

"Colony" Computer to Look for a Theory of Theories

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Among the new students, faculty and staff arriving at UC Davis this summer is a new resident on campus: COLONY, one of the most powerful computers of its type in the world.

COLONY was originally built by Sun Microsystems for chip design. Sun recently donated the machine to Professor James Crutchfield at the Center of Computational Science and Engineering at UC Davis.

"It's the most complex machine Sun Labs ever built," Crutchfield said.

COLONY has 14 motherboards, each with 64 chips, with each of those containing 64 32-bit processors, for a total of 57,344 processors. That's a lot of computational power, but what makes COLONY special is the extremely fast connections between the processors. The result is that it can run simulations thousands of times faster than conventional machines.

Crutchfield will use the machine for running a kind of computer simulation called "cellular automata." A simple cellular automaton would be a lattice of cells, each of which can be in a set number of different states, such as black or white, one or zero. Programmed rules set how cells influence the state of their neighbors. Cellular automata quickly give rise to complex patterns from a simple set of instructions.

COLONY can run very large lattices and also run models in three or four dimensions, making for more powerful and realistic models, Crutchfield

said. The machine could be used for experiments in fluid dynamics, weather forecasting, geology or ecology. But Crutchfield is primarily interested in a deeper problem.

Working at the Santa Fe Institute in New Mexico and now at UC Davis, Crutchfield has developed a new theory of how cellular automata can spontaneously organize into miniature universes with their own unique "physics" -- structures of interacting particles. The ultimate goal is to understand how structure can appear at different levels of the universe, how the levels are related to each other, and how scientists (and computers) can automatically construct theories from data.

COLONY is only the most recent and unusual computing resource at UC Davis. Researchers already have access to more conventional computing on campus including a number of "clusters," made up of desktop computers linked together and supercomputers at the Lawrence Livermore National Laboratory and elsewhere.

Source: UC Davis

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