*From the Editor-in-Chief . . .*

# DEGREES OF SEPARATION

*Munindar P. Singh* • *singh@ncsu.edu*

Two key aspects of being interactive are figuring out whom to interact with and using interactions to modulate further interactions. Technologies for dynamic host configuration and ad hoc mobile networks facilitate interactivity at the network level. But the need for interactivity and dynamic configurations also arises in the realm of applications. Let's examine a "personal" application that the newer networking technologies are enabling.

The people you deal with—your colleagues, friends, or business partners—form your social circle. Combined, all of our social circles form a social network. Under this definition, you are in a social network not only when socializing in the traditional sense, but also when trading goods or ordering services.

Broadly speaking, participants in a social network can be corporate entities as well as people. Thus, social networks are key enablers of electronic commerce because they can help you find the right services or the best customers for your services. Although social networks can be rigid, they don't have to be—at least not on the Internet.

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### Seeking Referrals

Current Internet approaches to finding information or services are based on either centralized directory services or heuristic methods such as collaborative filtering. Given a specific user, collaborative filtering involves first finding a set of people similar to that user, then making a recommendation to the user based on choices made by this set of people. This is what amazon.com does when recommending books for you on the basis of purchases by people who made choices similar to yours. Such approaches have two strikes against them, however: first, they

are centralized, and second, they are impersonal, because you don't know the source of the recommendations.

Now contrast the Internet's methods with the way you traditionally obtain recommendations in a purely distributed, personal social network. First, you ask acquaintances, who will help if they can or refer you to someone else if they can't. You might then ask those you've been referred to, and so on. Often you will find the information you need, and you will know who made the recommendations. The widely recognized "six degrees of separation" idea is based on the empirical observation that people in the U.S. can generally find any other person through about six referrals.[1] The company sixdegrees.com is motivated by the same idea.

### Adaptivity

Naturally, you want to find the most precise information with as *few* messages and referrals as possible. You don't want to ask everybody, just those who can help. Since your initial social circle might not be very effective, you might try to adapt the circle you maintain to reduce your separation from those who are the most valuable to you. While this isn't always possible in human social life, it *is* possible for computerized assistants. Moreover, personal assistants can automate some of the grunt work of requesting and following up on referrals because they don't necessarily have to interrupt people's activities.

Our challenge is how best to apply personal assistants to the social network paradigm. How can we use them to realize adaptivity? How much value should an agent assign to a good answer versus a referral that leads to a good answer? Will a network stabilize if all the agents adapt all the time? What happens if some users' interests change arbitrarily? There are many ways to formalize and address these questions. Yu et al. provide some preliminary results.[2]

### Strength in Diversity

Just to get a flavor of how the social network metaphor changes certain things, let's look closely at

the topic of clustering. Traditional approaches for gaining recommendations, such as collaborative filtering, favor clustering similar users to better predict an individual's likes and dislikes on the basis of those of others in the cluster (as in the amazon.com example).

Social networks mediated by personal assistants seeking referrals for information or services operate in the opposite manner. Each user needs to maintain contacts that can produce the most valuable referrals quickly. Arguably, a user's best bet would be to link up with mutually dissimilar entities. This way, each will produce more accurate answers or referrals in different domains, thus leading to broader coverage of the possibilities and a reduced effective separation. Intuitively, this relates to the common-sense argument that people benefit from having acquaintances outside their own parochial community.[1]

A preliminary simulation that my students and I conducted confirms this hunch.[2] We observed that a social network's quality (in terms of reduced separation of a user from those they need) always decreases when clustering in the network increases. We defined a metric to capture the careful scattering of contacts in a social network; the network's quality and the scattering metric tracked each other uncannily.

The problem of building personal assistants that can participate in social networks is far from solved, but the above results are interesting if only because they show how being interactive challenges the traditional ways of building applications.

## REFERENCES

1. M. Gladwell, "Six Degrees of Lois Weisberg," *The New Yorker*, 11 Jan. 1999, pp. 52-63.
2. B. Yu, M. Venkatraman, and M.P. Singh, *The MARS Adaptive Social Network for Information Access: Architecture and Experimental Results*, North Carolina State Univ. Tech. Report 99-10, May 1999.

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## CALL FOR PAPERS

### Agent Technology and the Internet (March/April 2000)

**Submission deadline:**
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**Guest Editors:**
**Mike Wooldridge** •
M.J.Wooldridge@elec.qmw.ac.uk
**Keith Decker** • decker@cis.udel.edu

This issue will investigate the issues surrounding the application and use of agent technology for internet/intranet-related applications. The scope of the issue is intended to be broad, and will look at issues ranging from the technological to the pragmatic.

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