Topological Rankings in Communication Networks

In the theory of communication, the central problem is to study how agents exchange information. This problem may be studied using the theory of connected spaces in topology, since a communication network can be modeled as a topological space such that agents can communicate if and only if they belong to the same path-connected component of that space. In order to study combinatorial properties of such a communication network, notions from algebraic topology are applied. This makes it possible to determine the shape of a network by concrete invariants, e.g., the number of connected components. Elements of a network may then be ranked according to how essential their positions are in the network by considering the effect of removing them. Defining a ranking of a network which takes the individual position of each entity into account has the purpose of assigning different roles to the entities, e.g., agents, in the network. In this paper, it is shown that the topology of a given network induces a ranking of the entities in the network. Furthermore, it is demonstrated how to calculate this ranking and thus how to identify weak sub-networks in any given network.

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