Articulating Mechanisms in Molecular Systems Biology

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Abstract

We contrast two broadly different approaches toward developing mechanistic explanations, specifically within molecular systems biology. One focuses on modelling system behaviours, without specific attention to information concerning the composition of the system. The other constructs models based on independent information concerning the parts, processes, and organization present. On the former approach, the development or "articulation" of mechanistic models includes four phases, beginning with an initial adequate description of systemic behavior, and ending with the articulation of an elaborate a causal model. This approach to modelling the behaviour of complex systems has a number of strengths. Most importantly, it emphasizes the idea that we must at least begin with some reasonably robust phenomenon to be explained. So, for example, the characteristic switching behavior exhibited in the growth of micro-organisms under changing nutritional regimes is a phenomenon that is relatively robust and important. It demands a causal and mechanistic model. The latter approach follows a different, more constrained, methodology. These latter models emphasize functional composition rather than functional decomposition, with more detailed structural data, including kinetic data concerning componential behavior, and complex networks. Much of contemporary molecular systems biology offers its allegiance more to the detailed modelling of pathways, given better information about component capacities, and somewhat less to its cybernetic ancestors. We sketch an analysis of heuristics in mechanistic explanation of this latter sort and emphasize the dynamic 'fluid' character involved in the process of articulating and elaborating mechanistic models.

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