

Case-based Reasoning and Recommender Systems

Claudio Baccigalupo
Ph.D. student, IIIA - CSIC, Barcelona (Spain)

RECOMMENDER SYSTEMS



vs.

amazon.com.



Humans exploit and reuse knowledge from real-world transactions

Automatic systems apply this behaviour in complex contexts



I WANT TO BUY A CAMERA...



- 4-6 mega-pixels
- Known manufacturer
- Less than 300 €

- 4MP, Canon, 310 €
- 3MP, Canon, 250 €





**content-based
recommender**



I WANT TO BUY A CAMERA...



- 4-6 mega-pixels
- Known manufacturer
- Less than 350 €

- 4MP, Canon, 310 € 
- 5MP, Pentax, 340 € 

- 4MP, Canon, 310 € 



**content-based
recommender**



I WANT TO BUY A CAMERA...



• 4-6 mega-pixels
Input Problem
• Less than 350 €

• 4MP, Canon, 310 € 
Retrieve and Reuse 
• 5MP, Pentax, 340 €

Revise

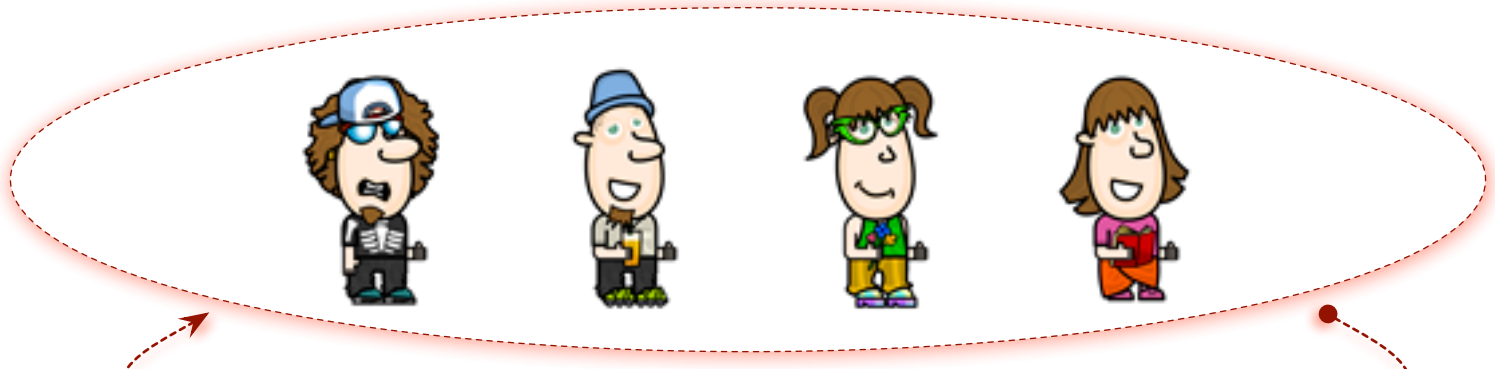
• 4MP, Canon, 310 € 
Retain



content-based recommender



I WANT TO BUY A BOOK...



- I just bought “Jane Eyre”
- I don’t like Oscar Wilde
- I am French

- “Jane Eyre”
- “The Picture of Dorian Gray”
- “Madame Bovary”
- “C++ Manual”
- “Wuthering Heights”



**collaborative filtering
recommender**

- “Madame Bovary”
- “Wuthering Heights”
- “C++ Manual”



I WANT TO COMPILE A PLAYLIST...

FIQL

Art of
the Mix

mystrands

mixlister

- Containing 5 songs
- Including “Strangers In The Night” (F. Sinatra)

1. Just The Way You Are (D. Krall) 2. Let's Fall In Love (D. Krall) 3. Nunca Es Para Siempre (Presuntos Implicados) 4. Strangers In The Night (F. Sinatra)

1. Strangers In The Night (F. Sinatra) 2. The Candy Man (Sammy Davis Jr.) 3. Unforgettable (Nat King Cole) 4. What A Wonderful World (L. Armstrong)

1. Let's Fall In Love (D. Krall)
2. Nunca Es Para Siempre (Presuntos Implicados)
3. Strangers In The Night (F. Sinatra)
4. The Candy Man (Sammy Davis Jr.)
5. Unforgettable (Nat King Cole)



**knowledge-based
recommender**

I WANT TO COMPILE A PLAYLIST...



- Containing 5 songs
- **Input Problem**
The Night” (F. Sinatra)

1. Just The Way You Are (D. Krall)
2. Let’s Fall In Love (D. Krall)
3. Nunca Es Para Siempre (Presuntos Implicados)
4. Strangers In The Night (F. Sinatra)

Retrieve

1. Strangers In The Night (F. Sinatra)
2. The Candy Man (Sammy Davis Jr.)
3. Unforgettable (Nat King Cole)
4. What A Wonderful World (L. Armstrong)



knowledge-based recommender

1. Let’s Fall In Love (D. Krall)
2. Nunca Es Para Siempre (Presuntos Implicados)
3. Strangers In The Night (F. Sinatra)
4. The Candy Man (Sammy Davis Jr.)
5. Unforgettable (Nat King Cole)

Reuse



RECOMMENDER SYSTEMS AND CBR

- **Case Base:** includes all the previous “experiences” that can give information about new problems
- **Retrieval:** extract from the Case Base a subset of items similar to the problem that the user might be interested in
- **Reuse:** adapt/rank the retrieved items based on implicit/explicit knowledge on users/products, and present the user with the items that best solve the problem
- **Revise:** evaluate users’ interest in the new items, using both implicit and explicit feedback
- **Retain:** store in the Case Base new information about the user, interest in the product, the recommendation session

MANY CBR RECOMMENDER SYSTEMS

Several expects in which can differ

- **What is a case?**
- **Which similarity measure is used?**
- **How cases are retrieved/reused?**
- **Are the recommendations revised/retained?**
- **Can the user interact (conversational CBR)?**



WHAT IS A CASE ?

A composition of elements from 4 different models

- **Content Model:** describes the product, usually as a feature vector (e.g., list of attributes)
- **User Model:** contains personal information about the user (e.g., preferred products)
- **Session Model:** collects information on recommendation sessions (e.g., user queries)
- **Evaluation Model:** describes the outcome of recommendation (e.g., user a-posteriori evaluation)



SIMILARITY MEASURE

- The key element that distinguishes a CBR system from a filter-based system (e.g., querying a database)
- For numeric attributes, normalised distance can be used as **local similarity** measure; for symbolic attributes, more work is required (e.g., a table of possible values)
- Local similarities are **combined**, usually in a non-linear form (e.g., an attribute has a higher weight)
- **Global knowledge** about the context can be helpful

RETRIEVE AND REUSE

- **Retrieval is typically the main phase** of a CBR recommender systems, whereas reuse can be as easy as showing the retrieved cases (ranked) to the user
- **Retrieval size** can be static or dynamic; similarity constraints can be hard or soft (or softened)
- If the solution is configurable, retrieved cases can be **adapted** into a new case (e.g., Constructive Adaptation)
- **Diversity** and usefulness also play a role

REVISE AND RETAIN

- **Conversational systems** allow users to review their choice and the proposed solutions
- **Explicit feedback** can help to evaluate quality of cases
- **Implicit feedback** might also help
- Revision helps to **adapt the Case Base** to the user
- Retain helps to **maintain** “good cases” in the Case Base

Here are some **recommended** papers:

- *J.B. Schafer, J.A. Konstan, J. Riedl*
E-Commerce Recommendation Application
- *F. Lorenzi, F. Ricci*
Case-Based Recommender Systems: a Unifying View
- *C. Baccigalupo, E. Plaza*
Case-based Sequential Ordering of Songs for Playlist Recommendation

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