Applying CBR to Playlist Recommendation

Claudio Baccigalupo – Enric Plaza
Industry Day – ECCBR 2006 – Ölüdeniz (Turkey)
Tasks of Music Recommenders

“If you like this music, you may also like…”

…this set of songs”
(songs recommender)

…this ordered sequence of songs”
(playlist recommender)
Playlist Recommenders

Suggest a sequence of songs where:

Order is relevant

Possible applications: automatic playlist generators, radio programs, music organisers, DJ tools
1. MUSICSTRANDS™
2. THE CBR PLAYLIST RECOMMENDER
3. INTEGRATION WITH MUSICSTRANDS™
4. DEMO
1. MUSICSTRANDS™

2. THE CBR PLAYLIST RECOMMENDER

3. INTEGRATION WITH MUSICSTRANDS™

4. DEMO
MusicStrands™ Mission

“To understand musical taste in order to help people discover new music and get greater enjoyment out of the music they already love.”
MusicStrands™ Homepage

- DISCOVER MUSIC
  - My Recommendations
  - Playlists
  - Tags

- MEMBERS
  - My Community
  - Discover Members
  - Groups

- TOP MUSIC
  - Recently Played
  - Browse Music
  - World Map

Already a Member? Log in here.
Sign Up for FREE!...for Personalized Music Discovery!
Music Catalog

Download MyStrands - M-Charts - Indy Artists - Take a Tour

Rockin' In The Free World - (live, acoustic)

on album: Freedom
by Neil Young
released: 1989 on Reprise

Overview Recommendations Get this song!

Community

How well is this song doing?
Played 15 times by the community

Recently Played by...

Listen Now:

Special merchandise for fans of Neil Young

Weight, The
by The Band

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Real-time Recommender

Rockin' In The Free World - (live, acoustic) by Neil Young
on album: Freedom
by Neil Young
released: 1989 on Reprise

Heart Of Gold
on Harvest
by Neil Young

Masters Of War
on The Freewheelin' Bob Dylan
by Bob Dylan

Free Fallin'
on Greatest Hits
by Tom Petty

Born In The U. S. A.
on The Rolling Stone Collection: 25 Years Of Essentials
by Bruce Springsteen

Fortunate Son
on Chronicle
by Creedence Clearwater

Welcome To The Jungle
on Appetite For Destruction
by Guns N' Roses

Wish You Were Here
by Pink Floyd
Buy now in iTunes

Southern Cross
by Crosby, Stills & Nash
Buy now in iTunes
How to build a playlist Recommender

• We cannot simply use content-based (artist, genre) or user-based data, because they do not help us to order songs in a specific sequence

• To gather knowledge about good orderings of songs, we should first analyse how songs are sorted in a collection of existing playlists
Shared Playlists

Classifica playlist at MusicStrands

Classifica playlist
Created: June 20, 2005
Updated: May 16, 2006

Classifica Songs (5)

<table>
<thead>
<tr>
<th>SONG</th>
<th>ARTIST</th>
<th>GET IT</th>
<th>LISTEN</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Between The Bars</td>
<td>Elliott Smith</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Oh!</td>
<td>Sleater-Kinney</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Wake Up, Go To Work</td>
<td>Stylex</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
1. MUSICSTRANDS™

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Why CBR?

- We view MusicStrands™ users’ playlists as a **Case Base** of well-ordered sequences of songs.
- Just by analysing these playlists, we can infer which songs “sound well” in sequence, with no additional data about songs or users.
- CBR works well with large case bases, and returns recommendations in reasonable times.
CBR Process

Case Base Setup → Case Base → Retrieve → Reuse → Recommended Playlist

Users' Playlists → Input Song → Case Base

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Case Base Setup

OpenStrands

Users' Playlists

Case Base Filter

Co-occurrences analysis

Case Base (Playlists)

Relevant Patterns
Case Base Setup (example)

U2 Numb  Coldplay Yellow  Roxette Joyride  The Beatles Help!

U2 Numb  Coldplay Yellow  R.E.M. Stand  Radiohead Creep

U2 Lemon  U2 Numb  Coldplay Yellow  Coldplay In my place  Coldplay Trouble

Radiohead Creep  Travis Sing  U2 Numb  The Beatles Penny Lane  Oasis Wonderwall

A sample collection of 5 playlists from different users
Case Base Setup (example)

One playlist filtered out (too short)
Case Base Setup

One relevant pattern found
(length: 2 occurrences: 3)
Retrieve Process

OpenStrands

Users' Playlists

Case Base Filter

Co-occurrences analysis

Case Base (Playlists)

Retrieved Playlists

Retrieve

User

Input Song

Retrieved Playlists

User's Playlists

Case Base Filter

Co-occurrences analysis

Case Base (Playlists)

Retrieved Playlists

Retrieve

Input Song

User
Retrieve Process

Given an input song $s$, we retrieve from the Case Base the best playlists in relation to $s$, according to two properties:

• **Variety of the playlist**: we favour playlists without repeated songs or artists

• **Coherence with $s$**: we favour playlists that include many relevant patterns containing $s$
Retrieve Process (example)

Given the input song *Numb*, which are the best two playlists to retrieve?

U2 Numb, Coldplay Yellow, Roxette Joyride, The Beatles Help!

U2 Numb, Coldplay Yellow, R.E.M. Stand, Radiohead Creep

U2 Lemon, U2 Numb, Coldplay Yellow, Coldplay In my place, Coldplay Trouble

Radiohead Creep, Travis Sing, U2 Numb, The Beatles Penny Lane, Oasis Wonderwall
Retrieve Process (example)

Not the third one, which repeats many times the same artists.

<table>
<thead>
<tr>
<th>U2</th>
<th>Coldplay</th>
<th>Roxette</th>
<th>The Beatles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numb</td>
<td>Yellow</td>
<td>Joyride</td>
<td>Help!</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U2</th>
<th>Coldplay</th>
<th>R.E.M.</th>
<th>Radiohead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numb</td>
<td>Yellow</td>
<td>Stand</td>
<td>Creep</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>U2</th>
<th>U2</th>
<th>Coldplay</th>
<th>Coldplay</th>
<th>Coldplay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lemon</td>
<td>Numb</td>
<td>Yellow</td>
<td>In my place</td>
<td>Trouble</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Radiohead</th>
<th>Travis</th>
<th>U2</th>
<th>The Beatles</th>
<th>Oasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creep</td>
<td>Sing</td>
<td>Numb</td>
<td>Penny Lane</td>
<td>Wonderwall</td>
</tr>
</tbody>
</table>
Retrieval Process (example)

Not the fourth one, which does not contain any relevant pattern with the song *Numb*.
Retrieve Process (example)

Given the input song *Numb*, the first two playlists should be retrieved.
Reuse Process

OpenStrands

Users' Playlists

Case Base Filter

Co-occurrences analysis

Case Base (Playlists)

Retrieve

Relevant Patterns

Retrieved Playlists

Reuse

Input Song

Recommended Playlist

User
Reuse Process

• Given the songs of the retrieved playlists, we search through a subset of their combinations.

• In the search, we aim at maximising the **variety** of the playlist and **coherence with s**.

• The result is a playlist that includes **s**, has good variety, and contains songs coherently ordered with **s**.
Reuse Process (example)

How to combine these playlists in a good 5-songs playlist for the song *Numb*?
Reuse Process (example)

Find a combination that contains *Numb*, includes relevant patterns, avoiding repetitions
Reuse Process (example)

This can be considered a good combination (both varied and coherently ordered with s):

- Oasis
- Wonderwall
- Blur
- Beetlebum
- U2
- Numb
- Coldplay
- Yellow
- R.E.M.
- Stand

Then it is returned as a recommended playlist.
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The Songs Recommender

MusicStrands™ SQL DB

Songs

Playlists

Users

OpenStrands™ Web Server

SONGS RECOMMENDER

INTERNET

Web Browser

Input Song

Recommended Songs
The CBR Playlist Recommender

![Diagram of the CBR Playlist Recommender system]

- **MusicStrands™ SQL DB**
- **OpenStrands™ Web Server**
- **Web Browser**
- **INTERNET**
- **Input Song**
- **Recommended Playlist**

**Songs** ➔ **Playlists** ➔ **Users**

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The CBR Playlist Recommender

MusicStrands™ SQL DB

Songs

Playlists

Users

OpenStrands™ Web Server

Case Base

Relevant Patterns

Playlists (flat file)

INTERNET

Input Song

Recommended Playlist

Web Browser

CLAUDIO BACCIGALUPO – APPLYING CBR TO PLAYLIST RECOMMENDATION
MusicStrands™ Labs

New Technologies

- **CBR for Playlist Recommendation**
  This project implements a Case-based Reasoning (CBR) approach to musical playlist recommendation.
  04/28/2006 - Give us feedback and get a free t-shirt!

- **Mobile Technologies**
  Mobile website and applications up and running!
  02/08/2006 - Give us feedback and get a free t-shirt!

New Features

- **Cross-content Recommendations**
  The first Cross-content Recommender that we would like to propose is about recommending music given a movie.
  06/08/2006 - Give us feedback and get a free t-shirt!

- **Music Discovery through Web 2.0 Mashups**
  With these collections of mashups, you are able to discover multi-media content related to your favorite artist/s...
  04/28/2006 - Give us feedback and get a free t-shirt!
The CBR Playlist Recommender

Case-based Reasoning for Playlist Recommendation

This project implements a Case-based Reasoning (CBR) approach to musical playlist recommendation. Search for song and click on ☐ icon to generate a playlist that contains that song with others in a meaningful order. Also, you may want to input directly a track ID that you can extract from our website, for example ‘track:3398494’ or just ‘:3398494’ for Slow Hands by Interpol.

Track:  

Search

04/25/2006 - Give us feedback

Please note: These technologies are still in the beginning stages of development, so they may disappear without warning or perform erratically. If something’s not working on this page, please come back and try it again later.
The CBR Playlist Recommender

Case-based Reasoning for Playlist Recommendation

This project implements a Case-based Reasoning (CBR) approach to musical playlist recommendation. Search for song and click on icon to generate a playlist that contains that song with others in a meaningful order. Also, you may want to input directly a track ID that you can extract from our website, for example 'track:3398494' or just ':3398494' for Slow Hands by Interpol.

Track: :2637264

» Calculating a playlist for track I Will Always Love You.

1. Honey And The Moon by Joseph Arthur
2. Where Did You Sleep Last ... by Nirvana (USA)
3. In Your Eyes by Peter Gabriel
4. Every Breath You Take by The Police
5. My Girl by Various Artists
6. Meet Virginia by Train
7. All I Want Is You by U2
8. Can't Stop Loving You by Van Halen
9. I Will Always Love You by Whitney Houston
10. Nightporter by Japan
Organisational Impact

- Recommender implemented in **Common Lisp**
- Runs in MusicStrands Labs, behind an **Apache web-server**, using **CMUCL + mod_lisp**
- **Autonomous** (no side effects on the SQL DB) but **integrated** (each song in the playlist linked to its entry in the MusicStrands™ Catalog)
Benefits for MusicStrands™

• Reuses internal knowledge (in the form of users’ playlists) to provide a new service

• Allows to choose between a songs or a playlist recommender

• Finally users will discover/buy new music
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4. DEMO
That’s it!

The recommender is available at:

http://labs.musicstrands.com

Anyone has a song to suggest?

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