Modelling self-organizing networks

Abstract: There has been a great deal of recent interest in modelling complex networks, a result of the increasing connectedness of our world. The hyperlinked structure of the Web, citation patterns, friendship relationships, infectious disease spread, these are seemingly disparate collections of entities which have fundamentally very similar natures.

Many models of complex networks—such as copy models and preferential attachment models—have a common weakness: the ‘uniformity’ of the nodes; other than link structure there is no way to distinguish the nodes. One family of models which overcomes this deficiency is spatial (or geometric) models, wherein the nodes are embedded in a metric space. A node’s position—especially in relation to the others—has real-world meaning; the character of the node is encoded in its location. Similar nodes are closer in the space than dissimilar nodes. This distance has many potential meanings: in communication networks, perhaps physical distance; in a friendship graph, an interest space; in the World Wide Web, a topic space. As an illustration, a node representing a webpage on pet food would be closer in the metric space to one on general pet care than to one on travel.

During this talk, I am going to investigate a stochastic model for complex networks called the Spatial Preferred Attachment (SPA) model. In the SPA model, nodes have spheres of influence of varying size, and new nodes may only link to a node if they fall within its influence region. The spatial embedding of the nodes models the background knowledge or identity of the node, which influences its link environment.