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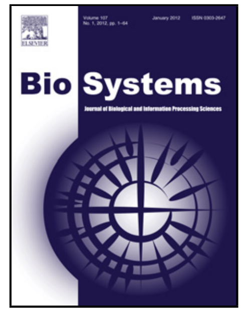

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Towards Measuring the Semantic Capacity of a Physical Medium Demonstrated with Elementary Cellular Automata

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Abstract

The organic code concept and its operationalization by molecular codes have been introduced to study the semiotic nature of living systems. This contribution develops further the idea that the semantic capacity of a physical medium can be measured by assessing its ability to implement a code as a contingent mapping. For demonstration and evaluation, the approach is applied to a formal medium: elementary cellular automata (ECA). The semantic capacity is measured by counting the number of ways codes can be implemented. Additionally, a link to information theory is established by taking multivariate mutual information for quantifying contingency. It is shown how ECAs differ in their semantic capacities, how this is related to various ECA classifications, and how this depends on how a meaning is defined. Interestingly, if the meaning should persist for a certain while, the highest semantic capacity is found in CAs with apparently simple behavior, i.e., the fixed-point and two-cycle class. Synergy as a predictor for a CA's ability to implement codes can only be used if context implementing codes are common. For large context spaces with sparse coding contexts synergy is a weak predictor. Concluding, the approach presented here can distinguish CA-like systems with respect to their ability to implement contingent mappings. Applying this to physical systems appears straight forward and might lead to a novel physical property indicating how suitable a physical medium is to implement a semiotic system.

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