Expertise Sharing Dynamics in Online Forums

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Outline

1 motivation

2 Java Forum: inferring expertise (WWW2007)

3 Yahoo Answers (WWW2008)
   - Clustering categories
   - Characterizing breadth of users
   - Predicting best answers

4 Witkeys: competing to share expertise (EC and ICWSM 2008)

5 User motivations (CHI 2009)
motivation: millions of users are using the Web to pose and answer questions
“Knowledge search is like oozing out knowledge in human brains to the Internet. People who know something better than others can present their know-how, skills or knowledge”

NHN CEO Chae Hwi-young
Limitations of current systems

Automatically inferring expertise could be helpful

- response time gap
- expertise gap
- difficult to infer reliability of answers
related work: study of online communities

- NetScan (Smith, Fisher, et al.)
  “Answer People"
- Motivations in online participation
  (Lakhani & Hippel, Kraut)
- Expertise recommenders
  - ContactFinder (Krulwich et al.),
    Answer Garden (Ackerman)
  - Small Blue (Lin)
- Automatic evaluation of expertise levels
  - Using different text resources
    (Kautz, et al, and a lot of others)
  - Using email networks (Campbell et al.)
related work: QA sites

- Harper et al. how can one obtain good answers?
  - CHI 2008: paying for (Google) Answers lead to higher answer quality than not (Yahoo! Answers), but free (open) QA sites outperform dedicated experts
  - CHI 2009: automatically identify question types, predict answer quality

- Agichtein et al.: Identifying good answers, facts, experts
  - use text & link analysis, clicks, and community ratings
  - find that good questions lead to good answers

- Gyöngyi et al. (QA Workshop @ WWW2008)
  - using HITS to identify good contributors: good askers attract the attention of good repliers
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2. **Java Forum: inferring expertise (WWW2007)**
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3. **Yahoo Answers (WWW2008)**
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4. **Witkeys: competing to share expertise (EC and ICWSM 2008)**

5. **User motivations (CHI 2009)**
Sun’s 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
Sun’s Java Forum

- ‘answer people’ may reply to thousands of others
- ‘question people’ may elicit many responses

\[ \alpha = 1.87 \text{ fit, } R^2 = 0.9730 \]
Fragment of the Java Forum

Expertise Sharing Dynamics in Online Forums

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Yahoo Answers (WWW2008)
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Witkeys: competing to share expertise (EC and ICWSM 2008)

User motivations (CHI 2009)
Network measures of expertise

- # answers posted
- # users helped
- # zscores for above
- PageRank: helping those who help others
- HITS: good answerers help good askers

PageRank: helping those who help others
HITS: good answerers help good askers
**Relating network structure to expertise**

**Human-rated expertise levels**

- 2 raters
- 135 JavaForum users with >= 10 posts
- inter-rater agreement (t = 0.74, r = 0.83)
- for evaluation of algorithms, omit users where raters disagreed by more than 1 level (t = 0.80, r = 0.83)

<table>
<thead>
<tr>
<th>L</th>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Top Java expert</td>
<td>Knows the core Java theory and advanced topics.</td>
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<tr>
<td>4</td>
<td>Java professional</td>
<td>Can answer all or most of Java concept questions.</td>
</tr>
<tr>
<td>3</td>
<td>Java user</td>
<td>Knows advanced Java concepts.</td>
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<tr>
<td>2</td>
<td>Java learner</td>
<td>Knows basic concepts and can program.</td>
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<tr>
<td>1</td>
<td>Newbie</td>
<td>Just starting to learn java.</td>
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</table>
Automated vs. human ratings

All measures give good agreement. Some simple (non-network) measures work best.
Modeling community dynamics to explain algorithm performance

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
Models of expertise pairing

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

\[ p_{ij} \sim e^{\gamma (i-j)} / i \quad j>i \]

\[ p_{ij} = \text{probability a user of expertise } j \text{ replies to user of expertise } i \]
Resulting networks

Best “preferred”

just better
Degree correlation profiles

Java Forum Network

best preferred (simulation)  just better (simulation)
Simulation can aid in algorithm section

Preferred Helper: ‘best available’

Preferred Helper: ‘just better’
Summary of Java Forum findings

- Expertise Networks have interesting characteristics
- A set of useful metrics
- Ranking algorithms are affected by network structures
- Simulation as an analysis tool
- There are rich design opportunities
  - Find experts with the help of structural information (and content analysis)
  - Predict good answers
  - Re-order questions/answers to match expertise

UIST2007: “Expertise-Level based Interface Personalization for Online Help-seeking Communities”
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What is being shared?

Not everyone is a Java expert, but everyone knows something...

cars & transportation

beauty & style

maintenance & repairs

hair
Why not just search the web?

can’t spell what does this Russian phrase mean? "dobroe utro not horoshee"

common-sense knowledge What will happen if I leave the racks in my gas oven while using the cleaning cycle?

support Q: How do I get rid of my fear of bees?
A1: Being afraid of bees is a pretty reasonable fear...
A2: I’m like that too!

discussion Have conservatives been good for the USA?
Data we collected

- 1 month (Feb. 2007)
- 8,452,337 answers
- 1,178,983 questions
- unique repliers: 433,402
- unique askers: 495,414
- users who are both askers and helpers: 211,372
category popularity and intensity of response

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<th>Computers &amp; Internet</th>
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category: baby names

Ready to Participate?
Get Started!

Categories
- All Categories
- Pregnancy & Parenting
  - Adolescent
  - Adoption
- Baby Names
  - Grade-Schooler
  - Newborn & Baby
  - Parenting
  - Pregnancy
  - Toddler & Preschooler
  - Trying to Conceive
  - Other - Pregnancy & Parenting

Answer
Open Questions

Discover
Resolved Questions

Vote
Undecided Questions

View by: Date | No. of Answers

Should I name my child Liam or Nicholas?
🌟 In Baby Names - Asked by morgan - 0 answers - 2 minutes ago

Another spin on Benjiman?
🌟 In Baby Names - Asked by mothermavc - 0 answers - 4 minutes ago

What do you think of this one for a boy?
🌟 In Baby Names - Asked by the_little_one_said - 4 answers - 9 minutes ago

The name liam ,do you like it a lot, a little or not at all?
🌟 In Baby Names - Asked by morgan - 8 answers - 10 minutes ago

Please suggest a name for my girl baby born on 16.9.2007 at 1.15pm?
🌟 In Baby Names - Asked by AtanuR - 4 answers - 16 minutes ago

Changing the spelling?
🌟 In Baby Names - Asked by the_little_one_said - 4 answers - 17 minutes ago

What is your favorite?
🌟 In Baby Names - Asked by baby_menehune13 - 22 answers - 20 minutes ago
Expertise Sharing Dynamics in Online Forums

motivation
Java Forum: inferring expertise (WWW2007)
Yahoo Answers (WWW2008)
Clustering categories
Characterizing breadth of users
Predicting best answers
Witkeys: competing to share expertise (EC and ICWSM 2008)
User motivations (CHI 2009)

category: alternative science
Are the replies numerous? Lengthy?

- Clustering categories
- Characterizing breadth of users
- Predicting best answers

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Are the same users asker and repliers?

Let $a_{iA}$ and $r_{iA}$ be the number of answers and replies, respectively by user $i$ in category $A$.

asker/replier overlap in $A = \cos(a, b) = \frac{a \cdot r}{\|a\| \|r\|}$

Apply k-means clustering using:
- log(average thread length)
- log(average post length)
- asker/replier overlap
We selected 3 categories which were stably placed in separate clusters: programming, marriage, and wrestling.
differences in interaction: a matter of degree

Botany: red (posted mostly answers), blue (posted mostly questions), size (# of posts)
The answerers do not reply to one another.
A hint of generalized reciprocity: married or divorced users sometimes offer advice & support to one another.
ego networks: wrestling

Discussion leads to mutual interaction: users engage through asking & replying
ecology of expertise

arrows: people who answer in A then ask in B
size: number of other categories users are coming from to ask
hue: number of other categories answerers go to to ask
a measure to reflect breadth: entropy

\[ H_L = - \sum_i p_{L,i} \log(p_{L,i}) \]

And then sum over the levels.

\[ H_T = \sum_L H_L \]
Distribution of entropies for users with >= 40 answers

![Histogram of entropies for users with >= 40 answers]
Low entropy user: $H_T = 0$

All answers are in the Pets > Dogs subcategory

Low entropy user: $H_T = 0$

Member since: November 26, 2006

3,780 points
6%
Level 4
Best answer

About me: I show shelties in Agility, Obedience and Rally. I have shown in the breed ring also. I am a Female person.

Answers | Questions | Starred Questions

View by: All Answers | Best Answers

- If your dog is bit by a rabid animal how will it act?
  1. In Dogs - Asked by Steve K - 7 answers - 3 days ago - Open

- Most likely, what color will a poodle puppy be if the mother is creaminsh and the dad is ch
  1. In Dogs - Asked by Hale J - 12 answers - 4 days ago - Open

- What is meant by a dog being 'crate trained'?
  1. In Dogs - Asked by Buu's-baby - 16 answers - 4 days ago - Resolved

- Why does my dog like to dig holes in the dirt of my back yard?
  1. In Dogs - Asked by Cleynol - 25 answers - 1 week ago - Resolved

- How can you train a cocker spaniel?
  1. In Dogs - Asked by Tnterbell - 4 answers - 1 week ago

- How many dogs are you legally allowed to have?
  1. In Dogs - Asked by DogOwner - 13 answers - 1 week ago - Resolved

- How often should raw egg yolk be added to a dogs diet?
  1. In Dogs - Asked by M eyebrows - 10 answers - 2 weeks ago - Resolved
High entropy user: $H_T = 5.75$

$L_1$ entropy: 2.64
$L_2$ entropy: 3.11
Does focus matter?

Metric: percentage of best answers
- best answer is selected by asker
- otherwise is put up to a vote by the community

Answer: No, combined entropy is uncorrelated with percentage of best answers.
Does focus matter for certain types of categories?

Metric: percentage of best answers *in category*
- compute $H_2$ limiting to a single $L_2$ category

<table>
<thead>
<tr>
<th>level 1 category(ies)</th>
<th>Pearson $\rho$ (entropy, % best)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>computers &amp; internet science &amp; math</td>
<td>$-0.22$</td>
<td>$10^{-7}$</td>
</tr>
<tr>
<td>family &amp; relationships</td>
<td>$-0.13$</td>
<td>$10^{-13}$</td>
</tr>
<tr>
<td>sports</td>
<td>$-0.01$</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Answer: Yes, focus does matter when answers sought are factual.
What else matters in predicting best answers?

No matter whether what one seeks is facts, advice, support, or conversation, lengthier replies are appreciated.
What else matters in predicting best answers?

<table>
<thead>
<tr>
<th></th>
<th>Programming</th>
<th>Marriage</th>
<th>Wrestling</th>
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<tr>
<td>answer length</td>
<td>+</td>
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<tr>
<td>thread length</td>
<td>−</td>
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<td>−</td>
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<td># previous best answers</td>
<td>+</td>
<td>+</td>
<td>+</td>
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<td># previous answers</td>
<td>−</td>
<td>−</td>
<td>−</td>
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<td>$R^2$</td>
<td>0.729</td>
<td>0.693</td>
<td>0.692</td>
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The difference: for programming, the users’ past track record is *more* predictive.
summary of Yahoo! Answers findings

- everyone knows something
- user interactions differ by category
- some users are more focused than others (and it matters in technical matters)
- simple metrics hold predictive power for best answers
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Competing to share expertise on Witkey sites
User prestige networks

previously (Java Forum): asker $\rightarrow$ replier
in Task CN: submitter $\rightarrow$ winner

If one of 2 people wins in two tasks, same person wins 77% of the time.
Participation matters

3,100 tasks in total (design, business strategy, programming...)

- more participants, lower average “ExpertiseRank"
- more participants, higher winner’s “ExpertiseRank"

![Graph showing the relationship between number of submitted solutions and number of tasks. The graph indicates a downward trend, suggesting that as the number of submitted solutions increases, the number of tasks decreases.](image-url)
Money matters

- **log(money)**: 0.64
- **log(views)**: 0.77
- **log(submissions)**: 0.43
Strategy matters

Winners tend to choose less popular tasks, and both winners and losers adjust over time.
People who win 5 or more times narrow the intervals between wins.
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Is there a “stable core“?  

Even most active users have intermittent activity.
The “regulars” are better than odds at providing best answers

<table>
<thead>
<tr>
<th>Variable</th>
<th>estimate (se) * 100</th>
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<tbody>
<tr>
<td># answers</td>
<td>-0.001</td>
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<tr>
<td># active weeks</td>
<td>0.170***</td>
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<tr>
<td># active periods</td>
<td>-0.863***</td>
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<tr>
<td>time span (weeks)</td>
<td>0.047.</td>
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\[ R^2 = 0.04 \]
Open question: Are users stepping in for one another?

C/C++ Naver Forum

12 most active users

User motivations (CHI 2009)

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motivation
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Expertise Sharing Dynamics in Online Forums
What motivates users to answer hundreds or thousands of questions? From interviews of 26 highly active Naver KnowledgeIn (Korean Q&A site) users

- Altruism
- Learning
- Hobby
- Business
- Points
Correcting others

Users select unanswered questions. For questions with 2-5 answers, last answer chosen 50% of the time compared to 40% for next-to-last.
future work

- augmenting interfaces to match expertise
- tracing replier strategies over time in question selection
- analyzing the role of community in QA forums
PhD program at SI

- HCI
- social computing
- incentive centered design
- information analysis and retrieval
- + much more
- [http://www.si.umich.edu/phd/](http://www.si.umich.edu/phd/)
Jun Zhang

Mark Ackerman

Jiang Yang

Eytan Bakshy

Kevin Nam

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