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Cascade-likeness is an intrinsic property of biological processes[1]

HAO CHEN, GUANYU WANG, CHENGHANG DU, Department of Physics, George Washington University, RAHUL SIMHA, Department of Computer Science, George Washington University, CHEN ZENG, Department of Physics, George Washington University — A central theme in systems biology is to reveal the intricate relationship between structure, dynamics, and function of biological networks. The biological function is usually realized by the transformation of the relevant molecules through their interacting network. We name this trajectory of transformation as a biological process. In contrast to the structure-centric approach, we take a process-centric view to address such questions as what a biological process looks like and how it differs from an arbitrary process. As an example, we studied a simple Boolean model for the cell cycle process of budding yeast to characterize a large number of putative processes. This computational task was made possible by some highly efficient algorithms we developed. Our results demonstrated that the biological process is very robust and highly designable. Moreover, we uncovered two dynamical rules that dramatically enhance the robustness and designability. Finally, all processes in a system of small size were enumerated and highly designable processes are cascade-like. This implies that cascade-likeness is an intrinsic property of biological processes.

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