Darwin's demons—better video games through natural selection

October 5 2016, by Jens Hegg

If you've played a video game you know what I'm talking about. Getting past the first levels is all about memorizing the landscape, remembering where the extra lives are hidden, and where enemies pop out to get you. Trial and error, and lots of quarters, eventually will get you through the beginning levels. Some understanding of predictable enemy behaviors will help you find your way through the rest. Every level is essentially a memorization and muscle-memory problem to be solved. But for Dr. Barrie Robison, his collaborator Dr. Terrence Soule, and his team of

students at University of Idaho, this memorization isn't very interesting at all.

Instead, the team behind the [game](#) Darwin's Demons runs on the idea that games can be better if the enemy can evolve to defeat you. "Evolution makes games super hard," says Robison, explaining that at each level of Darwin's Demons the [aliens](#) regroup, survivors reproduce, and you must face their progeny…children whose ability to destroy you is higher based on the survival of traits from their parents! The name itself comes from the scary idea of [the creature that would result](#) if evolution could proceed without constraint…and Robison's team has placed few constraints on the aliens you must fight.

So, while the game is based around the classic arcade game [Space Invaders,](#) the aliens don't simply speed up with each level. Instead, the difficulty of each level is controlled by a genetic algorithm based on Darwinian natural selection and you, the player, are the agent of selection. The aliens are sexually reproducing, diploid, hermaphrodites. They evolve based on a genotype with several traits including dominance, aggression, lifespan and accuracy. Aliens that succeed in moving furthest down the screen have the highest fitness. As the game proceeds you can watch the evolution of traits, and the most successful alien phenotypes, in an interactive graph between levels.
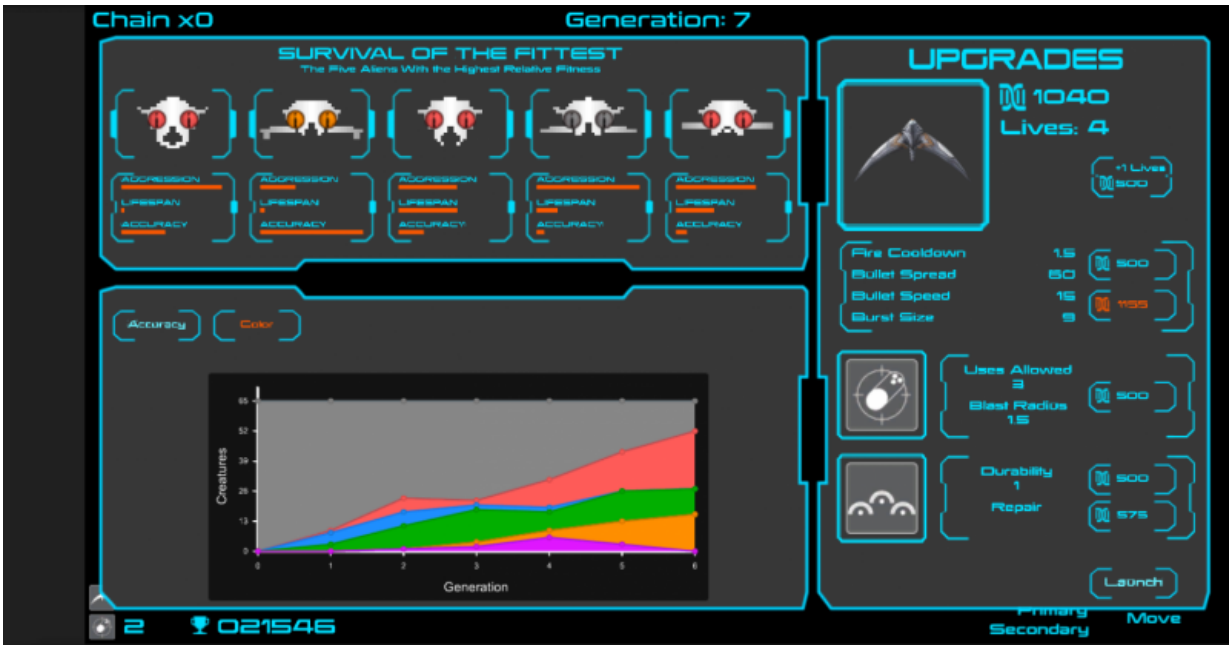
Between each generation (level) in Darwin's Demons you can track the evolution of your enemy and see what the successful phenotypes look like.

Robison is, by trade, an evolutionary biologist but teamed up with Dr. Terrence Soule, a computer scientist, to explore his idea of introducing evolution to gaming. The beginning attempts at evolutionary gameplay began as a co-taught class, listed in both biology and computer science, titled Evolving Games. It was a resounding success and led to a grant that funded a dozen full time summer students, in areas as diverse as art and business, to develop the game this year. It has since been "greenlit" by the online gaming platform Steam and Robison is working with the university's office of technology transfer to begin marketing the game and the idea. The game itself is free and can be downloaded from their website, Polymorphic Games.

"I haven't had this much fun in my job… ever," says Robison. He is excited by ways evolutionary algorithms could shape future gaming,

potentially launching a new paradigm in game design.

Robison sees the potential for evolution-based game design to revolutionize gaming in much the same way modern physics engines have allowed games to simulate ever more realistic scenarios. "Why can't we have games with functional ecologies," asks Robison? In his view evolutionary design concepts could allow your actions as a player in one area of the game to act on other parts of the game through a sort of community ecology, with selection in one "population" affecting the balance of other populations in the "community" of game parameters.

The game play of Darwins Demons shares many similarities with Space Invaders, but the engine behind it is uniquely darwinian. Credit: Polymorphic Games

His example is that of a literal ecology simulation; a world where hunting one animal for energy could result in an increase in dragons…making maintaining the right ecology a key to winning the game. But, it's not hard to take this one step further into abstraction and imagine assigning evolving parameters to characters in a first-person-shooter, causing their actions, position, and tactics to evolve in response to your interactions with other parts of the world of the game.

"These [aliens] evolve based on their perception of the fitness landscape, not how you think the game is designed," says Robison, which makes game play different every time and a huge challenge.

No game is ever the same. Sometimes the enemy evolves quickly, stunning you with a fullisade of aggressive aliens shooting missiles that seek-and-destroy after only the third generation. The next game might select for aliens that hang out further up the screen, dodging your bullets rather than aggressively attacking…and you might survive for a few more levels. In the end Robison is right, you will always lose.

The author's son playing Darwin's Demons and successfully avoiding bed time.
Credit: Jens Hegg

With a bit of experience you can even try to tip the balance of selection by targeting specific aliens early, effectively ensuring that their traits are selected against in the next level. But, perhaps this is overthinking it, it's just fun. My eleven year old son liked the game enough to argue for a later bedtime so he could play, "just one more generation," which he managed to stretch into several generations because I was too hooked on the gameplay to send him to bed. So, the team Robison has assembled is clearly doing something right.

Evolutionary algorithms have been around for quite awhile, so why is it that they haven't made their way into gaming already? The general idea

of evolution has appeared as a central element of games like Spore, and evolution is included as an element in Pokémon, but the "evolution" depicted in these games has little to do with darwinian evolution by natural selection.

According to Robison, "it's hard to do an evolutionary game. So, if you are trying to make money it's not the first thing you go for." This difficulty is fast becoming a thing of the past as computing power makes evolutionary simulation faster and easier to use.

"By every measure Darwin's Demons succeeded," and Robison is excited to see where this idea can go from here. The grant that funded Darwin's Demons is active for another year and Robison is convinced that the future is bright for developing more ways to use evolutionary theory in game design.

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