

Searching Social Network Landscapes
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Abstract:

Landscape metaphors are ubiquitous in descriptions of complex systems, intuitively representing the non-homogeneous search space explored by adaptive agents and evolving systems. In many fields, formal landscapes models are used to understand how systems search for optima in a space of possibilities. Physical systems explore a space of possible states for ones that minimize free energy. Living organisms search for peaks in genetic and ecological fitness landscapes. Engineers explore design spaces for good solutions just as law-makers search for good public policies. Critical to these search processes is how agents measure optimality. We consider a class of landscape searching (also known as global optimization) where agents use knowledge encoded in the structure of the landscape for navigation. We present a model based on a probabilistic network where a particle's position at a given node denotes the current state of the system and each outgoing link to other nodes is weighted by the probability of the system transitioning to that state from the current state. Models like this have been used to simulate complex dynamical systems governed by stochastic processes and are meant to represent statistical features of an ensemble of system trajectories. Hence it is appropriate to speak of a particle swarm traveling the network, tracing out unique paths, revealing the characteristic landscape of the model system. Attractors in the landscape are defined as regions where we are more likely to observe a particle at any arbitrary moment. As a practical example we show how these landscape/particle models are highly suited to describing the macrostructure of social networks and modeling complex exchange processes that operate across them, namely status and reputation formation. For instance, the landscape could provide a map of expertise within an organization, where attractors signify regions of high expertise because they are more likely to receive tokens (particles) of esteem. This paper contributes the following discovery: with the addition of a single construct we show how all such models of dynamical systems contain an intrinsic self-modeling algorithm such that a proper subset of the state-space can plausibly represent the entirety. This algorithm has extremely useful applications to the human sphere: enabling distributed problem-solving in groups, optimizing division of labor in organizations, and identifying representatives that accurately reflect public opinion for policy-making in government.