like the Rubik's cube and the lava lamp. In a year or two, people will look at them and say, 'I'm not getting anything out of this,'" Stoll said.

Stoll is not alone in his views, but he appears to be in the minority. A more widely held belief is that we are embracing virtual pets in the way we have always embraced inanimate objects. For example, we talk to our cars, our stuffed animals, and our favorite blankets when we are kids. We own dolls and lucky charms, even pet rocks.

"Children have dolls and stuffed animals and imbue them with feelings and relationships," said Barbara Hayes-Roth, director of the virtual theater project at Stanford University. "There is a universal willingness to suspend disbelief and go with appearances. It's pleasurable — for kids and for adults." Furthermore, Hayes-Roth said computers and computer-based life may provide a vastly more satisfying medium for relating to virtual creatures. There is one key reason for this: Computers are interactive. A virtual pet is like a stuffed animal, but it's also animated, acts somewhat autonomously, even talks back. Some digital pets are clearly more interactive than even a live pet fish, or lizard. Our interaction with these pea-brained creatures amounts to no more than watching them, dropping food into their tank, and cleaning out the excrement, but we can grow quite attached.

Finally, there is another theory as to why virtual pets have so dramatically captured our imagination. It is perhaps the strangest possible reason of all — that these pets actually are alive. In this regard, possibly the best argument can be made for the Norm.

Creature Features

The CD-ROM *Creatures*, published by Mindscape, contains an animated woody world called AlbiaNornia, and six Norm eggs — three containing males and three containing females. The game



To begin the experience of *Creatures* the user must first choose an egg to hatch

reinforcing healthy behaviors and discouraging destructive ones. Reinforcement comes in the form of a tickle or a compliment, whereas admonition is conveyed with a light spanking or a verbal rebuke. The Norms can also be taught simple language, how to recognize objects in the world, and simple concepts like "push", "pull", or "come." Norms can learn to utter basic phrases like "push ball" or "eat lemon."

The scientists at CyberLife, the company that created the Norms, insist the creatures are not a gimmick and truly are capable of a form of learning. They said this is possible because the Norm coding



represents a radical departure from most gaming software. CyberLife said its coding is meant to mimic biology, and calls it Digital DNA. "We haven't used mirrors or strings," said Toby Simpson, general manager of CyberLife. "This is biologically accurate."

To understand the Norm coding, it is useful to

mutation, or new breeds of Norms.

The random crossover feature has spawned some rather unexpected mutations. There have been different colored Norms, Norms that performed more efficiently, and some that didn't turn out so well. One couple from Australia frantically emailed CyberLife earlier this year to report that they had



Where we are most certainly headed, though, is to a world of richer videogames with more believable characters, and these virtual pets are laying the groundwork for it

first understand how most gaming software is created. Very simply put, most software is built using elaborate versions of "IF/THEN" statements. "IF" this happens, "THEN" you react with this action. In contrast, the developers at CyberLife said they have not preprogrammed the Norms' behavior, but their drives. For instance, the Norms are programmed to take care of certain basic needs, such as hunger, sex, loneliness, and being cold. "What the creature's brain is trying to do is to remember what actions it took to reduce those drive levels," Simpson said. "It is able to see for itself which actions worked and which didn't."

Simpson said the software dictates how 256 chemicals will react with one another inside a Norm, but it does not tell the Norm how to respond to the sum of those chemical reactions. The behavior is a natural product of the structure. The Norms also are able to breed, which takes place in the form of an extended kiss. What happens during that kiss — on a programming level — is very much analogous to what happens during breeding in actual life. When the creatures breed, they combine their coding, or genes. Half of the baby Norm's coding comes from the father, half from the mother. "When they breed, we effectively line up the two digital DNA strands and take half from the mother and half from the father," Simpson said. However, the company has built in a random crossover feature, so the strands occasionally miss, which sets the stage for

bred a Norm that did not move upon birth. The couple emailed the Norm to CyberLife, which discovered, by putting the creature in a gene editor, that the genes from its mother and father Norms had rendered it deaf and blind.

The flip side is that the mutation can lead to advances in the creatures. For instance, one creature that is being traded on the Internet features the Highlander Gene, which represents an improvement in the Norm's chemical neural dynamics. "It has resulted in the creatures being better able to organize and store key events," Simpson said. "This breeding has helped us clean up the rough edges."

Not everyone is convinced. Richard Dawkins, a professor at Oxford University and one of the world's leading experts on evolution, told National Public Radio that while he believes Norms interact with human beings in an interesting way, they are more a cunning illusion than living beings. "I think there is something open-ended in the sense that these Creatures do reproduce; they have genetics," Dawkins told NPR. "That means they have potential. They have an evolution."

Of course, there is an element of unnatural selection at work, too. Namely, human beings are able to select which creatures they want to breed, and which bloodlines they want to prosper. They even can begin to tinker with the life forms by changing the programming. A group of German

university students, for example, figured out where the gene boundaries were and started gene splicing. They spliced the genes of the Norm with that of its predatory, the Grundle. Suddenly, a creature called the Grunorm has been popping up all over the Internet.

Frankenstein and the future

In the book *Do Androids Dream of Electric Sheep*, Philip Dick wrote about a world in which it became so expensive to own pets that people began owning virtual pets. So lifelike were these creatures that the human beings wondered: Are they conscious? Are they alive? Are we headed in this direction too? Probably not in the near future.

Where we are most certainly headed, though, is to a world of richer videogames with more believable characters, and these virtual pets are laying the groundwork for it. In the multiplayer adventure games of the future, for instance, it may become difficult to tell the difference between a computer-generated character and an avatar that represents an actual player. The technology may also ascribe basic intelligence to our own avatars so that we, as players, only have to worry about higher functions.

The technology should find itself in the real world too. Already, some of the same researchers working on AI for gaming are looking at more practical applications. Among their quests,

researchers are looking to create Internet agents that not only search, but have a personality. Finally, for better or worse, we may also become willing to accept the digital creatures as exhibiting lifelike characteristics, whether or not those feelings are deserved. "People love characters," said Hayes-Roth from Stanford. "[AI] is a way to bring characters to life far beyond what's been found before."



The Norms' world is chaotic and sometimes a dangerous one. The user must become familiar with potential pitfalls