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'Animals' grown from an artificial embryo

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Virtual creatures, with muscles, senses and primitive nervous systems, have been "grown" from artificial embryos in a computer simulation. The multi-celled organisms could be the first step towards using artificial evolution to create intelligent life from scratch.

How cells with different senses combine to make an artificial organism

Each creature begins life as a single "embryo" cell, containing a string of random numbers that represent its genome. Some genes tell the cell to split in two, forming a joint between the two new cells. Others tell it to develop different kinds of ability to make the organism move within or sense its virtual environment.

Given a particular genome, each embryo cell will develop in a predetermined way. For example, it could develop cells with the ability to move the joints they are attached to, forming a virtual limb. Or they could develop sensitivity to light or touch. Give the embryo a different genome and it will develop into a different cell arrangement.

In a parallel with real cells, the virtual embryos contain simulated chemicals that switch its genes on or off. When the simulation is run, genes activated by the "chemicals" make the cell act in different ways. And some of the virtual genes produce chemicals that activate other genes.

Josh Bongard, an AI researcher at the University of Zurich, ran the simulation until each cell had grown into a creature of up to 50 cells. He then tested each one to see how well it pushed a simulated box. By setting one creature against another, Bongard was soon able to find which cells grew into the most effective "pushing" creatures.

Successful creatures

He then took the genomes that led to the most successful creatures and mixed them to produce new genomes for his virtual embryos, which he grew and tested. Bongard, who reported the work at the International Workshop on Biologically Inspired Robotics at HP Labs, Bristol, now has a bunch of creatures that excel at box-pushing.

"Evolution seems to figure out that it's useful to organise the growth process," says Rolf Pfeifer who works with Bongard. "You get repeated structures, and they discover things like increasing body mass helps to push the block."

So far, none of the virtual creatures has grown the equivalent of a brain - a dense collection of neurons in one region. Instead, they have neurons connected through each cell, allowing the creatures to move and sense in a primitive manner.

Bongard thinks brain-like regions will develop if the creatures are given tougher tasks. "The mid-term goal is to keep posing increasingly complex tasks to see at what point you get a centralisation of the neural systems and where you start to see cognition," says Bongard. This, he adds, would mark a move from evolving artificial life to evolving artificial intelligence.

Once you have evolved a genome capable of producing such a complex creature, it should be possible to build it, says Bongard.

Gerald Edelman a neurobiologist at the Neurosciences Institute in San Diego, California, says the work is important because the muscles, joints and nerves are evolved and grown together, which is necessary if they are to work well as a unit.

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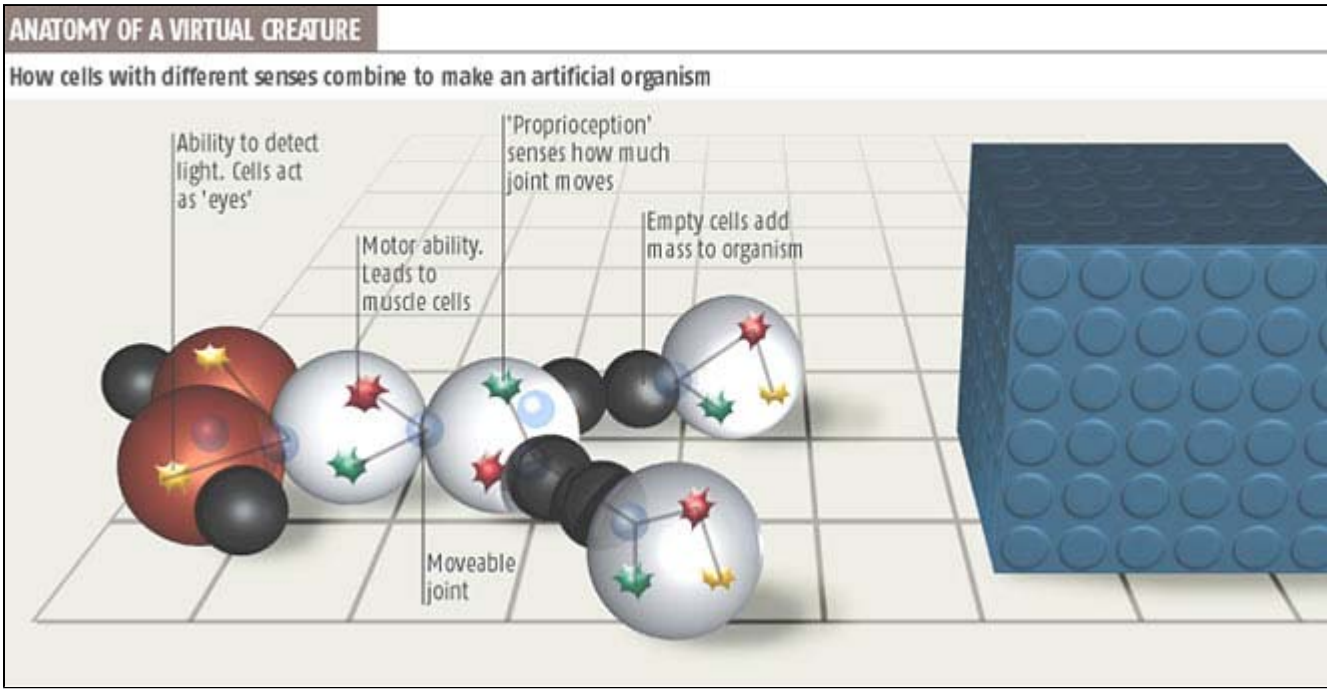

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