Min(e)d Your Tags: Analysis of Question Response Time in StackOverflow

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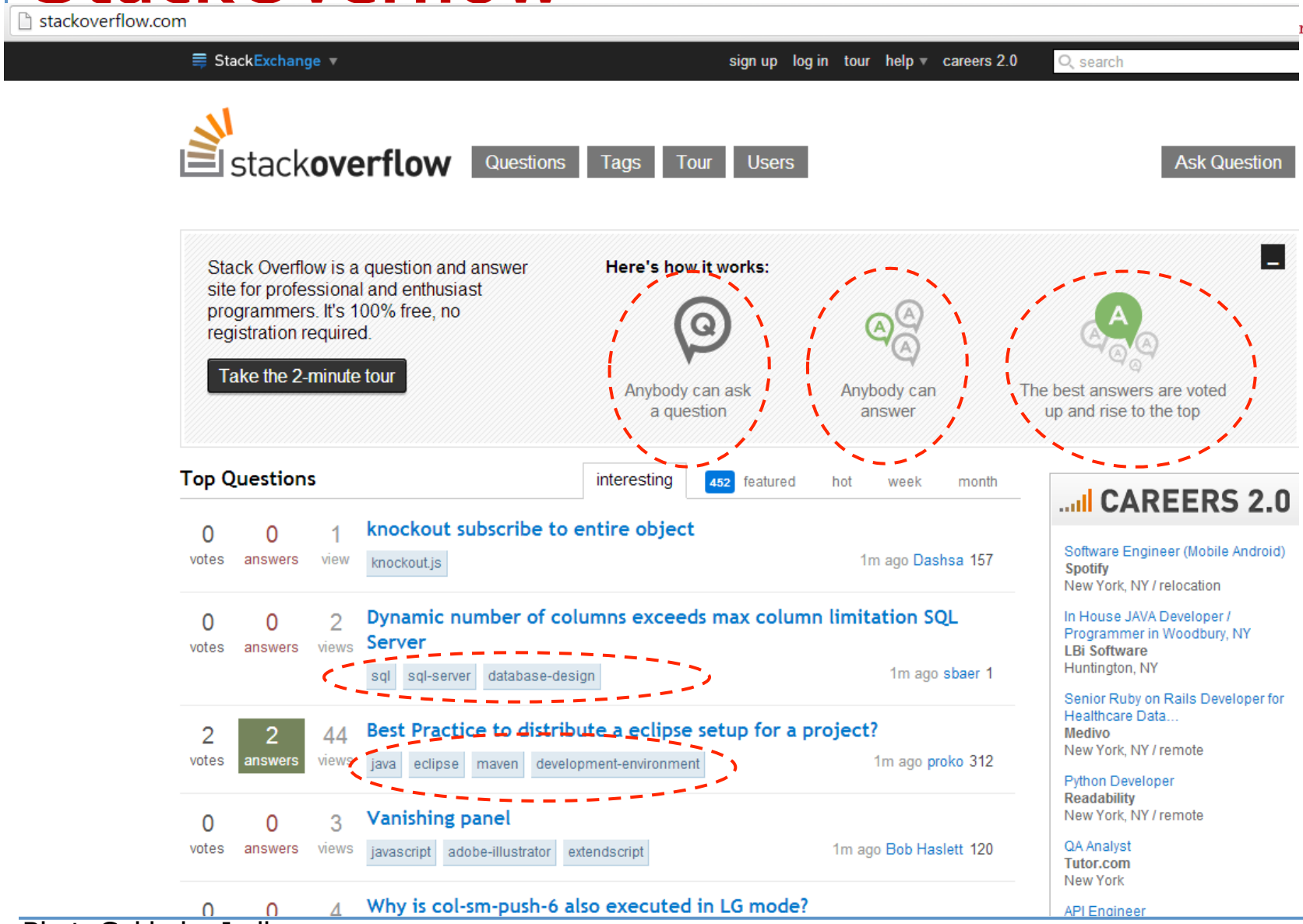
Computer Science

StackOverflow



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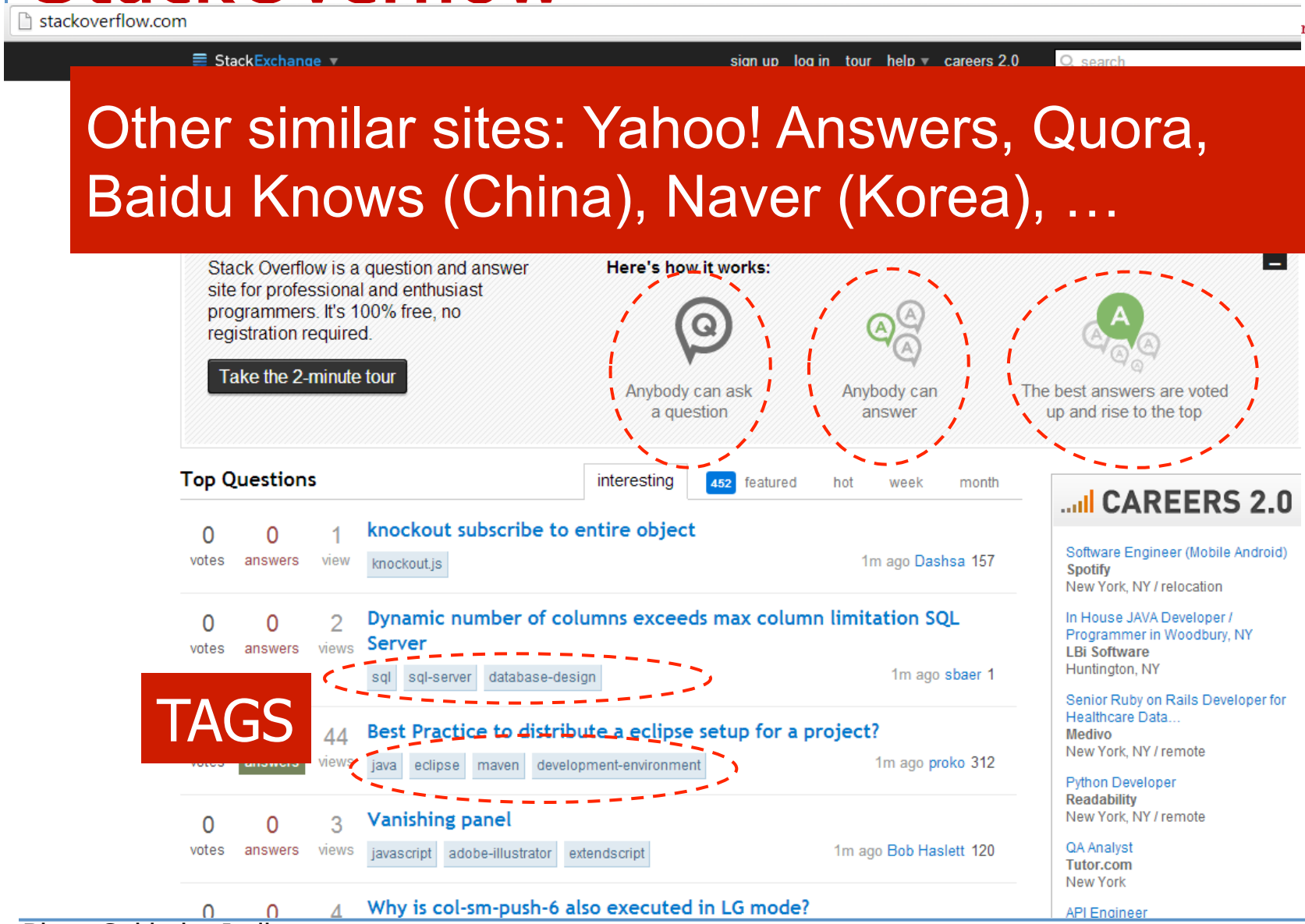

Response Time Distribution

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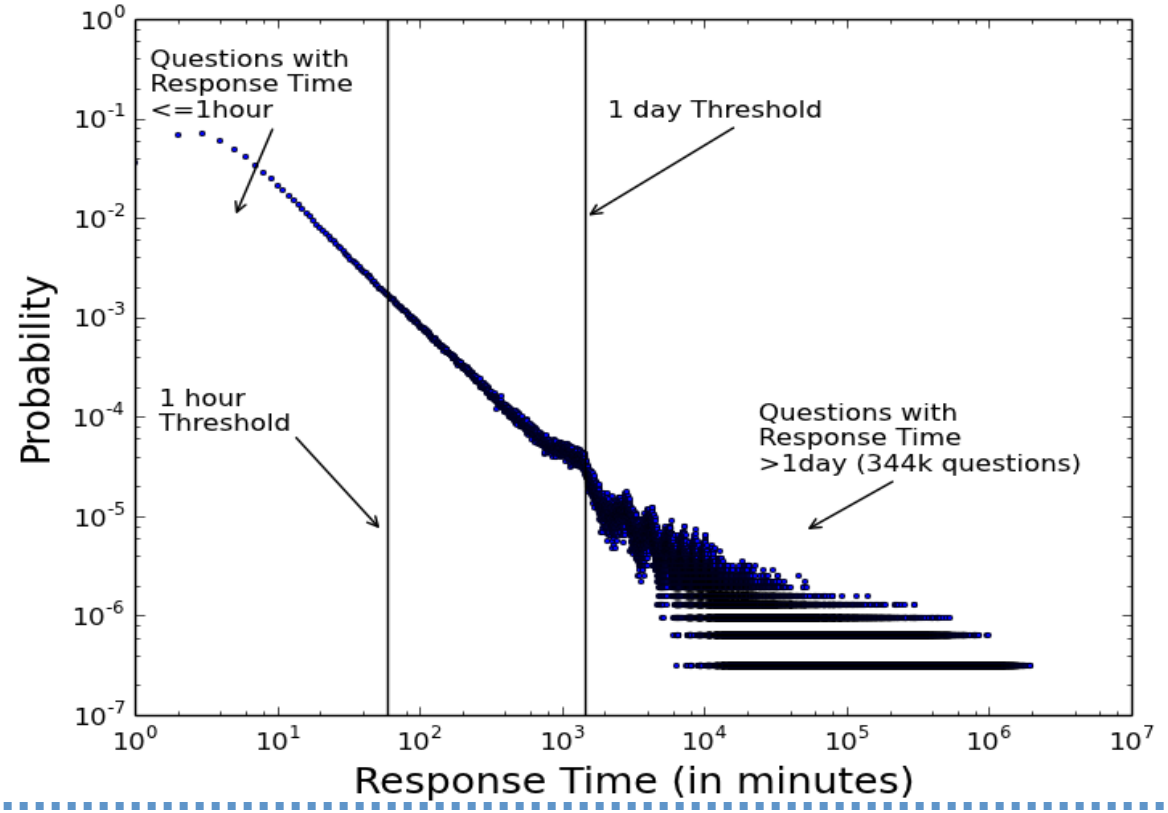
30% of questions not answered within an hour have a response time of more than a day



Research Questions

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- What are the intrinsic factors and signals that are likely to influence a question's response time?
- What site-level information is available that shows significant correlation with response time.
- How do tag-related factors relate to response time?
- Can we predict question response times using the evidential features available on the site? How effective are the tag-based features?

StackOverflow Data Statistics

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- Users: 1.3 million
- Questions: 3.4 million, Answers: 6.8 million
- Questions answered: 91.3%
- Median time to receive an answer: 16 minutes
- Questions answered in ≤ 1hr: 63.5%
- Questions answered in > 1 day: 9.98%
- Expected number of tags a question has: 2.935

2 Prediction Tasks

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Task 1.

Given a question (its tags, body, title, post date),
Predict if it will be answered in $\leq$ 16 minutes (median response time) or not.

Task 2.

Given a question (its tags, body, title, post date),
Predict if it will be answered in $\leq$ 1 hr or $>$ 1 day

Feature Extraction

- We find and organize 2 groups of features likely associated with response time

1

Tag based Question Features
tag_popularity: Average frequency of tags
num_pop_tags: Number of popular tags
tag_specificity: Average co-occurrence rate of tags
num_subs_ans: Number of active subscribers
percent_subs_ans: % of active subscribers
num_subs_t: Number of responsive subscribers
percent_subs_t: % of responsive subscribers

Feature Extraction

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- We find and organize 2 groups of features likely associated with response time

2

Non-tag based Question Features
num_code_snippet: Number of code segments
code_len: Total code length (in chars)
num_image: Number of images
body_len: Total body length (in chars)
title_len: Title length (in chars)
end_que_mark: Whether title ends with question mark
begin_que_word: Whether title starts with 'wh' word
is_weekend: Whether question posted on weekend
num_active_verb: Number of verbs that indicate action
num_selfref: Number of self references of the asker

Feature Analysis: Tag-Based

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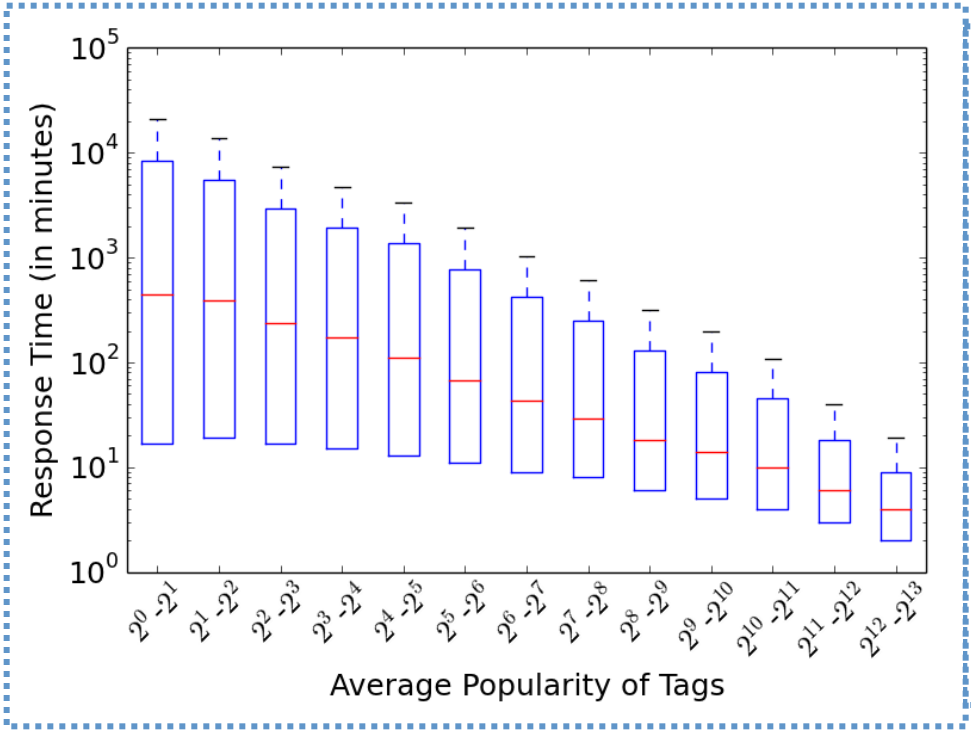
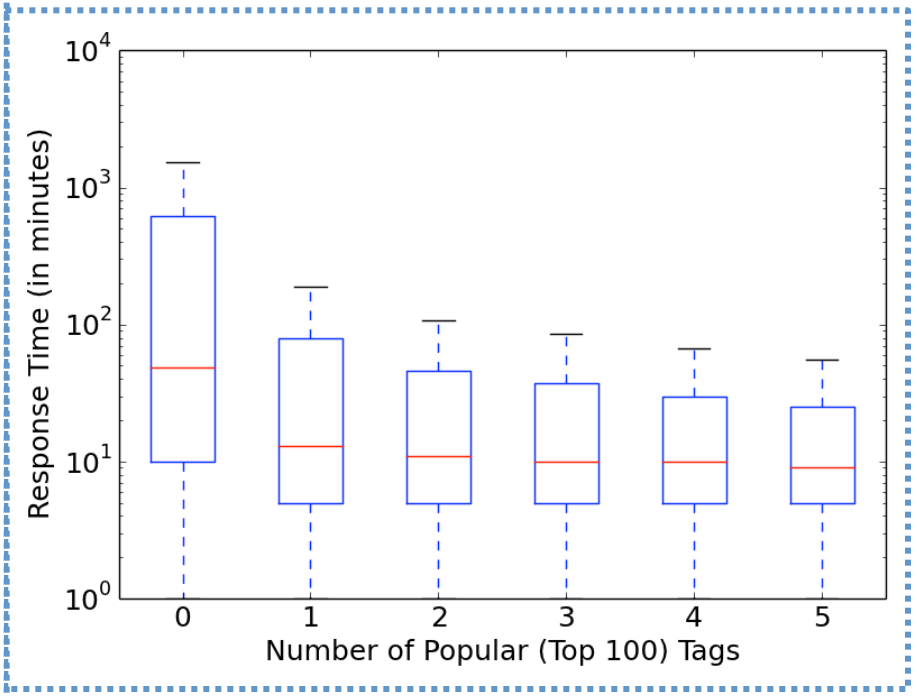
- Tag Popularity





Questions with popular tags receive an early response.

Feature Analysis: Tag-Based

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- Subscribers: 2 Types
  - Active Subscriber:
    - Activeness is associated with the amount of questions with a certain tag that a user is capable of answering.
    - A user who has posted "greater than a threshold δ(ans) number of answers" in the past predefined "number of months δ(mo)".
  - Responsive Subscriber:
    - Responsiveness is associated with the speed with which the user answers questions containing a certain tag.
    - User is a "responsive subscriber" of a tag t if his average response time for questions containing t and posted in "recent past" is less than a threshold δ(t).

Feature Analysis: Tag Based

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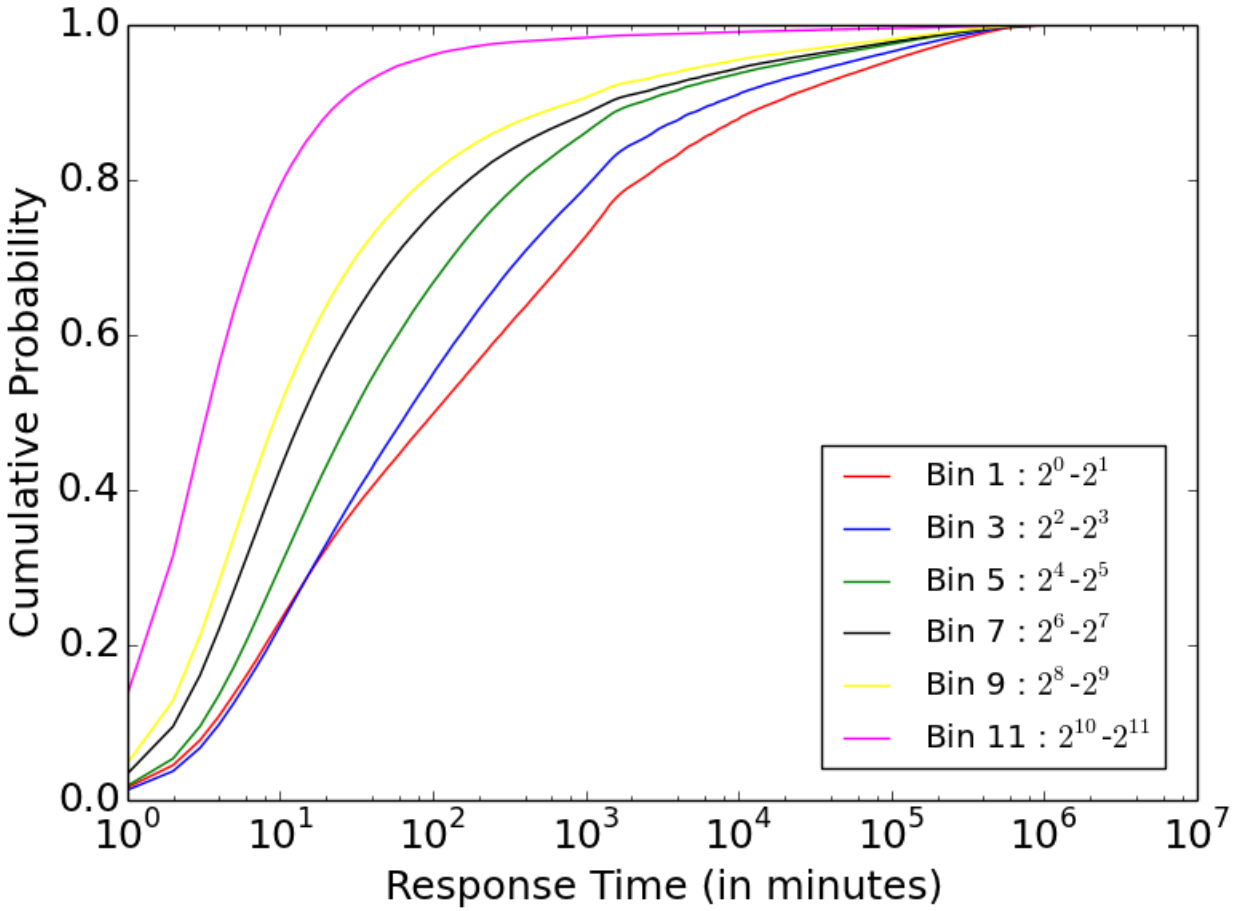
- Active Subscribers



Higher bin numbers correspond to larger subscriber count and lower response time.

Feature Analysis: Tag Based

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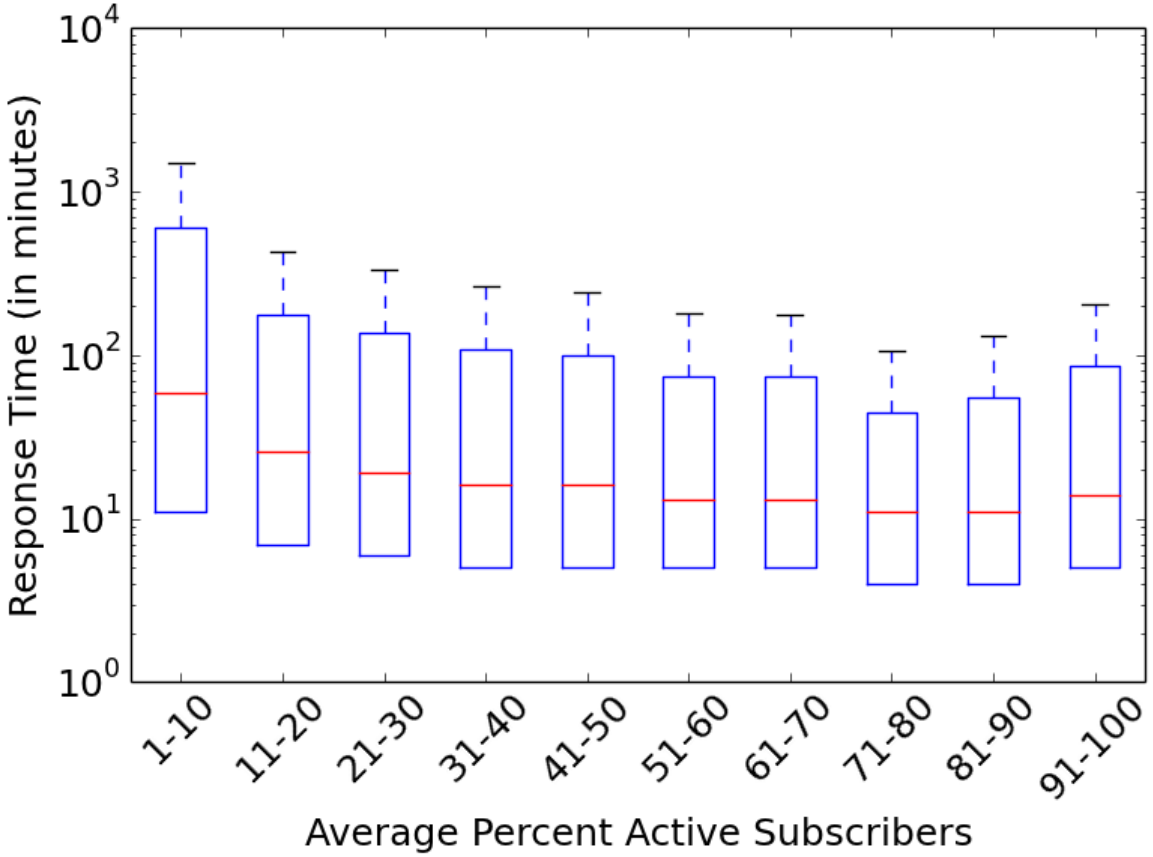
- Percent Active Subscribers



Greater the percentage of active subscribers, lesser is the response time.

Feature Analysis: Tag Based

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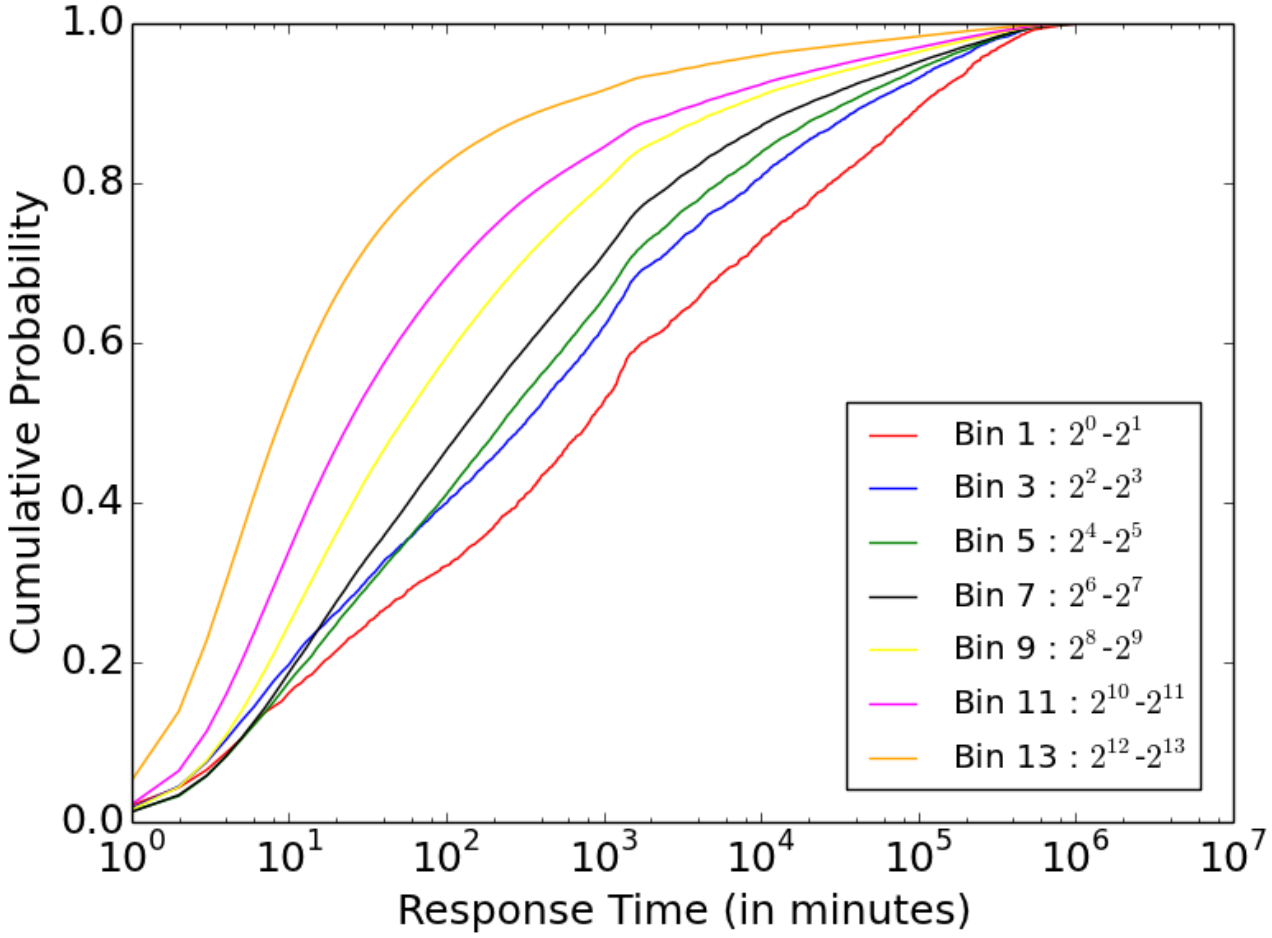
- Responsive Subscribers



Higher bin numbers correspond to larger subscriber count and lower response time.

Feature Analysis: Tag Based

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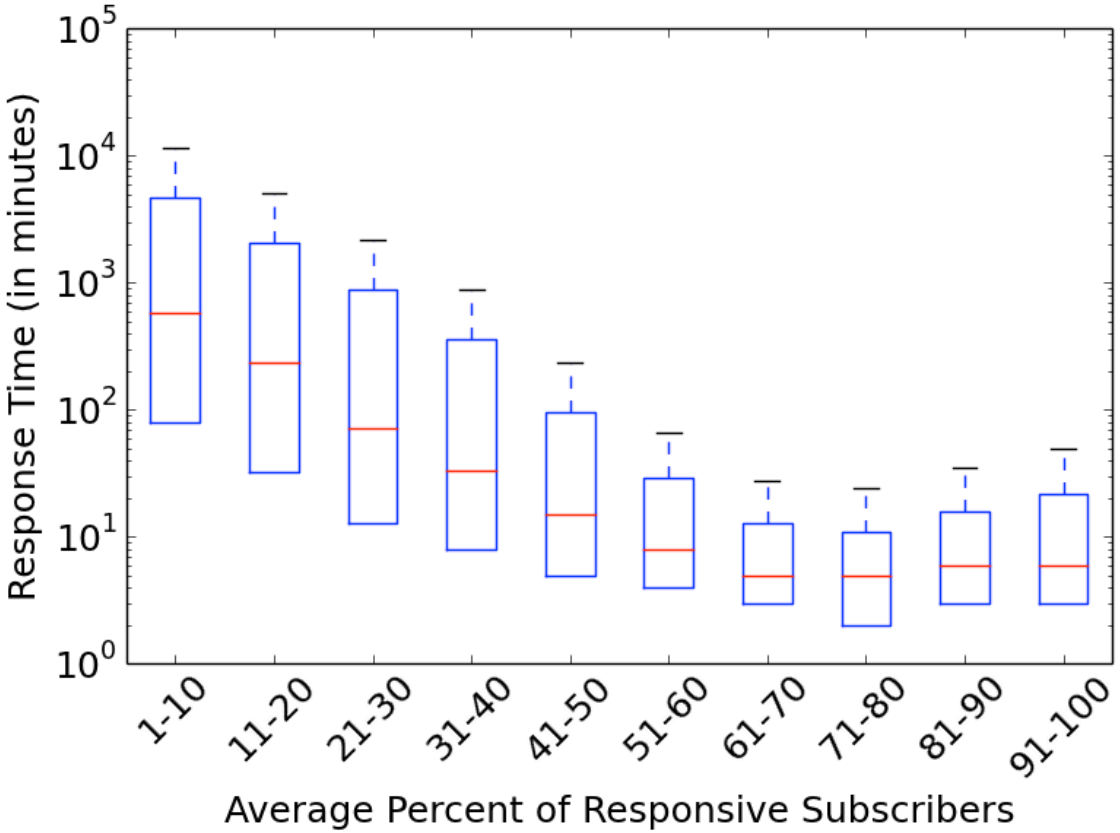
- Percent Responsive Subscribers



Greater the percentage of responsive subscribers, lesser is the response time.

Feature Analysis: Tag Based

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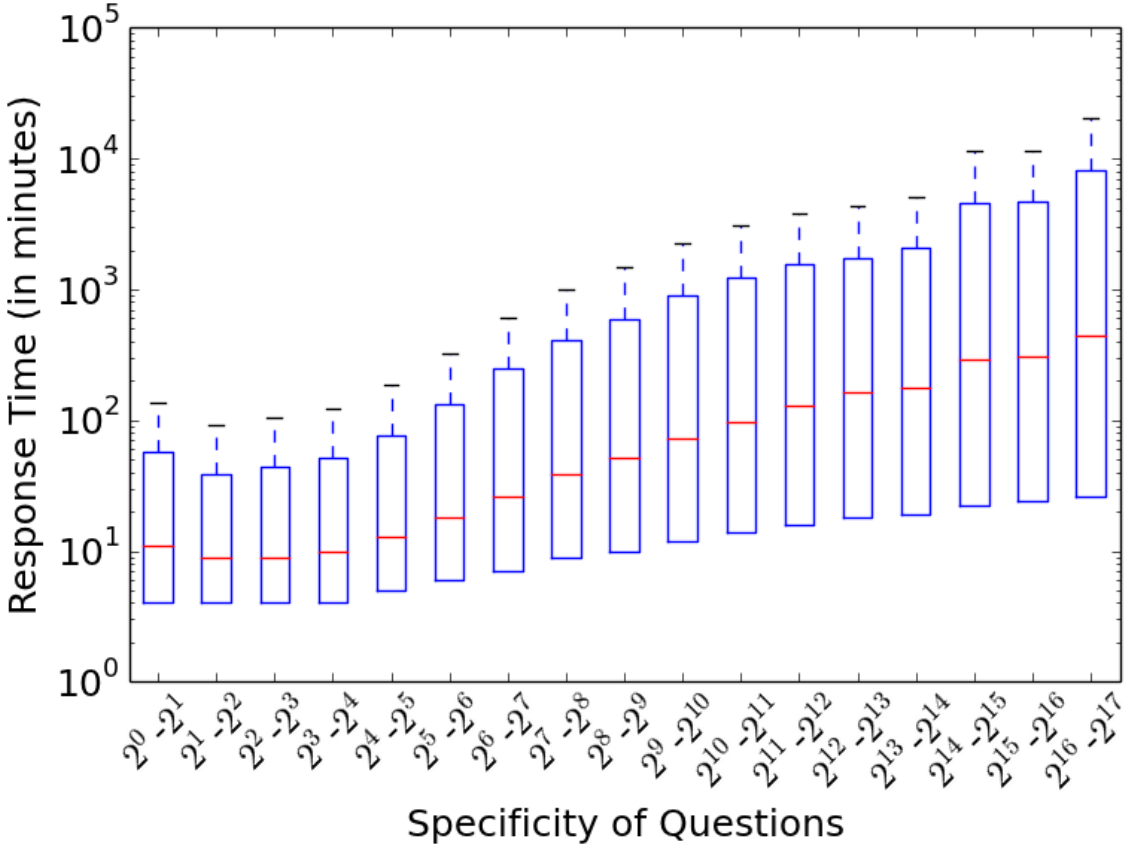
- Specificity: Pairwise togetherness of tags in a question



More the Specificity, greater is the response time

Feature Analysis: Non-Tag Based

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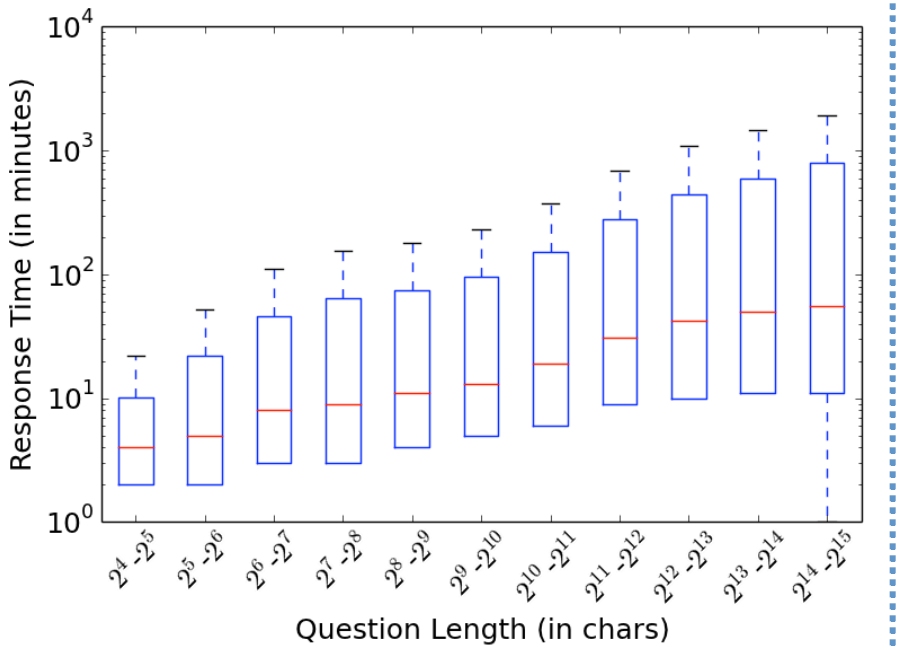
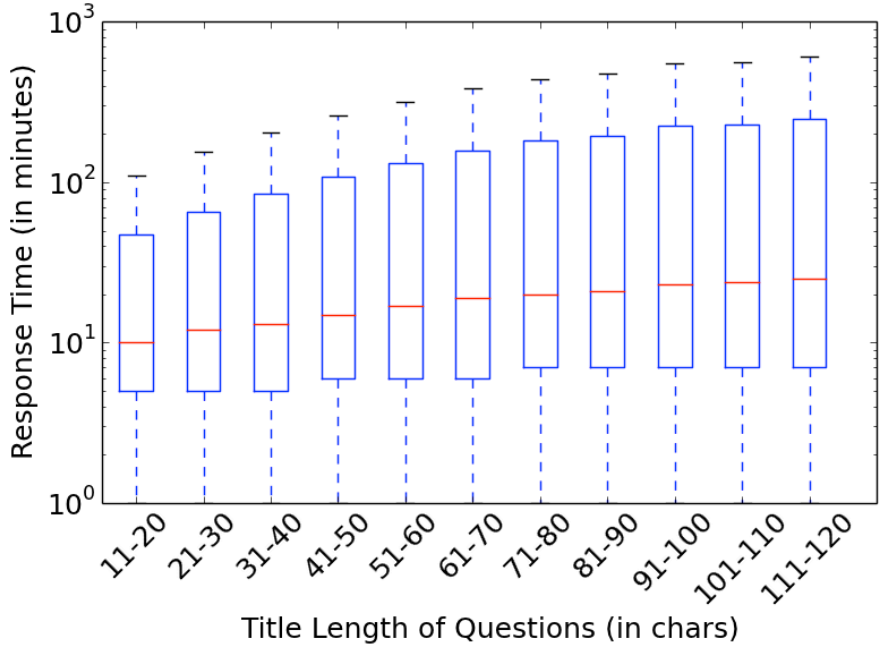
- Body Length



- Title Length



Questions with smaller length (body/title) receive quicker response.

Feature Analysis: Non-Tag Based

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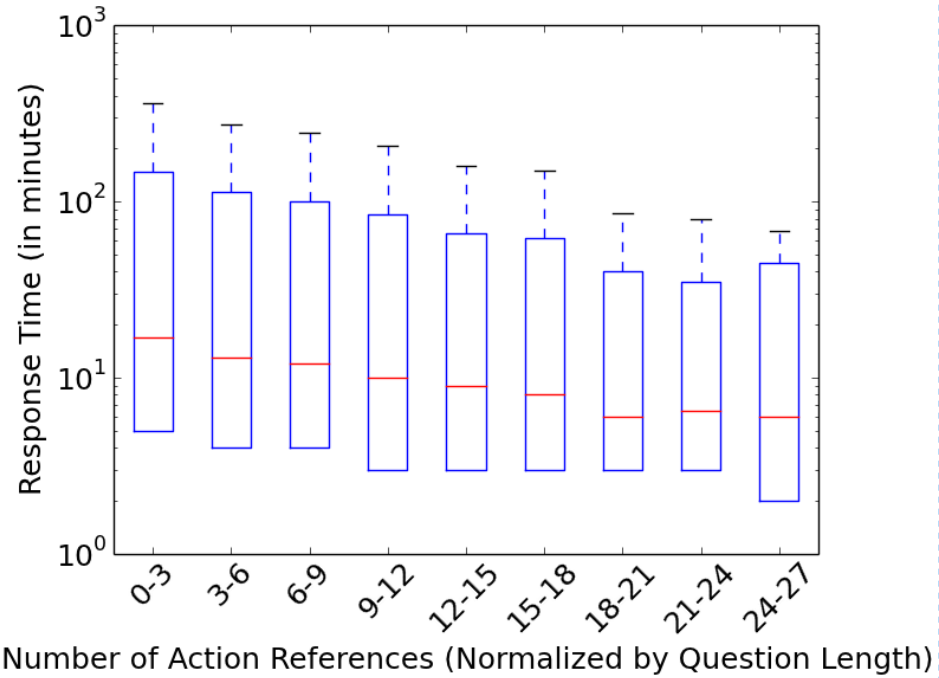
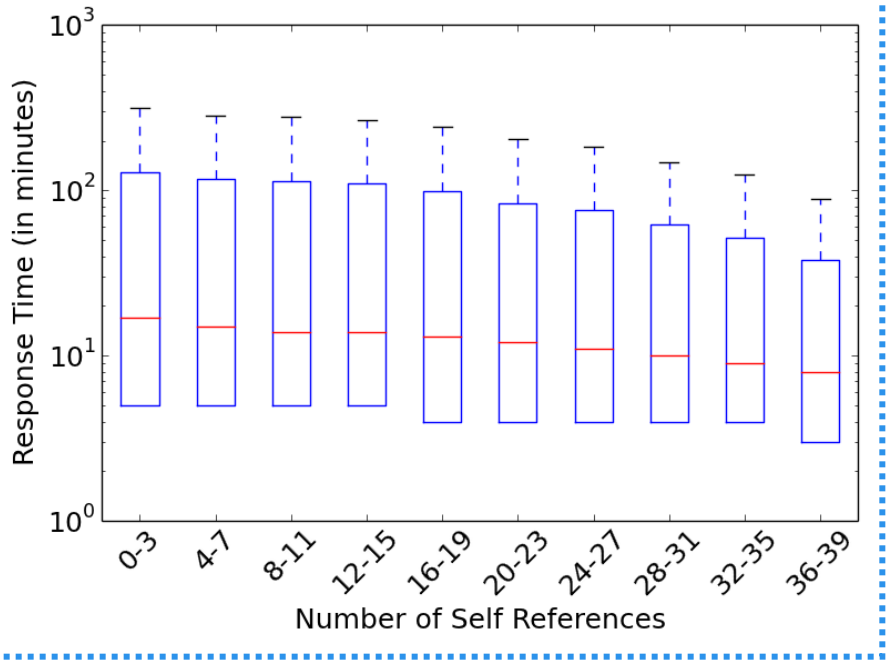
- # Action Verbs



- # Self References



Feature Analysis: Summary

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- Positive Correlations

Given a question, higher its

- body length
- title length
- code length
- tag specificity

the higher its response time tends to be.

Feature Analysis: Summary

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- Negative Correlations

Given a question, the larger its

- tag popularity, number of popular tags
- active subscribers, responsive subscribers associated with its tags
- number of active verbs and self-referencing words

the lower its response time tends to be

Types of Experiments

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- Type 1: All but only non-tag based (10) features.
- Type 2: Only tag popularity (1).
- Type 3: Only percent responsive subscribers(1).
- Type 4: All but only tag-based (9) features.
- Type 5: All (19) features.

Prediction results: Task 1

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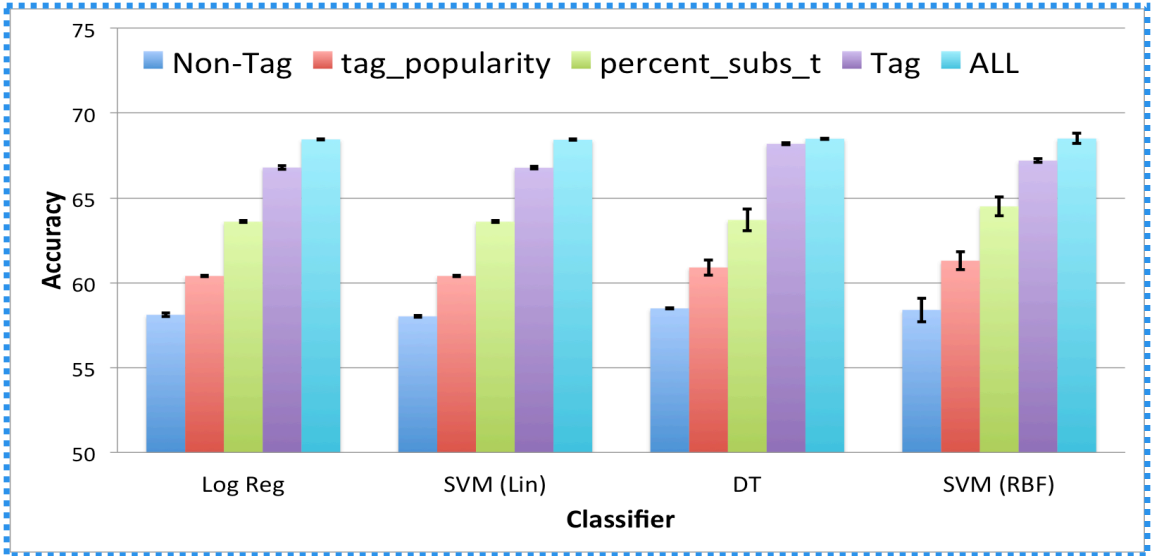
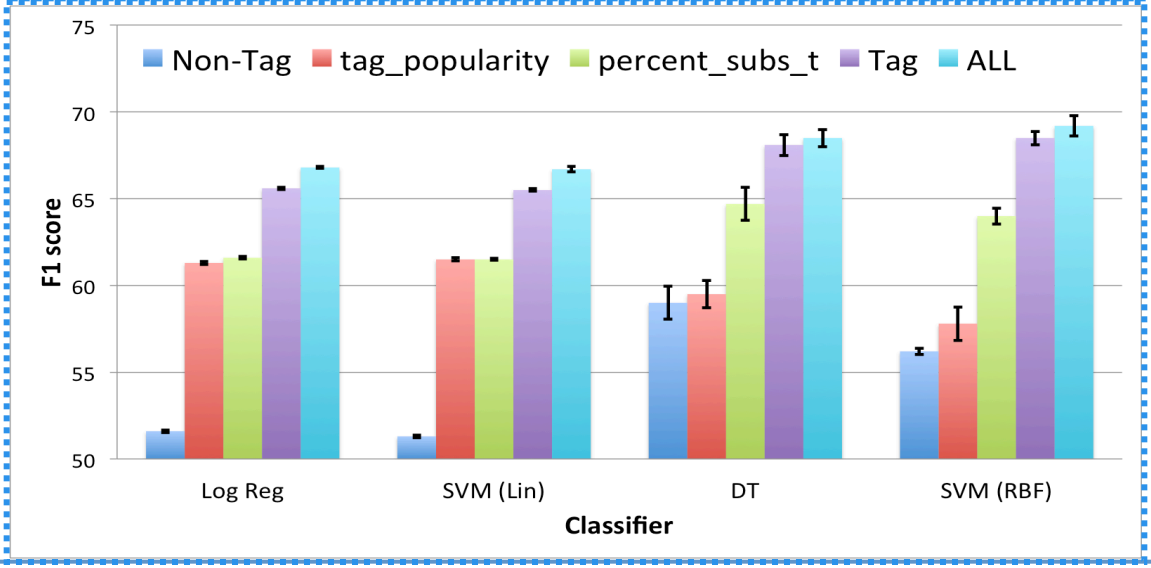
Accuracy



F1 Score



Prediction results: Task 2

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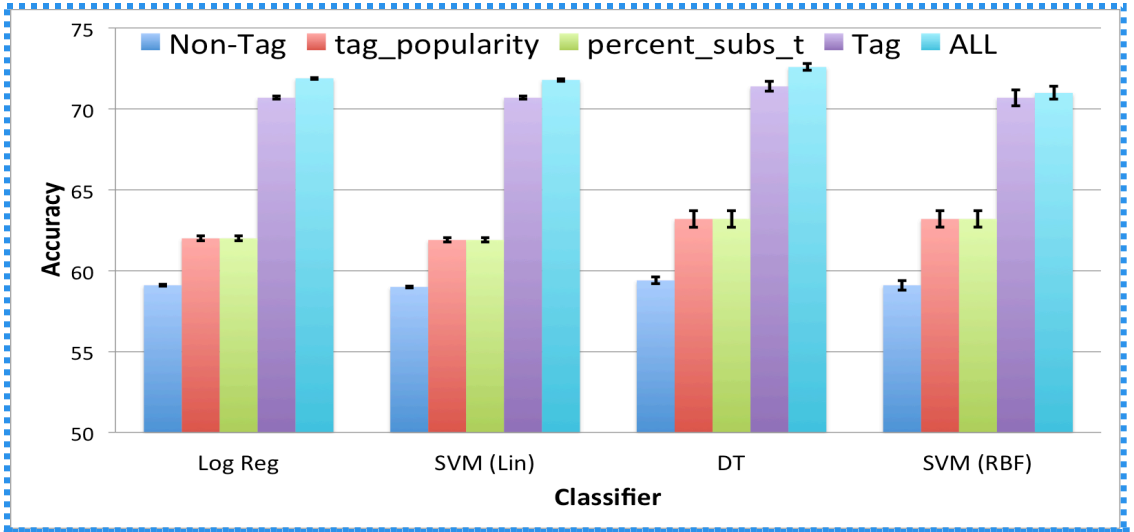
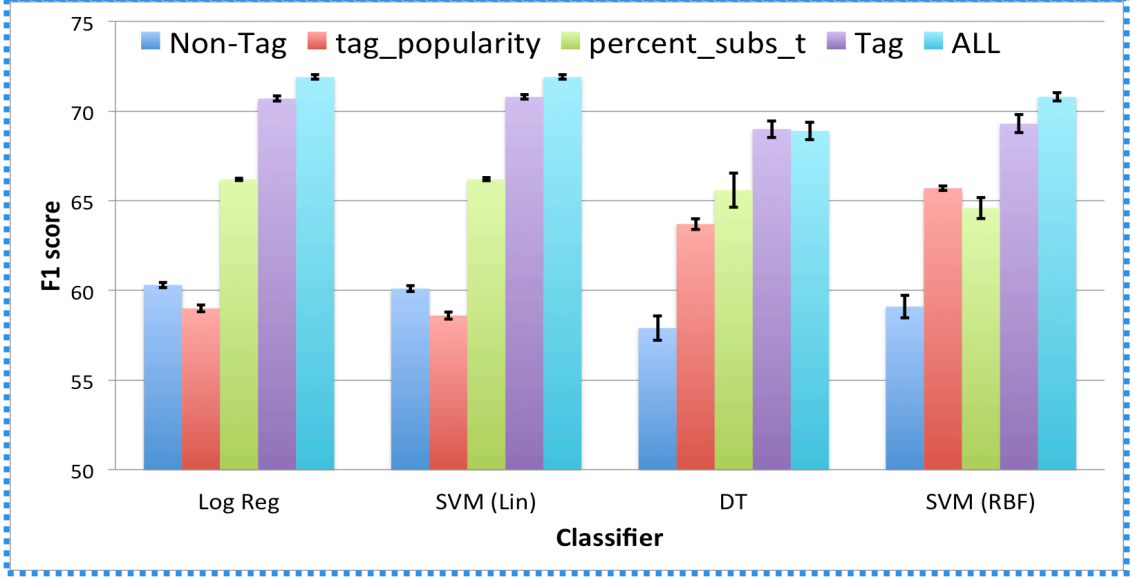
Accuracy



F1 Score



Prediction analysis

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- Top 3 features: Tag based

Task 1		Task 2	
* percent_subs_t	0.440	* percent_subs_t	0.506
* tag_popularity	0.173	* percent_subs_ans	0.266
* num_subs_t	0.130	* tag_popularity	0.085
body_len	0.123	body_len	0.057
* percent_subs_ans	0.033	* num_subs_ans	0.030
* num_subs_ans	0.026	end_que_mark	0.013
* tag_specificity	0.025	title_len	0.010
end_que_mark	0.013	* num_subs_t	0.010
title_len	0.013	code_len	0.009
code_len	0.012	* tag_specificity	0.007

Summary

- Studied a large set of factors likely to be associated with question response time.
- Analyzed tag-based features and illustrated the strong correlation between question tags and response time.
- Exploited tag-based features to estimate the response time.

Thank You

NORTHROP GRUMMAN

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