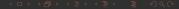
#### Introduction to Recommender Systems

 $Readings = Introductory\ Chapters\ from\ Ricci/Aggargal$ 

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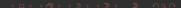
#### Summary

Overview of Recommender Systems

2 Practical Matters

Overview of Recommender Systems

Overview of Recommender Systems



#### Information Access Systems

- Recommendation
- 2 Search



#### Information Access Systems

- Recommendation
- 2 Search

#### Definitions 1

 "Recommender systems (RS) are software tools and techniques providing suggestions for items to be of use to a user" (Ricci, Rokach, & Shapira, 2011)

#### Definitions 2

- Users: People who are interacting with items within a RS
- Items: The entities that are being recommended (e.g., products, articles, social media posts, other users to follow, etc.)
- o Transactions: The ways in which users interact with items
  - Explicit feedback: Ratings of 1-5 stars, slider ratings, binary thumbs up/thumbs down, unary "likes", etc.)
  - Implicit feedback: Derived from user behavior. Examples include clicks, purchases, view time, returns, shares, etc. Note that there are often no negative examples.

#### A Multi-stakeholder Problem

RS must account for multiple stakeholders who often have competing goals

- Users
- Content Providers
- Primary Service Providers
- Third-Party Service Providers



#### User Goals

- Find some good items
- Find all of the relevant items
- Find a sequence of items that make sense (e.g., playlist)
- Find sets of items (e.g., complementary items)
- o Find items that are good for a particular situation

# Primary Service Provider Goals

- Sell more items
- Sell more diverse items/promote items they want to get rid of
- Improve user satisfaction
- Increase user loyalty
- Improve understanding of the customer

### Third-Party Provider Goals

- o Improve primary service provider loyalty
- Up-sell primary service providers on new services or products
- Collect data that can be packaged and sold as DaaS
- Collect data that can improve current or future algorithm performance
- Understand consumer behavior across multiple sites/platforms

#### A Multi-stakeholder Research Problem

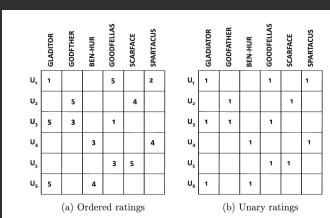
- Academics tend to focus on research relevant to users (including content providers as users)
- Industry tends to focus on users to some extent, but also on service providers to a large extent
- There is very little research that attempts to address more than one stakeholder at a time
- o This is a problem

#### Some Common Notation Stuff

- $\circ$  A user-item interaction matrix  $\mathbb{R}^{m \times n}$  is a matrix with m users and n items. We usually refer to the matrix as R.
- $\circ \ R(u,i)$  represents user u's actual rating for item i
- $\circ$   $\hat{R}(u,i)$  represents a prediction for user u's rating for item i
- $\circ$  Most of the entries in R are empty because most users don't interact with most items (i.e., sparse data)

# The Matrix Need Not Be Scary

Figure: Examples of user-item matrices from Aggarwal



#### Types of RS Algorithms

- Content-based: Uses item meta-data
- o Collaborative filtering: Uses patterns in the user-item matrix
- Knowledge-based: Uses domain knowledge to match users to item profiles
- Hybrid: Uses some combination of algorithms
- Lots of others

# What is a good recommendation/RS? #1

- Accuracy/Relevance: How well did the recommendation prediction for an item/list of items match the user's utility for an item/list of items?
  - Point-wise accuracy: For each individual item, how far off was the recommendation?
    - We predicted a user would rate Bodacious Bourbon 1.5 stars, and she rated it 2 stars. We were off by 0.5 stars.
  - List-wise accuracy: How well did we order the list of recommendations given the user's actual ordering?
    - We predicted the ranking would be 1. Stellar Scotch, 2. Righteous Rye, 3. Bodacious Bourbon and the user's actual preference orderings were 1. Righteous Rye, 2. Stellar Scotch, 3. Bodacious Bourbon
  - Can be measured offline (using historical data) or online (using A/B testing, etc.). These metrics don't always agree.

# What is a good recommendation/RS? #2

- Novelty: Did the RS algorithm recommend some stuff the user hasn't seen in the past?
- Serendipity: Did the user recommend some items that are a little unexpected, but still really useful for the user?
- Diversity: Within a given list of items, did the algorithm recommend products that were appropriately distinctive?
- Coverage: Did the algorithm recommend most of the available items to at least some of the users?
- Usability: Did the interfaces for the RS enable users to accomplish their goals?

# What is a good recommendation/RS? #3

- Fairness: No singular definition within RS or machine learning, generally
  - Did all content-providers get a fair shake at having their content be consumed (i.e., harms of allocation)?
  - Did the RS represent some users in a fashion that could be considered offensive and/or harmful (i.e., harms of representation)?
- Explainability: Can we tell the user on what basis we made this recommendation?

### What is a good recommendation/RS? 4

- Click-through rate: What proportion of the recommended items that the user saw did the user click on?
- Attributable sales: How many sales can we attribute to an item being recommended?
- Overall cart value: Did users who saw recommended items end up having higher checkout totals
- And many more!

# Discussion/QA

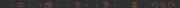
- o Thoughts?
- o Questions?

# **Practical Matters**



#### Meeting Format

- Presentations with presenter
- Q & A with moderator
- Free-form discussion
- o Something else?



## Meeting Frequency

- Bimonthly
- Monthly
- o Something else?



#### Discussion

o Is there anything else we need to talk about?



#### References

- Aggarwal, C. C. in *Recommender Systems: The Textbook* 1–28 (Springer, 2016).
- Ricci, F., Rokach, L. & Shapira, B. in *Recommender Systems Handbook* 1–35 (Springer, 2011).



# The End