

# TUTORIAL ON MUSIC RECOMMENDATION

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## ABSTRACT

As the world of online music grows, music recommendation systems become an increasingly important way for music listeners to discover new music. Commercial recommenders such as Last.fm and Pandora have enjoyed commercial and critical success. But how well do these systems really work? How good are the recommendations? How far into the ‘long tail’ do these recommenders reach? In this tutorial we look at the current state-of-the-art in music recommendation. We examine current commercial and research systems, focusing on the advantages and the disadvantages of the various recommendation strategies. We look at some of the challenges in building music recommenders and we explore some of the ways that MIR techniques can be used to improve future recommenders.

## 1 INTRODUCTION

In the last ten years, we have seen in incredible transformation in the music world as we transition from albums and compact discs to MP3s and iPods. Online music stores are growing rapidly while traditional brick-and-mortar stores are shutting their doors forever. Currently, music services such as iTunes, Rhapsody and Napster boast collections of several million songs. It is not hard to imagine that in the near future, all of recorded music will be available online and digital music stores will offer billions of tracks with millions more arriving every week.

This sheer volume of music becomes a problem for the music listener. A listener somehow must wade through this gigantic slush pile of music to find the artists and songs that they will enjoy.

As the size of our online music collections grow, music recommendations become a key part of the music ecosystem. Recommender systems serve as the middle-man in the music marketplace, helping a music listener find their next 5-star song among the millions of 0-star songs.

We are already seeing music recommenders play an important role in online music. Sites such as Last.fm and Pandora provide recommendations for millions of listeners every month. Yet, these music recommendation system use few if any of the techniques that we in the Music

Information Retrieval community have developed.

In this tutorial, we survey the current state-of-the-art in music recommendations. We look at the advantages and disadvantages of the various recommendation techniques that are in use today. We also explore ways that MIR techniques can be used to improve music recommendations, especially as the size of our music collections grow.

## 2 TUTORIAL OUTLINE

This tutorial presents an overview of the music recommendation problem, describes the various issues and challenges in developing a music recommender, explores the various approaches used for recommendation, including a detailed discussion of the advantages and disadvantages of these approaches, gives real-world examples of different types of recommenders and finally presents some of the challenges to building the next generation of music recommenders.

This tutorial also presents results from a subjective evaluation of a number of music recommendation systems, as well as presenting results using objective measures — based on graph and complex networks theory— to compare inherent differences between the various recommendation techniques, including collaborative filtering and content-based methods.

### 2.1 Index proposal

In this section we present the main elements that will be covered in the tutorial.

1. Why music recommendation is important
2. Formalization of the recommendation problem
3. Recommendation issues
  - (a) User modeling
  - (b) Scaling
  - (c) Evaluation
  - (d) User Interfaces
  - (e) Transparency and Trust
4. Types of recommenders
  - (a) Expert

- (b) Demographic filtering
- (c) Collaborative filtering
- (d) Content-based
- (e) Context-based
- (f) Hybrid

#### 5. Recommender examples

- (a) Last.fm
- (b) Pandora

#### 6. Future of music recommendation

- (a) Billions of users
- (b) Billions of songs
- (c) How can MIR help?

### 3 MISCELLANEOUS

#### 3.1 Motivation

The tutorial will serve several purposes:

- We will provide an up-to-date survey of state-of-the-art for music recommendation.
- We intend to raise the awareness in the MIR community, especially among researchers in audio processing, that content-based recommender systems are limited. However, content-based methods can be used in combination with other approaches to achieve better recommendations.
- We will propose a list of promising trends in automatic music recommendation.

Most of the music recommendation work in the MIR community has been focused on presenting a list of artists, or creating an ordered sequence of songs (i.e a playlist) that the user might like. We hope to broaden the understanding of the music recommender beyond that of a simple playlist generator.

#### 3.2 Intended Audience

This tutorial will be of interest to the general ISMIR audience, especially to those who are interested in a deeper understanding of the current state-of-the-art of music recommender systems and especially to those who are looking to direct their research toward areas with high commercial interest.

#### 3.3 Course material

Handouts of the presentation slides will be provided together with an extensive bibliography.

#### 3.4 Required equipment

Projector and loudspeakers. Internet connection.

### 4 INSTRUCTORS' BIOGRAPHIES

Oscar Celma is a researcher at Music Technology Group since 2000, and Associate Professor at the Pompeu Fabra University, Barcelona (Spain). Since 2006 he is an Invited Expert of the W3C Multimedia Semantics Incubator Group. He is a member of the program committee of the Workshop on Learning the Semantics of Audio Signals (LSAS). Since 2003, Oscar has been involved in several EU projects, such as Cuidado, Opendrama and SIMAC. The main focus of his research lies in the music recommendation arena, as well as the combination of music and Semantic Web technologies. Other interests include semantically modeling of music content, music information retrieval in the context of the Semantic Web. Recently, he received 2nd prize in the International Semantic Web Challenge for the system named "Foafing the Music" (a personalized music recommendation and discovery application), presented in ISMIR-2005.

Paul Lamere is the Principal Investigator for a project called "Search Inside the Music" at Sun Labs where he explores new ways to help people find highly relevant music, even as music collections get very large. Paul is especially interested in hybrid music recommenders and using visualizations to aid music discovery. Paul serves on the program committee for ISMIR 2007 as well as on the program committee for Recommenders'07. Paul also authors "Duke Listens!" a blog focusing on music discovery and recommendation.