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Integrated Information in Discrete Dynamical Systems: Motivation and Theoretical Framework

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It is possible, but inefficient, to build systems with high φ using grid architectures. As a point of comparison, the 8-element *AND*-gate network in Figure 12 generates φ=3.75 bits, considerably more than the maximum attained (2.3 bits) by a 3×3 grid of *AND*-gates. The inefficiency increases with the size of the grid; for example an *XOR*-grid of a million elements is needed to generate 1000 bits of integrated information. φ of a grid is limited by the interactions occurring along the perimeters of the parts, so that the expected value of φ for an $n \times n$ grid is proportional to n (see Text S1, section 6). More generally, three-dimensional lattice interactions occur along the surfaces of the parts, so φ will be proportional to their surface area, a phenomenon similar to the holographic principle