A Data-Driven Approach to Question Subjectivity Identification in Community Question Answering

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[2]Google Research
[3]AT & T Labs Research

AAAI 2012, Toronto, Canada

Sometimes the questions are complicated
and the answers are simple.
--Dr. Seuss

what is the capital of canada

Chao Zhou 0 + Share

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What is the capital city of **Canada**
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The **capital of Canada** is Ottawa, Ontario. It was named the national capital by Queen Victoria on December 31, 1857, but the government did not move there ...

Ottawa - Wikipedia, the free encyclopedia
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ˈɒtəwɑː/ or /ˈɒtəwə/) is the **capital of Canada**. It is the second largest city in Ontario and the fourth largest city in the country. The city is located on the south ...
↳ Demographics of Ottawa - Neighbourhoods - Geography of Ottawa - Ottawa River

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The **capital** cities of **Canada** - the national **capital** and **capital** cities of the provinces and territories of **Canada**.

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Map of **Canada** with Provincial **Capitals**

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Wikipedia

Population: 812,135 (2006)
Area: 1,073 sq miles (2,779 km²)
Weather: 59° F, Wind S at 8 mph, 94% Humidity
Local time: 11:15pm Thursday (EDT)
Province: Ontario

3

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Facebook | Google | Major Internet Companies | Technology Trends | The Internet Edit

What will be the next big trend on the Internet after "search" of Google and "social" of Facebook? Edit

Add Question Details

3+ Comments • Post (5) • Wiki • Options • Redirect Question

Answer Wiki

- Mobile
- Influence
- Connecting business to clients dynamically
- Personalization
- Offline-to-Online
- Social Discovery
- Connecting people through the interest graph

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39 Answers

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39 Answers

Research Topic

Automatic Question Answering (AQA)

Research Topic

Information Retrieval

Natural Language Processing

Automatic Question Answering (AQA)

Research Topic

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Research Topic

Automatic Question Answering (AQA)

Automatic **Factual** Question Answering (AFQA)

Automatic **Subjective** Question Answering (ASQA)

Automatic Factual Question Answering

- AFQA
  - Fact, a fixed answer
  - Compute from fact resources, e.g. Wikipedia
  - Harabagiu et al. 2001, Demner-Fushman and Lin 2007

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- IBM Watson
  - Win Jeopardy! Challenge
  - Q: He was president during the War of 1812.
  - A: Who is James Madison?

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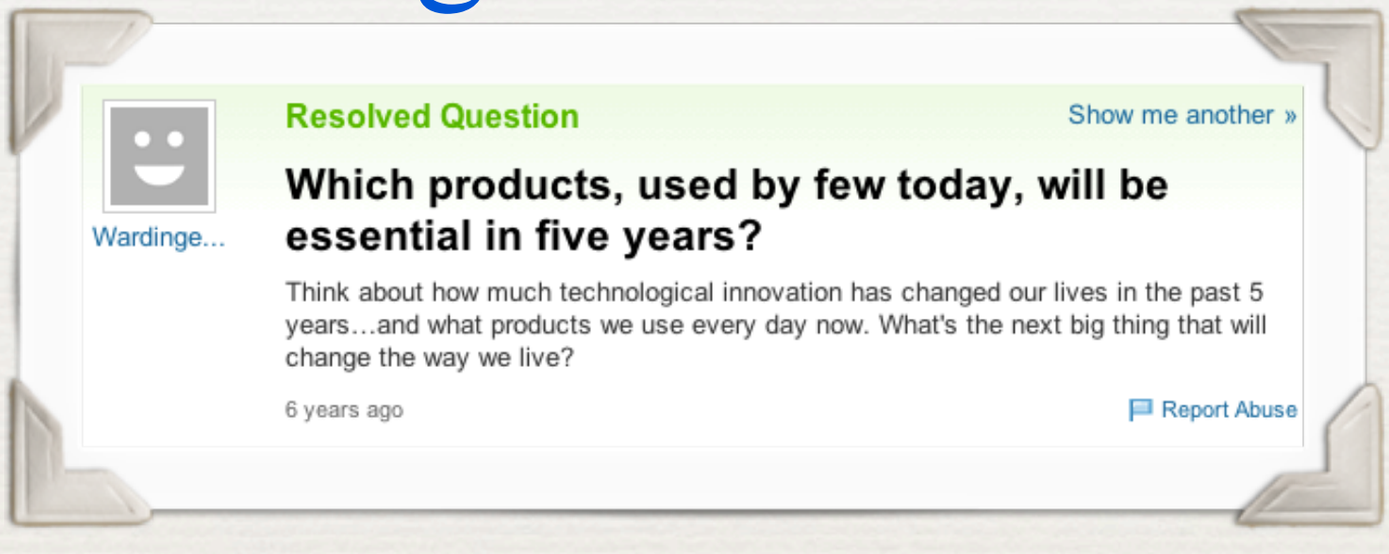
Automatic Subjective Question Answering

- ASQA
  - Opinions
  - Summarized answer, different perspectives
  - Soricut and Brill 2004, Li et al. 2008

Automatic Subjective Question Answering



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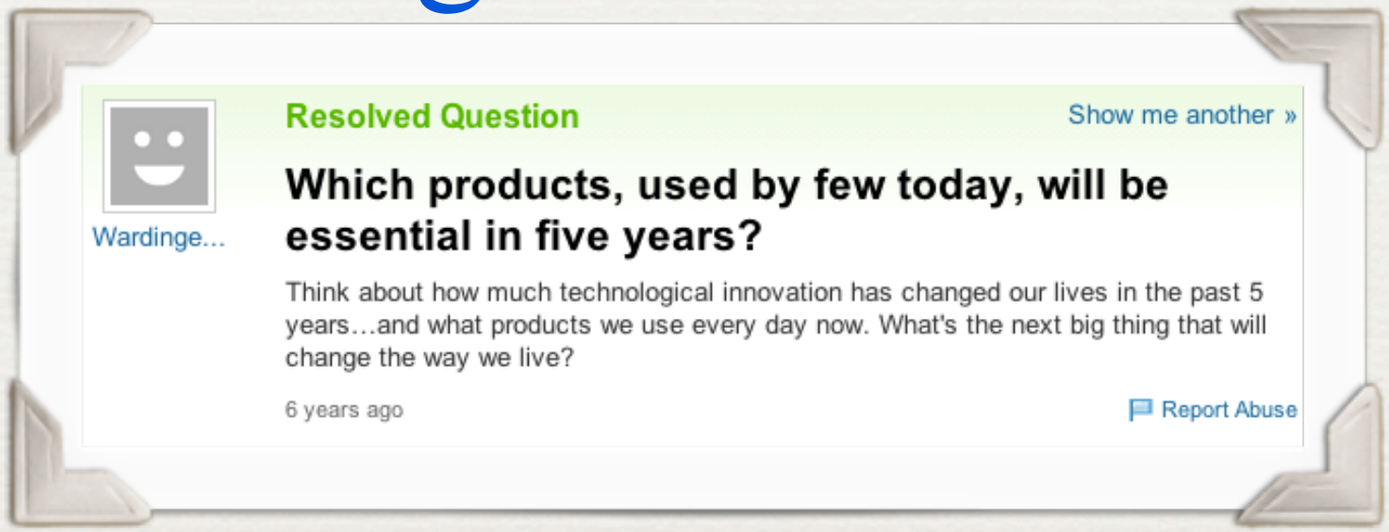

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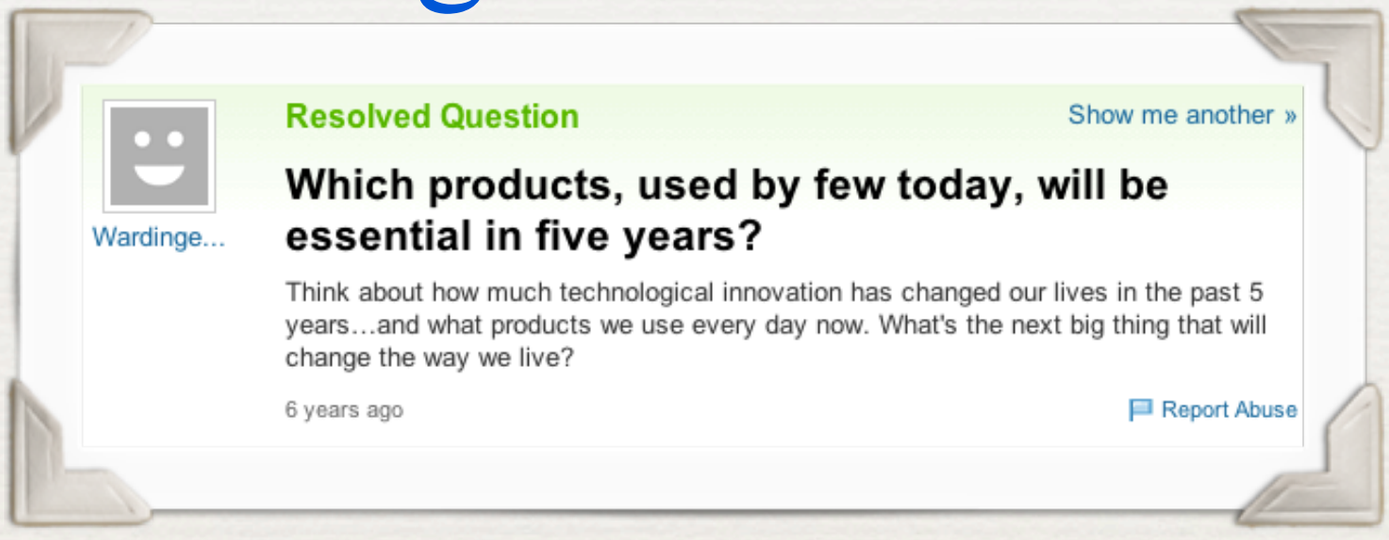

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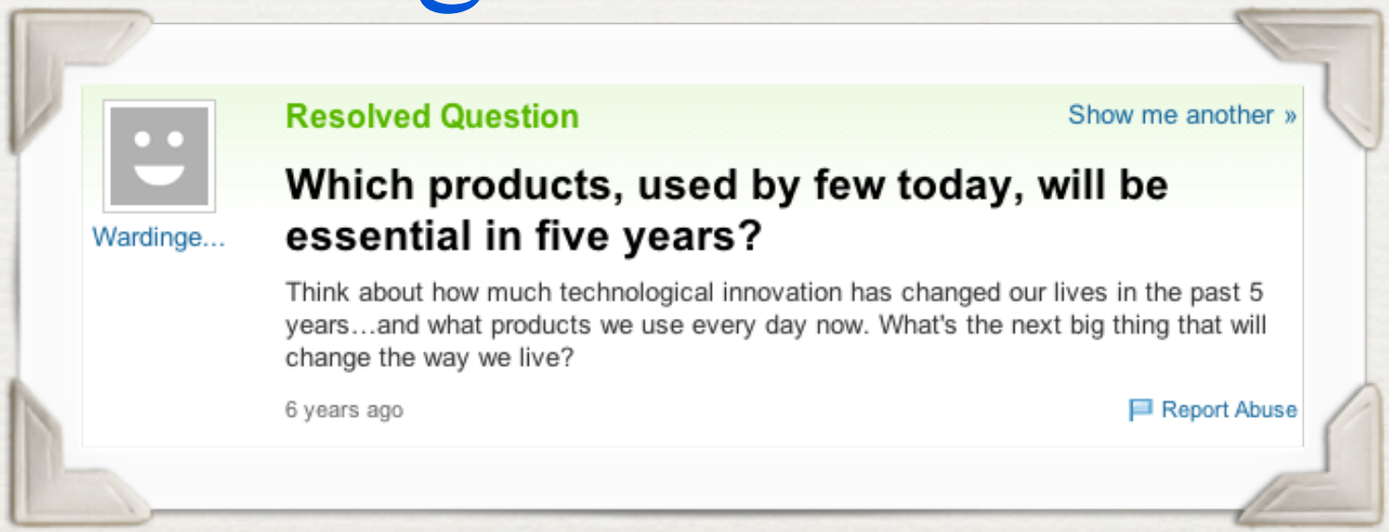

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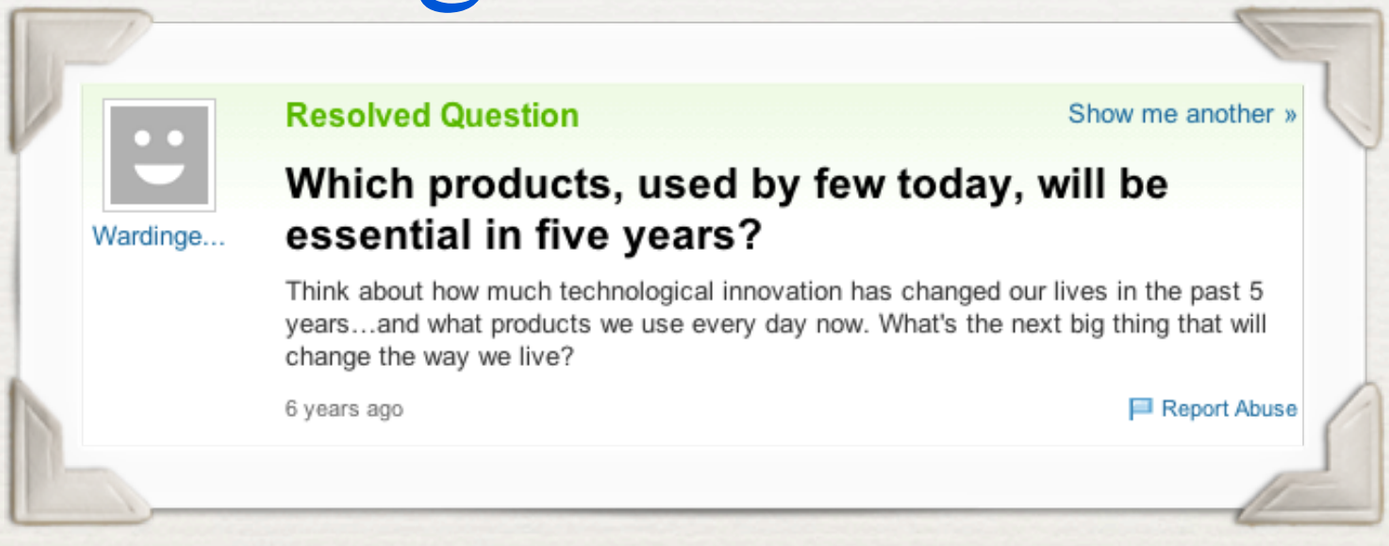

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More challenge!

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Outline

- Motivation
- Social Signal
- Feature
- Experiments
- Related Work
- Conclusions && Future Work

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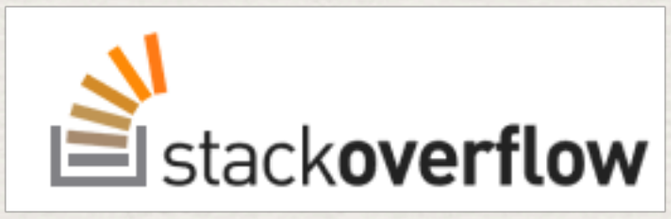
Motivation

- Alternative to ASQA?

Motivation

- Alternative to ASQA?
- Yes! Community Question Answering (CQA)

- Platform
- Post questions
- Answer question
- Give feedbacks



Challenge

- Challenge of using CQA for question analysis
  - Ill-phrased, vague and complex
  - Lack of labeled data

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"Web-scale learning is to use available large-scale data rather than hoping for annotated data that isn't available."

--Alon Halevy, Peter Norvig and Fernando Pereira

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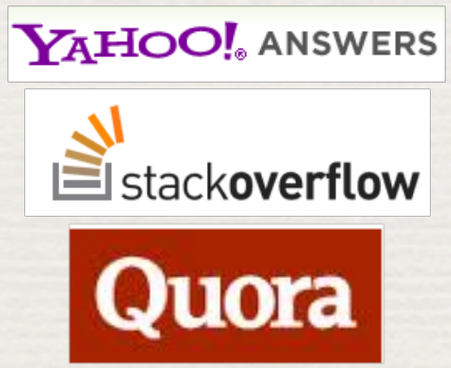
Social Signal



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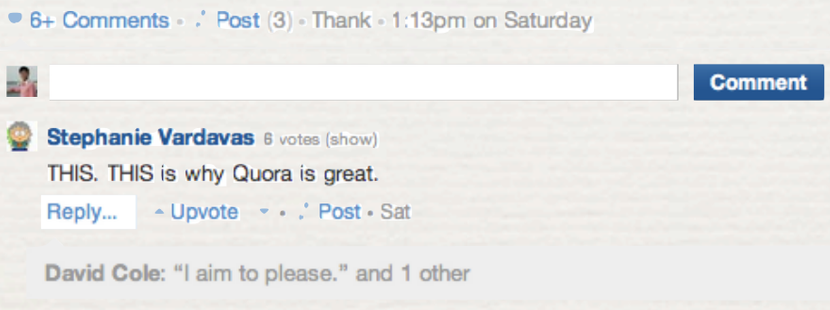
Social Signal



Commenting

YAHOO! ANSWERS

stackoverflow

Quora

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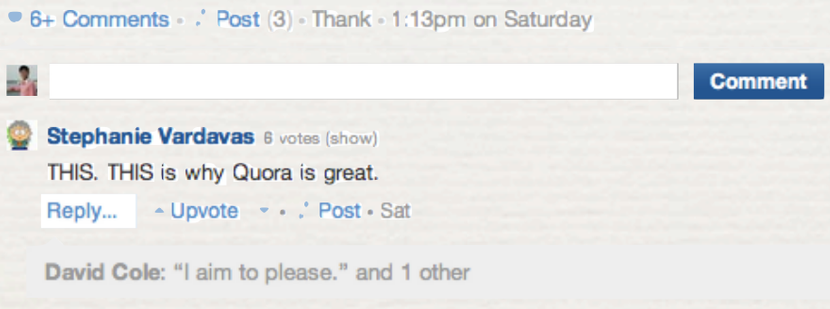
Social Signal



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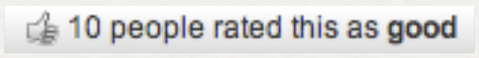

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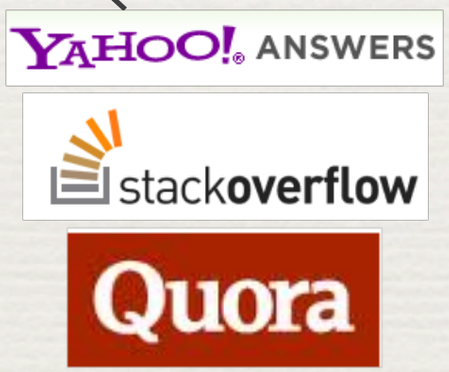

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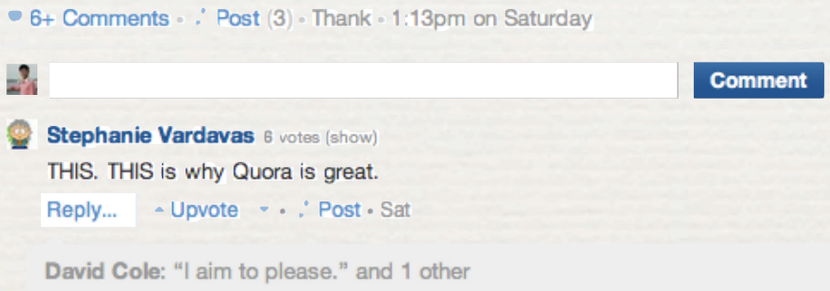

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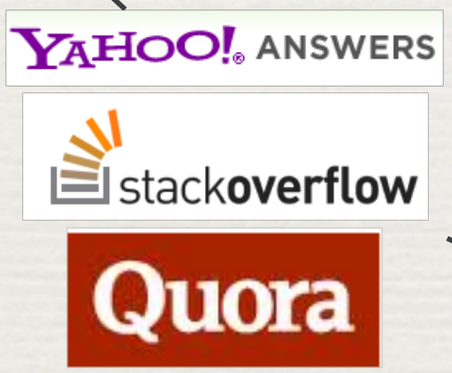

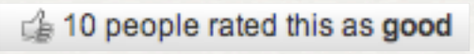

Rating

Voting

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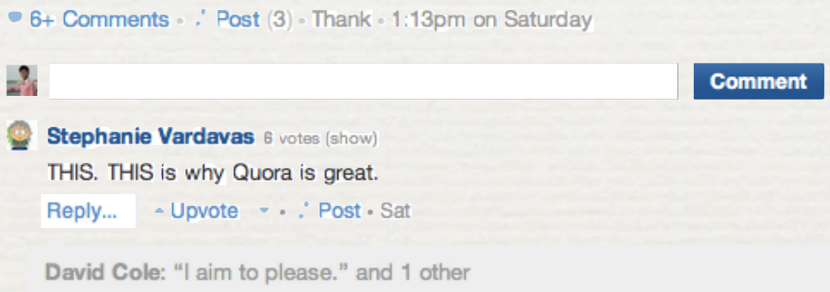
Social Signal

Social Signal



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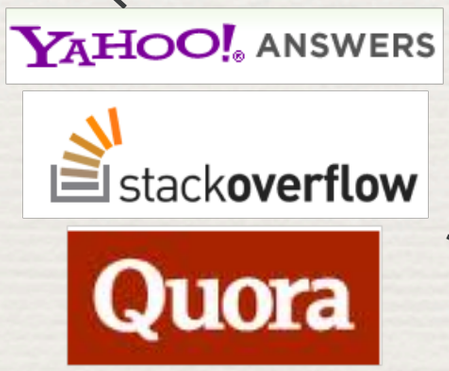

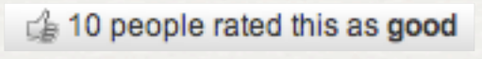

Rating

Voting

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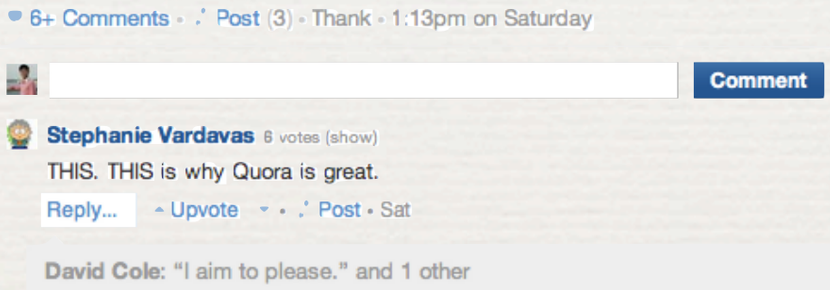
Social Signal

Social Signal



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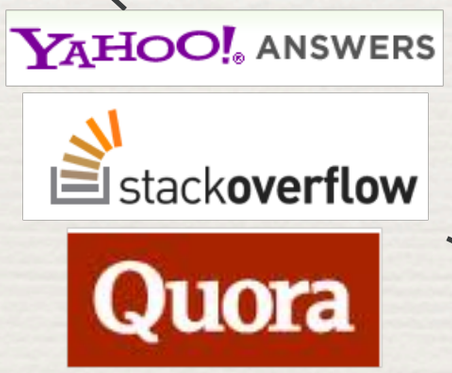


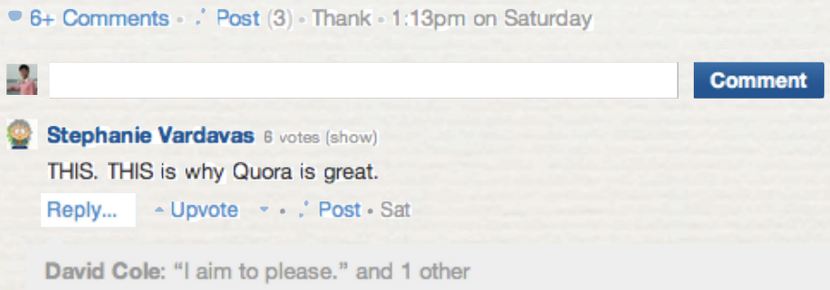
Rating

Voting

Community Wisdom

Social Signal

Social Signal



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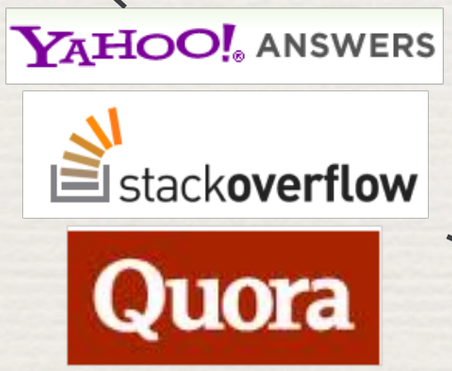

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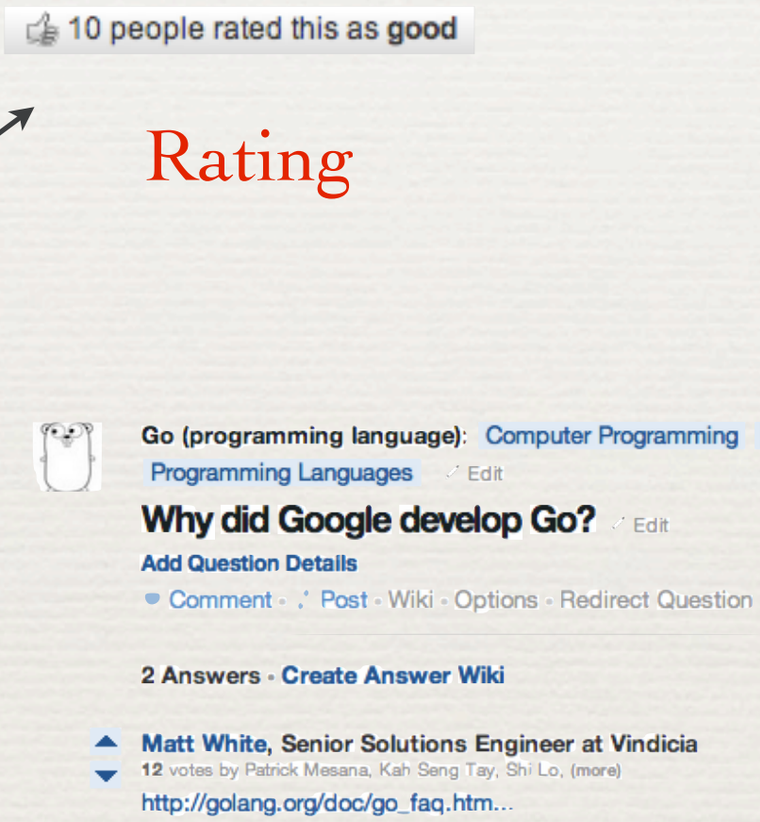

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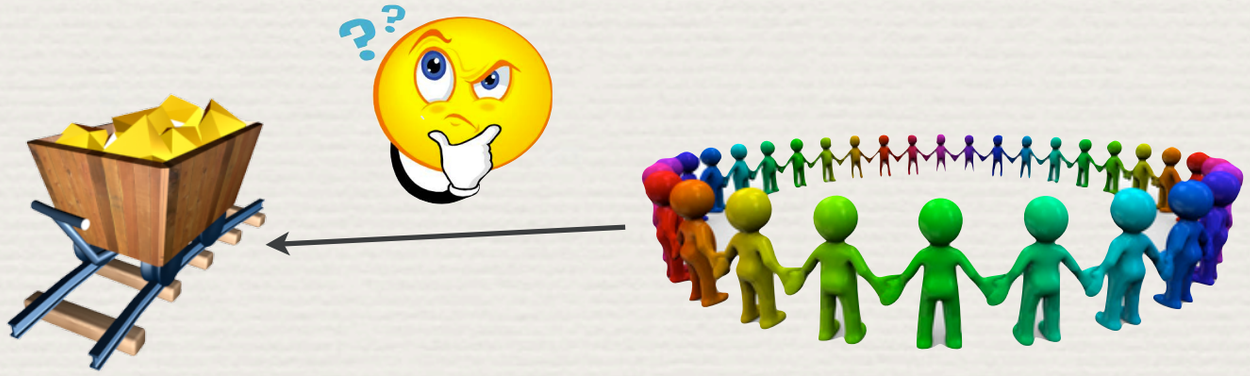

Community Wisdom

Whether we can utilize social signals to collect *training data* for question analysis with NO manual labeling?

13

Motivation

- Question Subjectivity Identification (QSI)
  - A test case

14

Motivation

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- Subjective Question
  - One or more subjective answers

Motivation

- Question Subjectivity Identification (QSI)
  - A test case
- Subjective Question
  - One or more subjective answers
- Objective Question
  - Authoritative answer, common knowledge or universal truth

14

Examples

- Subjective
  - Does anyone remember a book called the “Robe” by Lloyd C. Douglas? What did you think of it?
  - What was your favorite novel that you read?
  - What are the ways to calm myself when flying?
- Objective
  - When and how did Tom Thompson die? He is one of the group of Seven.
  - What makes the color blue?
  - Was Roy Orbison blind?

15

Why Perform QSI?

- More accurately identify similar questions
- Better rank or filter the answers
- Crucial component of inferring user intent
- Subjective question --> Route to users
- Objective question --> Trigger AFQA

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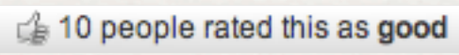
Social Signal

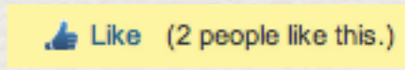
- QSI
  - Classification task
  - Subjective question: positive
  - Objective question: negative

17

Social Signal

- Like: like an answer if they find the answer useful

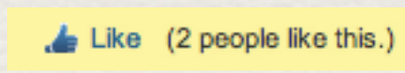




18

Social Signal

- Like: like an answer if they find the answer useful
- Intuition
  - Subjective
    - Answers are opinions, different tastes
    - Best answer receives similar number of likes with other answers
  - Objective
    - Like an answer which explains universal truth in the most detail
    - Best answer receives higher likes than other answers



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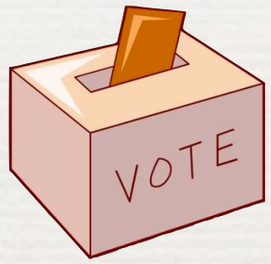
Social Signal

- Vote: users could vote for best answer



Quora

Michael Forrest Jones,
129 votes by Miles Dolphin, Tra

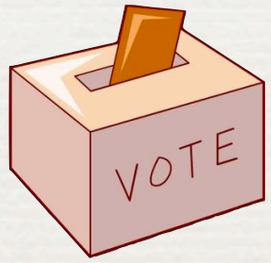
YAHOO! ANSWERS

Baidu 知道

19

Social Signal

- Vote: users could vote for best answer
- Intuition
  - Subjective
    - Vote for different answers, support different opinions
    - Low percentage of votes on best answer
  - Objective
    - Easy to identify answer contains the most fact
    - Percentage of votes of best answer is high



19

Social Signal

- Source: references to authoritative resources

- Intuition
  - Only available for objective question that has fact answer

Who invented the computer mouse?

does anyone know who invented the first Computer mouse and when was it invented?

3 years ago — Report Abuse

Best Answer - Chosen by Asker

A guy called Engelbart - here it is
http://sloan.stanford.edu/MouseSite/Arch...

...mmmmm, sweet!!
Source(s):
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By Mary Bellis

"It would be wonderful if I can inspire others, who are struggling to realize their dreams, to say 'if this country kid could do it, let me keep slogging away'." - Douglas Engelbart

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Social Signal

- Poll and Survey
- Intuition

  - User intent is to seek opinions
  - Very likely to be subjective

21

Social Signal

- Poll and Survey
- Intuition

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- What is something you learned in school that you think is useful to you today?
- If you could be a cartoon character, who would you want to be?

21

Social Signal

- Answer Number: the number of posted answers to each question varies

Social Signal

- Answer Number: the number of posted answers to each question varies
- Intuition
  - Subjective

    - Post opinions even they notice there are other answers
  - Objective
    - May not post answers to questions that haveM received other answers since an expected answer is usually fixed
- A large answer number indicate subjectivity
- HOWEVER, a small answer number may be due to many reasons, such as objectivity, small page views

Summary of Social Signals		
Name	Description	Training Data
Like	Capture users' tastes	Positive && Negative
Vote	Reflect users' judgments	Positive && Negative
Source	Measure confidence on authoritativeness	Negative
Poll and Survey	Indicate users' intent	Positive
Answer Number	Imply users' willingness to answer a question	Positive

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Feature

- Word
  - Effective in many question answering applications
  - Each word is represented with term frequency (tf)

Feature

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  - Each word is represented with term frequency (tf)
- Word n-gram
  - Li et al. 2008 (supervised), Li, Liu and Agichtein 2008 (semi-supervised) observe the performance gain of word n-gram compared with word is not large
  - May be due to sparsity of their small amount of training data
  - Each word n-gram is represented with term frequency

Feature

- Question Length
  - Information needs of subjective questions are complex, users use descriptions to explain, Wang et al. 2010 ==> larger question length
  - Divide into 10 buckets, corresponding bucket number is a feature

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Feature

- Request Word
  - Particular words to explicitly indicate their request for seeking opinions
    - E.g. Should I buy the blackberry torch 9860 or the curve 9380 and why?
- should, might, anyone, can, shall, may, would, could, please
- Total number of request word as a feature

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Feature

- Subjectivity Clue
  - External lexicon, Wilson et al. 2005, over 8000 clues
  - Manually compiled word list from news to express opinions

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Feature

- Punctuation Density
  - Density of punctuation marks
  - Use short sentence segments when sharing their experiences

$$PDensity(Q) = \frac{\#\text{ punctuation marks}}{\#\text{ punctuation marks} + \#\text{ words}}$$

Feature

- Grammatical Modifier
  - Inspired by opinion mining research of using grammatical modifiers on judging users' opinions
  - Adjective and adverb are considered as grammatical modifiers

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Feature

- Entity
  - Objective
    - Expect answer is fact, leading to less relationships among entities
  - Subjective
    - More descriptions, may involve relatively complex relations

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Experiments

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- Comparison Methods
  - Supervised learning with manual labeling
  - CoCQA, co-training, state-of-the-art, Li, Liu and Agichtein 2008

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  - Yahoo! Answers, 4,375,429 questions with associated social signals
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  - Ground truth: adapted from Li, Liu and Agichtein 2008
- Classification Method
  - Naive Bayes with add-one smoothing, more effective than SVM
  - Parallelized using MapReduce

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Experiments

Performance of word n-gram	
Method	Precision on Sub
Supervised	0.6596
CoCQA	0.6861 (+4.2%)
L+V+PS+AN+S	0.6626(+0.45%)
L	0.5714(-13.37%)
V+PS+AN+S	0.6981(+5.84%)
PS+AN+S	0.6915(+4.84%)
V+PS+AN	**0.7214(+9.37%)**
V+AN	0.7201(+9.17%)
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- Why Like signal is not effective? Complex of best answer selection criteria of the asker, social-emotional factor affect a lot, Kim et al. 2007

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Experiments

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CoCQA	0.6432	0.6861 (+6.66%)
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- CoCQA, use several thousand unlabeled data, tackled sparsity to some extent
- Training data collected by social signals, large amount, better solve data sparsity problem

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Experiments

Performance of varying amount of training data				
Method	20%	40%	90%	100%
V+AN	0.6549	0.7004	0.7188	0.7201
AN+S	0.6550	0.6696	0.6842	0.7038
V+PS +AN	0.6640	0.6846	0.7037	0.7214

- Three best performing combinations of social signals
- Increase training data, performances improve

Experiments

Performance of Heuristic Features									
	ngram	+qlength	+rword	+sclue	+pdensity	+gmodifier	+entity	heuristic features	+heuristicf eatures
Precision	0.6596	0.6896	0.6834	0.6799	0.7000	0.6950	0.6801	0.6995	**0.7337 (+11.23%)**

- Adding any heuristic feature to word n-gram improve precision
- Combining heuristic feature and word n-gram achieves 11.23% relative gain over n-gram

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Related Work

- Factual Question Classification
  - Stoyanov et al. 2005, Ferrucci et al. 2010

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- Automatic Question Answering
  - AFQA: Soricut and Brill 2004, Harabagiu et al. 2001, Demner-Fushman and Lin 2007, Ferruci et al. 2001
  - ASQA: Dang et al. 2007 TREC

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  - AFQA: Soricut and Brill 2004, Harabagiu et al. 2001, Demner-Fushman and Lin 2007, Ferruci et al. 2001
  - ASQA: Dang et al. 2007 TREC
- Question Subjectivity Identification
  - Li et al. 2008, Li, Liu, and Agichtein 2008, Aikawa et al. 2011

Conclusions && Future Work

- Conclusions
  - Data-driven approach for QSI by utilizing social signals in CQA with NO manual labeling
  - Study various light-weight features for QSI
    - Experiments indicate effectiveness of proposed approaches
- Future Work
  - Feature investigation: semantic analysis using NLP
  - Characteristics of subjective questions, whether we could find popular semantic patterns for subjective questions

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Thanks!

Q & A

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FAQ

- How to define subjective or objective questions?
  - Ground truth data was created using Amazon's Mechanical Turk service. Each question was judged by 5 qualified Mechanical Turk workers. Subjectivity was decided using majority voting

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FAQ

- Formula of like social signal
  - Positive $L(Q_{best\_answer}) \leq \frac{\sum L(Q_{answer})}{AN(Q)}$
    - L() is number of people like this answer
    - Q_{best_answer} is the best answer
    - Qanswer is an answer of Q
    - AN() is the number of answers of a question
  - Negative $L(Q_{best\_answer}) \geq \alpha \times MAX(L(Q_{other\_answer}))$
    - α is a parameter
    - Qother_answer is an answer except the best answer
    - MAX() is the maximum function

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FAQ

- Formula of vote social signal
  - Positive $V(Q_{best\_answer}) \leq \beta$
    - V() is the percentage of votes of an answer
    - β is a parameter
  - Negative $V(Q_{best\_answer}) \geq \gamma$
    - ϒ is a parameter

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FAQ

- Formula of answer number social signal
  - Positive $AN(Q) \geq \theta$
    - AN() is the number of answers of a question
    - θ is a parameter

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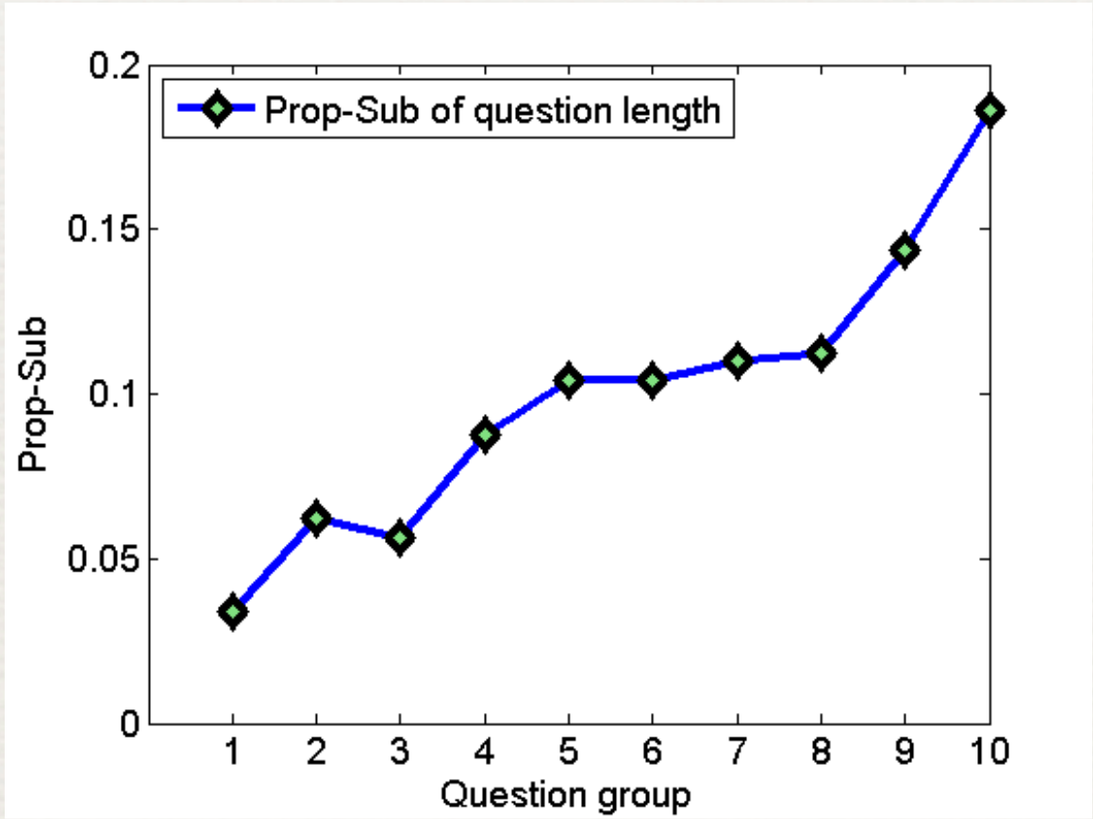
FAQ

- Proportion of subjective questions with respect to questions' lengths
- Objective question, express needs precisely
  - Which player has won the fa cup twice with 2 different teams?
- Subjective question, share his/her personal opinion together with the question
  - Has anyone read "Empire" by Orson Scott Card? This is scary. I especially liked the "Afterword" by him. Its amazing how close you can feel today to it coming true.



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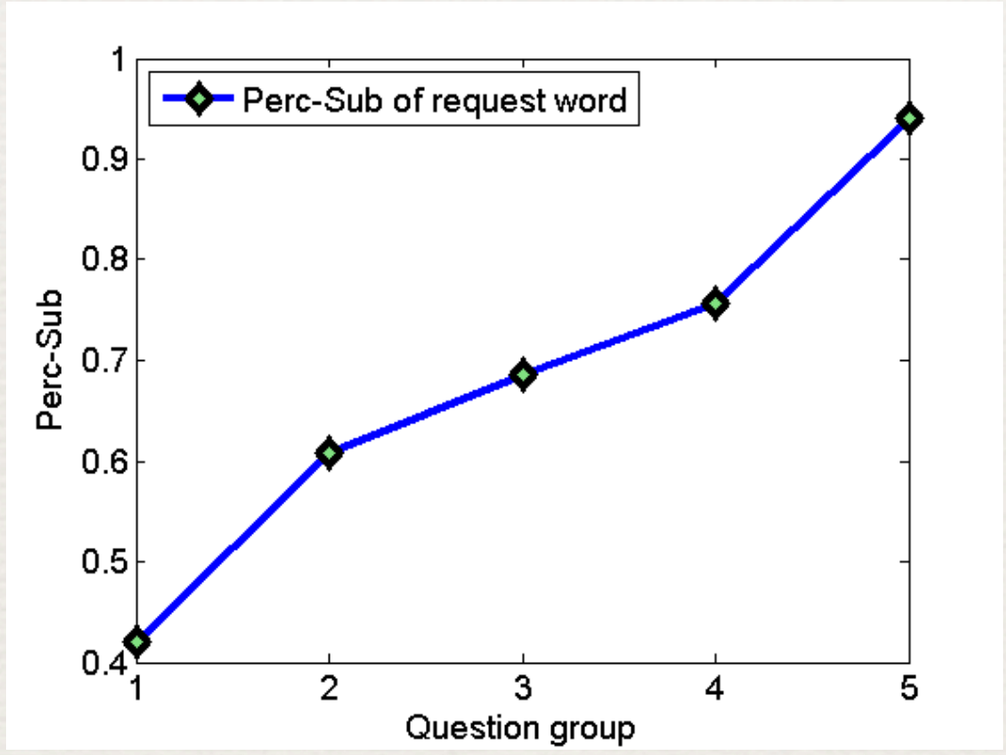
FAQ

- Group 1 contains questions that don't have any request word, groups 2 contains questions having 1 request word, group 3 contains 2 request words, group 4 contains 3 request words, and group 5 contains at least 4 request words

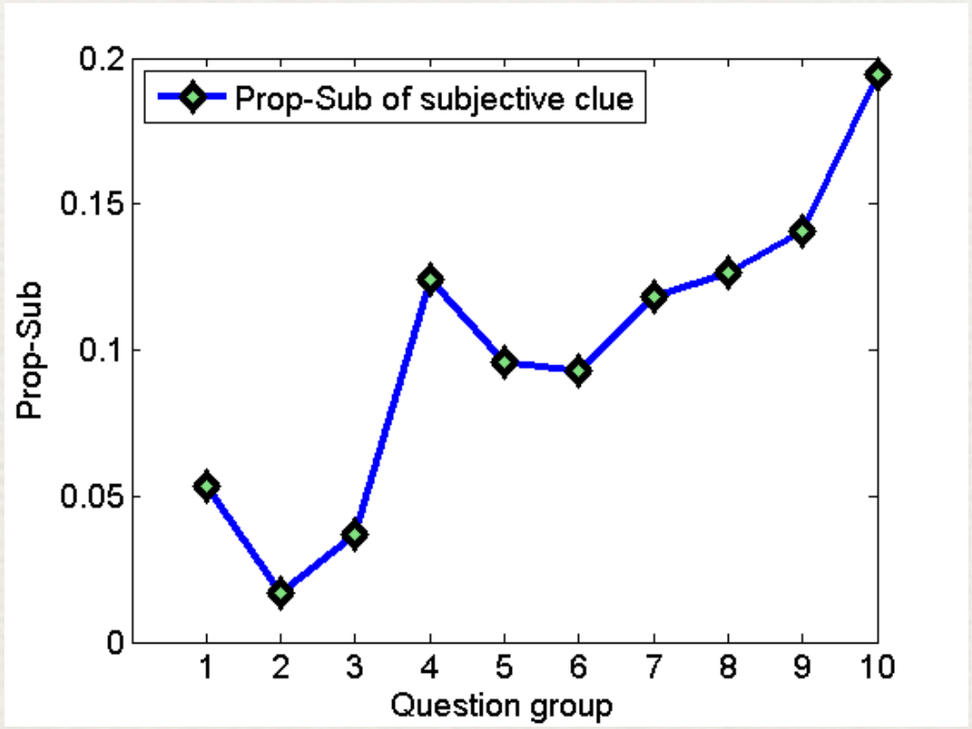
- Percentage of subjective questions among all questions in each group

- Subjective questions
  - Complicated background or detailed opinions
  - Question relatively long
  - Attract potential answerers



FAQ

- External lexicon still help distinguish between subjective and objective questions to some extent



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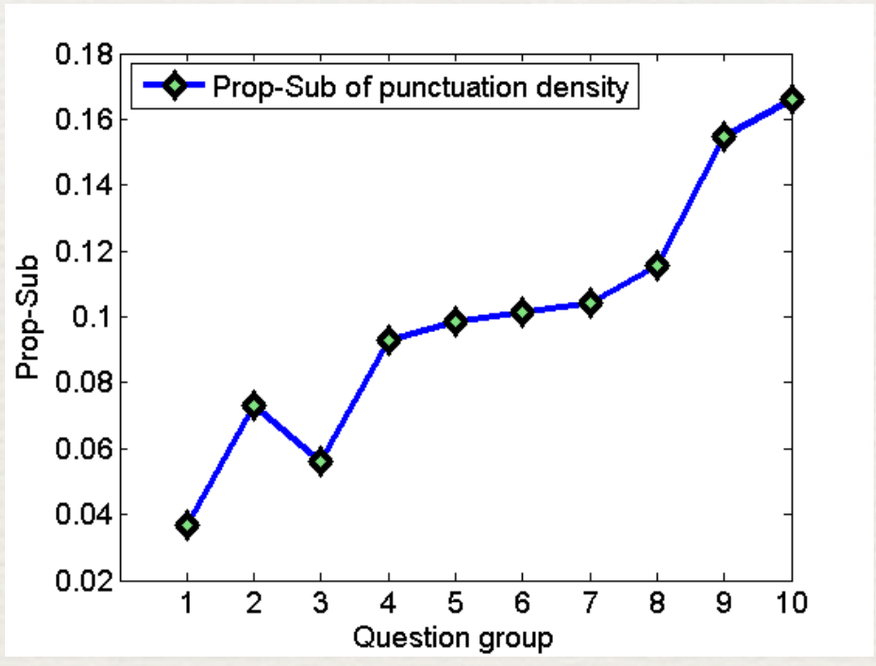
FAQ

- Punctuation mark density of subjective question is higher than that of objective questions

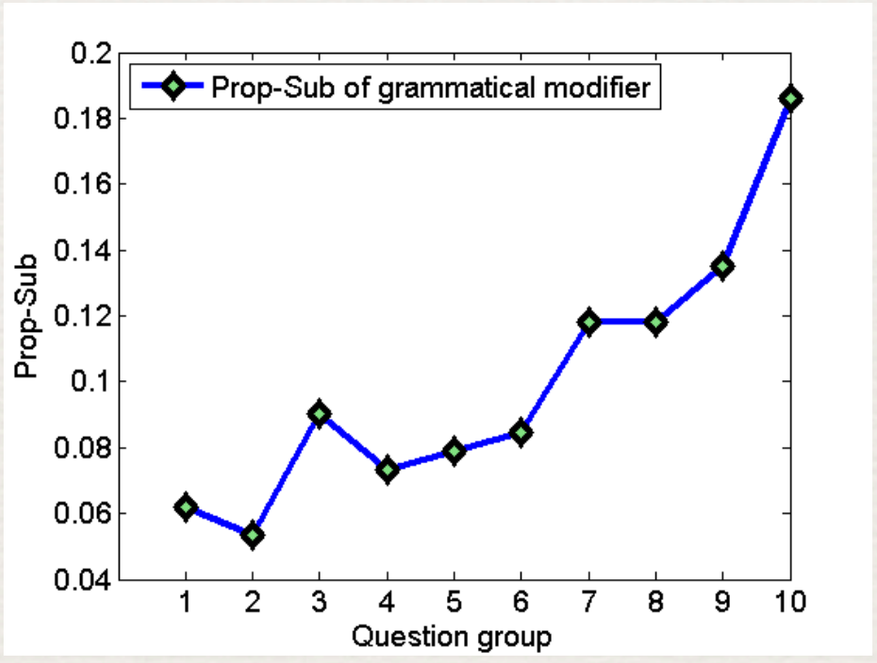
- Use short sentence segments when sharing their experiences in subjective questions

- Short sentences help better express users' feelings and opinions in asking subjective questions



FAQ

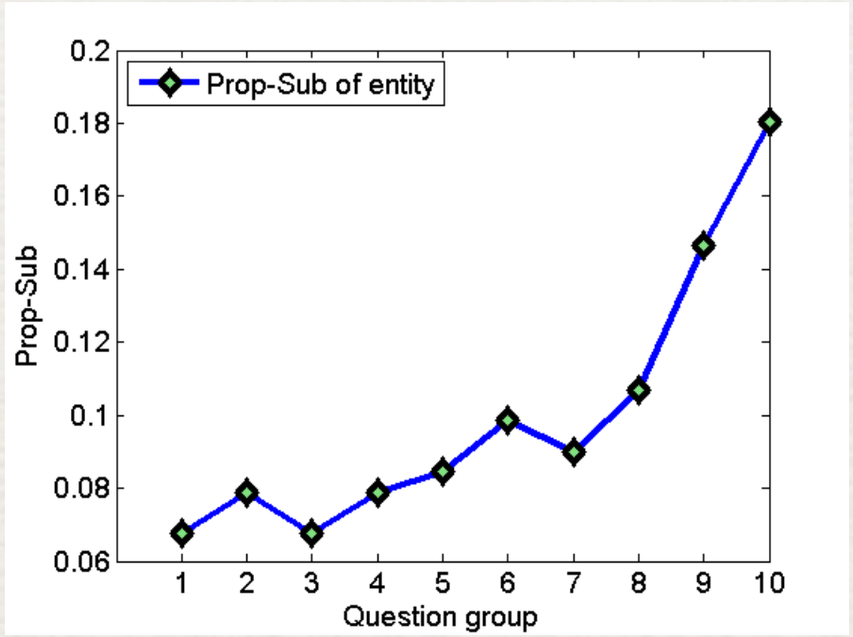
- Grammatical modifiers are commonly used to describe users' feelings, experiences, and opinions in subjective questions



FAQ

- Objective questions involve fewer entities

- Subjective questions involve more descriptions, which also contain entities



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