

Tools and techniques to understand the evolutionary origins of modularity

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Abstract:

A central biological question is how natural organisms are so evolvable (capable of quickly adapting to new environments). A key driver of evolvability is the widespread modularity of biological networks but there is no consensus regarding why modularity itself evolved. Although most hypotheses assume indirect selection for evolvability, we recently demonstrated using computational evolution experiments that the ubiquitous, direct selection pressure to reduce the cost of connections between network nodes can cause the emergence of modular networks. To obtain this result, we introduced a novel approach to select for multiple objectives in computational evolution (stochastic Pareto dominance), an method to visualize feed-forward networks, and a novel algorithm to illuminate fitness landscapes (MAP-Elites). This talk will describe these new techniques and show how we used them to study the evolutionary origins of modularity.