

Canalization and other design principles of gene regulatory networks

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The concept of canalization in gene regulation was proposed by Waddington in the 1940s as a possible answer to the question of how the outcome of embryonal development can lead to predictable phenotypes in the face of widely varying environmental conditions, as well as frequent genetic mutations. Kauffman introduced canalizing functions as suitable update rules of Boolean gene regulatory network models. Since then, several ways to measure canalization have been introduced. In this talk, I will review and compare these different notions of canalization. Besides theoretical considerations, I will also describe the prevalence of various types of canalizing functions in a newly established database of roughly 150 published Boolean models of biological networks. I will further describe several other design principles of published gene networks and end by motivating an important open question: given that all these principles are “correlated”, which one(s) does evolution actually optimize for?