Modeling User Information Needs on Mobile Devices

from Recommendation to Conversation

Mohammad Aliannejadi
Faculty of Informatics
Università della Svizzera italiana (USI)
mohammad.alian.nejadi@usi.ch

13 September, 2019

Abstract

Recent advances in the development of mobile devices equipped with multiple sensors, together with the availability of millions of applications, have made these devices more pervasive in our lives than ever. The availability of the diverse set of sensors, as well as high computational power, enable information retrieval (IR) systems to sense a user's context, and personalize their results accordingly. Relevant studies show that people use their mobile devices to access information in a wide range of topics in various contextual situations, highlighting the fact that modeling user information need on mobile devices involves studying several means of information access.

In this thesis, we study three significant aspects of information access on mobile devices. First, we focus on proactive approaches to *modeling users for venue suggestion*. We investigate three methods of user modeling, namely, content-based, collaborative, and hybrid, focusing on personalization and context-awareness. Our content-based model is based on multiple relevance scores derived from multi-modal information that we collected from multiple sources of information [1]. We further propose a two-phase collaborative ranking algorithm for leveraging users' implicit feedback while incorporating temporal and geographical information into the model [3]. We then extend our collaborative model to include multiple cross-venue similarity scores and combine it with our content-based approach to produce a hybrid recommendation [2].

Second, we introduce and investigate a new task on mobile search, that is, *unified mobile search*. We take the first step in defining, studying, and modeling this task by collecting two datasets [5, 4]. Our analyses show that a limited number of popular apps attract most of the search queries. We further observe notable differences between queries submitted to different apps. We show that query length and content differ among apps. We also show that 39% of search queries were done in Google Search, and it was the top choice of users in 35% of the tasks. Given that more than 71% of the defined tasks could be done with the current features of Google Search, this indicates that users prefer to search using a more specific app. Also, we conduct experiments on one of the main components of unified mobile search

frameworks, which is target apps selection. To this end, we propose two neural approaches that learn high-dimensional app representations based on their respective queries.

Finally, we address the *conversational aspect of mobile search*, where we propose an offline evaluation protocol and build a dataset for asking clarifying questions for conversational search [6]. Also, we propose a retrieval framework consisting of three main components: question retrieval, question selection, and document retrieval. The experiments and analyses indicate that asking clarifying questions should be an essential part of a conversational system, resulting in a high performance gain. In particular, experiments on the oracle model demonstrated that asking only one good clarifying question leads to over 150% relative improvement in terms of P@1 and nDCG@1. Moreover, we observed that asking clarifying questions improves the model's performance for a substantial percentage of the facets, even though a more effective retrieval model than the one we used could potentially improve the performance.

Supervisor: Fabio Crestani

The dissertation is available online at `http://bit.ly/AlianThesis`

References

[1] M. Aliannejadi and F. Crestani. Personalized context-aware point of interest recommendation. *ACM Trans. Inf. Syst.*, 36(4):45:1–45:28, 2018.

[2] M. Aliannejadi, D. Rafailidis, and F. Crestani. A collaborative ranking model with multiple location-based similarities for venue suggestion. In *ICTIR*, pages 19–26. ACM, 2018.

[3] M. Aliannejadi, D. Rafailidis, and F. Crestani. A joint two-phase time-sensitive regularized collaborative ranking model for point of interest recommendation. *IEEE Trans. Knowl. Data Eng.*, 2019 (in press).

[4] M. Aliannejadi, H. Zamani, F. Crestani, and W. B. Croft. In situ and context-aware target apps selection for unified mobile search. In *CIKM*, pages 1383–1392. ACM, 2018.

[5] M. Aliannejadi, H. Zamani, F. Crestani, and W. B. Croft. Target apps selection: Towards a unified search framework for mobile devices. In *SIGIR*, pages 215–224. ACM, 2018.

[6] M. Aliannejadi, H. Zamani, F. Crestani, and W. B. Croft. Asking clarifying questions in open-domain information-seeking conversations. In *SIGIR*, pages 475–484. ACM, 2019.