# MULTI-LAYERED NETWORKS AND EMERGENCE OF SPATIO-TEMPORAL ORDER

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Evolutionary-game based models, in which the success of one species depends on the behaviour of the others, have become paradigmatic for addressing the fundamental problem of species coexistence in ecological systems. The generic properties of the competition can be characterized by the traditional rock-paper-scissors game in combination with spatial dispersal of static populations. I will, initially, consider a complex network, defined on a lattice or a population patch in which the interaction among the nodes changes the state of the nodes stochastically. The interaction can be competition, given by the rock-paper-scissors game, reproduction and intra-patch migration. On top of that, I will require that each node can be either infectious or susceptible, allowing for removal or death, in order to model epidemic spreading microscopically. I will then define a multi-layered network, formed by different sub-networks or population patches, thus in addition to intra-patch migration, I am creating an inter-patch migration. The interaction among the sub-networks is again stochastic. The interplay between intra- and inter-patch migration leads to self-organised waves in each sub-network in the absence of external control. It can also lead to the occurrence of synchronization and lag-synchronisation of patterns among different patches or sub-networks. This is relevant to the emergence of spatio-temporal order from disordered network states, resulting from migrations and stochastic interactions among the sub-networks.
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