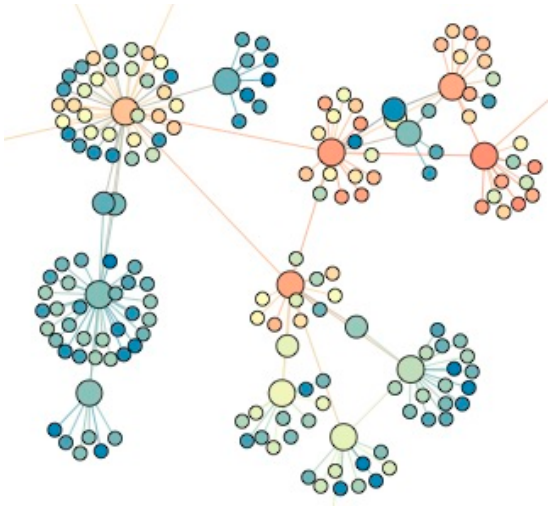
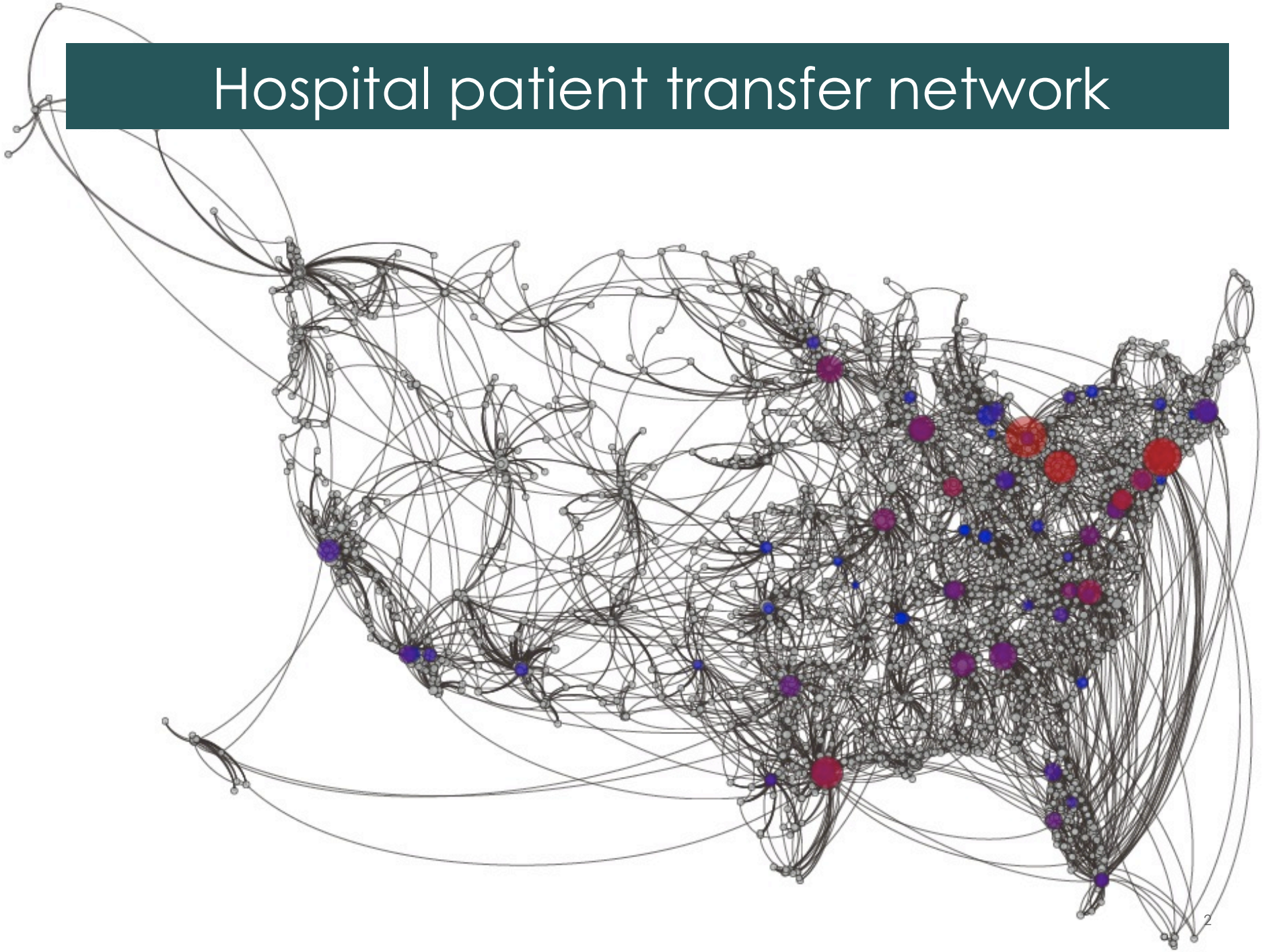


# SNA 3C: Applications of network centrality

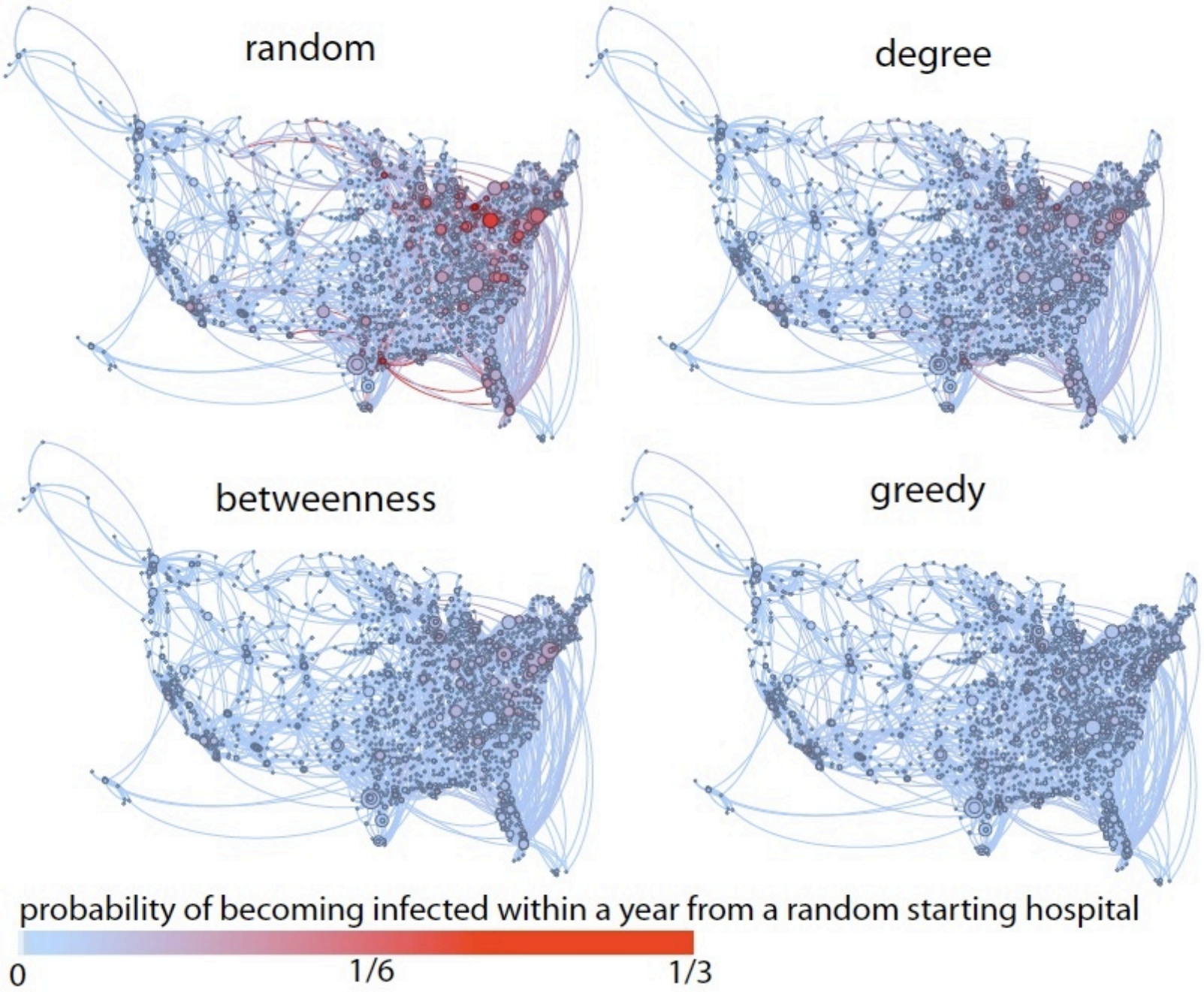
Lada Adamic

school of information

# Hospital patient transfer network

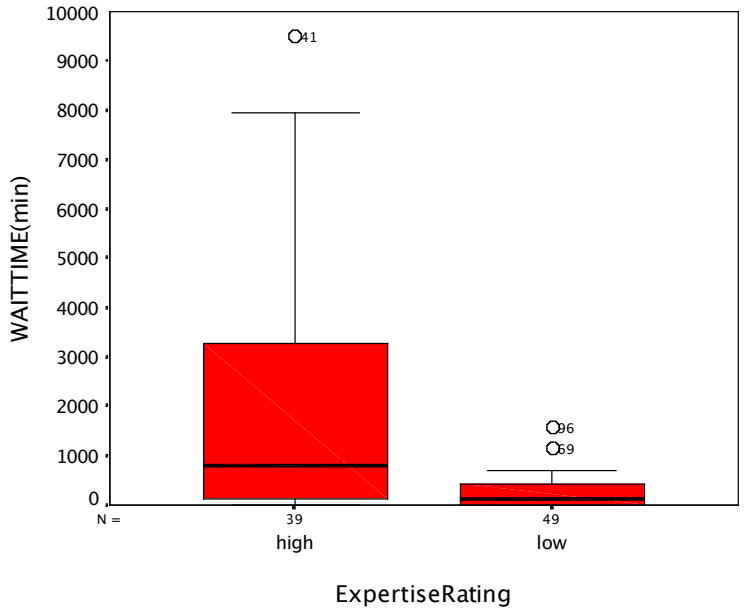


## Infection prevention strategies in a hospital patient transfer network



# Identifying expertise

- The Response Time Gap

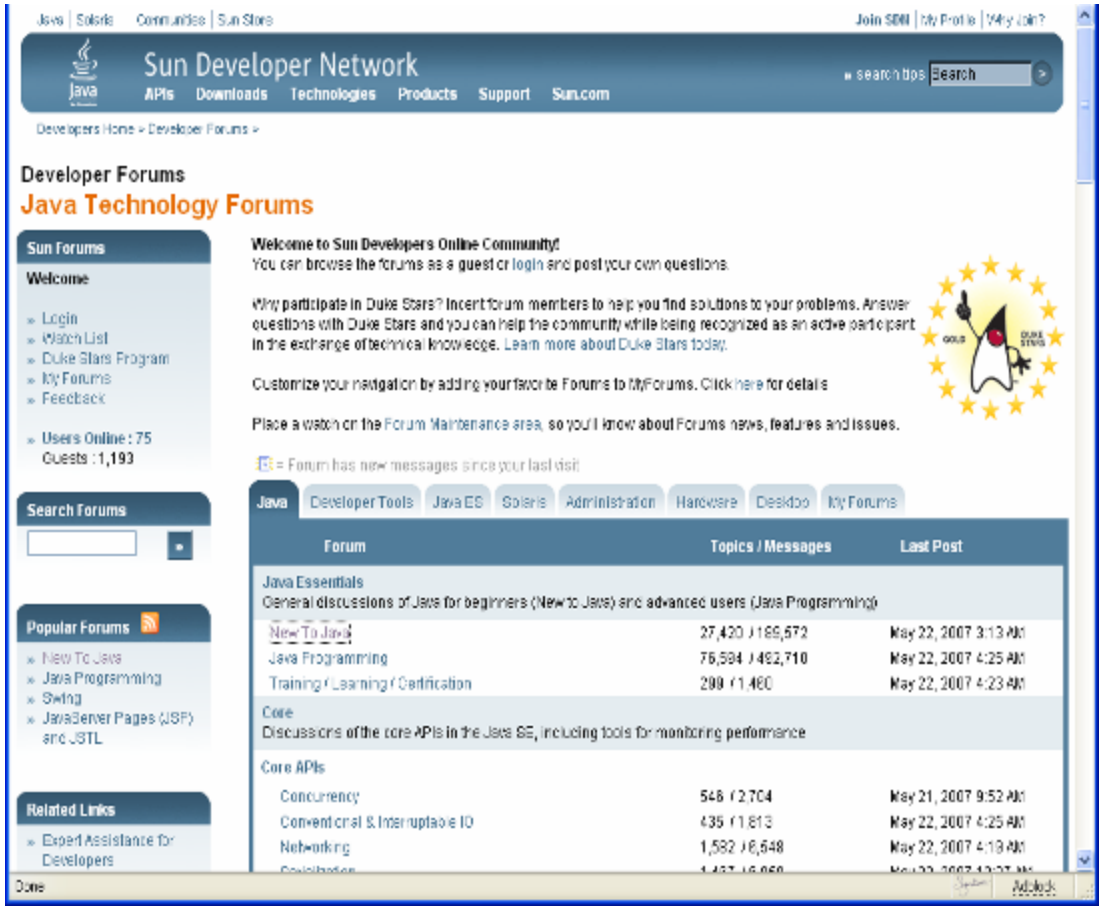



- The Expertise Gap
- Difficult to infer reliability of answers

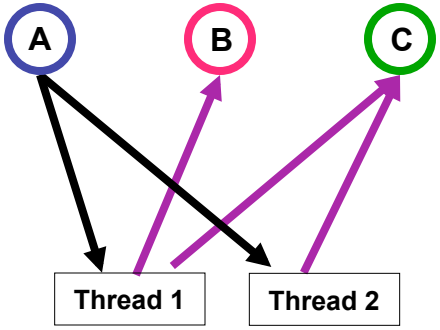
Automatically ranking expertise may be helpful.

# Java Forum

- 87 sub-forums
- 1,438,053 messages
- community expertise network constructed:
  - 196,191 users
  - 796,270 edges

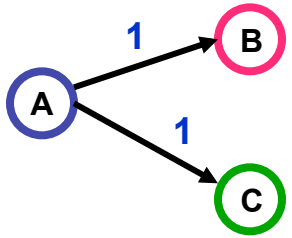


# Constructing an expertise network

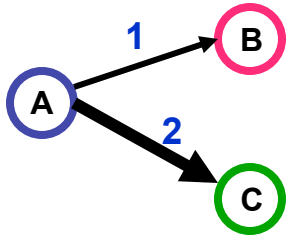



**Thread 1:** Large Data, binary search or hashtable? *user A*
Re: Large... *user B*
Re: Large... *user C*
**Thread 2:** Binary file with ASCII data *user A*
Re: File with... *user C*

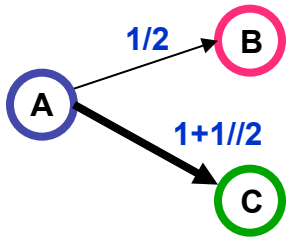
unweighted



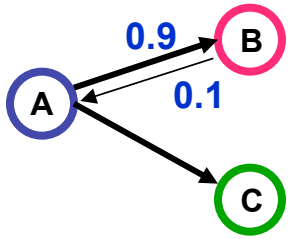

weighted by # threads



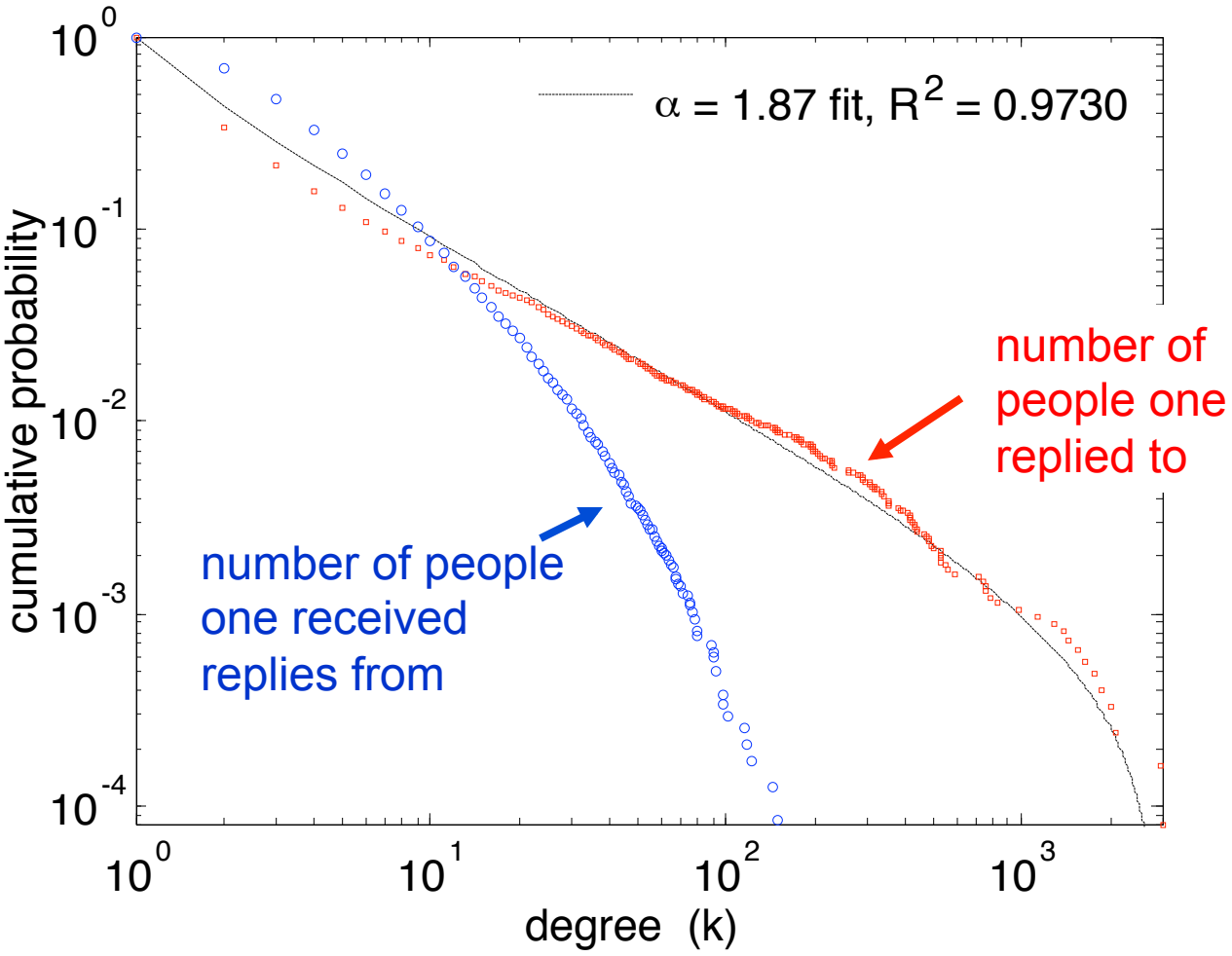

weighted by shared credit




weighted with backflow

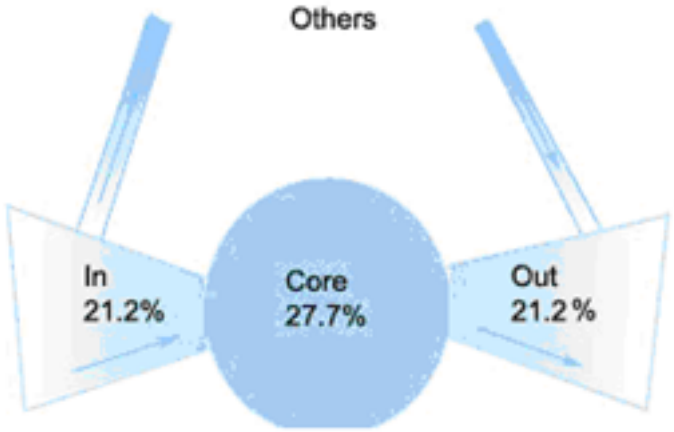


# Uneven participation

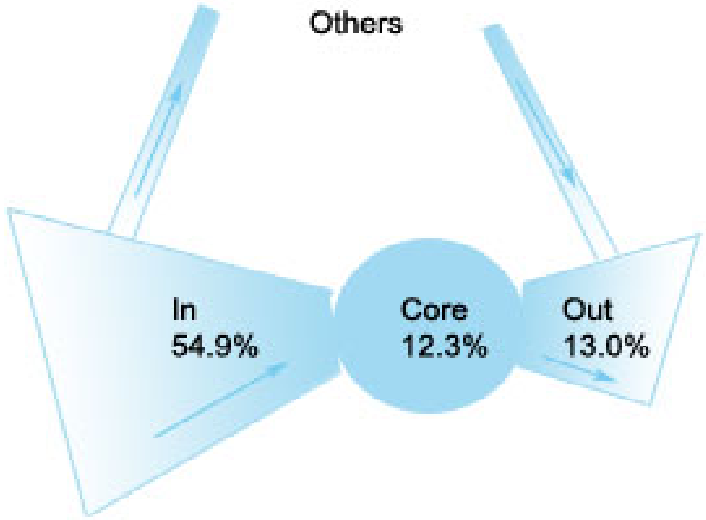



- ‘answer people’ may reply to thousands of others
- ‘question people’ are also uneven in the number of repliers to their posts, but to a lesser extent

# Not Everyone Asks/Replies



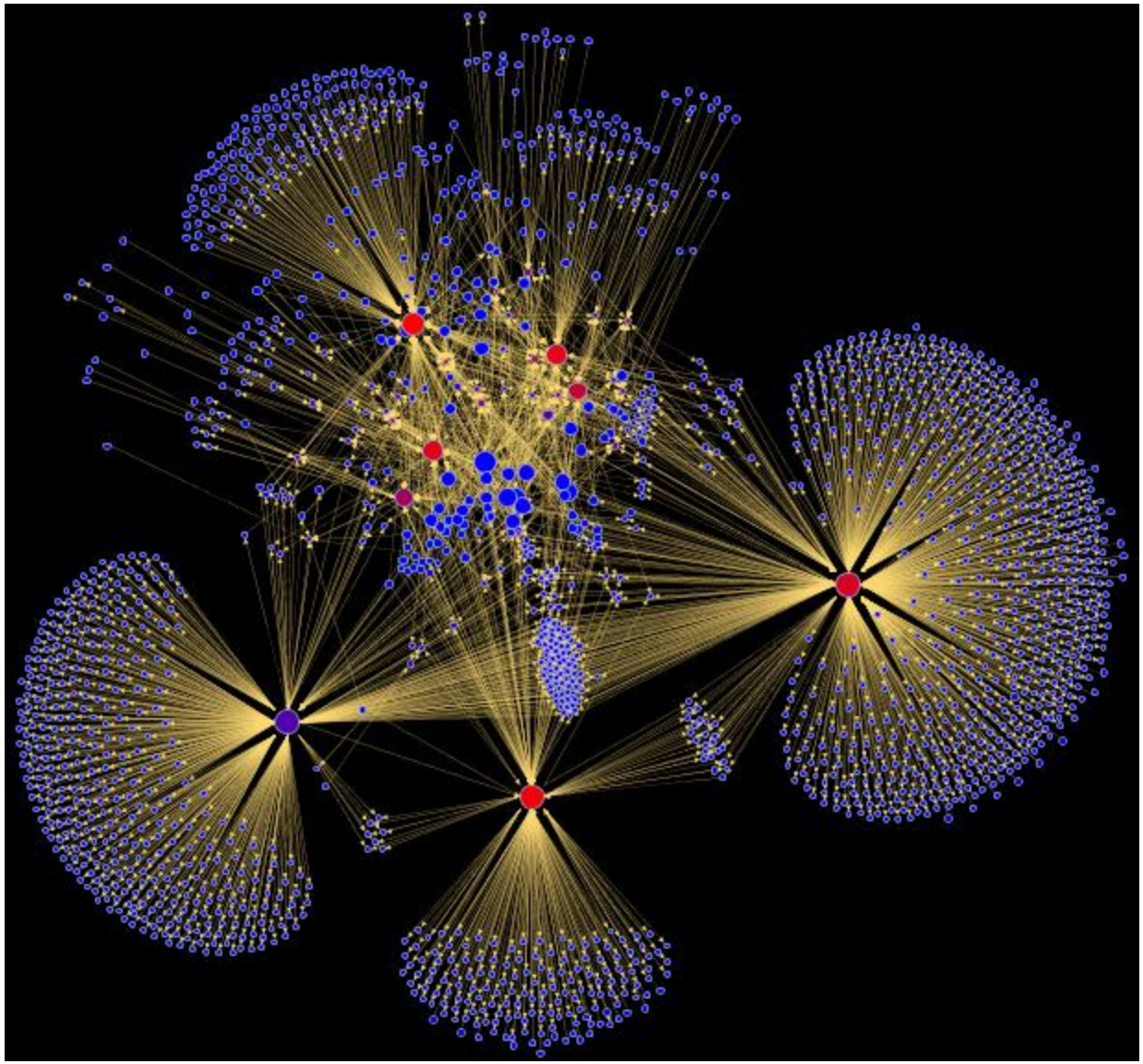

The Web is a bow tie




The Java Forum network is an uneven bow tie

- Core: A strongly connected component, in which everyone asks and answers
- IN: Mostly askers.
- OUT: Mostly Helpers

# fragment of the Java Forum

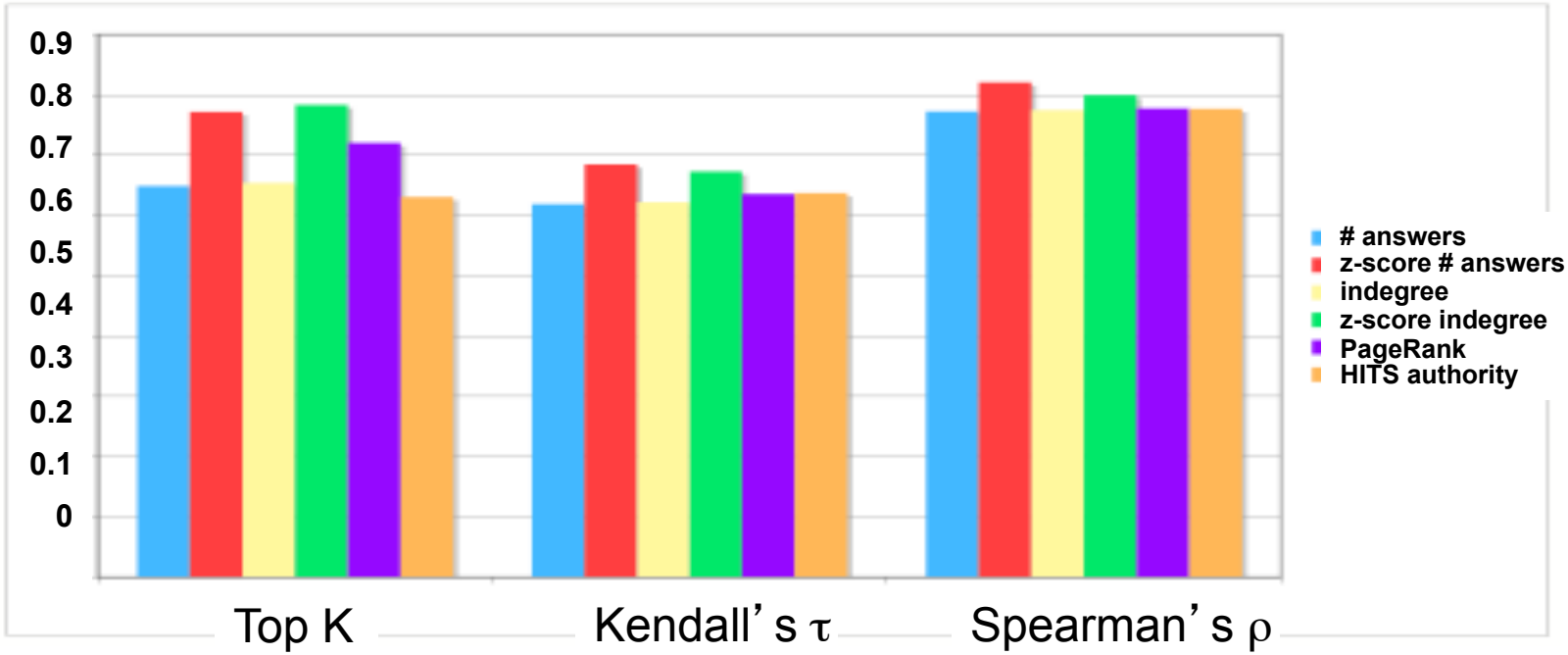


# Relating network structure to expertise

- Human-rated expertise levels
  - 2 raters
  - 135 JavaForum users with >= 10 posts
  - inter-rater agreement ($\tau$ = 0.74, $\rho$ = 0.83)
  - for evaluation of algorithms, omit users where raters disagreed by more than 1 level ($\tau$ = 0.80, $\rho$ = 0.83)

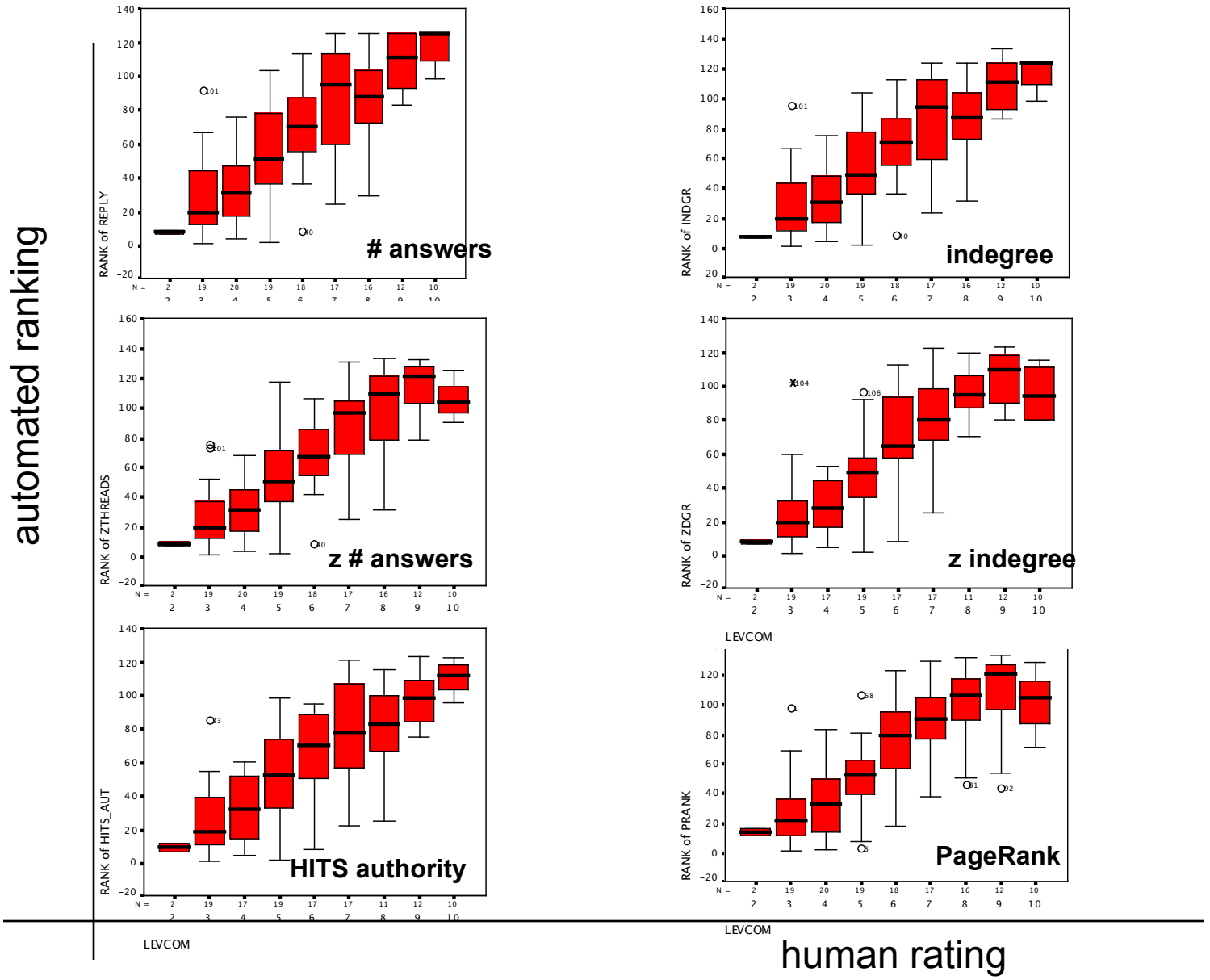
| L | Category | Description |
|---|---|---|
| 5 | Top Java expert | Knows the core Java theory and related advanced topics deeply. |
| 4 | Java professional | Can answer all or most of Java concept questions. Also knows one or some sub topics very well, |
| 3 | Java user | Knows advanced Java concepts. Can program relatively well. |
| 2 | Java learner | Knows basic concepts and can program, but is not good at advanced topics of Java. |
| 1 | Newbie | Just starting to learn java. |

# Algorithm Rankings vs. Human Ratings

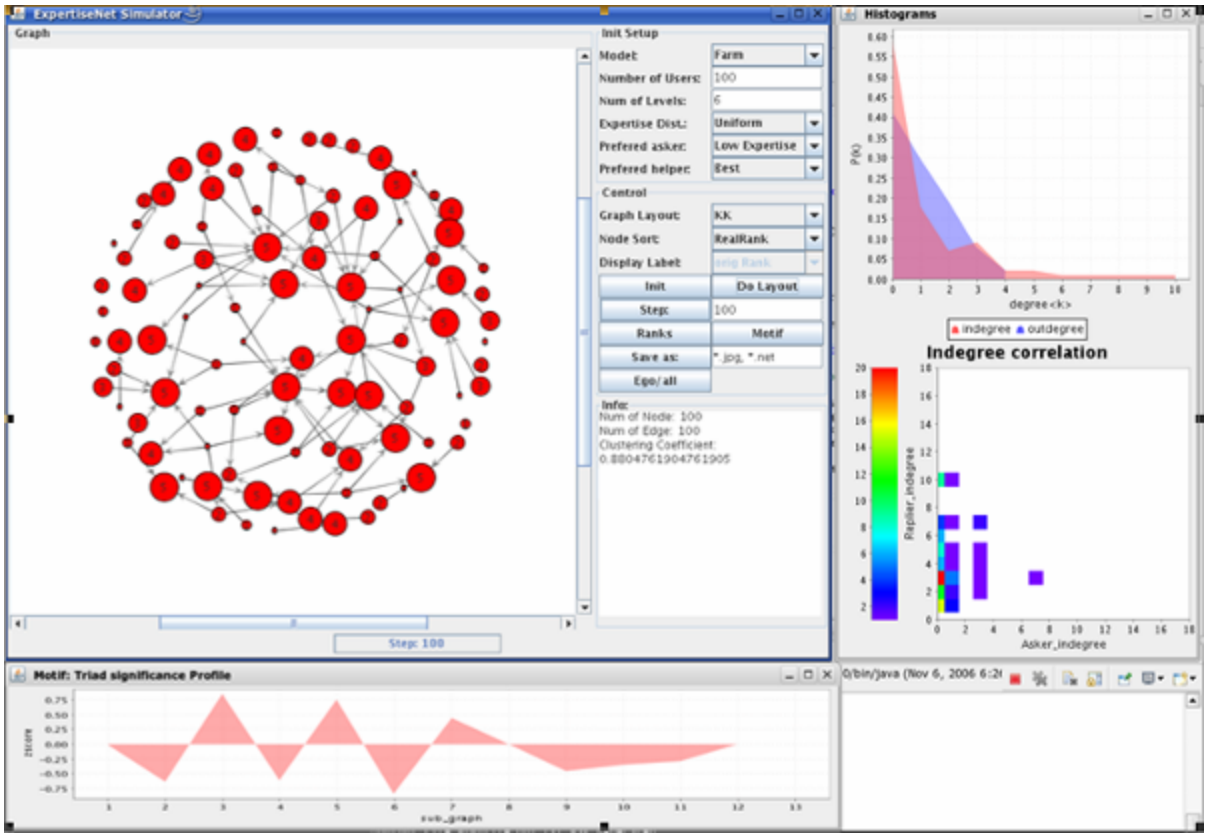



simple local measures do as well (and better) than measures incorporating the wider network topology

# automated vs. human ratings



# Modeling expertise network formation




ExpertiseNet Simulator

**Control Parameters:**

- Distribution of expertise
- Who asks questions most often?
- Who answers questions most often?
  - best expert most likely
  - someone a bit more expert

# Simulating probability of expertise pairing

suppose:

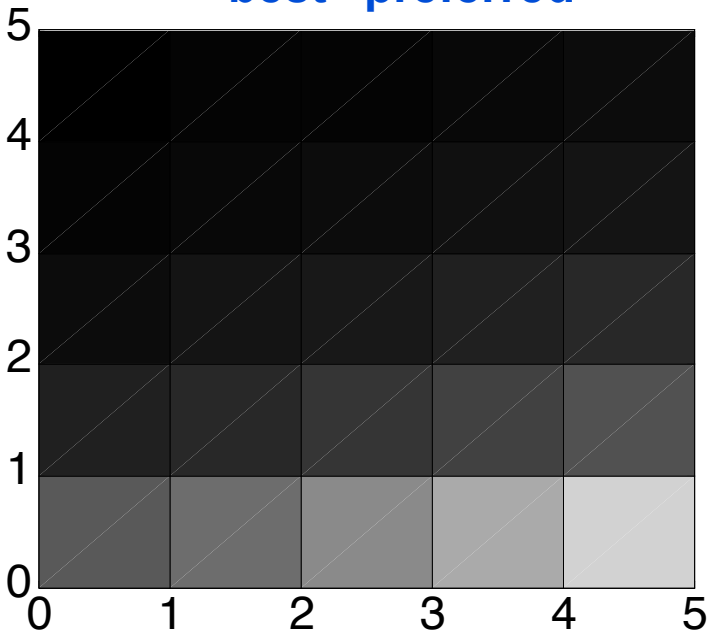
expertise is uniformly distributed

probability of posing a question is inversely proportional to expertise

$p_{ij}$ = probability a user with expertise *j* replies to a user with expertise *i*

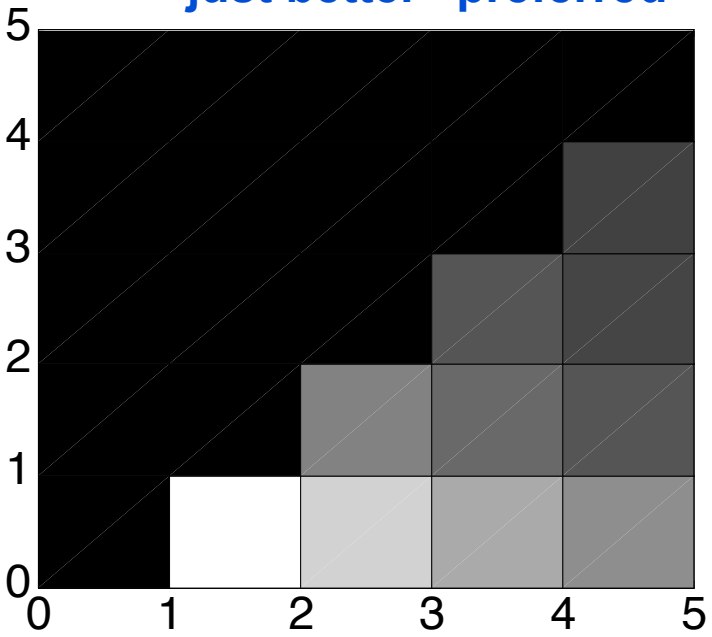
2 models:

**'best' preferred**



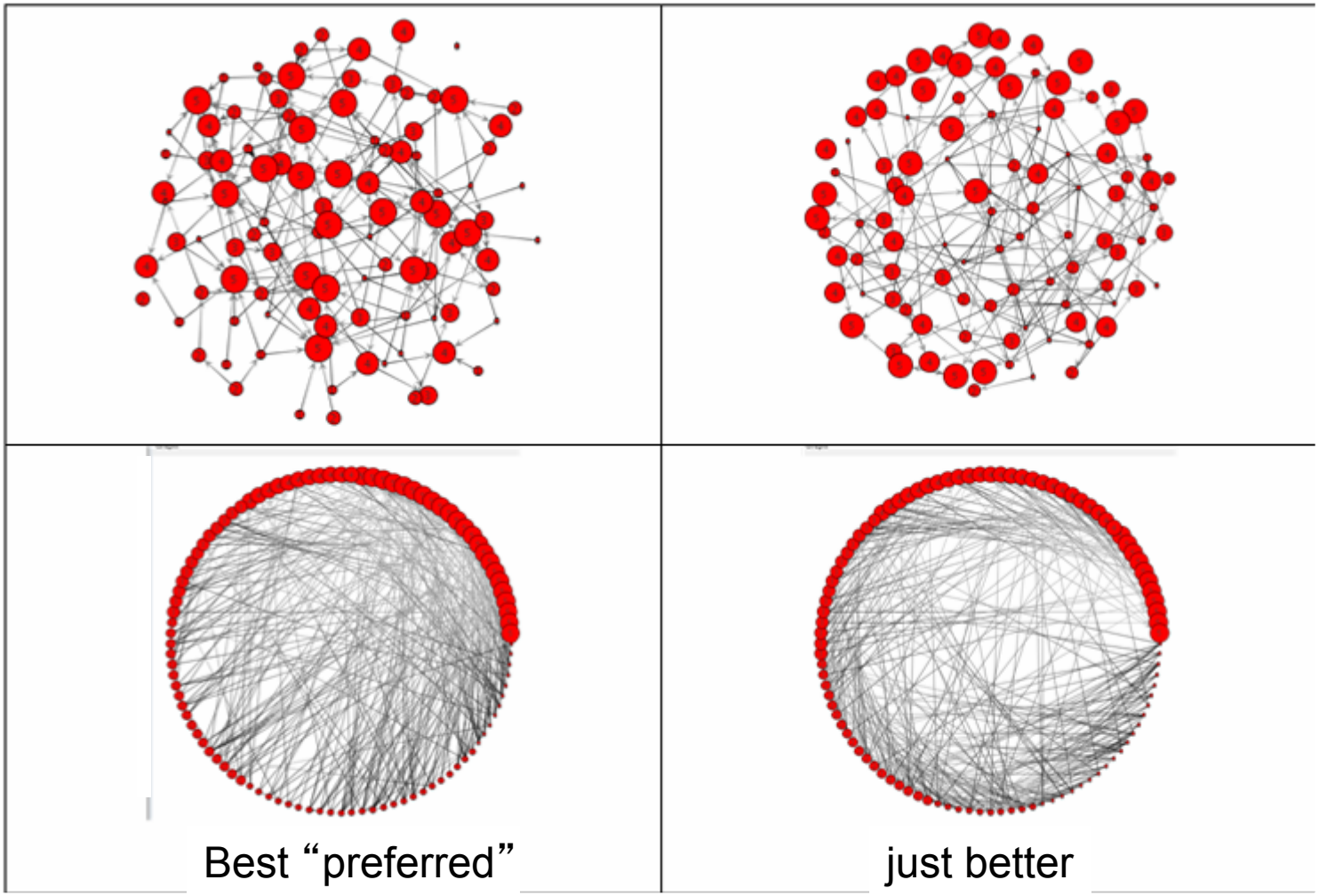

$$p_{ij} \sim e^{\beta(j-i)} / i$$

**'just better' preferred**




$$p_{ij} \sim e^{\gamma(i-j)} / i \qquad j>i$$

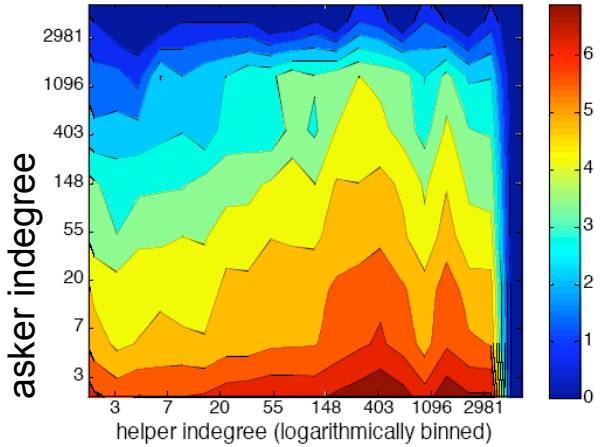
# Visualization



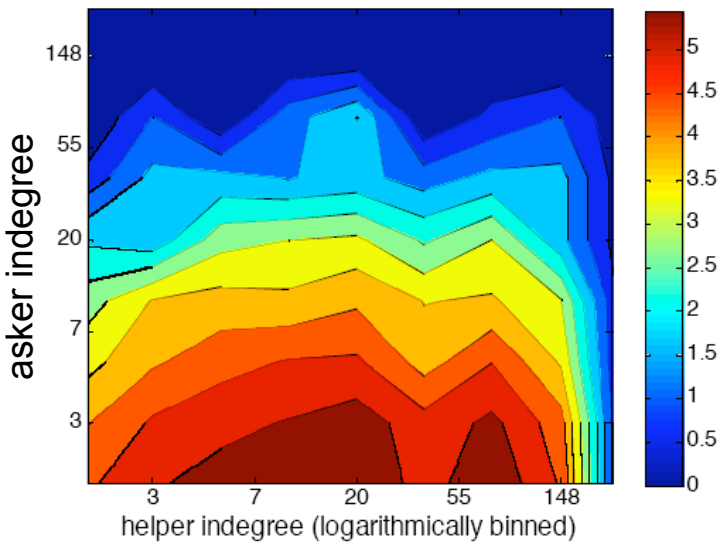
Best “preferred”

just better

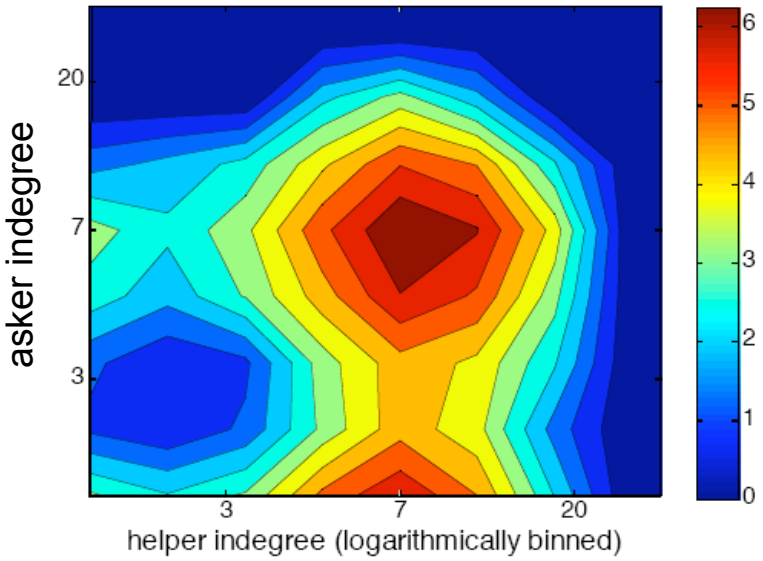
# Degree correlation profiles




Java Forum Network

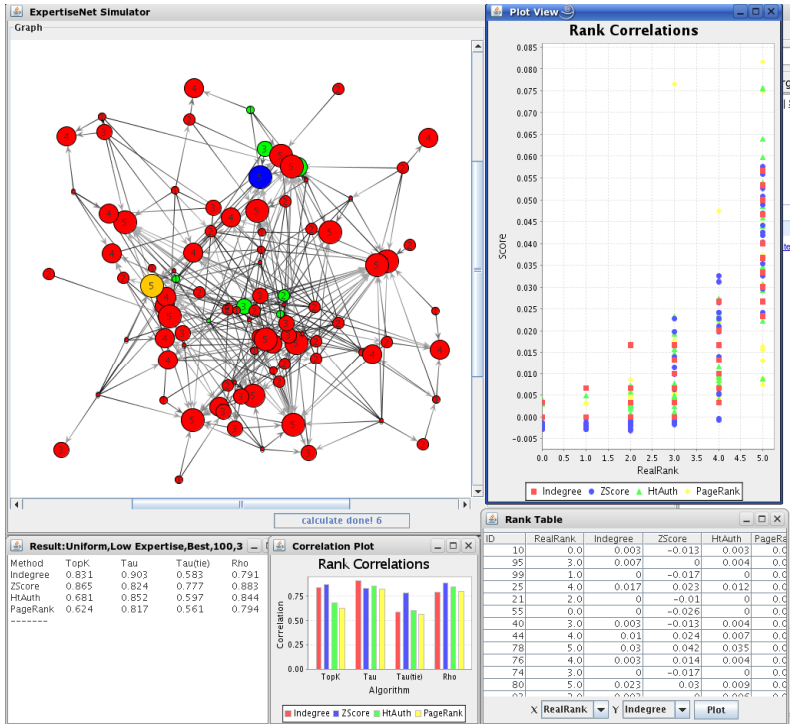


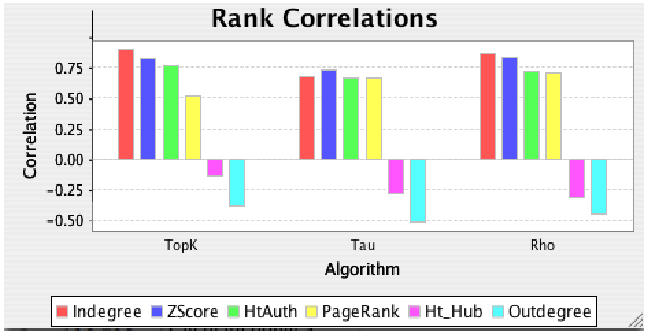

best preferred (simulation)



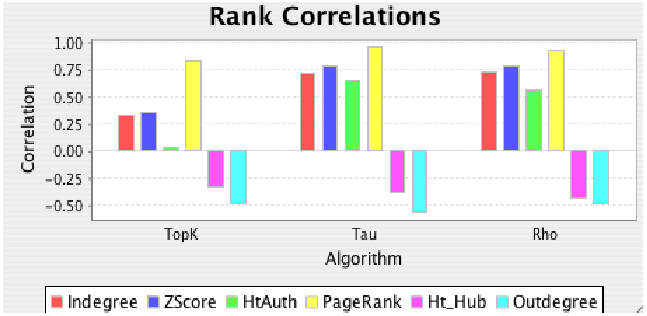

just better (simulation)

# Algorithm selection



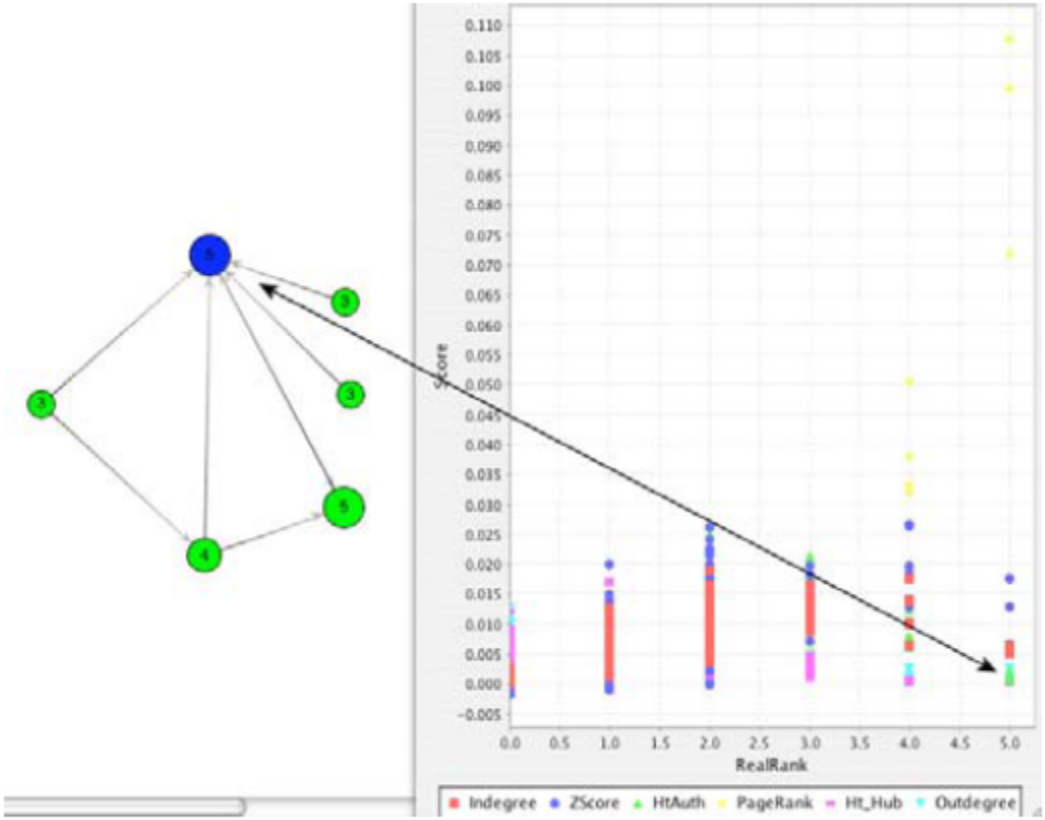




Preferred Helper: 'best available'




Preferred Helper: 'just better'

# Algorithm evaluation




In the ‘just better’ model, a node is correctly ranked by PageRank but not by HITS