Solving the Complexity of Biological Systems

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A long-term goal of biology is to understand, how the genome of an organism determines its phenotype and interaction with the environment. In the last decades, the functions of numerous individual genes were identified that, for example, affect human health or determine seed numbers in crops. However, how all genes of the genome act together in networks to form complex organs and organisms is still poorly understood. One of the challenges is that the translation of the genome information into a phenotype is subject to many layers of regulation acting at the level of DNA, RNA, proteins, and metabolites. Whereas we learned to measure and analyze many of these regulatory processes, we still are far from mastering this complexity. Biologists are now starting to apply machine learning and artificial intelligence approaches to biological systems at multiple scales. I shall present my views on future directions on the analysis of complex biological systems and I shall illustrate this with examples of our research on genetic networks that govern organ sizes in plants.