Effective Neural Architectures for Context-Aware Venue Recommendation

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Abstract

Users in Location-Based Social Networks (LBSNs), such as Yelp and Foursquare, can search for interesting venues such as restaurants and museums to visit, or share their location with their friends by making an implicit feedback (e.g. checking in at venues they have visited). The users can also leave explicit feedback on the venues they have visited by providing ratings and/or comments. Such explicit and implicit feedback by the users provide rich information about both users and venues, and thus can be leveraged to study the users' movement in urban cities, as well as enhance the quality of personalised venue recommendations. Unlike traditional recommendation systems (e.g. book and movie recommendation systems), making effective venue recommendations is more challenging because we need to take into account the users' current context (e.g. time of the day, user's current location as well as his recently visited venues).

In this thesis, based upon Matrix Factorisation (MF) and Bayesian Personalised Ranking (BPR) models, we aim to generate effective *context-aware* venue recommendation that a user may wish to visit based on the user's historical explicit and implicit feedbacks, the user's contextual information (e.g. the user's current location and time of the day) and additional information (e.g. the geographical location of venues and users' social relationships). To achieve this goal, we need to address the following challenges: namely (**C1**) modelling the users' preferences and the characteristic of venues, (**C2**) capturing the complex structure of user-venue interactions in a Collaborative Filtering manner, (**C3**) modelling the users' short-term (*dynamic*) preferences from the sequential order of user's observed feedback as well as the contextual information associated with the successive feedback, (**C4**) generating accurate top-K venue recommendations based on the users' preferences using a pairwise ranking-based model and (**C5**) appropriately sampling potential negative instances to train a ranking-based model.

First, to address challenge **C1**, we leverage the users' explicit feedback (e.g. their ratings and the textual content of the comments) and additional information (e.g. users' social relationships) to effectively model the users' preferences and the characteristics of venues. In particular, we propose a novel regularisation technique [1] and a factorisation-based model [2] that leverages the users' explicit feedback and the additional information to improve the rating prediction accuracy of the traditional MF model. Experiments conducted on a large

scale rating dataset on LBSN demonstrate that the textual content of comments plays an important role in enhancing the accuracy of rating prediction.

Second, we investigate how to leverage the users' implicit feedback and additional information such as the users' social relationship and the geographical location of venues to improve the quality of top-K venue recommendations. In particular, to address challenges **C4** and **C5**, we propose a novel pairwise ranking-based framework for top-K venue recommendations [3] that can incorporate multiple sources of additional information (e.g. the users' social relationship and the geographical location of venues) to effectively sample the potential negative instances. Experimental results on three large scale checkin and rating datasets from LBSNs demonstrate that the social correlations and the geographical influences play an important role to the quality of sampled negative instances and hence can improve the quality of top-K venue recommendations.

Finally, to address challenges **C2** and **C3**, we propose a framework for sequential-based venue recommendations [4] that exploits Deep Neural Network (DNN) models to effectively capture the complex structure of user-venue interactions and the users' long-term (*dynamic*) preferences from their sequential order of checkins. Moreover, we propose a novel Recurrent Neural Network (RNN) architecture [5] that can effectively incorporate the contextual information associated with the successive implicit feedback (e.g. the time interval and the geographical distance between two successive checkins) to generate high quality context-aware venue recommendations. Experimental results on three large scale checkin and rating datasets from LBSNs demonstrate the effectiveness and robustness of our proposed framework and architecture for context-aware venue recommendations.

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References

[1] Jarana Manotumruksa McDonald, Craig Macdonald, and Iadh Ounis. Regularising factorised models for venue recommendation using friends and their comments. In *Proc. of CIKM*, pages 1981–1984. ACM, 2016.

[2] Jarana Manotumruksa McDonald, Craig Macdonald, and Iadh Ounis. Matrix Factorisation with Word Embeddings for Rating Prediction on Location-Based Social Networks. In *Proc. of ECIR*, pages 647–654. ACM, 2017.

[3] Jarana Manotumruksa McDonald, Craig Macdonald, and Iadh Ounis. A Personalised Ranking Framework with Multiple Sampling Criteria for Venue Recommendation. In *Proc. of CIKM*, pages 1469–1478. ACM, 2017.

[4] Jarana Manotumruksa McDonald, Craig Macdonald, and Iadh Ounis. A Deep Recurrent Collaborative Filtering Framework for Venue Recommendation. In *Proc. of CIKM*, pages 1429–1438. ACM, 2017.

[5] Jarana Manotumruksa McDonald, Craig Macdonald, and Iadh Ounis. A Contextual Attention Recurrent Architecture for Context-Aware Venue Recommendation. In *Proc. of SIGIR*, pages 555–564. ACM, 2018.