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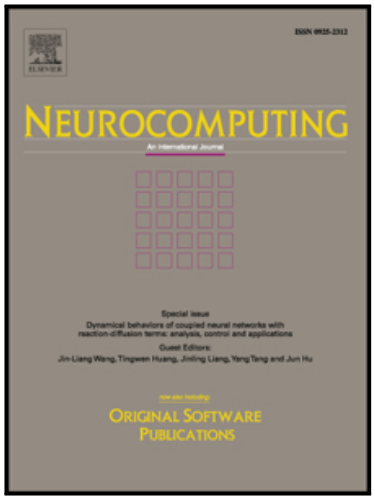

A Personalized Point-of-Interest Recommendation Model via Fusion of Geo-social Information

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A Personalized Point-of-Interest Recommendation Model via Fusion of Geo-social Information

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Abstract

Recently, as location-based social networks (LBSNs) rapidly grow, general users utilize point-of-interest recommender systems to discover attractive locations. Most existing POI recommendation algorithms always employ the check-in data and rich contextual information (e.g., geographical information and users' social network information) of users to learn their preference on POIs. Unfortunately, these studies generally suffer from two major limitations: (1) when modeling geographical influence, users' personalized behavior differences are ignored; (2) when modeling the users' social influence, the implicit social influence is seldom exploited. In this paper, we propose a novel POI recommendation approach called GeoEISo. GeoEISo achieves three key goals in this work. (1) We develop a kernel estimation method with a self-adaptive kernel bandwidth to model the geographical influence between POIs. (2) We use the Gaussian radial basis kernel function based support vector regression (SVR) model to predict explicit trust values between users, and then devise a novel trust-based recommendation model to simultaneously incorporate both the explicit and implicit social trust information into the process of POI recommendation. (3) We develop a unified geo-social framework which combines users' preference on a POI with the geographical influence as well as social correlations. Experimental results on two real-world datasets collected from Foursquare show that GeoEISo provides significantly superior performances compared to other state-of-the-art POI recommendation models.

Keywords: matrix factorization, point-of-interest, recommendation, geographical information, social information

1. INTRODUCTION

Nowadays, location-based social networks (LBSNs), such as Foursquare and Gowalla, has been growing rapidly, due to the advances in location-acquisition and wireless communication technologies. In LBSNs, users check in some interesting locations and share their travel experiences by uploading photos, providing ratings and comments. Since LBSNs have collected a huge volume of users' activity records, LBSNs have become an ideal platform to investigate users' online behavior patterns. Many interesting and valuable applications can be built on this platform, such as location recommender system[1, 2], traveling routes recommendation[3, 4],extracting robust feature of location from remote sensing images[5, 6], and so on. As an important component of LBSNs, POI recommendation first helps users to explore new POIs. Then, it also helps advertising agencies to launch location-aware personalized services for potential customers and improve business profits[7].

Most existing POI recommendation methods[8, 9, 10] apply the collaborative filtering techniques with the user-POI check-in matrix to compute the preference score between a user and an unvisited POI. However, the user-POI check-in matrix is highly sparse with numerous missing entries, because users have only visited a very small proportion of POIs in an LBSN. As a result, these methods usually suffer from low recommendation quality.

Since the Netflix-prize competition, the recommendation algorithm based on matrix-factorization (MF) techniques[11] have received extensive attention from academia and industry due to their good scalability and accurate predictive ability to deal with large-scale data. Several sophisticated and highly efficient MF-based models have been proposed. Representative ones of this kind include SVD++ model[12], probabilistic MF model[13], and nonparametric MF model[14].

In recent years, further research on matrix factorization yields more sophisticated models, e.g., LF-based CF model via second-order optimization model[15], weighted trace-norm regularization-based model[16], collaborative Gaussian process-based preference model[17], alternating direction method-based nonnegative latent factor model[18, 19, 20, 21, 22].Meanwhile, these ideas are also used to address other relative issues. e.g., QoS prediction[23, 24], heavy computational overhead in ELM[25], particle swarm optimization[26, 27, 28], kalman filter extension[29, 30], video re-indexing[31], and mobile-user tracking[32].

Compared with the conventional recommendation systems, POI recommender systems using sparse geo-social networking data are more complex in LBSNs, which have the following unique features:

(1) Geographic influence: in LBSN, POIs are encoded with latitude and longitude, which distinguishes POIs form other items, such as books, music and movies in conventional recommender systems, which is called geographical influence.

(2) Social influence: In LBSNs, a person may prefer POIs

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