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ELECTRICAL AND COMPUTER ENGINEERING

Panagiotis Symeonidis  
Dimitrios Ntempos  
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# Recommender Systems for Location-based Social Networks

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# Chapter 1

## Introduction

Social networking sites, such as Facebook and LinkedIn, have attracted a huge attention after the widespread adoption of Web 2.0 technology. These systems contain data, which can be mined and used for making personalized predictions and recommendations of products, users and digital content. In particular, they collect information from users' social contacts and their interactions (co-tagging of photos, co-rating of products etc.) and make recommendations of products or even people to users based on their common friends, common commenting on written posts etc.

Mobile communication devices reach now every corner of planet earth. People are inextricably linked to the internet through mobile devices that allow ubiquitous and pervasive computing. Lately, technological progressions in mobile devices (GPS, Wi-Fi) enabled the incorporation of geo-location data in the traditional web-based online social networks, which have been evolved to Location-based Social Networks (LBSNs). Geo-location data seems to serve as the physical dimension that Web lacks. In this new era, users can benefit by getting pervasive and ubiquitous access to location-based services from anywhere via mobile devices. Moreover, users can share location-related information with each other to leverage their collaborative social knowledge.

The goal of this book is to bring together important research in a new family of recommender systems aimed at serving LBSNs. The chapters introduce a wide variety of recent approaches, from the most basic to the state-of-the-art, for providing recommendations in LBSNs. The material covered in the book is addressed to graduate students, teachers, researchers, and practitioners in the areas of web data mining, information retrieval, and machine learning. The book is organized into three parts. Part I provides introductory material on recommender systems, online social networks and LBSNs. Part II presents a wide variety of recommendation algorithms, ranging from the most basic methods to the state-of-the-art, as well as a comparison of the characteristics of these recommender systems. Part III provides a step-by-step case study on the technical aspects of deploying and evaluating a real-world LBSN, which provides location, activity and friend recommendations.

In the sequel, a brief introduction to each chapter of the book follows:



## **Chapter 2: Recommender Systems**

Recommender systems base their operation on past user purchases/ratings over a collection of items, for instance, books, CDs, etc. Collaborative Filtering (CF) is a successful recommendation technique that confronts the “information overload” problem. Memory-based algorithms recommend according to the preferences of nearest neighbors, and model-based algorithms recommend by first developing a model of user ratings. In this chapter, we bring to surface factors that affect recommendation process. Moreover, we describe the most important problems related to recommender systems and give some references to actual solutions. Finally, there is an economic and social report regarding recommender systems, which examines them under a rather market-based angle.

## **Chapter 3: Online Social Networks**

This chapter provides: (1) some definitions and basic concepts for Online Social Networks (OSNs), (2) a brief literature review of OSNs, (3) some paradigms of commercial OSNs, and (4) the transition of OSNs towards location as an auxiliary dimension. Finally, the social and economic report of commercial OSNs helps the reader to realize the huge potential that Location-based Social Networks (LBSNs) have, based on the fact that OSNs have incorporated the location dimension in recent years.

## **Chapter 4: Location-Based Social Networks**

Location-based Social Networks (LBSNs) can be considered as a special OSN category. Actually, an LBSN has the same OSN’s properties, but considers location as the core object of its structure. This chapter initially provides some definitions and basic services that are offered by LBSNs, a brief literature review, and two commercial paradigms of LBSNs. Additionally, a few location-based research projects are presented. Moreover, there is an economic and social report regarding LBSNs, which aims to investigate the field under a different, more market oriented prism. The last section provides an example of how a recommender system can benefit an LBSN.

## **Chapter 5: Framework**

This chapter introduces the challenges that recommendation algorithms have to overcome in LBSNs. We also present the main algorithmic categories in the field of LBSNs (i.e. Collaborative Filtering, Semantically-enhanced, etc.). Moreover, we introduce the four types of recommendations in LBSNs (i.e. location, activity, friend, event). Finally, the reader meets an experimental framework for evaluating the quality of recommendations in LBSNs.

## **Chapter 6: Algorithms**

This chapter provides more details on advanced research work proposed in LBSNs, and deepens in the algorithmic side of each method. We present algorithms for generic and personalized recommendations. For readability reasons, we have categorized the state-of-the-art methods in different algorithmic families such as matrix and tensor factorization, graph-based methods, and hybrid models.

## **Chapter 7: Comparison**

This chapter compares and categorizes the algorithms that are described in Chap. 6 based on their basic characteristics. We categorized them based on (1) the kind of recommendation they provide (i.e., generic or personalized), (2) the type of recommendation they provide (i.e. Friend, Location, Activity, and Event), (3) the data representation they use for their model (i.e. matrix, tensor, graph), (4) the technique they are based on (i.e. probabilistic, semantic, collaborative filtering, etc.), (5) the data sets and the metrics they use in their experiments. The aforementioned categorizations help the reader to understand the main research choices that have been proposed in the research field of LBSNs and provides insight for further directions in the future.

## **Chapter 8: Real World Location-Based Social Network**

This chapter presents a real-world recommender system for LBSNs. GeoSocialRec allows to test, evaluate and compare different recommendation styles in an online setting, where the users of GeoSocialRec actually receive recommendations during their check-in process. The system's experimental evaluation checks its performance

in terms of accurate recommendations. Moreover, we present a user study for evaluating different styles of explanations that come along with a recommendation to users.

## **Chapter 9: Conclusion**

The last chapter concludes the book with a summary and future research directions.