TasteWeights
A Visual Interactive Hybrid Recommender System

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Motivation

Problems

- Many traditional recommenders are “black boxes” and lack explanation and control [Herlocker]

- “Why am I being recommended this movie? I don’t like horror films.”

- Even in modern recommenders, data can be static, outdated or simply irrelevant from the beginning.

- Data about users and items is spread far and wide.
Motivation

Challenges:

→ Need for more dynamic, more adaptable algorithms that can cope with diverse data from APIs.

→ And, we need an interface that can keep up...

Solutions?

User interfaces help to explain provenance of a recommendation. This can improve users’ understanding of the underlying system and contribute to better user experience and greater satisfaction.

Interaction allows users to: tweak otherwise hidden systems settings; provide updated preference data, recommendation feedback etc. etc.
**TasteWeights: Background**

**Initial Work on Graph-based Representations of Collaborative Filtering Algorithms:**
- **PeerChooser**: Based on static MovieLens data
- **SmallWorlds**: Web-based, dynamic data from Facebook API.

**Issues discovered during evaluations:**
- **PeerChooser**: Interaction with nodes that represent movie genres ...too coarse.
- **SmallWorlds**: A “complete” representation, but far too complicated view.

**Learning from evaluations:**
- Abstraction, Detail-on-demand, Interactive Visual Cues, Cleaner game-like graphics, and more flexible API connectivity. Focus on “social” recommendation.
SmallWorlds

Interactive, Trust-based Recommendation for the Social Web

Live at http://apps.facebook.com/smallworlds
Interactive, Trust-based Recommender for Facebook Data

Supports user interaction to update information at recommendation time

>Solves stale data problem.

Makes the ACF algorithm transparent and understandable.

>increases satisfaction, acceptance etc.

Enables fast visual exploration of the data

>what-if scenarios
>increases learning
Combining Social and Semantic Recommendations

Facebook / Twitter (Social Recs)

DBPedia/Freebase (Semantic Recs)
TasteWeights Design

John's music
- U2
- Pink Floyd
- Queen
- Gorillaz
- Prodigy
- Velvet Underground
- Johnny Cash
- Andrea Bocelli
- Green Day
- Tom Waits
- Thin Lizzy
- Orbital
- Kraftwerk
- Killers
- Doors
- Gary Jules
- Cranberries
- Kings Of Leon
- Vampire Weekend

Context
- English Rock Music Groups
- Guitar
- Grammy Award Winners

Recommendations
- Beatles
- Coldplay
- Rolling Stones
- Muse
- Red Hot Chili Peppers
- Nirvana
- Daft Punk
- Radiohead
- Metallica
- Michael Jackson
- Lenny Kravitz
- Foo Fighters
- Oasis
- Nine Inch Nails
- 30 Seconds To Mars
- Arctic Monkeys
- Beatsteaks
- Ok Go
Approach
Parallel hybrid recommender system

Input Data (FB likes)
- Input Data Resolution (W articles)
  - Similarity Model
- Input Data Resolution (FB pages)
  - Similarity Model
- Input Data Resolution (TW #tags)
  - Similarity Model

Entity Resolution
- Wikipedia Sources (W articles)
  - Rec Algorithm (recs)
- Facebook Sources (band pages)
  - Rec Algorithm (recs)
- Twitter Sources (WF Experts)
  - Rec Algorithm (recs)

Recommendation

Hybridization
- Hybrid Rec Algorithm

Output Data (recs)
Recommendation Sources

Input Data Resolution
Mapping between Wikipedia articles, Facebook pages, and Twitter #tags

Similarity Models

Wikipedia
(Data source: DBpedia)

Facebook
(Data source: Facebook Graph API)

Twitter
(Data source: wefollow.com)

\[
W_{wiki_i} = \sum_{Linked(profile_j, wiki_i)} W_{profile_j}
\]

\[
W_{friend_i} = \frac{TWCI_{user, friend_i}}{\sqrt{TWT_{user}^2 \cdot TWT_{friend_i}^2}}
\]

\[
S_{expert_i, item_j} = \frac{|Experts_{item_j}| - Rank_{expert_i, item_j}}{|Experts_{item_j}|}
\]

\[
W_{expert_i} = \sum_{Linked(profile_j, expert_i)} (W_{profile_j} \cdot S_{expert_i, profile_j})
\]
Generating Recs.

**Individual Source**

\[
W_{rec_i,source_j} = \sum_{\text{Linked}(rec_i,item_k)} W_{item_k}
\]

**Hybrid Strategies**

**Weighted**

\[
W_{rec_i} = \sum_{source_j \in \text{sources}} (W_{rec_i,source_j} \cdot W_{source_j})
\]

**Mixed**

\[
W_{rec_i} = \sum_{source_j \in \text{sources}} (W_{rec_i,source_j} \cdot W_{source_j}) \cdot |\text{Sources}_{rec_i}|
\]
Evaluation

Goals
Evaluate combining social and semantic recommendations
Evaluate explanation and transparency in a hybrid recommender
Evaluate interaction in a hybrid recommender

Setup
Supervised user study. 32 participants from the human subject pool at UCSB

Procedure
Pre-questionnaire
Tasks
Interact with Profile
Interact with Sources
Interact with Full interface
Rate recommendations
Post-questionnaire (Explanation & Interaction)
Evaluation: Accuracy

Experiment
One-way repeated measures ANOVA
Compared 9 recommendation methods (below) in terms of rec. accuracy

Method (independent variable)
- **Single-source:** Wikipedia, Facebook, Twitter
- **Hybrid:** Weighted, Mixed, Cross-source
- **Interaction:** Profile, Sources, Full

Accuracy (dependent variable)
Measured in terms of “Utility”

\[ R_u = \sum_j \frac{\max(r_{uij} - d, 0)}{2^{j-1}} \]
Results: Accuracy

Plot of means of recommendation methods over utility with 95% confidence intervals

<table>
<thead>
<tr>
<th>Method 1</th>
<th>Method 2</th>
<th>Diff</th>
<th>Lower</th>
<th>Upper</th>
<th>P Val</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross Hybrid</td>
<td>Wikipedia</td>
<td>1.568</td>
<td>0.119</td>
<td>3.017</td>
<td>0.023</td>
</tr>
<tr>
<td>Cross Hybrid</td>
<td>Facebook (CF)</td>
<td>1.678</td>
<td>0.229</td>
<td>3.127</td>
<td>0.011</td>
</tr>
<tr>
<td>Cross Hybrid</td>
<td>Twitter</td>
<td>2.477</td>
<td>1.028</td>
<td>3.926</td>
<td>0.000</td>
</tr>
<tr>
<td>Full Interaction</td>
<td>Cross Hybrid</td>
<td>1.542</td>
<td>0.935</td>
<td>2.991</td>
<td>0.027</td>
</tr>
</tbody>
</table>

Results from a Tukey post-hoc analysis of the recommendation methods: multiple comparisons of means with 95% family-wise confidence level
The system helped me understand how I got the recommendations
I learned about my Facebook friends' music tastes
I see value in combining different data sources to get better recommendations
Looking at the line connections between items were useful
I would like to use a similar interface on Amazon, Netflix, YouTube, Pandora, etc.

The system was:
informative: 4
easy to use: 3.9
not intuitive: 1.8
fun to use: 4.1
Interaction

Interaction helped me get better recommendations: 4.2
Refining the ratings in my music profile helped me get better recommendations: 3.9
Interacting with middle column was useful: 3.6
Interacting with the system was clumsy: 1.8
Data from X was useful for generating recommendations:
  - Wikipedia: 3.5
  - Facebook: 3.9
  - Twitter: 1.9
Results: Diversity
Case Study: Portability of TW interface
- Developed a Social-Semantic Recommendation algorithm for data from LinkedIn API
- Personalized for one “active” logged-in user.
- Visualized the algorithm in TasteWeights interface

Algorithm:
- Map profile items to noun-phrases
- Resolve to Wikipedia articles
  - e.g.: ph.D => PHD, UCSB => UC Santa Barbara
- Compute similarity based on overlap in resolved entities.

Features
- Segmented / Organized user profile
- Interactive profile weighting
- Interactive weighting of social connections
- Dynamic re-ranking of recommendations (visual feedback)
- Provenance views to show effects of each interaction.
Conclusions

UI and interaction design are important considerations for RSs
- Increased explanation, provenance
- Expose otherwise hidden controls (e.g: control of hybrid recommender)
- Helps ease the stale data problem
- Support user input at various granularity (recommended item, recommendation partner, profile items etc)
- Increase ambient learning.
- Promote interest in the recommender system (game-like feel)

Contributions:
- Demonstrated a novel interactive RS
- Hybrid of recommendations from Wikipedia, Facebook and Twitter
- Evaluated via a 32 person supervised user study at UCSB.
- Demonstrated portability of the system on LinkedIn’s API.

Results
- Interaction increases user satisfaction in all conditions. (more interaction = higher accuracy)
- Cross-source hybrid strategy outperformed individual source strategies.
After the break... Inspectability and

In this work we touched on the ideas of inspectability and control in the context of our hybrid recommender system.

In the next talk, Bart Knijnenburg (UC Irvine) will present results from a larger study that focuses on a general analysis of inspectability and control in social recommenders. This study used some components from our TasteWeights system.
Thanks for listening!