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Book Review

Self-Stabilization, by Shlomi Dolev. Cambridge, MA: The MIT Press, Cambridge MA, 2000. 197 pp. ISBN 0-262-04178-2.

This is a meticulously presented and argued book about self-monitoring and self-correction as stabilization. It is a review of algorithms in computer science that were created to give a process the capacity to correct errors as they are generated. Although it is written from the strict perspective of programming theory, it inevitably touches on a series of questions about human cognitive processing and about dynamical representations of human performance in a wider sense.

Self-stabilization is a term given to a system that can automatically recover following the occurrence of transient faults. To see why this problem is pertinent to human dynamics, consider a pianist who is practicing playing an unfamiliar sonata. Each time a mistake is made, he or she jumps back a bar or two and starts again. If he or she is in an orchestra, then the task is to play a part, which is scored so that other players' scores are compatible. In rehearsals the conductor may require one or more players to start a phrase again. Indeed in master classes this is the emergent pattern. The individual has to employ some repeated method of correction, either to match a solo score or to play with the other musicians. The theory of self-stabilization, which originated with Dijkstra in 1973, has generated a technical literature that has now created a diversity of algorithms to achieve on-line correction. Correction in dynamical systems, both in a sole computer and in a linked network, correction in the presence of noise, correction with defective memory, pseudo-correction, and correction in finite time, are all considered in detail, with programs, in this monograph.

Innumerable experimental studies in psychology have used error scores as a direct measure of performance. The rate of change in the elimination of errors has been modeled in learning curve theory since the 1920s, and some network models may match learning curves, in pattern discrimination tasks, to the rate of learning of the same task in a three-layer network. Specific models of how an individual continuously monitors his or her own performance and corrects errors are relatively few, however. There are

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some studies of the correction of speech defects such as stammering, and the wider literature of motor tracking tasks, yet the difficult question of how the brain can store both a plan and a record of execution, and use one continuously to monitor the other, is rather neglected. It is, undoubtedly, a problem in sequential dynamics. We know it happens, or we would never learn to do anything. Nonetheless, the hard metatheoretical questions of necessity and sufficiency, about how much storage is needed, what feedback has to be sequenced, what randomization of inputs does to performance, expected times to solution, and the expected efficiency of solution, are still obscure.

There are links in self-stabilization theory to more familiar dynamics. One computer can serve as an attractor to others, and the leader role in a collective can be switched around in the way that occurs in slaving relationships. One is not obliged to accept that the algorithms of computer science are faithful models of the brain, but the tight logical structure of this book makes it plain what sort of explanations would not work, and tells us how much care is needed in creating models of human performance that would actually work as process descriptions, not just as accounts of what is observed after the event. It is still the case that there are tasks we do better than computers, and other tasks that computers do better than us; error correction is almost certainly an area in which both sorts of clever self-stabilization may be found. Perhaps this book might help us to see why we are sometimes still the most subtle performers. I think it extends our notions of what should constitute the nonlinear dynamics of behaviour.

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