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USING FLIES TO SOLVE COMPUTER NETWORK PROBLEMS

Got a computer network problem? Don't call I.T. Get a microscope, catch a fruit fly, and study its sensory bristles. Preposterous? No.

Scientists studying biological organisms like the fruit fly have discovered algorithms that aid in designing airplane control systems and web search engines. Such discoveries seem to indicate that a deep, underlying design exists within living creatures. Here's one example.

Consider a longstanding problem in computer science when using swarms of sensors or robots, such as those used to monitor volcanic activity. Often, each sensor works on tasks independently of the other sensors yet the overall result requires some coordination or networking between the sensors. Efficiently utilizing resources requires balancing the amount of communication against the complexity of the sensors. For example, although numerous detectors listen for the rumblings of volcanic activity, some act as leaders by gathering that information and reporting it back to headquarters. In other words, more communication allows the analysis to proceed more thoroughly but requires more complex (and thus more expensive or power-hungry) sensors. Too much cross-talk over the network becomes too costly.

Typically, the key to finding the right balance requires some sensors to assume a local leadership role such that no two leaders connect to one another but every sensor connects to one (and only one) leader. Computer scientists refer to such a configuration as a "maximally independent set" or MIS. The difficulty arises when determining an algorithm (set of rules for solving a problem) such that the sensors "elect" the leaders with the minimal amount of communication.

Although computer scientists have worked for three decades to devise algorithms to solve MIS problems, none operate as efficiently and robustly as the one employed by the developing nervous system of the fruit fly.[1] Now computer scientists seek to emulate this process in human-designed networks.

The fly's sensory bristles begin developing during the larval and pupal stage. Several clusters of cells form, and any of these cells could eventually result in a bristle. As the cells continue to mature, some of them express high levels of a protein that prevents the growth of neighbor cells into bristles. The net result is an MIS of bristles that form from stochastic (random) processes with very minimal messaging between cells.

Mathematical modeling of the process indicates two improvements of the fruit fly's solution compared to human-derived algorithms. First, selection of leaders does not rely on knowledge of the number of neighbors available for selection. Second, the messaging occurs nonlinearly such that the chemical message amounts to a binary ON/OFF signal.

One coauthor, after developing a computer algorithm based on the fruit fly's approach that was a fast solution to the MIS problem, noted that the "biological approach is efficient and more robust because it doesn't require so many assumptions". Another coauthor declared that "it is such a simple and intuitive solution, I can't believe we did not think of this 25 years ago."

Many secular scientists claim that life arose and evolved by unguided naturalistic processes. However, researchers continue to find solutions to complex problems—in this case, by studying biological organisms—that outpace those discovered by means of the human mind alone. This fact fits far more comfortably in a worldview where a superintelligent Designer fashioned life on Earth. NR

ENDNOTES

1. Yehuda Afek et al., "A Biological Solution to a Fundamental Distributed Computing Problem," *Science* 331 (January 14, 2011): 183–5.