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Rescue Interventions in Biological and Physical Networks SEAN CORNELIUS, Northwestern University — Gene knockout experiments on single cells have established that expression of most genes is not needed for optimal growth. Yet, environmental and genetic perturbations to these organisms are known to be accompanied by the transient activation of a large number of latent metabolic pathways, suggesting that the temporarily activated reactions increase growth in the presence of perturbations. We have tested this hypothesis computationally and found, surprisingly, that the availability of latent pathways tends in fact to inhibit growth after genetic perturbations. This adverse effect indicates that latent pathway activation is derivative of a suboptimal response and that consequently, growth can actually be improved by removing these pathways from the network. In this talk, I will relate this counterintuitive effect to very recent research showing that a loss in network performance inflicted by an external perturbation can be mitigated by the application of additional perturbations. The challenge is to identify such "rescues" under constraints that limit the type of perturbations that can be made. I will present an approach to identify such eligible rescues for general networks modeled as dynamical systems, and present computational examples for biological and physical networks.

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