Rethinking Collaborative Filtering: A Practical Perspective on State-Of-The-Art Research Based on "Real-World" Insights and Challenges

Noam Koenigstein

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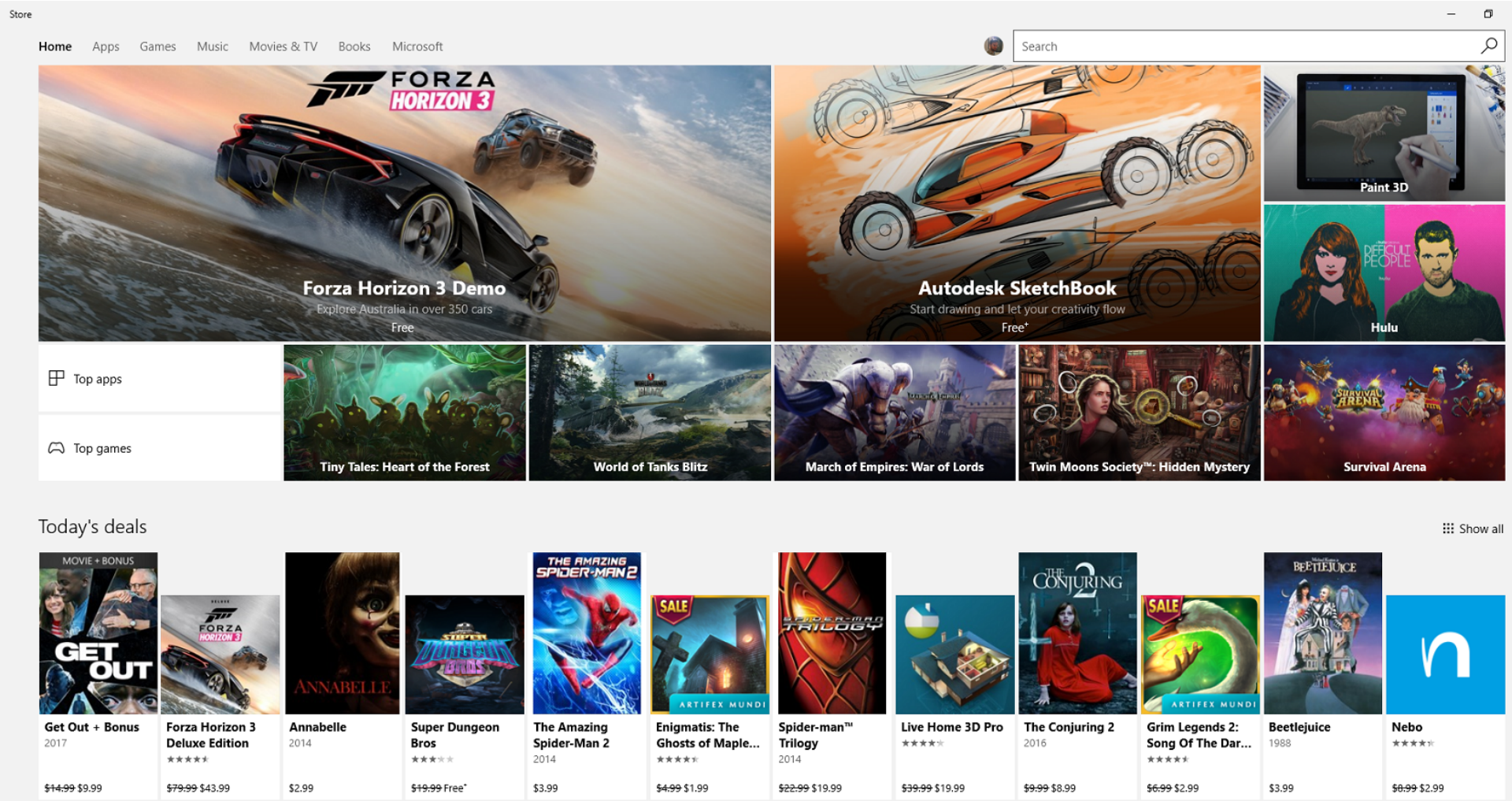
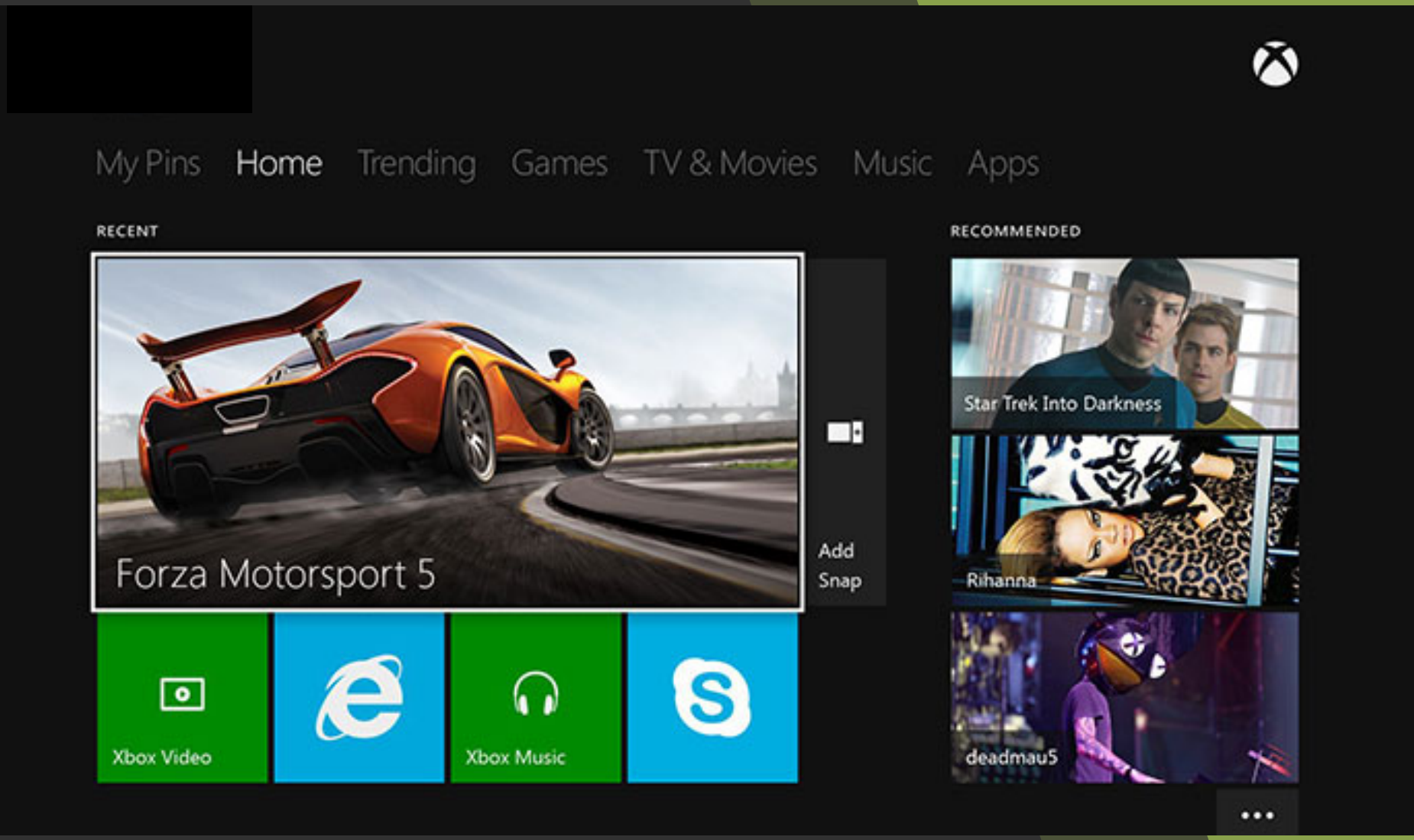
RECOMMENDATIONS IN MICROSOFT STORE

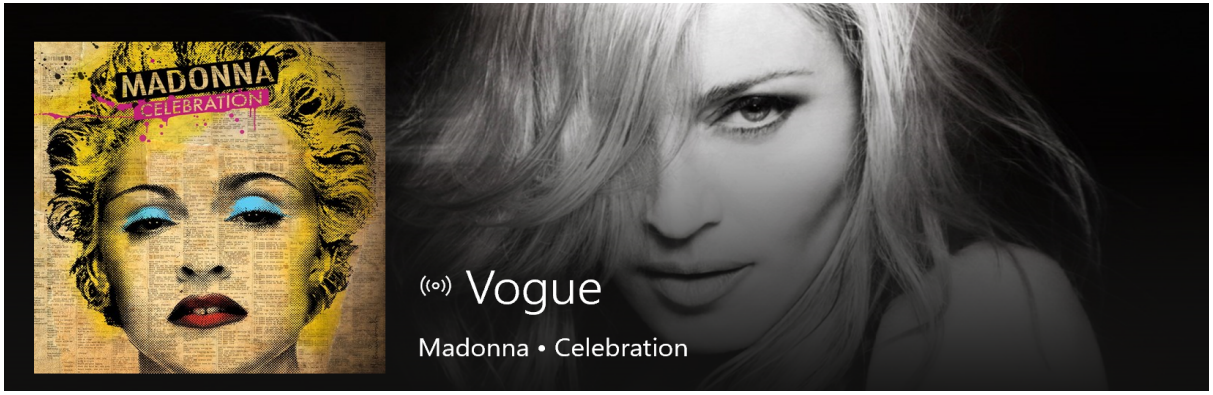
Windows Store



The Xbox Marketplace



Groove Radio



Vogue	Madonna	Celebration (Double Disc	2009	Pop	5:16
Well, Well	Nelly Furtado	Whoa, Nelly!	2000	Pop	2:59
1,2,3 (Remix)	Gloria Estefan	Greatest Hits	1992	Pop	3:34
Viva Forever	Spice Girls	Spiceworld	1997	Rock	5:10
Man in the Mirror (2012 Rem	Michael Jackson	Bad (Remastered)	1987	Pop	5:18
Hung Up	Madonna	Confessions On A Dance	2005	Pop	5:37
So What (Main Version)	P!nk	Funhouse	2009	Pop	3:35

Microsoft’s Web-Store

Microsoft Store Products Support Search Microsoft.com 0

Store Devices Software & Apps Games & Entertainment Deals More Store Locations

Students save 10% on new Surface Pro. SHOP NOW >

BUNDLE AND SAVE

New Surface Pro i5 128GB + Type Cover

★★★★½ (4)

Build your bundle

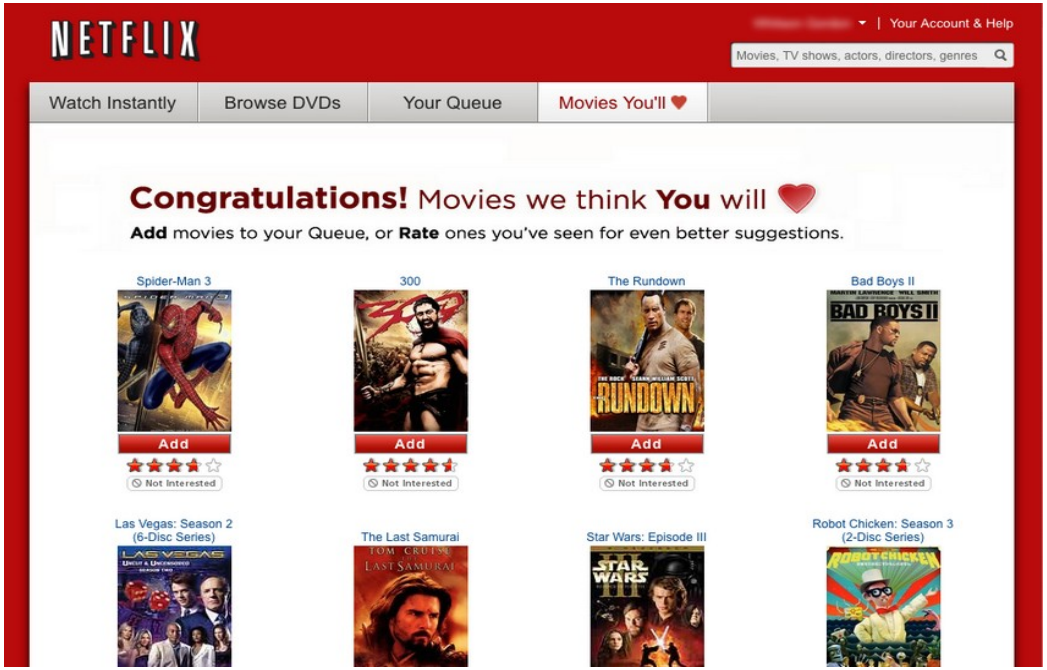
Free shipping. Free returns.

Description

- Save $150
- Intel Core i5, 128GB SSD, 4GB RAM
- Choice of Surface Type Cover (Burgundy, Cobalt Blue, or Platinum)
- A best-in-class laptop, with the versatility of a studio and tablet
- Powerful Intel Core processor
- The fastest startup and resume of any Surface Pro yet
- Up to 13.5 hours of battery life[2]
- Surface Pen sold separately

A DECADE AGO…

A Decade Ago… The Netflix Prize



The goal: 10% improvement in RMSE over Netflix's Cinematch

$$RMSE=\sqrt{1/n \sum_{i=1}^{n} (y_i - y_i)^2}$$

It took tens of thousands of participants over 2 years….

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The Problem with Ratings

- They do not exist!

- Missing items not at random
  Collaborative Filtering and the Missing at Random Assumption

  B. M. Marlin, R. S. Zemel, S. Roweis, M. Slaney

- Ratings are fuzzy and influenced by the order of items
  Rating vs. Preference: A comparative study of self-reporting
  G. N. Yannakakis, J. Hallam

- Learning ratings is very different from personalization!
  Yahoo! Music Recommendations: Modeling Music Ratings with Temporal Dynamics and Taxonomy
  Gideon Dror, Noam Koenigstein and Yehuda Koren

IF NOT RMSE THEN WHAT?

Implicit Feedback and Ranking

- Collaborative Filtering for Implicit Feedback Datasets
  Y. Hu, Y. Koren, C. Volinsky

- Implicit-to-Explicit Ordinal Logistic Regression
  D. Parra, A. Karatzoglou, X. Amatriain, I. Yavuz

- BPR - Bayesian Personalized Ranking
  S. Rendle, C. Freudenthaler, Z. Gantner, and L. S. Thieme

- RankALS – Alternating Least Squares for Personalized Ranking
  G. Takacs, D. Tikk

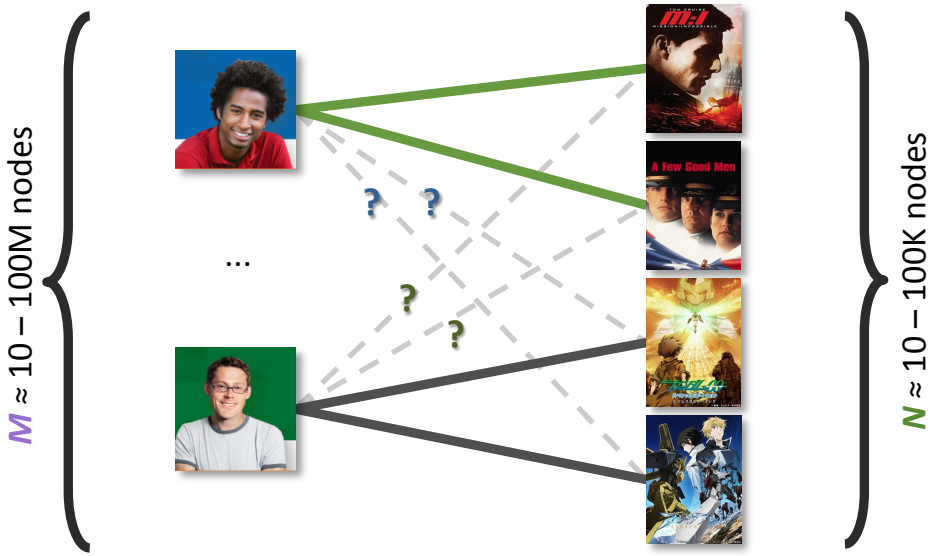
- CLiMF – Reciprocal Rank Optimization
  Y Shi, A. Karatzoglou, L. Baltrunas, M. Larson, N. Oliver, A. Hanjalic

ONE-CLASS COLLABORATIVE FILTERING WITH RANDOM GRAPHS

Ulrich Paquet and **Noam Koenigstein**

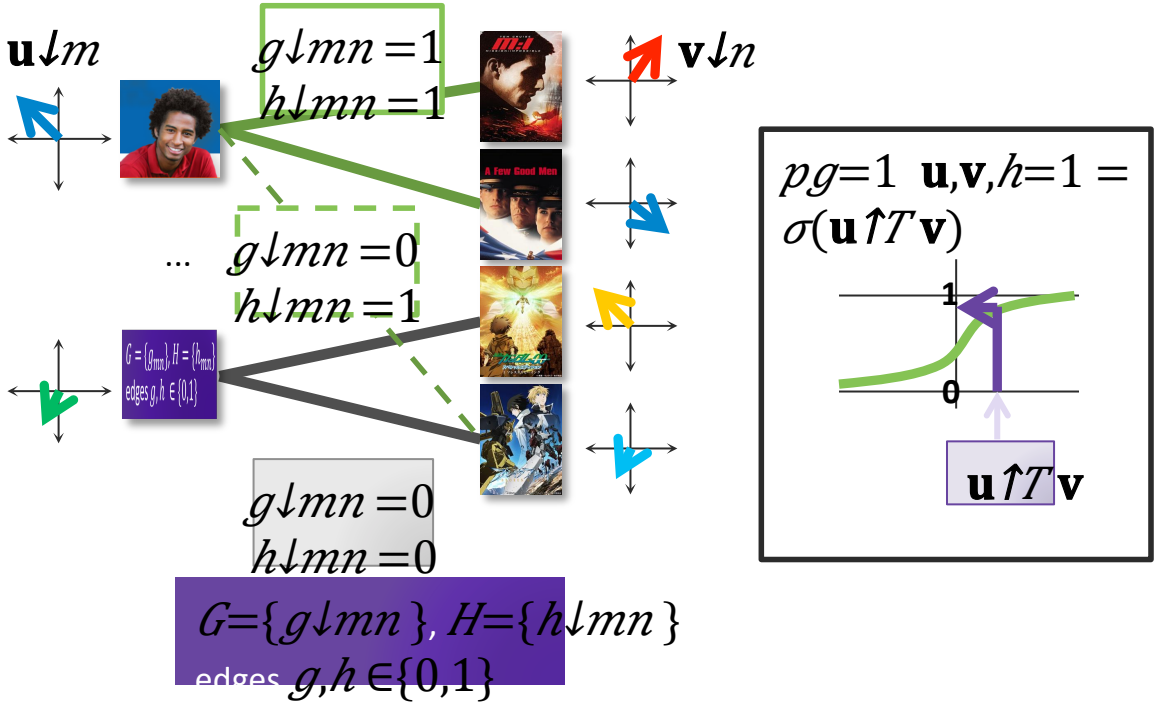
International World Wide Web Conference (WWW'13), May 2013, Rio de Janeiro, Brazil.

Problem Formulation



Bipartite graph → We care about ? = *p*(***link***)

The Hidden Graph



BESIDES FEEDBACK: COLD START, META-DATA, HYBRID, CONTEXTUAL…

XBOX MOVIES RECOMMENDATIONS: VARIATIONAL BAYES MATRIX FACTORIZATION WITH EMBEDDED FEATURE SELECTION

Noam Koenigstein and **Ulrich Paquet**

ACM Conference on Recommender Systems (RecSys'13), October 2013, *Hong Kong, China.*

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Movie Features (tags)

Harry Potter and the Philosopher's Stone

Categories:

- Plot
- Mood
- Audience
- Time Period

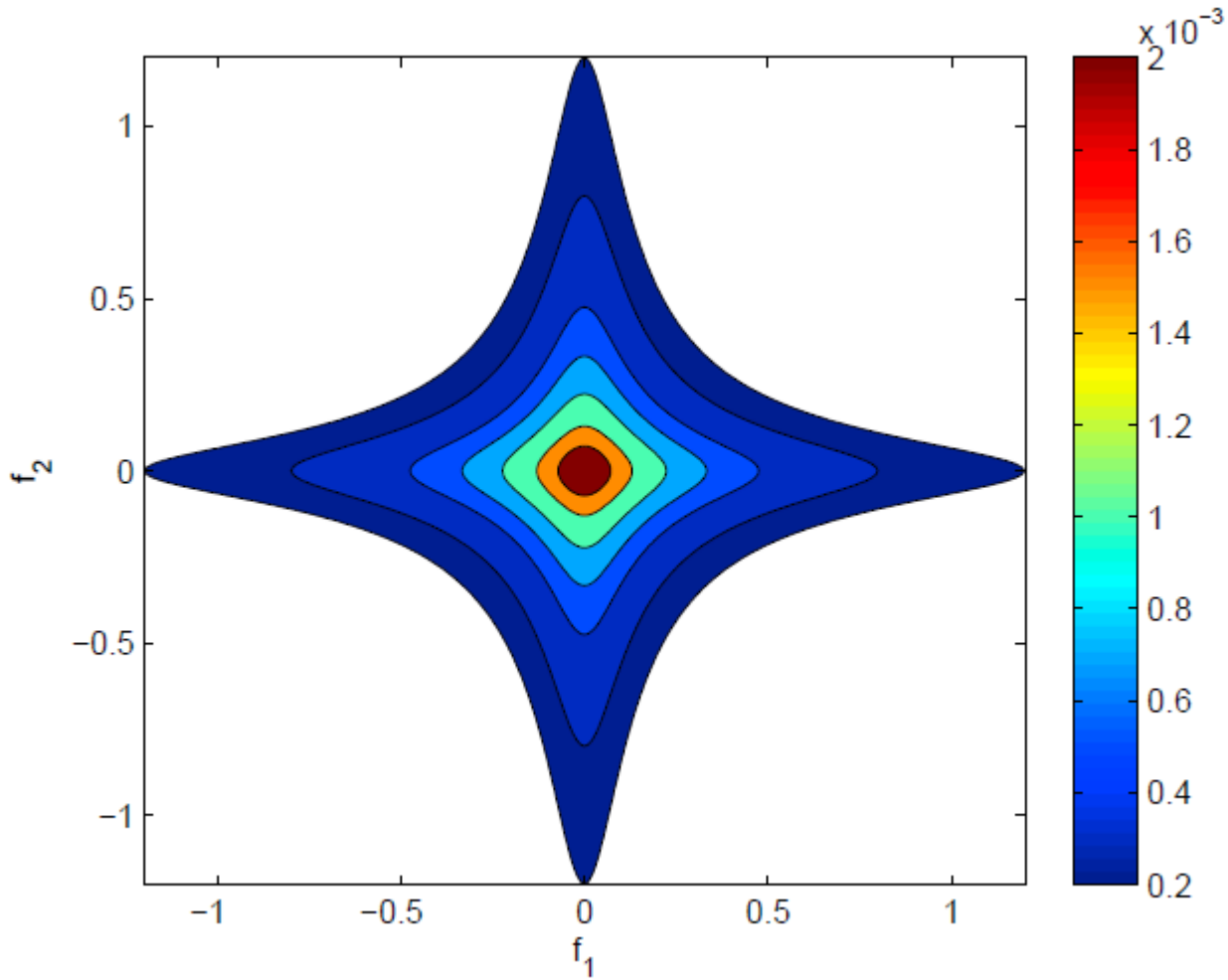
- Imaginary
- Wizards and Magicians
- Best Friends

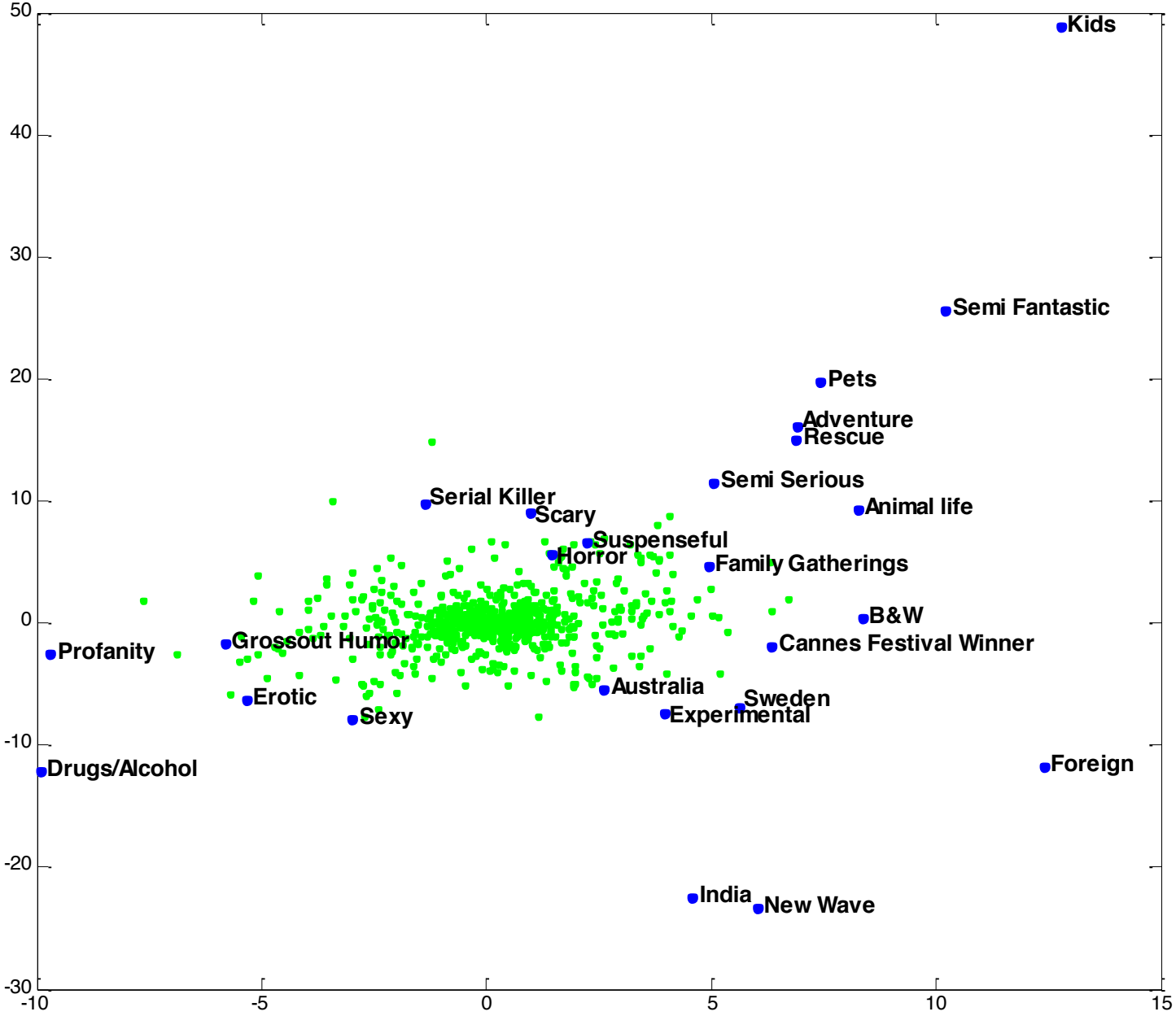
- Exciting
- Humorous
- Danger

- Kids
- Teens

- Contemporary
- 21st Century

$p(f_1, f_2 \mid \alpha=0.01, \beta=0.01)$




Kids
Semi Fantastic
Pets
Adventure
Rescue
Semi Serious
Serial Killer
Scary
Animal life
Suspenseful
Horror
Family Gatherings
B&W
Grossout Humor
Cannes Festival Winner
Profanity
Australia
Erotic
Sweden
Sexy
Experimental
Foreign
Drugs/Alcohol
India
New Wave
50
40
30
20
10
0
-10
-20
-30
-10
-5
0
5
10
15

GROOVE RADIO: A BAYESIAN HIERARCHICAL MODEL FOR PERSONALIZED PLAYLIST GENERATION

Shay Ben-Elazar, Gal Lavee, Noam Koenigstein, Oren Barkan, Hilik Berezin, Ulrich Paquet, Tal Zaccai

ACM Conference on Web Search and Data Mining (WSDM'17), Cambridge UK, February 2017.

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THE GAP BETWEEN COLLABORATIVE FILTERING RESEARCH AND REAL WORLD RECOMMENDATIONS

The Gap Between Collaborative Filtering and Real Recommenders

- Diversity vs. accuracy - tradeoff??
- Popularity vs. personalization
- Item fatigue / freshness – repeating items
- Serendipity – when and how much to "surprise" the user
- List Recommendations / page optimization
- Predicting the future vs. influencing the user
- Metrics and Evaluation

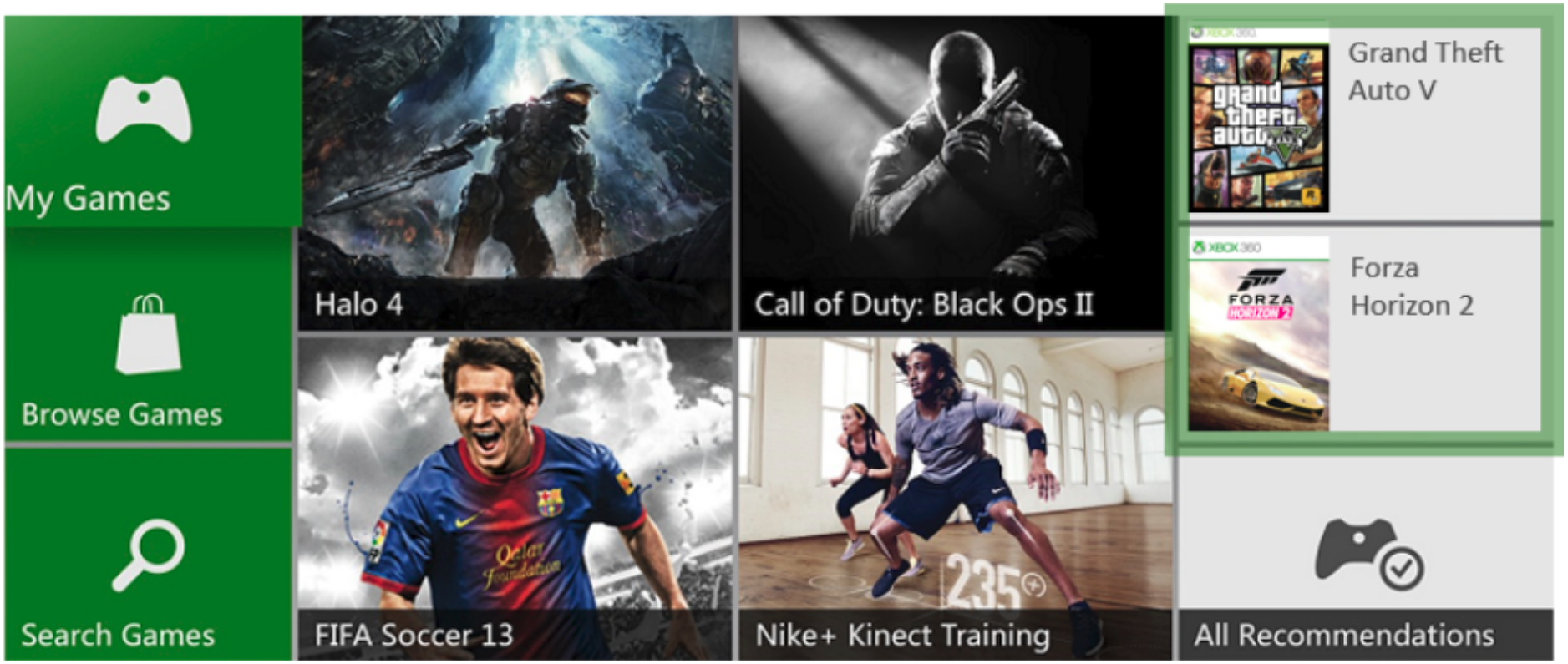
The Salesperson Analogy

BEYOND COLLABORATIVE FILTERING: THE LIST RECOMMENDATION PROBLEM

Oren Sar Shalom, Noam Koenigstein, Ulrich Paquet, Hastagiri P. Vanchinathan

International World Wide Web Conference (WWW'16), April 2016, Montreal, Canada.

List Recommendations in Xbox 360



Conclusions

- There is still a gap between most CF models and the actual goal of recommender systems

- Learning individual user-item tuples or ranking preferences is problematic because:
  - Can't handle the diversity vs. accuracy "tradeoff"
  - List recommendations / Page optimization

- Learning to predict future events from historical data is insufficient because:
  - Can't handle balancing popularity and personalization
  - Freshness / Item Fatigue
  - Serendipity

- RL alone is not the ultimate solution because:
  - The abundance of implicit data
  - Representing the "taste space"

- Offline evaluation metrics are insufficient
  - They measure our ability to predict the future but not our ability to change it (influence the user)

- <u>Bottom line</u>: We still have a lot to work in the RecSys community!

Thank You!

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We are looking for postdocs in Israel!!!

Interested?
Find me during the coffee break….