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Dealing with Concept Drift in Exploratory Search: An Interactive Bayesian Approach

Problem Setting

Exploratory search

- The user initially has some knowledge of the search topic but not enough to reduce the task into simple fact retrieval tasks
- The user has to learn while searching, iteratively reformulating a hypothesis of what information would satisfy her information need and where to find it
- This setting makes it difficult for the user to directly formulate good search queries

A recently developed search system called SciNet (IUI 2013, 2015) helps the user by allowing interactive formulation of the search query through relevance feedback on a visualized user model. However, the user model makes many implicit assumptions:

- All user feedback is assumed equally accurate
- The user is assumed to make no mistakes in giving feedback
- No learning or change in search interests is assumed to occur

Our Contribution

Hypothesis: it might be useful for the user to be able to see the feedback history as a whole and to get suggestions on which feedback are likely in need of adjustment.

In this paper we present

- Timeline interface that visualizes the user's feedback history
- User model that estimate both user's current interest and the accuracy of feedback

We demonstrate that

- The new user model improves performance over a baseline model
- Users report that the new interface provides usability improvements
- Users give more feedback and interact more with the new interface

User Model

We assume that the user's interest can be approximately described with a linear Gaussian model, where the accuracy of feedback given by the user may be different for each observation. This gives us the following model:

 $y_i \sim Normal(x_i\phi, \sigma^2/w_i),$

where y is relevance, x is item feature vector, phi are linear model parameters, sigma is variance and w is feedback accuracy. We further assume priors for the parameters:

$$\phi_j \sim Normal(\mu_\phi, \lambda_\phi),$$

$$\sigma^2 \sim InverseGamma(\alpha_{\sigma^2}, \beta_{\sigma^2}),$$

 $w_i \sim Gamma(\alpha_{w_i}, \beta_{w_i}), w_i^{fix} \sim Delta(1.0),$

where the distribution of w depends on whether the user has marked that feedback as accurate. We approximate the posterior distribution of the model parameters using mean-field variational inference.



We extended the SciNet search interface with a timeline interface function. The timeline:

- Visualizes the history of relevance feedback
- Provides suggestions on what feedback to adjust (based on estimated accuracy)
- Allows user interaction with the past feedback
- Delete a feedback from the model
- Revise relevance value given to a keyword
- Access keywords from past search sessions
- Mark feedback as accurate (indicate false positive suggestions)

Simulation Study

We conducted an experiment with a simulated user. The user was searching for newsgroup articles using noisy relevance feedback. We compared the performance of the new model to an oracle and to a baseline that did not estimate accuracy of feedback.

Left graph

- User did not make corrections to past feedback Center graph
- Search engine made suggestions on what feedback to correct
- User corrected feedback values is case of true positive suggestions
- User marked feedback accurate in case of false positive suggestions

Right graph

• As above, but user did not mark feedback accurate in case of false positives

User Interface

Articles [show bookmarked (0)] User: test / UI: 4 / Task: 0

Exploratory search and HCI designing and evaluating interfaces to support exploratory search interaction

Steven M. Drucker, Gary Marchionini, Marti Hearst, m. c.

schraefel (Conference On Image And Video Retrieval, 2007-01-01T00:00:00) he model of search as a turn-taking dialogue between the user and an intermediary has r decades. However, there is growing interest within the search community in evolving this model to support search-driven information exploration activities. So-called "exploratory search" describes a class of search activities that

e beyond fact retrieval toward fostering learning, investigation, and information u Exploratory search interaction focuses on the user-system communication essential during exploratory search processes. Given this user-centered focus, the CHI conference is an his workshop aims to gather researchers, academics, and practitioners working in human computer interaction, information retrieval, and other related disciplines, for a discussion of the issues relating to the design and evaluation of interfaces to help users explore, learn, and use information. These are important issues with far-reaching implications for how many computer users accomplish their tasks.

Model-driven formative evaluation of exploratory search: A study under a sensemaking framework

Y Qu, G W Furnas (INFORMATION PROCESSING & MANAGEMENT, 2008-01-01T00:00:00) xploratory search model-driven evaluation sensemaking representation construction

exploratory search relies on the ongoing paradigm shift from focusing on driven formative evaluation approach, in which the goal is not the evaluation of a specific system, per se, but the exploration of new design possibilities. This paper gives an example of this approach where a model of sensemaking was used to inform the evaluation of abasic exploratory search system(s) in the context of a sensemaking task. The model ather than just looking at simple search performance measures, we shoul examine closely the interwoven, interactive processes of both representation construction and information seeking. Participants were asked to make sense of an unfamiliar topic using an augmented guery-based search system. The processes of representation construction and information seeking were captured and analyzed using data from experiment structuring representations and a tightly coupled relationship between search and nstruction in their exploratory searches. For example, users strategically used search to find useful structure ideas instead of just accumulating information facts. Implications for improving current search systems and designing new systems are discussed. Published by Elsevier Ltd.

INFRARED SPECTRAL SEARCH FOR MIXTURES IN LARGE-SIZE

S C LO, C W BROWN (APPLIED SPECTROSCOPY, 1991-01-01T00:00:00)

chemometrics multivariate analysis library search pattern recognition multicomponent analysis infrared search infrared spectra principal component analysis

User Study

We ran a user study where we compared the new interface with a baseline where the timeline was hidden. The study had 4 participants who performed 4 tasks each.

Average number of different user actions per task (20 min) during the experiment:

Interface	Keyword queries	Relevance feedbacks on radar	Relevance feedbacks on timeline	Feedbacks deleted	Feedbacks marked as accurate	Total keyword interactions
Baseline	4.0	5.4	N/A	N/A	N/A	5.4
Timeline	4.0	5.6	1.0	1.6	0.6	8.9

After each task set, we conducted a semi-structured interview with the user • Main benefits of the timeline interface:

- It is easier to understand what feedback affects the results

• The users also reported the following drawbacks:

- feedback was changed automatically
- their focus was on performing the task well

Conclusion

- search intent model is refined iteratively
- feedback is most likely in need of adjustment

Overall, the initial results from the user study look encouraging and as the next step we are planning to conduct a larger study with an improved version of the system.

To the best of our knowledge, this is the first time a system has been presented that both models the accuracy of individual user feedback in a search setting and allows the user to directly interact with this model.



Figure: Results from simulation study. ARD is the new user model, LG is the baseline.





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• It is easy to re-find keywords both from current and past search sessions

• It helps in the search process as it is easy to "go back" by deleting feedback

• The red question mark icon made the user feel as if she had made an error

• The user felt like the system was not fully under her control when the accuracy of

• The task time limit made them avoid functionality they were not familiar with, as

• We have presented a user model that is able to take into account concept drift when a

• We have presented a timeline interface that offers the user suggestions on what past