

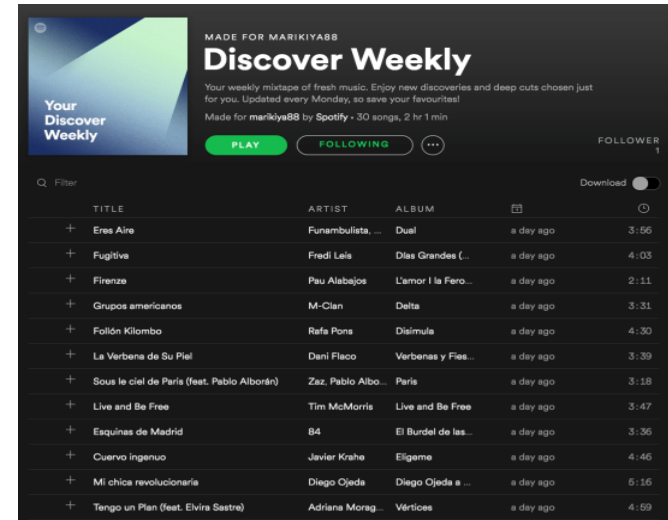
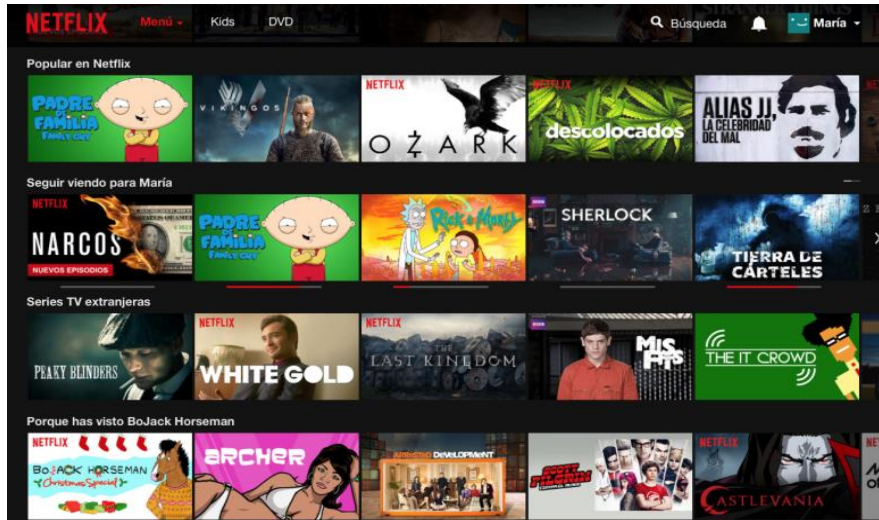


Aspect-based active learning for user preference elicitation in recommender systems

María Hernández Rubio (*presenting author*)
Alejandro Bellogín
Iván Cantador

Recommender systems

NETFLIX



User Preferences

Ratings



Intex 86" x 23" Rectangular Frame Above Ground Outdoor Child Safe Splash Swimming Pool

by Intex

★★★★☆ 4,473 ratings

Available from these sellers.

Size: 7' 2" x 4' 11" x 23"

7' 2" x 4' 11" x 23"

9 options from \$326.50

8' 6" x 5' 3" x 25"

1 option from \$488.88

14' 9" x 7' 3" x 33"

3 options from \$699.00

- SUMMERTIME FUN: Escape the summer heat and help keep your little ones cool with the Intex Rectangular Frame Baby Pool. This pool can fit up to 6 people and has a water capacity of 439 gallons of water.

Categorical



Thumbs up / down

👍 6K 👎 186

Reviews



jwood1964

★★★★★ PERFECT FOR BACK PATIO

Reviewed in the United States on May 3, 2019

Size: 8' 6" x 5' 3" x 25" | [Verified Purchase](#)

Easy to set up, Instructions were clear. I am seriously thinking about buying another one for Camping! Enough space for water exercise. We added a pump/filter and it creates a perfect back yard oasis. We used foam (for under laminate flooring) as underlay. very comfortable. An adult can sit in the pool and water is up to shoulders. There is a cover sold on amazon which is a perfect fit! Bestway 58105 Frame Pool Cover, 102 by 67-Inch and the Intex filter/pump is Intex Krystal Clear Cartridge Filter Pump for Above Ground Pools, 1000 GPH Pump Flow Rate, 110-120V with GFCI also sold on amazon!

Aspect Information



LG
 LG Nexus 5X H791 32GB Carbon Black, Factory Unlocked EU GSM
 Smartphone, International Model, No Warranty
 380 customer reviews | 201 answered questions

Price: **\$280.00** & FREE Shipping—or get **FREE Two-Day Shipping** with Amazon Prime

In Stock.
 Wait til **Wednesday, Sept. 27** Order within **19 hrs 57 mins** and choose **One-Day Shipping** at checkout. [Details](#)
 Sold by **Open Group Wireless** and Fulfilled by Amazon. Gift-wrap available.

Color: **Carbon**

\$280.00 **\$255.59**

Carrier	Compatibility Rating
AT&T	Fully Compatible
Sprint	No Service
T-Mobile	See Details
Verizon Wireless	No Service

[View More Compatibility Details](#)

- 5.2-inch with 1080 x 1920 Resolution Display, Qualcomm Snapdragon 808 1.8 GHz Quad-core + Dual-core, 32GB ROM, 2GB RAM; Does Not Support Micro-SD card, Main Camera: 12.3 MP, laser autofocus, dual-LED (dual tone) flash; Front Camera: 5 MP, Nano SIM
- Unlocked cell phones are compatible with GSM carriers such as AT&T and T-Mobile, but are not compatible with CDMA carriers such as Verizon and Sprint.
- Please check if your GSM cellular carrier supports the bands for this model before purchase.

★★★★★ **Honest, unbiased, and straight to the point**

By **Michael** on December 4, 2016

Color: Quartz | **Verified Purchase**

Makes you satisfied and glad you bought it. It's snappy processor can handle most anything you through at it.

Pros- even with plastic backing it still feels premium, the design leaves you breathless, camera is sub par, and it's stock Android which is a great experience

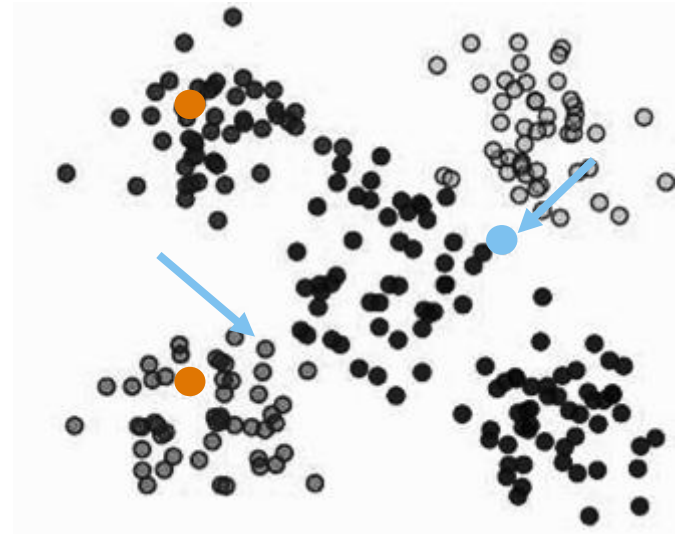
Cons- lack of as compatibility, no wireless charging, comes with travel charger with an adapter

Overall- definitely a deal and bang for your buck. Highly recommended and after time using it I've fallen in love with no regrets.

User preferences acquisition

Preference elicitation: how to model user's preferences

➔ **Active Learning (AL):**
ask users to rate items
smartly



Our work

Build an **AL algorithm** based on **aspect opinions** extracted from **reviews**.

Objective: get similar recommendation metrics with fewer items asked.



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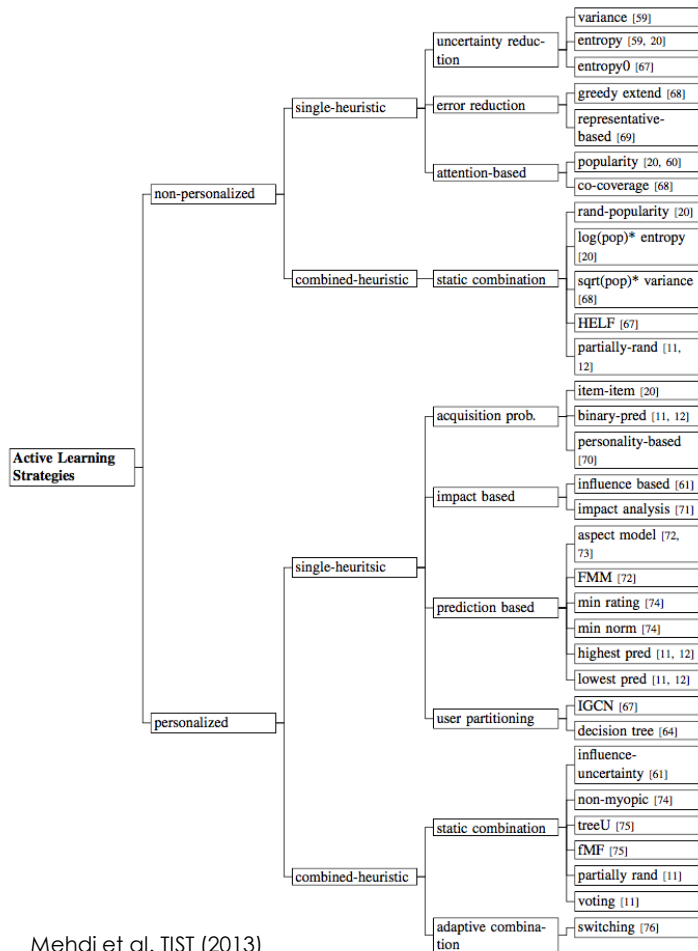
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- **Introduction and Motivation**
- Active Learning Methods
 - SoA item-based methods
 - Proposal: aspect based method
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 - Datasets
 - Evaluation
 - Results
- Conclusions and Future Work

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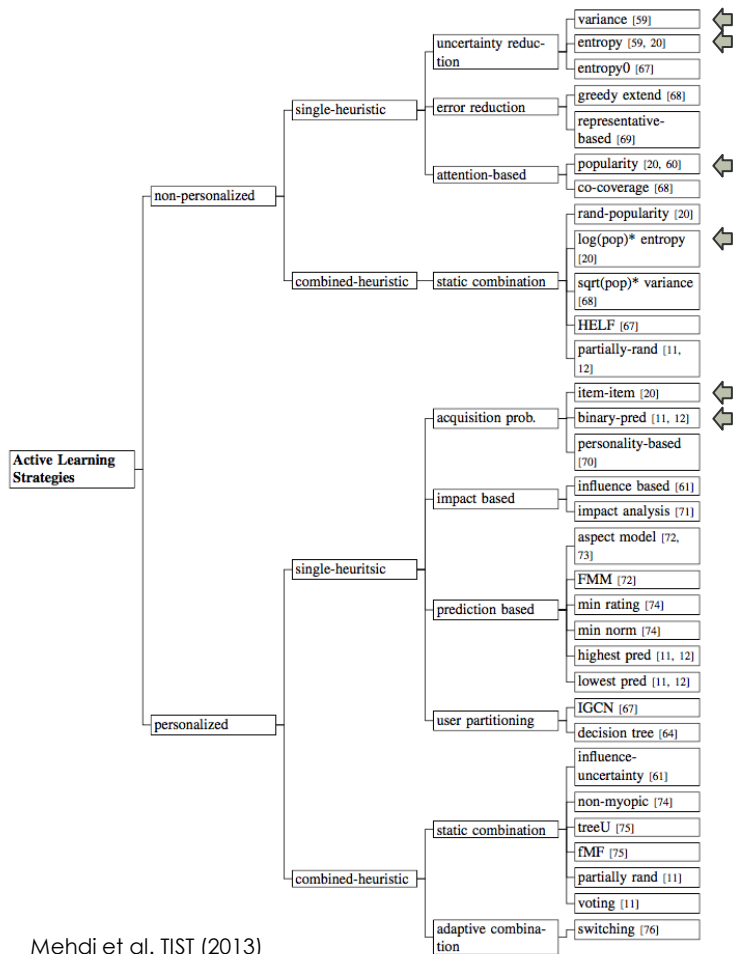
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SoA item-based methods

- **Non-Personalized vs Personalized Active Learning:**
 - Take into account users' previously expressed ratings
 - Request all the users to rate the same items

- **Single- vs combined-heuristics**
 - Single: implements a unique item selection rule
 - Combined: hybridize several single-heuristics strategies



- **variance**: items with highest rating variance
- **popularity**: items with highest number of ratings
- **entropy**: items with highest rating dispersion
- **log(pop)*entropy**
- **item-item**: items more similar to user's previously rated items
- **binary-pred**: items with highest probability of being rated by the user

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Aspect-based Active Learning method

*Exploiting the rich information that can be extracted from reviews: **item aspects** mentioned and the **opinion or sentiment** associated to them.*

- Help user to find items that share characteristics with previously interacted items
- Item aspects (vs other content or collaborative information) should alleviate the cold-start problem

Aspect-based Active Learning method

Exploiting the rich information that can be extracted from reviews: **item aspects** mentioned and the **opinion or sentiment** associated to them.

- Hybrid recommendation approach (Frolov & Oseledets, RecSys 2019): aspect-based item-item similarity matrix plus collaborative information.
- Similarity between item i_n and i_m is computed as the cosine similarity over the item profile $i_n = \{w_{na}\}_{a=1}^K$ built on the K aspect opinions, where w_{na} is the weight assigned to aspect a for item i_n .

$$\text{sim}(i_n, i_m) = \frac{\sum w_{na}w_{ma}}{\sqrt{\sum w_{na}^2 w_{ma}^2}}$$

- *item-item* (personalized and single heuristic)

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Dataset

- Product Dataset: Movies & TV Amazon product reviews dataset (McAuley, WWW (2016))
- Aspect method: vocabulary (voc) (Hernández-Rubio et al. UMUAI (2019))

	Ratings	Users	Items	Annotations	Aspects
<i>Initial</i>	1,697,533	123,960	50,052	369,175	23
<i>Items with aspects</i>	1,683,190	123,960	48,074	369,175	23
<i>Users with ≥ 20 ratings</i>	819,148	14,010	47,506	367,750	23

Table 1: dataset and aspects statistics

* for this work we have sample to 1500 users for computational reasons

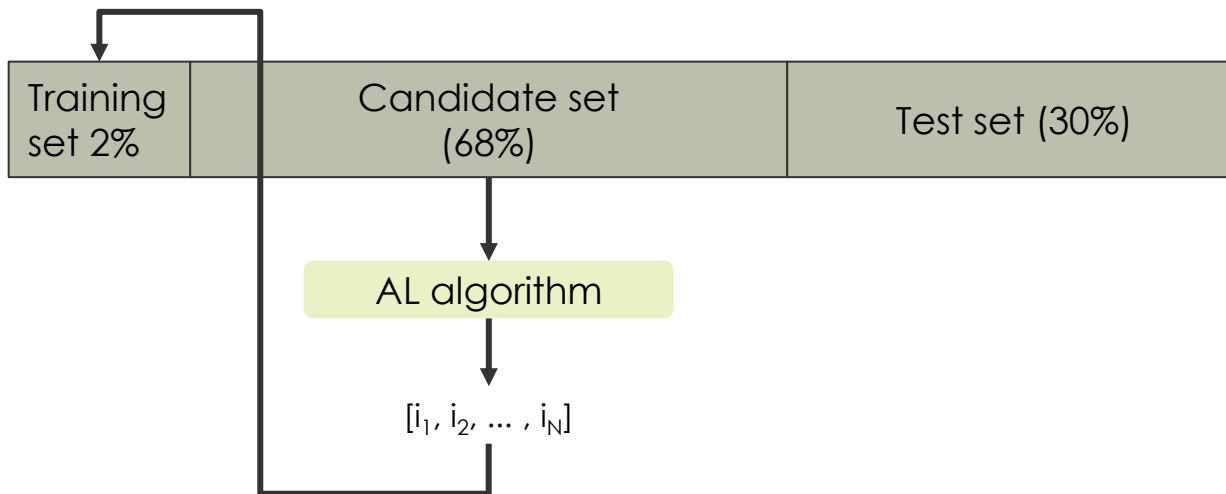
Evaluation

Methodology:

Training set 2%	Candidate set (68%)	Test set (30%)
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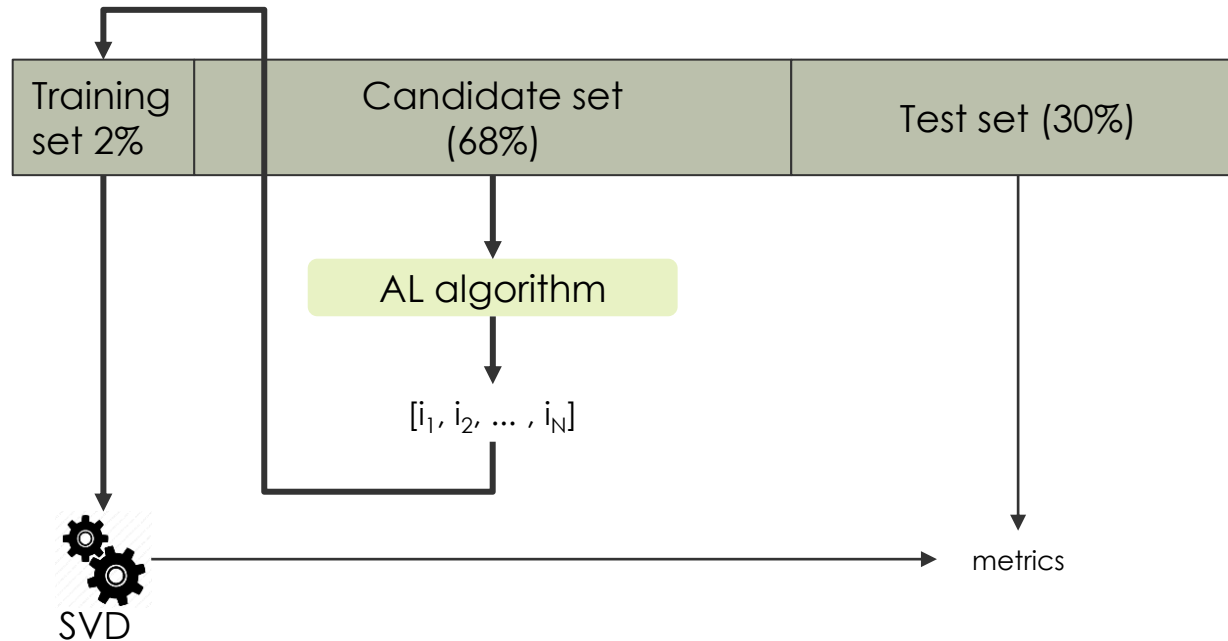
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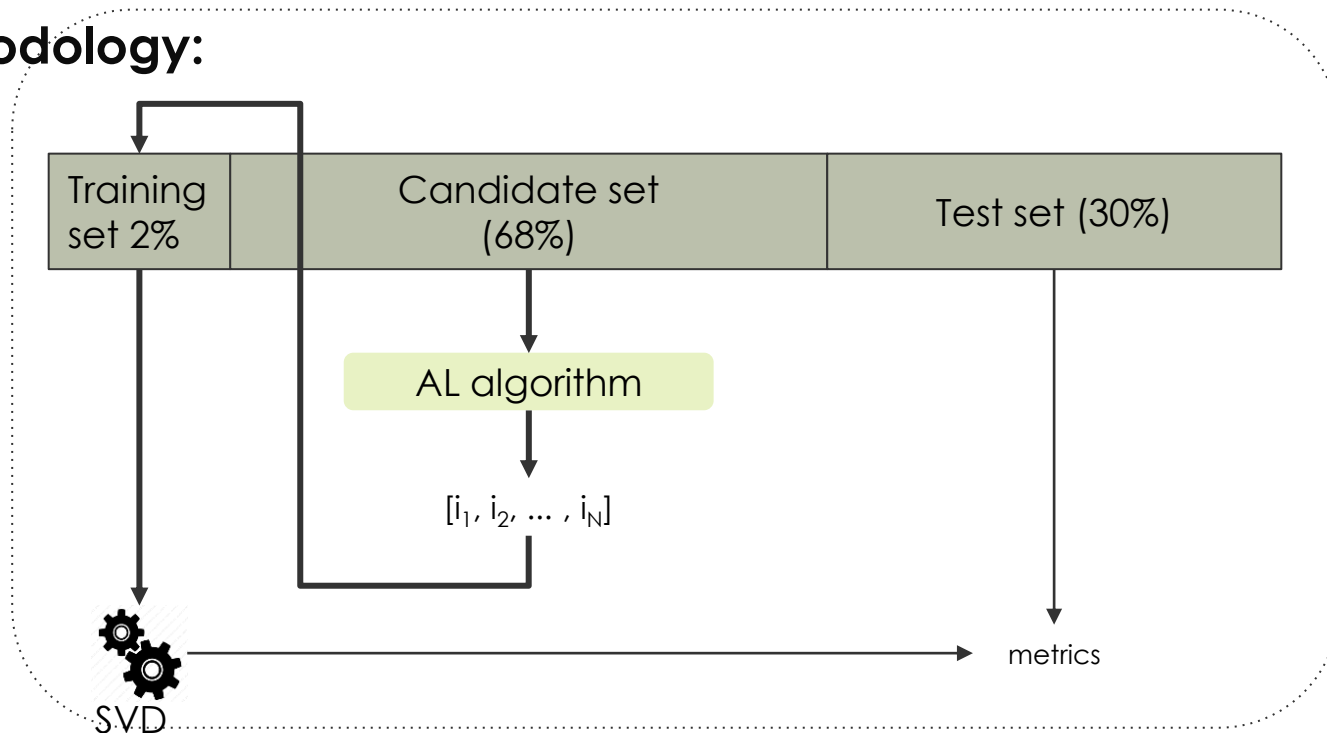
Evaluation

Methodology:



Evaluation

Methodology:



$N = 10$
iter = 170
CV = 3

Evaluation

- Metrics:
 - Rating: MAE, RMSE
 - Ranking: P@1, P@5, P@10

- Baselines:
 - random
 - variance
 - popularity
 - entropy
 - log-pop-entropy

Results

- Aspect-based method is not able to find all known items for the user

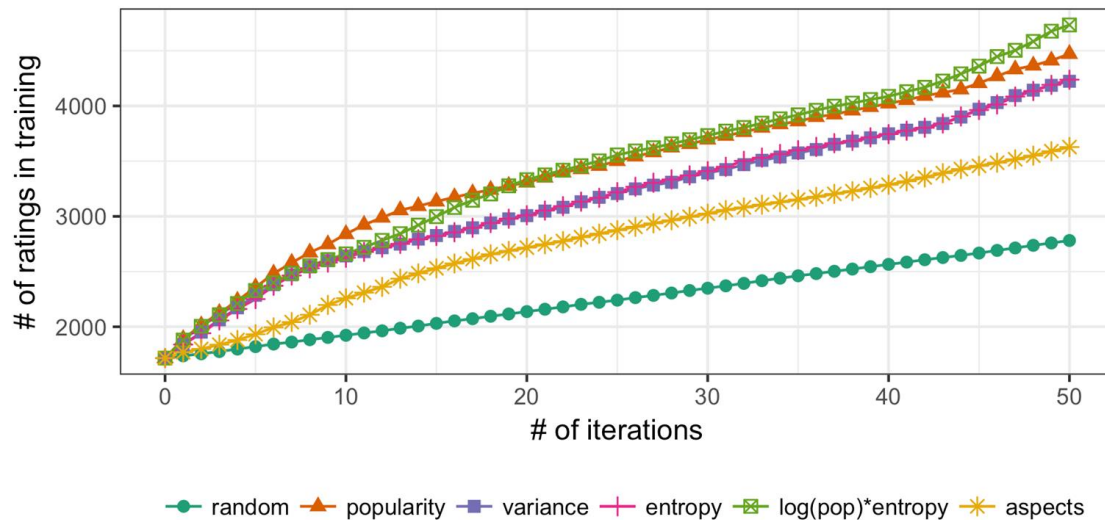


Figure 1: Evolution on the number of ratings correctly elicited by each strategy (zoomed in on the first 50 iterations)

Results

- Aspect-based method gets the highest improvement in error.

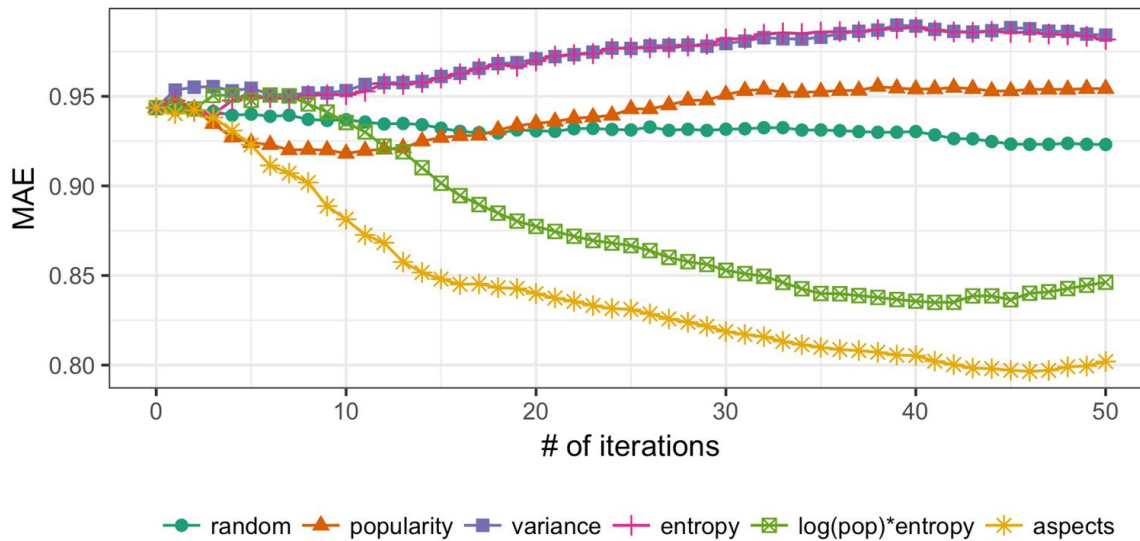


Figure 2: Evolution on the error accuracy (the lower, the better) under the effect of six elicitation strategies.

Results

- Aspect-based method is the best performing method throughout most of the elicitation process.

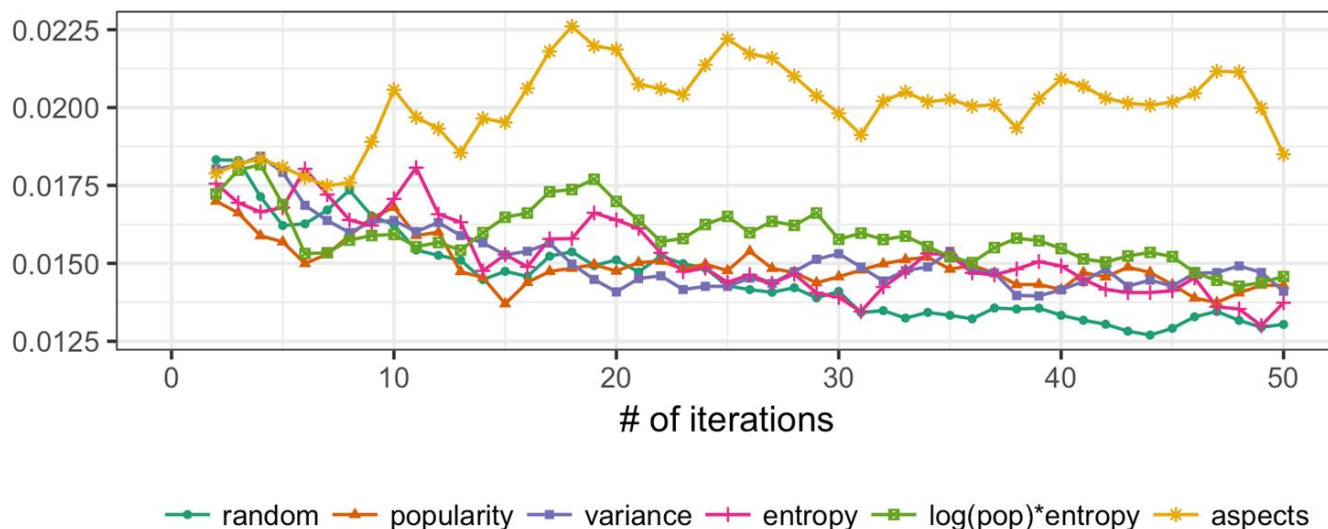


Figure 3: Ranking accuracy measured as P@5 (the higher, the better) under the effect of six elicitation strategies, smoothed values taking the average of the last 3 points.

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Conclusions



- Novel active learning approach based on opinions about item aspects.
- Tested on a real world dataset
- Outperforms AL strategies on rating prediction error and ranking precision metrics.

Future Work



- More exhaustive experiments:
 - more sophisticated aspect extraction methods
 - several recommender systems
 - datasets from several domains
- Analyze the behaviour of our method on different cold-start settings
- Online evaluation with real users to confirm offline results
- Integrate into a conversational agent or chatbot



Questions?

Thank you!