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App Awe: Dwarf Fortress — Just another computer game?

In an App Awe editorial, Eddie Lee, a research associate at WID's C4 group, probes the science and philosophy in the popular computer game 'Dwarf Fortress.'

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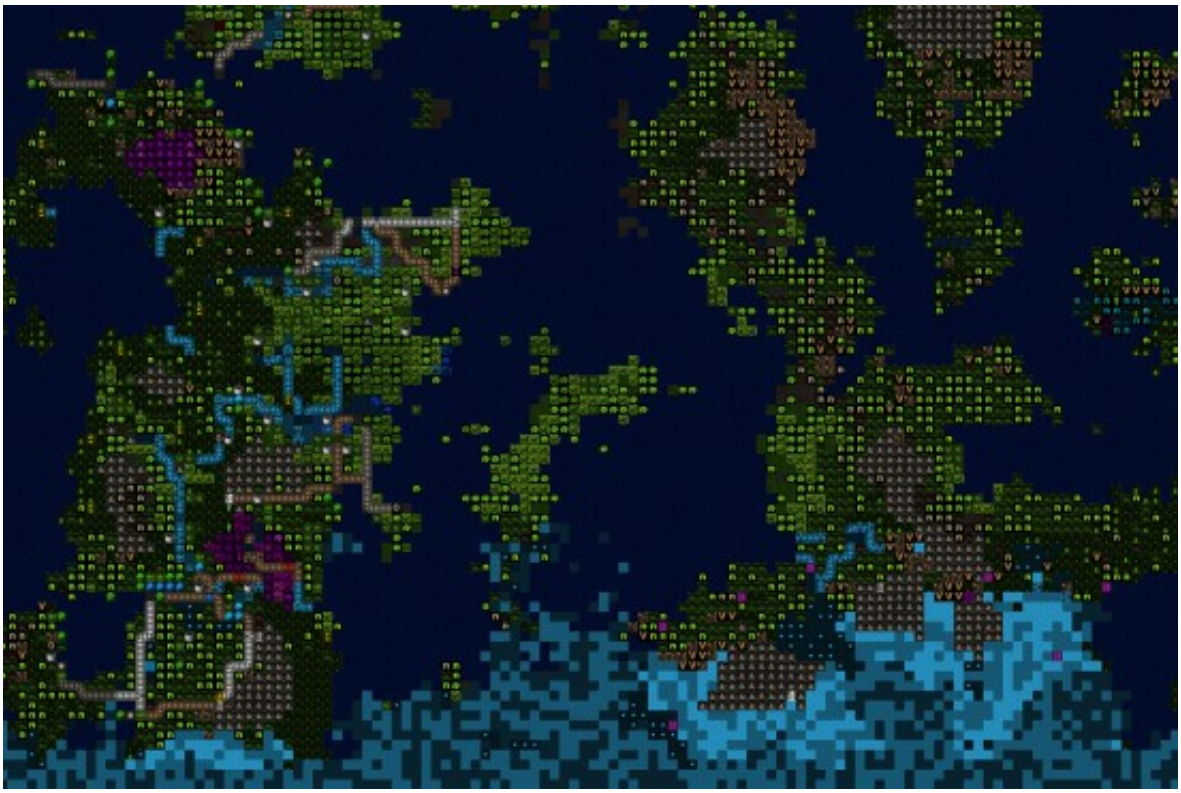

App Awe is a WID essay series exploring the transformative potential that lives at the intersection of gaming, science, education and society.

By Eddie Lee, research associate at the Center for Complexity and Collective Computation (C4)

Computers are not infinitely powerful. Computers are what facilitate impressive feats like endowing us with access to the accumulated knowledge of humanity on any topic in an absurdly short amount of time or beating chess grandmasters. But when it comes down to it, there is a whole realm of problems and considerations that computers probably cannot do (*Computers Ltd.: What They Really Can't Do* by Harel).

This leads to one of the famous examples of computer science: the halting problem. The problem is to decide whether a computer program will eventually halt or run forever, and it can be proved that no universal computer can always solve this problem. This limitation is analogous to Gödel's incompleteness theorems, showing no formal system can be both consistent and complete.

Thus, it is the case that anything that runs on a computer abides by those same restrictions, but computer games might be different because they do not run in isolation. They interact with the world through the player — including at more abstract levels — different aspects of the world that are not necessarily logical or bounded by the confines of the underlying machine.

Is there an aspect here that could turn into something more than just a game? Can a game break the boundaries of a computer? Usually the game serves as a vise, squeezing the player between virtual rules that cannot be broken. But there are games that instead constrain the medium that players mold into action, putting more of the player into the game than the other way around. This framework breaks boundaries between reality and virtual reality, melding them into a living synthesis of the worlds. Could these games implicate more than just a program running through

its routines via interaction with the player?

Eddie Lee

One game in that field is being written by Tarn Adams, the creator of Dwarf Fortress (DF), an insanely complicated, only-for-the-diehard, intimidating program that involves directing a group of dwarves as long as possible until the society inevitably implodes. The predecessor of Minecraft — a commercialized ripoff, according to DF fans — and in the genre of SimCity, DF is quite different from the typical game with set rules and objectives. Although to survive the player must build a functioning society while surmounting internal and external challenges, there is no fixed storyline. The game is open-ended and the point — if I were to name one — is to write one's own narrative while struggling against impossible odds. This feature has led to the game motto: "Losing is fun."

This open-ended philosophy is ingrained at the most intimate level of dwarven behavior: Players have no explicit control over what their dwarves choose to do, but in a sense watch their dwarves play DF. Yes, dwarves have the "choice" of whether to complete a task at given time or not. Tarn drives this point home by the universal dwarven description, "A short, sturdy creature fond of drink and industry." Players do not control dwarves like an absolute deity, but rather dwarves complete tasks as a matter of personal preference. This is a game where open-ended means that even the player cannot necessarily predict the next move.

> "This is a game where open-ended means that even the player cannot necessarily predict the next move."
> -Eddie Lee

The programming is also open-ended: The elements in the game are endowed with properties that allow them to interact with each other. Creatures are not programmed to interact directly, but through a more generalized sort of physical logic as might emulate the real world. For example, Tarn recalls one episode where a creature unexpectedly began eating dwarves, but in retrospect this was completely natural; it was larger than a dwarf and ate meat, and dwarves are meat! In another case, Tarn produced a sewer system, only to have nearby hippos move in because they found it a natural environment, but there was no explicit code detailing that hippos live in sewers.

Indeed, this game is organized around a broader set of principles that free the player from structural confines, allowing him to explore a virtually unlimited space of possibilities. We know that at the very least the game is Turing complete. This means that anything possible on a computer can be simulated within DF — admittedly limited by time, memory and the confines of the map. One avid fan took this to heart and built — out of a set of automated mine carts and probably a year's worth of time — an 8-bit computer. A running joke in the community is that Minecraft should be simulated within DF as a game within a game. Some have suggested simulating DF within DF.

Kurt Gödel

If this game is vast enough to contain the world of computers, what else can it do? Does it contain paradoxes or contradictions like an analog of Gödel's incompleteness theorems? Gödel's famous proofs that all axiomatic systems (namely mathematics) are incomplete and inconsistent is essentially built out of the difficulty of proving "This statement is false." If we assume it to be true, then the statement must be false — wait, but if we take it to be false, then it must be true! Building from this intuition, Gödel proves first that all axiomatic, formal systems like mathematics can express statements unprovable within the system, and secondly, they must have inconsistencies.

Are there those "strange loops" Hofstadter (in his book *Gödel, Escher, Bach*) attributes to consciousness and intelligence? He writes, "What I mean by 'strange loop' is — here goes a first stab, anyway — not a physical circuit but an abstract loop in which, in the series of stages that constitute the cycling-around, there is a shift from one level of abstraction (or structure) to another, which feels like an upwards movement in a hierarchy, and yet somehow the successive 'upward' shifts turn out to give rise to a closed cycle. That is, despite one's sense of departing ever further from one's origin, one winds up, to one's shock, exactly where one had started out. In short, a strange loop is a paradoxical level-crossing feedback loop."

Since the game is tethered inextricably to the world of the player (besides some enforced stochasticity), we could directly insert the strange and the contradictory, but that would be cheating. It is clear that the arrow does flow back the other way, from the game to the player, closing a loop straddling the *in vivo* and *in silico* worlds.

Players do not simply game in DF, but are inspired by the game's open-endedness. The player is no longer a set on a deterministic trajectory, but rather becomes a complicit maker who can produce an endless set of increasingly more complicated patterns. In the same way that great art inspires, DF forces us to go beyond simply following to producing, to impressing our own thoughts on reality. Indeed, Tarn's character reminds us more of the romantic idea of a great artist rather than just another "computer nerd." His single-hearted dedication to a feat that even he admits will at least take a lifetime is impressive. His Spartan lifestyle — he lives in a small, sparsely furnished apartment with his cat – and meditative focus on his project is extraordinary and no different from the determination of great artists in history. Even practically, he subsists on donations from a small group of benefactors like his humanist peers.

In this very sense, it is unfair to call Tarn a "computer nerd" because it evokes the typical stereotype that draws lines between the sciences and the humanities. He is an artist in the most complete sense: His work engages us to learn, to experiment and to express, to be human. He provides a sandbox, intricately styled by his own tastes, but wide enough to hold a universe of possibilities. I would argue that his work is greater than most art on which we only reflect; his

work propels us to produce. Tarn is the meta-artist whose art begets art. Now we have something evocative of a strange loop, where Tarn has built a masterpiece (though incomplete) that inspires further art forms, though produced separately, they are still within the original. By stepping away with our own inspiration, we have simply returned to our building blocks. But there is maybe something disappointing about the need for reality to intervene in this loop. As DF becomes increasingly complicated, potential outcomes and trajectories will grow immeasurably. At that point, I wonder if this cycle of production will close within the game, a world that produces its own art autonomously just as we do.

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