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**Title：**Category-based routing in social networks: Membership dimension and the small-world phenomenon[1]

**Abstract:**

A classic experiment by Milgram shows that individuals can route messages along short paths in social networks, given only simple categorical information about recipients (such as “he is a prominent lawyer in Boston” or “she is a freshman sociology major at Harvard”). That is, these net-works have very short paths between pairs of nodes (the so-called small-world phenomenon); moreover, participants are able to route messages along these paths even though each person is only aware of a small part of the network topology. Some sociologists conjecture that participants in such scenarios use a greedy routing strategy in which they forward messages to acquaintances that have more categories in common with the recipient than they do, and similar strategies have recently been proposed for routing messages in dynamic ad-hoc networks of mobile devices. In this paper, we introduce a network property called membership dimension, which characterizes the cognitive load required to maintain relationships between participants and categories in a social network. We show that any connected network has a system of categories that will support greedy routing, but that these categories can be made to have small membership dimension if and only if the underlying network exhibits the small-world phenomenon.

**Modified abstract:**

[Problem]A classic experiment by Milgram shows that individuals can route messages along short paths in social networks, given only simple categorical information about recipients (such as “he is a prominent lawyer in Boston” or “she is a freshman sociology major at Harvard”). That is, these net-works have very short paths between pairs of nodes (the so-called small-world phenomenon); moreover, participants are able to route messages along these paths even though each person is only aware of a small part of the network topology. Some sociologists conjecture that participants in such scenarios use a greedy routing strategy in which they forward messages to acquaintances that have more categories in common with the recipient than they do, and similar strategies have recently been proposed for routing messages in dynamic ad-hoc networks of mobile devices. The prior work does not explain where the categories come from or what properties they need to have in order to allow greedy routing to work. Problems in the state-of-the-art is as follows: 1) Which social networks support systems of categories that allow participants to route messages using the simple greedy rule of sending a message to an acquaintance who has more categories in common with the target?2)How complicated a system of categories is needed for this purpose, how much information about this system do individual participants need to know, and what properties of the underlying network can be used to characterize the complexity of the category system? [Method]In this paper, we introduce a mathematical model of categorical greedy routing. By studying the existence of mathematical and algorithmic frameworks that demonstrate the feasibility of local, greedy, category-based routing in social networks,

we introduce a network property called membership dimension, which characterizes the cognitive load required to maintain relationships between participants and categories in a social network and show that any connected network has a system of categories that will support greedy routing, but that these categories can be made to have small membership dimension if and only if the underlying network exhibits the small-world phenomenon. Based on the categories, we develop the mathematical model of categorical greedy routing ant further investigate under what conditions ROUTING can be successful in routing a message between any pair of nodes in a network. [Results] Results show that a construction of groups *S* on a connected graph *G* that allows a simple greedy routing algorithm, utilizing a notion of distance on group membership, to guarantee delivery between nodes in *G*. Such a construction will have membership dimension *O((diam(G)+log n)2)*, which demonstrates a reasonably small cognitive load for the members of *G*.

**参考文献**

[1]David Eppstein,Michael T. Goodrich,Maarten Löffleret al. Category-based routing in social networks: Membership dimension and the small-world phenomenon[J]. Theoretical Computer Science. 2013: