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Three ways to get A-life



If Victor Frankenstein were a modern scientist, he'd get rid of those smelly chemicals, rotting body parts, and dangerous electrodes. He'd create life on his computer workstation. And, if he were smart, he wouldn't unleash his creation on unsuspecting villagers. No, he'd sell it as a computer game.

But he'd have to wait in line. Programmers have already incorporated A-life into several computer-entertainment programs. We'll look at three that have recently been introduced in the US: *Creatures*, *Aquazone*, and *Fin Fin on the Magic Planet Teo*.

Odd, I feel no urge to laugh maniacally

Creatures' ad claims that with it you can "create and breed your own artificial life." That's only part of it. You install the creatures' world, *Albia*, from the CD-ROM. The simulation comes with a floppy disk containing six eggs. After placing an egg in an incubator (your presence in *Albia* is a hand) and incubating it, a small, large-eyed, furry norn appears (see Figure 1). (Norns look a bit like the gremlins in the movie *Gremlins*, before they turned evil.) Your job is to raise it. One of the first things you must do is teach it to eat. Fortunately, norns are initially attracted to your hand, and they know what to do once you bring some food to them or point it out.

Parental guidance suggested. Next, you need to teach your Norn language skills. You speak to your norns by typing. You teach them the names of objects by typing the names of what they're looking at (a special window shows you what's capturing their attention). To simplify things, it pays to name objects by category—for example, "food," "toy," and "plant." To help you teach them verbs and other concepts (such as "sleep," "get," "yes," and "what"), the program contains a teaching computer, which shows them pictographs of ideas and activities and the words for them. You need to repeat each term three to five times, until they get the hang of pronouncing and understanding it. Norns like

to play with the computer, so it's not too hard to teach them; however, sometimes my norns seemed to forget words over time.

To give your norn positive reinforcement, you tickle it by clicking on its upper half. To give negative reinforcement, you spank it by clicking on its bottom half. Determining which part you're clicking on is not always easy. I've accidentally rewarded them for bad behavior or punished them for good behavior many times. But once they've learned language, you can substitute "yes" and "no" for tickling and spanking.

After you've taught a norn how to eat and speak, you need to follow it though *Albia*. *Albia* is a colorful, detailed world containing many objects to occupy the norns' attention. These objects include plenty of food, toys such as tops and balls,

musical instruments, a slide projector, animals, plants, and a cannon. Norns can walk to many places, but to get around their entire world, they have to use vehicles such as elevators, a submarine, a steamboat, and a teleporter. You can manipulate any object that a norn can, so you can entice a norn into a vehicle and activate it to get your norn where you want it.

You can monitor their health through the Health Kit, which displays a norn's heart rate and body temperature, general brain activity, and the state of the norn's drives (pain, hunger, sleepiness, exhaustion, and boredom). If you want to know even more about your norn, the Science Kit lets you check your norns' antibody and hormone levels and genetics. *Cyberlife* also plans to market a Genetic Kit (for Windows 95) so that you can manipulate the norns' "digital DNA."

Trouble in *Albia*. Unfortunately, *Albia* is not paradise. Some of the foods, such as honey, give pleasure but have little nutritional value. Some plants are edible, but others are poisonous. As a good nornkeeper, you need to ensure that your norns get

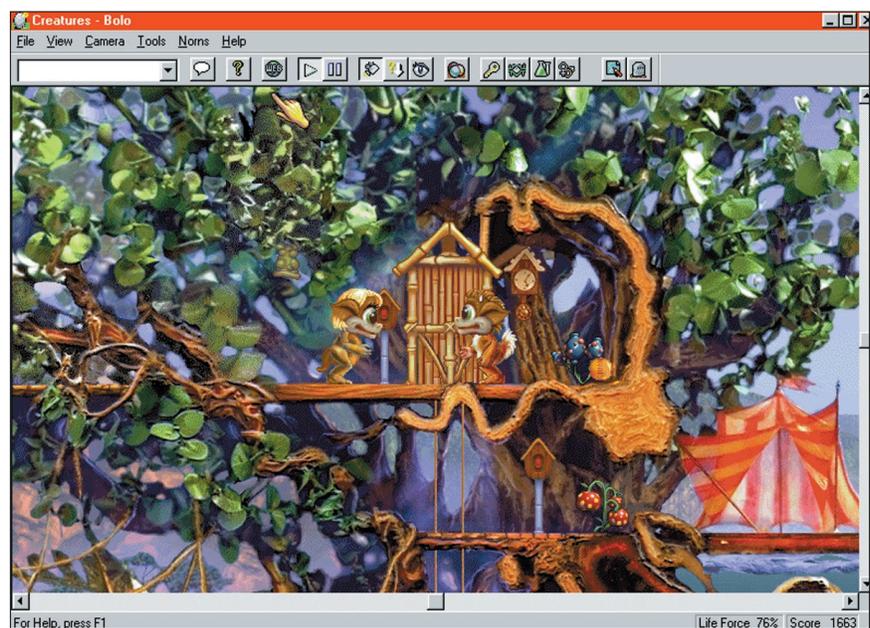


Figure 1. *Albia* and *Bolo*—two norns.

enough nutritious food. Norns can also catch and spread diseases, and can inherit genetic deficiencies. If they get ill, you must quarantine them and administer medicine (some of Albia's plants are medicinal). Also, the programmers, bless their hearts, included a distillery that produces an alcoholic drink. You have to be careful so that your norns don't become alcoholics.

If poor nutrition and illness were the only problems in Albia, life there would be pretty good. Evil enters into Albia through the presence of grendels—ugly green-skinned, red-eyed creatures whose idea of a good time is to pick on norns. Grendels also transmit diseases and bad behavior. My first norn, Ablia, had an early encounter with a grendel, and learned to hit. This made her relationships with the other norns problematic. Fortunately, it didn't stop her from breeding with Aluph, my second norn.

Grendels seem to share some of the A-life aspects of norns. They acquire some language and they interact with norns and with the user (you can spank them to get them to leave, but I often accidentally tickled them instead). Unlike norns, they don't breed (the program generates them automatically). I spent many frustrating moments trying to get my norns away from the grendels. You can kill a grendel by getting it to eat death's cap mushrooms, but another grendel will appear in a short while.

The nuts and bolts of norns. A norn possesses over 200 genes, each representing a specific trait, such as the norn's appearance, how it moves, and how it responds to stimuli. Baby norns inherit their parents' traits, with some mutation thrown in to make things interesting.

Norn intelligence is based on artificial neural networks. A norn's brain comprises approximately a thousand neurons, grouped into clusters. Each cluster performs a specific function: sensing, focusing attention, remembering and associating, or decision-making. Norns learn according to the amount of reward or punishment that results from their actions. They can generalize from previous experiences to decide how to handle new situations.

Norn behavior is based on simulated biochemistry. Different stimuli cause biochemical reactions in a norn, interacting with the norn's drives. Simulated chemicals include glucose, glycogen, carbon dioxide, testosterone, estrogen, adrenaline, and hist-

amines. Drives include pain, a desire for pleasure, hunger, coldness, hotness, exhaustion, sleepiness, loneliness, crowdedness, fear, boredom, anger, and breeding. Levels of chemicals in a norn's bloodstream indicate the state of its drives and needs. (For more information on the basics of Creatures, see "Creatures: an exercise in creation," on pp. 19–24).

They'll grow on you. You can control breeding, to some degree, by monitoring the norns' estrogen and testosterone levels, feeding them aphrodisiacs (tomatoes) or anti-aphrodisiacs (ugly tomatoes), and making sure they're in the right place at the right time. A pregnant norn eventually lays an egg. Eggs will hatch by themselves in



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the wild, but it is quicker if you place the egg in the incubator. Norns do not care for their children—that's your job as a norn-keeper. (They don't even seem to know who their children are, or that they even have children, which makes for interesting breeding situations.)

Norns develop similarly to humans. They start as crawling infants, and quickly develop into children who are eager to learn. When they hit adolescence, they become sexually mature and less interested in doing what you want. Adult norns become interested in mating (which sounds like a prolonged kiss with a pop at the end). Elderly norns lose their energy and might become senile. Eventually, they die. When that happens, you register them with the Graveyard Kit, which gives them a tombstone on which you can place a screen shot of them and write some words. Unfortunately, the graveyard is separate from Albia. Norns live only 10 to 15 hours of real time. Luckily, they go into suspended animation when the program is not running.

Just so my kids don't get jealous. In some ways, Creatures is an amazing simulation. The norns do learn, grow, interact, and breed. They are believable enough to involve you personally. I became caught up with the lives of my norns, and got panicky when they wouldn't obey me or when they came into contact with grendels. I was excited and elated when Ablia became pregnant and when Bolo, my first second-generation norn, hatched, and upset when Aurla died. When I got a new computer and had to reinstall the program, I feared that my norns might be lost (fortunately, I managed to find their data and reload it).

However, the program's simplicity often masks its inner complexity. Although all this heavy neural network learning and digital DNA exists, the creatures can seem awfully simple. Their facial expressions are limited. They seem either sad or happy, and their facial reactions do not always seem to fit the situation. They sometimes exhibit odd behaviors, such as continuing to walk even though they are up against a wall, running in place, or walking backward for no apparent reason. It is hard at times to tell exactly what they are doing; their motions are not accurate enough. I even saw two mate without touching each other! You'd have to watch them very closely to see if one norn behaves differently from another. Also, Albia is a 2D world; norns can only move up, down, left, or right.

Creatures would be ideal for older children and for adults who want to preview the joys and headaches of being a parent, albeit on a much smaller scale. The program can be addictive. Fans have set up a number of independent Web sites where other addicts can view screen shots of norns, and can exchange norns and grendels, which can be exported as files. However, as the father of a ten-year old girl and an eight-year old boy, I'm conducting a much more interesting "genetic experiment." My experiment is so complicated, frustrating, and rewarding that I'm too tired and preoccupied to spend much more time pondering the antics of Norns!

Creatures' suggested retail price is \$39.95. The program runs on Windows 95 or Macintosh. The Windows 95 version requires a 60-MHz Pentium or faster, a double-speed CD-ROM, a 16-bit sound card, a 256-color monitor at 640 × 800 resolution, 8 Mbytes of RAM, and 40 Mbytes of hard-drive space. The Mac version requires

a PowerPC chip, System 7.5 or greater, a double-speed CD-ROM, 16 Mbytes of RAM or 8 Mbytes of RAM plus 8 Mbytes of virtual memory, and 40 Mbytes of hard-drive space.

Everything but the mess, smell, and expense.

Aquazone is a realistic simulation of a tropical fish tank (see Figure 2). First, you have to select what size tank you want. Aquazone sets up a tank with a heater, filter, and light, but nothing else. Then, you add a backdrop, gravel, plants, objects (such as a miniature copy of Rodin's Thinker), and water. As with a real aquarium, you can't add fish just yet. You have to make sure that the water is the correct temperature and chemically suitable for the species of fish you'll be adding. The program comes with a supply of virtual water conditioner and dechlorinator. Or, you can just let the aquarium sit for a couple of days to eliminate the chlorine. If you don't like your aquarium's setup, you can rearrange things. If you're lazy or impatient, Aquazone includes six prepared tanks (my favorite is Ludwig, which includes Venus de Milo and a grand piano). You can't rearrange them, though.

When your tank is ready, you must import the fish files. The first time you do this for a species, you have to use the separate Install program. It would be easier if you could do this from within the main program. Aquazone comes with 20 fish each (and some eggs) for two species: neon tetras and leopard catfish. The fish already have names, but—if you're that kind of person—you can rename them. You might wonder what good it is to name 20 neon tetras who look more or less identical. Well, one of Aquazone's nifty (but unrealistic) features is that you can call up little boxes next to the fish that indicate who they are. However, the animation stops when you do this.

You have to tend an Aquazone aquarium as you would a real one. This means feeding the fish, changing the water (but not too much at a time or too frequently; it stresses the fish), checking their health, cleaning the filter, and turning the light on and off. Fortunately, the program lets you set timers to automatically feed them and switch the light. You also have to watch that your supplies of food and medicine do not run out. You replenish them by downloading them from the CD-ROM. This seems a little too

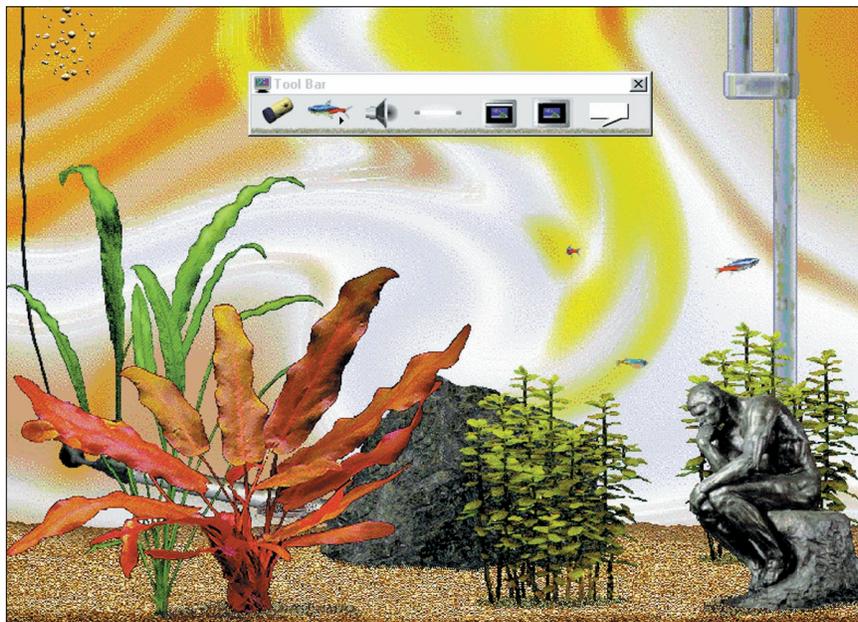


Figure 2. Aquazone.

tediously close to reality. You don't have to take care of the plants, though. It might be more interesting if you did. The plants are almost static objects. They contribute oxygen to the tank, but they do not grow, die, get dirty, or even move with the flow of water.

The program also features a convenient toolbar that lets you quickly feed the fish, get information on them, turn the sound or light on and off, change the window size, hide or show the menu bar, and display the names. Unfortunately, the window-size and menu-bar icons look almost exactly the same. In the Windows 95 version this isn't a problem; you can rest the cursor on the icon to see what it's for. On the Mac version, you can't; Aquazone does not incorporate Balloon Help.

Fishing for help. If you don't know anything about taking care of fish, the main program provides basic information. However, this information does not always suggest what you should do. For example, the information on water settings does not tell you what levels of oxygen, chlorine, and so on are good or bad, and how you fix them. It would be very useful if Aquazone made specific suggestions whenever a problem occurred.

For more detailed information, you can consult the *Aquazone User's Guide* or the AZ Library on the CD-ROM. The guide is a 134-page online manual that fairly thoroughly describes the program. Unfortunately, it does not have a search function, you must use the mouse to navigate, and you can't print the pages. You can go to the table of contents and click on the

page you want to see, though. The text on the PC version was very difficult to read, especially the "tips," which had black text on a gray background. The Mac version was much easier to read, but quite often the text on the right was cut off for no apparent reason.

The AZ Library comprises 11 short virtual books covering tropical fish and aquariums. The best is the AZ Tropical Species Guide, which presents fairly detailed information about 14 species of tropical fish. These books are a good introduction to the hobby, but their format hinders their practicality. As with the user's guide, you must use the mouse to navigate, there's no search function, and you can't print the text. In addition, most of the books have no table of contents and no way to jump from one page to another. You have to click "manually" page by page to navigate.

To access the guide and the library, you must go out of Aquazone. It would be far more convenient if you could access these books from within the program. Also, when you're in one book, you can switch to another by selecting a book from a tiny bookshelf at the bottom of the page and clicking on a tiny version of the book you wish to read. This would be much easier to do if the bookshelf were larger.

Acting up. The fish might look pretty much alike, but they aren't. Like *Creatures*, Aquazone incorporates "digital DNA." Each fish is ranked according to its health, strength, courage, and power. Strength refers to energy level; courage means how



Figure 3. Fin Fin with a lemo fruit and Biosensor readout.

brave a fish is or how well it resists stress; power is a fish's physical strength. A fish's heredity partly determines these characteristics. As in *Creatures*, parents pass some of their traits to their offspring.

The fish behave like their real-life counterparts. They swim, eat, mate and give birth, fight, get sick, grow old, and die. You have to protect eggs so that they don't get eaten. You have to quarantine sick fish and give them medicine. In the beta version that I tested, you can force them to do these things. That seemed like cheating, so I didn't take advantage of it. As with a real aquarium, some time might pass before you see some of these behaviors. Also, because the animated fish naturally appear at a lower resolution than do real fish, changes are hard to notice. Fortunately, the program notifies you when something important happens.

So far, the most interesting thing I've had happen in one of the three tanks I've been running is that Danielle, one of my neon tetras, contracted white spot, a common tropical fish disease. I put her in a quarantine tank (*Aquazone* comes with a preset hospital tank) and administered medicine. Immediately after she got better, she contracted tail rot. I put in different medicine, but she died. Oddly enough, right after the program notified me of her death (with appropriately sad music), it told me that she had been cured! I don't know if that was a bug in the program, or whether she might have died from the shock of the treatment, even though it was successful. In true dead-fish fashion, Danielle turned upside-down

and floated to the top of the tank.

Dead fish must be removed from the tank. You do this by saving them as a file! Just deleting them would be easier, but I suppose *Aquazone's* method is closer to realism. Normally, when you save a fish, the dialog box shows its picture. In Danielle's case, the picture was covered by a black circle with a horizontal line through it, labeled "DEAD." I'm afraid that when I saw this, I laughed so hard I hurt myself. I only hope Danielle can forgive me.

Not quite hooked. I rather liked *Aquazone*. It wasn't too difficult or too demanding (except when Danielle got sick), and I learned quite a bit about keeping tropical fish—enough to determine that I wouldn't want to do it for real. The display is attractive, and makes a pleasant substitute for a screen saver, although it does not function (and wasn't intended to function) as one. You might want to turn off the sound if you'll be close to the monitor, though. The sound of an aquarium is supposed to be soothing, but *Aquazone* plays the same short sound file over and over. I sometimes found this annoying.

Aquazone's suggested retail price is \$29.95. The PC version requires a 66-MHz 486 chip or higher, 8 Mbytes of RAM, a CD-ROM drive, Super VGA graphics (256 colors), and Windows 95 or Windows 3.1. The Mac version requires a 33-MHz 68040 chip or higher, a 256-color capable monitor, 8 Mbytes of RAM, a CD-ROM drive, and System 7.0 or higher. Umbrella software plans to release CD-ROMs with addi-

tional fish species and objects.

Teo for two

Ironically, the most outwardly simple program might be the most interesting. In *Fin Fin on Teo*, the *Magic Planet*, you interact with Fin Fin, a creature that looks like a cross between a bird and a dolphin (see Figure 3). You don't use the keyboard for basic communication. Instead, the program comes with a SmartSensor, a combination microphone and motion sensor that plugs into your PC's game port. According to Fujitsu, this lets Fin Fin hear and see you, although he doesn't understand speech, and his vision appears to be limited to an awareness of your presence or absence. You get his attention by making sounds or by blowing on the special whistle that comes with the program. You can adjust the sensor's sensitivity to compensate for background noise and other factors.

Hap-py feat. Fin Fin is the fruit of autonomous-agent research started at Fujitsu's Human Interface Laboratory in 1989. Some of this research occurred in collaboration with Carnegie Mellon's Oz Project. In 1994, Fujitsu started the Believable Agent Project (which became the Teo project), to incorporate this technology into a commercial entertainment product.

Fin Fin employs an expert-system-like *Hap engine*.¹ According to Michael Pontecorvo, the director of technology at Fujitsu Interactive, the Hap engine chooses from various hierarchical plan trees, depending on the goals to be satisfied, the world state, and the trees' relevance. The engine can concurrently evaluate actions and subgoals, and multiple plans for achieving a single goal.

To animate Fin Fin, the Hap engine executes a three-step loop. First, Fin Fin's model incorporates sensory data about his world. This data combines with information about Fin Fin's state—whether he's hungry, happy, afraid, and so on. Second, Fin Fin thinks. He does this at two levels: immediate, reflexive thought and slower, reflective thought. Finally, he acts. The expert system incorporates behaviors appropriate to different situations.

Getting to know him. The point of the program is that you have to spend a considerable amount of time with Fin Fin to get him to become your friend. Fin Fin is shy; loud noises scare him away. He can also sense

when you've been ignoring him. In that case, it takes even longer to win his confidence. So, ideally, you're supposed to work with him every day, talking softly to him and singing songs. Eventually, he'll feel comfortable around you and will perform aerobic tricks, sing songs (he has a repertoire of over 60 melodies), dance, or do other tricks.

Unlike Creatures or Aquazone, you don't have to worry about taking care of Fin Fin. He can take care of himself (his main diet is Tsubu nuts and an occasional fish), and he won't die. However, you can feed him Lemo fruits as a treat, and a Biosensor lets you measure Fin Fin's happiness, fear, hunger, thirst, fatigue, sleepiness, and temperature, when he's in the sensor's range. Just as with humans, at times Fin Fin might not want to interact, and you shouldn't bother him. Also, he can get ill from eating too many fruits, but he will get better if he's left alone.

Teo, Fin Fin's planet, is a tropical paradise similar to Earth (24-hour days, 365-day years, and seasonal changes). The program lets you visit three areas: "The Happy Amile Forest," "The Enchanting Tsubu Woods," and "The Water Hole of the Secret Inlet." Each offers a different level of interaction. In the Amile Forest, you can interact fully. In the Tsubu Woods, you can visit with Fin Fin, but not feed him. The Water Hole, where Fin Fin's nest is, is for observation only. There are three other areas where you are not allowed to interact or even observe: the nest, the West Bank, and Lemo Forest. I don't know why Fujitsu Interactive included places you can't visit; perhaps they'll be part of a later release.

Fin Fin is not the only creature on Teo; the planet has other animals that appear to be crossbreeds of familiar Earth animals. For example, the Shulu bird looks like a cross between a bird and a snake. Fin Fin can interact with these creatures, although he does not get along with all of them. Fin Fin also has a wife, but she doesn't appear in the program. According to the user's manual, Fujitsu Interactive is considering introducing a baby.

Getting to know all about him. It took some time before I could even run the program. Fin Fin requires Windows 95, a 75-MHz or higher Pentium processor, a two-speed CD-ROM drive, 16 Mbytes or more of RAM, a SoundBlaster-compatible sound card, a monitor and video card that can handle 640 × 480 resolution and 16-bit color

and that are Direct X 3.0 compatible, and a 15-pin game port. My first machine ran at only 60 Mhz, and Fin Fin wouldn't run on it. When I did get a fast-enough machine, configuring the sound card and drivers so that Fin Fin would run took several days. These difficulties might just have been the result of getting a previously owned computer that had been tweaked a bit. But if this situation is common, I wonder whether typical home users will be able to deal with it without becoming extremely frustrated.

Another problem cropped up when I first tried to use the windowed version of Fin Fin. (The program has two versions: full-screen and windowed. If you run the full version, you can't do anything else on your computer.) I got error messages, and then nothing happened. A call to Fujitsu's tech support uncovered the reason. Fin Fin was

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initially programmed in Japan, which does not have daylight savings time. They did not adjust this aspect of the program for the American market. So, to run the windowed version, you must set your machine to a time zone that doesn't have daylight savings time. (Fujitsu Interactive says they will fix this in a future version.) So now my computer thinks it's in Arizona.

Once I did get both versions of the program running, my frustrations were not over. It took about five days before Fin Fin got used to me. At first, he kept his distance. Occasionally he would come up closer, but it seemed that as soon as I started speaking, he would back off, and he did not stay in the area for any length of time. I found out from several people at Fujitsu Interactive that Fin Fin responds better to children and women—that is, people with higher-pitched voices. Being a baritone put me at a disadvantage. So, my colleagues at the Publica-

tions Office got to hear me speaking and singing in a high-pitched voice to my computer. On the fifth day, I got Fin Fin to eat a lemo fruit. Since then, he's become more and more friendly, singing different songs and doing a wider variety of tricks. I hope that Fin Fin doesn't take as long to get acquainted with the average user. Small children might not have the patience to spend the hours I spent.

The screen images look bitmapped (I got conflicting messages from Fujitsu tech support; one person said it was probably my video card; another said that the bitmapped image was normal). Nevertheless, Fin Fin's expressions and motions are smooth and quite realistic—his flying and singing are particularly good—and I found myself often reacting to him as if he were a real animal. Also, his tricks are amusing—for example, bouncing a lemo fruit on his nose, suspending it over his blow hole, and then gulping it down—and his songs are pleasant.

On the eighth day, I brought my daughter and son to see how they would react to Fin Fin and how he would react to them. At this point, Fin Fin was used to me, but I wondered how he'd react to three different voices. He didn't seem to notice that there were three different voices, but he spent more continuous time visiting than he had before. At first, my children were reticent about interacting with him; they're old enough to realize that he's just a computer program, and they felt a little embarrassed. Eventually, they treated him more like a real pet. And although they once or twice appeared bored by his somewhat repetitive behavior—he kept singing the same three songs—overall, they were delighted with him (and wouldn't admit to being bored).

Why can't we be friends? If the game sounds too cute, perhaps it is—for older children and some adults. However, that might be appropriate for its intended target: young children, starting at four years of age (especially girls, according to Yoshi Matsumoto, senior vice president of Fujitsu Interactive). Because Fin Fin is primarily for girls, why not let users choose to make Fin Fin female, if they wish? Also, the registration procedure involves pointing and clicking on letters to input information. It would be much more convenient to also allow keyboard input.

Other than the difficulty of the initial setup, my biggest problem with Fin Fin is the

Related Web sites

Aquazone	http://www.aquazone.com/
Cyberlife	http://www.cyberlife.co.uk/
Fin Fin	http://www.fujitsu-interactive.com/finfin.html
Fujitsu Interactive	http://www.fujitsu-interactive.com/
Official Creatures Web Site	http://www.cyberlife.co.uk/creatures_frameset.htm
Oz Project Home Page	http://128.2.242.152/afs/cs.cmu.edu/project/oz/web/oz.html
Teo World	http://www.teo-world.com/teo_hp_gif_e/main.html

marketing. One of their magazine ads states, "It's a true friendship, and we all know that takes some work." Call me old-fashioned, but I don't think you can have a true friendship with executing code, no matter how

interactive it is. To say that you can cheapens the meaning of the word friendship.

Fin Fin's suggested retail price is \$59.95. Fujitsu Interactive plans to improve the program by letting Fin Fin recognize multi-

ple users' voices and by increasing his interaction with Teo's other inhabitants.

Invasion of the time snatchers

Frankenstein's artificial life unintentionally wreaked havoc and killed. The main dangers of these three programs is that they require patience and considerable time working with them to get their full benefit. All three show an interesting new direction for computer entertainment, and possibly for computing itself. Perhaps soon we'll have software assistants that breed, do our bidding, and eventually die, and that we communicate with and treat almost exactly like people. Will they be so intelligent and behaviorally complex that they also become difficult to deal with (just like real people)?

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