What's New in Wolfram's New Kind of Science?

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Abstract. Wolframfs monumental best seller entitled gA new kind of scienceh was based almost entirely on brute-force computer simulations. In sharp contrast, this lecture presents a rigorous analytical theory based on attractors from a nonlinear dynamics perspective. New results and concepts to be presented include the partitioning (via Felix Kleinfs Vierergruppe) of all 256 local Boolean rules studied empirically by Wolfram into 88 global equivalence classes, one of which contains 4 topologically-conjugate rules capable of universal computation, and endowed with a 1/f spectrum. Another major result is the rigorous characterization of the time-asymptotic dynamics (attractors) of 112 local rules via an explicit generalized Bernoulli shift formula. Even more surprising, we have discovered the attractors of 170 local rules are blessed with the remarkable property of time-reversality. For such rules, the past evolution in time can be recovered from the future evolutions of a corresponding gtwinh rule. Only 86 local rules exhibit an garrow of timeh. One of our most fascinating discoveries is a new phenomenon, dubbed an gIsle of Eden,h having no counter part in hyperbolic differential equations, which has neither a past, nor a future! In addition to providing a mathematical foundation for brainlike dynamics, the discoveries cited above provide simple dynamical mechanism for mimicking many exotic phenomena from brain science, quantum physics, cosmology, etc.