Recommender Systems

- Group Recommender Systems -

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Austria
Motivation (1)

- Several decisions are made by groups

- All too often biases arise in decision-making processes which lead to suboptimal results

- Technical assistance for the identification of solutions for group decision tasks influence decision quality

Software support can increase decision outcome
Motivation (2)

• So far in recommender systems
  - System recommends items for one active user
  - Most techniques are tailored towards individual users

• Difference between individuals and groups in recommending information
  - Traditionally only recommenders for individuals available
  - Integrating the opinions of more than one user
  - Social influence
    - Process where people directly or indirectly influence the thoughts, feelings and actions or others.
    - Opinion leaders, a person who has important effects on group decision-making
    - Social contagion
Motivation (3)

- **Scenarios for group recommendation**
  - Collaborative Web surfing, news access
  - Tourist, restaurant, exhibition guides
  - Recommending a movie for cinema

- **Actual tools only for specific domains**
  - Doodle
  - MusicFX
  - IntelliReq
  - Travel Decision Forum
General Process / Subtasks

1. Acquiring information about group members’ preferences

2. Generating recommendation

3. Presenting and explaining recommendations to the members

4. Helping the members’ consensus about recommendations
# Overview Subtasks

<table>
<thead>
<tr>
<th>Subtask of the recommender system</th>
<th>Difference from recommendation to individuals</th>
<th>General issues raised</th>
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<tbody>
<tr>
<td>1. The system acquires information about the members’ preferences.</td>
<td>If members specify their preferences explicitly, it may be desirable for them to be able to examine each other’s preference specifications.</td>
<td>What benefits and drawbacks can such examination have, and how can it be supported by the system?</td>
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<td>2. The system generates recommendations.</td>
<td>Some procedure for predicting the suitability of items for a group as a whole must be applied.</td>
<td>What conditions might such a procedure be required to fulfill; and what kinds of procedure tend to fulfill these conditions?</td>
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<td>3. The system presents recommendations to the members.</td>
<td>The (possibly different) suitability of a solution for the individual members becomes an important aspect of a solution.</td>
<td>How can relevant information about suitability for individual members be presented effectively?</td>
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<td>4. The system helps the members arrive at a consensus about which recommendation (if any) to accept.</td>
<td>The final decision is not necessarily made by a single person; negotiation may be required.</td>
<td>How can the system facilitate the necessary communication among group members?</td>
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[Jameson & Smyth, 2007]
1. Acquiring Group Members’ Preferences

• Basically, the methods for acquiring information about users’ preferences are not much different with the methods applied in recommender for individuals

• Implicitly acquired preference
  • *MusicFX*: uses threshold how long a MP3 file is played
  • *Let’s Browse*: analyzing the words that occur in each user’s homepages

• Explicitly acquiring preference
  • *PocketRestaurantFinder*: asking each user the preference of restaurant by cuisine, price, amenity, location, etc.
  • *Travel Decision Forum*: asking each user the preference about dozens of attributes
  • *PolyLens*: each user does rate individual movies

• Negative Preference
  • *Adaptive Radio*: focus on negative preference for playing music for groups and avoid the playing of music disliked by any member
  • *MusicFX*: Genre which is completely disliked by anyone will be removed from the playlist
Sorting of items

- Sequence of Alternatives strongly influences the rating of those

Possible approach:

1. Sort by actual rating of user

2. Sort by MAUT (Multiattribute Utility Theory) principle
Adapting Acquired Preference

- However, the adaptation of the preference to the group recommendation is distinguishable.

- In group recommenders, each member may have some interest in knowing the other members’ preference:
  - To save effort
  - To learn from other members

- Collaborative preference specification:
  - Taking into account attitudes and anticipated behavior of other members
  - Encouraging assimilation to facilitate the reaching of agreement
Example: Collaborative Specification

- **Room Facilities**
  - **Sports Facilities**
  - **Leisure Activities**
  - **Health Facilities**
  - **Country**

- **Hotel Facilities**

- **Not Important**
- **Very Important**

- **Importance**

- **Rating**
  - **Don't want it**
  - **Want it**

- **Whirlpool**
  - Don't want it: -- -- ~ R C T
  - Want it: R R ++

- **Sauna**
  - Don't want it: -- -- ~ C R T
  - Want it: C C ++

- **Massage**
  - Don't want it: R -- C T
  - Want it: -- C ++

- **Beautyfarm**
  - Don't want it: -- -- ~ C T
  - Want it: C T ++

- **Fitness**
  - Don't want it: -- -- T
  - Want it: T C ++
Example: Choicla

Used Heuristic: **Average Vote**

- **Clocktower**
- **Häuserl im Wald**
- **El Gaucho**
- **La Botte**

- **My Vote:**
- **Gabi rated the alternative with 1 stars:**
- **Molanie rated the alternative with 5 stars:**
- **Bemd rated the alternative with 5 stars:**

**Group Preference:**
- **Rating:** (4)

(This alternative was rated by 4 users with an average of 4 and a standard deviation of 2.)
Choicla Mobile version

- Available in
  - iOS
  - Android
Exercise

• Select a decision problem that you can define on the basis of the “ChoiclaWeb” environment.
  • http://www.choiclaweb.com/createDecision

• Define this decision problem in ChoiclaWeb (should be done by one selected student of your team).
  • Set “Max Votes” variable in “Advanced” tab to a high number (e.g. 20)

• Participate in the group decision (all members of your group).

• Take the final decision.
2. Generating Recommendation

- Once the preferences of group members were acquired, the aggregation of the preferences is necessary.

- Aggregation of preferences is only for the group recommendation.

- Three most typical ways are:
  - Aggregating ratings for individuals:
    - E.g. computing average of ratings
  - Merging of recommendations made for individuals:
    - E.g. simply merging individual recommendations
  - Constructing group preference models
Aggregating Ratings for Individuals

- For each candidate $c_i$:
  - For each member $m_j$ predict the rating $r_{ij}$ of $c_i$ by $m_j$
  - Compute an aggregate rating $R_i$ from the set $\{r_{ij}\}$

- Recommend the set of candidates with the highest predicted ratings $R_i$ for instance
Average Vote

\[ \text{AVV} (o) = \frac{\sum_{u \in U} \text{präferenz}(u, o)}{|U|} \]

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Majority Vote

\[ \text{MAJV}(o) = \arg \max_{d \in D} \left( \# \left( \bigcup_{u \in U} \text{präferenz}(u, o) = d \right) \right) \]

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Least Misery

\[ \text{LEMI}(o) = \min \left( \bigcup_{u \in U} \text{präferenz}(u, o) \right) \]

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Most Pleasure

\[ \text{MOPL}(o) = \max \left( \bigcup_{u \in U} \text{präferenz}(u, o) \right) \]

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Group Distance

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\text{GRDI}(o) = \arg\min_{d \in D} \left( \sum_{u \in U} \text{distanz}(\text{präferenz}(u, o), d) \right)
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| GRDI | 5 | 3 | 3 | 4 |
## Ensemble Vote

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Exercise

• Define a user preference table using 5-star rating in a specific domain with at least 5 items and 5 users.

• Aggregate group member preferences using following aggregation strategies:
  • Average vote
  • Majority vote
  • Least misery
  • Most pleasure
  • Group distance
  • Ensemble voting

• Detect the winning item for each aggregation strategy
Merging Recommendations for Individuals

- For each member $m_j$:
  - For each candidate item $c_i$, predict the rating $r_{ij}$ of $c_i$ by $m_j$
  - Select the set of candidates $C_j$ with the highest predicted ratings $r_{ij}$ for $m_j$

- Recommend $\bigcup_j C_j$, the union of the set of candidates with the highest predicted ratings for each member

- Easy extension of the recommendations for individual users

- But recommendations does not in itself indicate which solutions are best for the group as a whole
Constructing Group Preference Models

- Construct a preference model $M$ that represents the preferences of the group as a whole.

- For each candidate $c_i$, use $M$ to predict the rating $R_i$ for the group as a whole.

- Recommend the set of candidates with the highest predicted ratings $R_i$.
Group Recommendation

• Explained methods in preference aggregation and recommendation merging are very basic

• Goals to be considered in more sophisticated models
  • Maximizing average satisfaction
  • Minimizing misery
  • Ensuring some degree of fairness
  • Treating group members differently where appropriate
  • Discouraging manipulation of the recommendation mechanism
  • Ensuring comprehensibility and acceptability
  • Preference specifications that reflect more than the individual users’ personal taste
Long-time fairness

- Several decision tasks reoccur regularly
- Past decision outcomes influence current recommendation
- User-rating of disadvantaged people in past have more impact on current recommendation
3. Presenting & Explaining Recommendations

- Explanation in group recommendations provide the ways to
  - Understand how other members opinions affect the suggested information
  - Get them acquainted how the recommendation was derived (do nothing behind users back)
  - Explanations increase trust in recommendations
Example (I)

This page might interest Bill, George, and Nicholas because it concerns technology and travel.

Bill Gates
Microsoft Corp.
billg@microsoft.com
PROFILE BUILT FROM:
http://www.microsoft.com/billgates/
PROFILE KEYWORDS:
technology (56) internet (50) travel (48)
windows (46) pc (43) subsidiary (39)
investment (32) ceo (29) intellectual (20)
property (20) ...

George Lucas
LucasArts Entertainment
PROFILE BUILT FROM:
http://members.tripod.com/~gnomebash/luc2a.htm
PROFILE KEYWORDS:
skywalker (32) business (42) travel (39)
force (30) star (25) wars (24) Internet (18)
graffiti (14) technology (11) digital (10)
Example (II)

"Separate listing by group": it shows separate lists, with items sorted on the basis of the different user's preferences.
"Unique listing (method 1)" : it shows a single list, taking into account the needs of the whole group.
"Unique listing (method 2)" : it shows a single list, trying to satisfy a little bit everybody.

Suggestions for the whole group:

- **Lingotto **** For children it is much eye-catching, it requires low background knowledge, it requires a bit is quite short. For yourself it is much eye-catching and it has high historical value. For impaired it is much eye-catching historical value.**

- **Palazzo Reale **** For children it is much eye-catching. For yourself it is much eye-catching, it has high artistic value. For impaired it is much eye-catching and it has high artistic value.**

- **Palazzo Madama **** For yourself it has high historical value.**

- **Palazzo Carignano *** For children the visit is quite short. For yourself it has high historical value.**

- **Palazzo Saluzzo di Paesana ** For children the visit is quite short.**
4. Helping Consensus About Recommendation

- Unlikely with individual recommendation, extensive debate and negotiation may be required

- Situation where explicit support for the final decision is unnecessary
  - System simply translates the recommendation into action
    - *Adaptive Radio, Flytrap* and *MusicFX* play the recommended music automatically
  - One group member is responsible for making the final decision
    - *Let’s Browse, Intrigue and Choicla* have an assumption that one person is in charge of the selection
  - Group members will arrive the final decision through conversational discussion
    - Interactive table on *CATS* vacation recommender
Current Research Results

- Information exchange can be significantly increased by the help of recommendations
  - No / less information exchange can lead to suboptimal decision outcomes

- Decision biases occur also in group decision contexts
  - Anchoring
  - Primacy/Recency effects
  - Serial position effects
Points to Consider

• Whether the group members should be allowed to see each other’s votes

• How the votes should be counted and weighted

• How the results of voting should be presented

• How to sort the alternatives

• How the final decisions ought to be made
Decision making in different involvement domains

- Analyzed domains:
  - [Very high-involvement item]: Shared apartment for students.
  - [High-involvement item]: To book a holiday for the group.
  - [Low-involvement item]: To reserve a restaurant for the group.
  - [Very low-involvement item]: Next musical genre to be played in a fitness studio for the next two hours.

- Analyze which aggregation heuristic will be more preferred

- Participate in ongoing user study:
References

A. Jameson, B. Smyth: “Recommendation to Groups”, chapter 20 in [*]
   Slides by Danielle Lee


   Bachelor Thesis of Henrik Mühe

Course Material

- D. Jannach, M. Zanker, A. Felfernig, and G. Friedrich. Recommender Systems – An Introduction, Cambridge University Press, 2010 (*can be found in library*).

- Lecture slides and slides from recommenderbook.net.

Thank You!