



# Recommender Systems @ SoundCloud

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# Why?

- huge catalogue
  - ~ 80 million tracks
- unique / mostly non major content
  - not advertised elsewhere
  - present alternatives to what user knows
- no quality control
  - through labels / distributors

# Constraints

- it's music
  - content based recommendation is tough
- content is sparsely annotated
  - even genres / tags might be wrong
- large user base

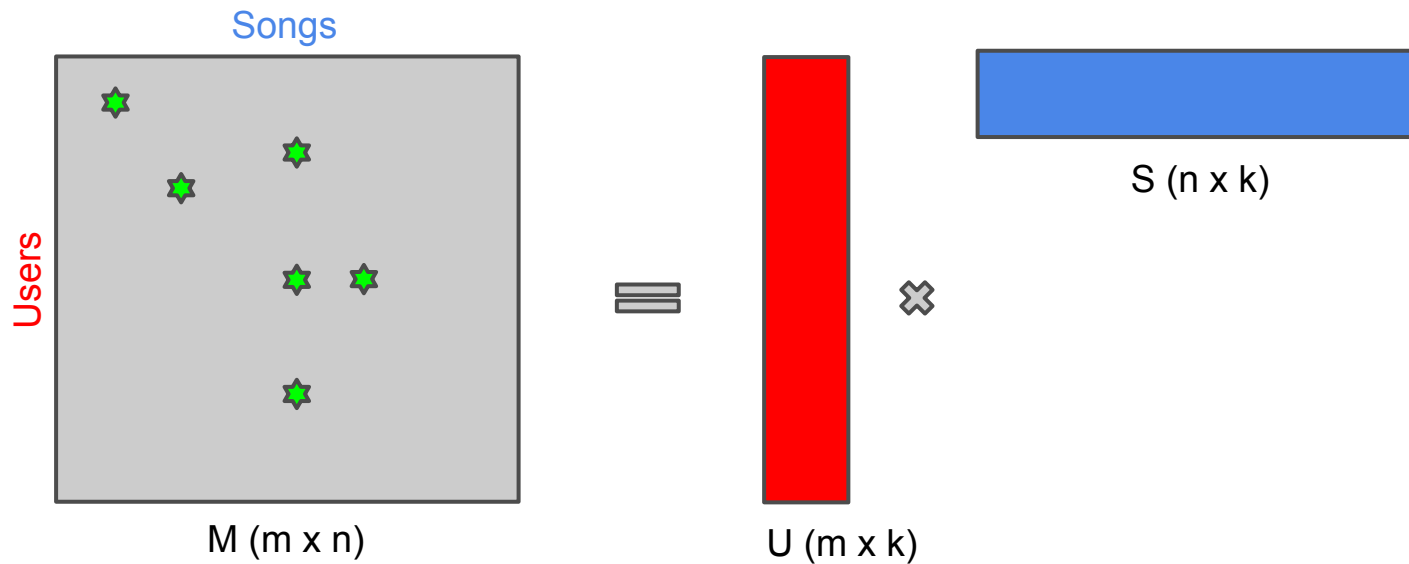
# Who to Follow

- following someone → seeing their activity in your stream
  - follow creators to get notified about new music
  - follow other users with similar taste

# WTF v1: item based collaborative filtering

- using mahout
- very slow (~17 hours)
- super nodes → everybody gets “Skrillex”
- likes, reposts → plays, skips
- 3-4 Million Users

# WTF v2: Matrix Factorization (SVD)



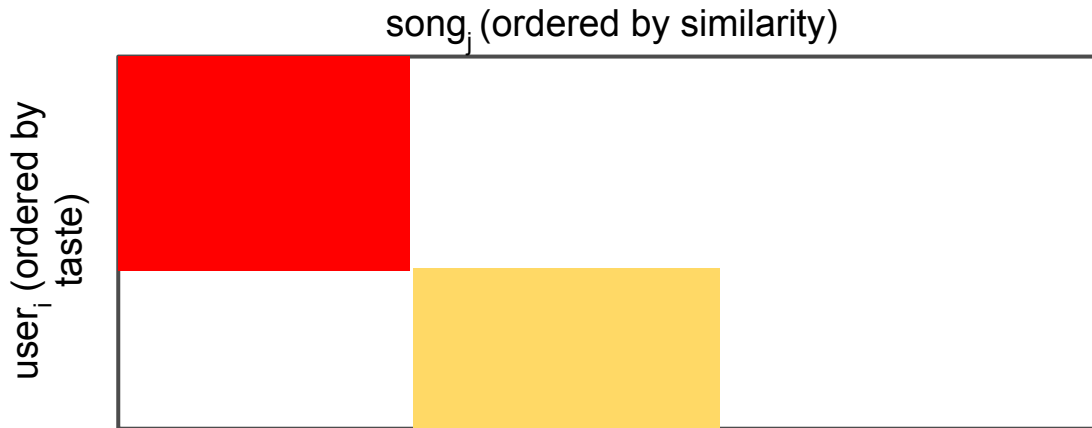
$$\min_{U, S} \|M - U \times S\|_2^2 + \lambda(\|U\|_2^2 + \|S\|_2^2)$$

# WTF v2: Matrix Factorization (SVD)

- influenced by Netflix price (isn't this the same?)
- no explicit rating → sum of implicit / explicit feedback
  - $rating(u_i, s_j) = w_1 * listen(u_i, s_j) + w_2 * like(u_i, s_j) + w_3 * repost(u_i, s_j) + \dots$
  - how to choose  $w_k$  → strongly user behaviour biased
- turn into classification problem
  - $class(u_i, s_j) = sign(listen(u_i, s_j) + like(u_i, s_j) + repost(u_i, s_j))$
  - negative class? Skips?

# WTF v2: Matrix Factorization (SVD)

- Matrix is too sparse  
→ number of latent factors?
- Users tend to stay in musical bay  
→ latent factors learned independently



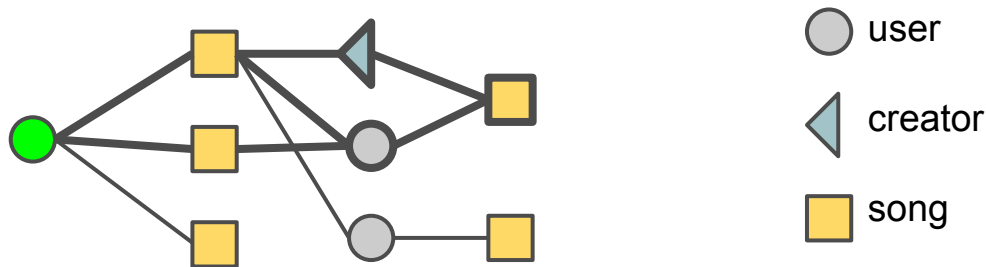


# Personalized Sound Recommendations

- show user relevant sounds
- use WTF experience
- explain the user why
- evaluate approaches before starting

# Personalized Sound Recommendations

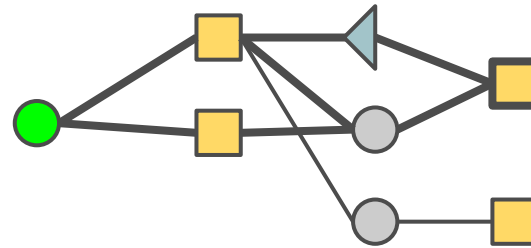
- Random Walks (Personalized PageRank)
  - start n random walks with reset to approximate personalized pagerank



# Personalized Sound Recommendations

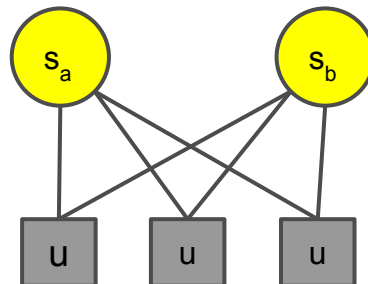
- Random Walks

- solve multiple problems at once
- good descriptor for other projects
- additional features e.g. interaction time, creation date...
- negative signals?
- social graph has high branching factor
- social graph is biased towards popular genres /songs
- teleportation factor?



# Personalized Sound Recommendations

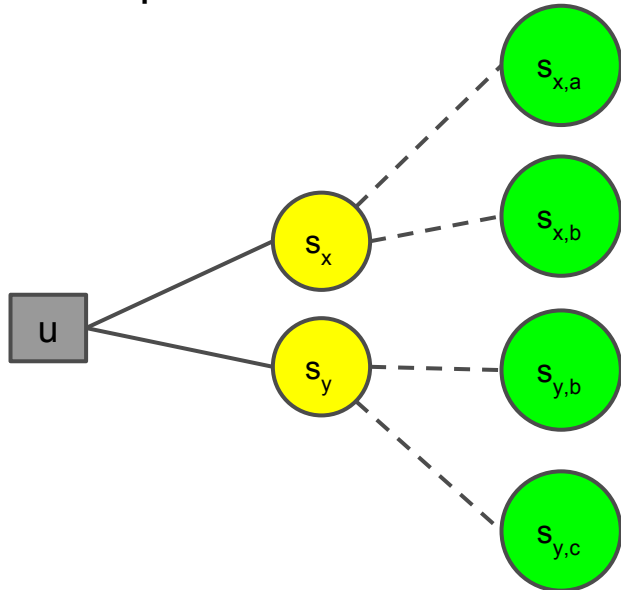
1. create item / item similarity
  - based on co-interactions
  - implicit / explicit feedback without weighting
  - used as candidate list



# Personalized Sound Recommendations

## 2. generate candidates

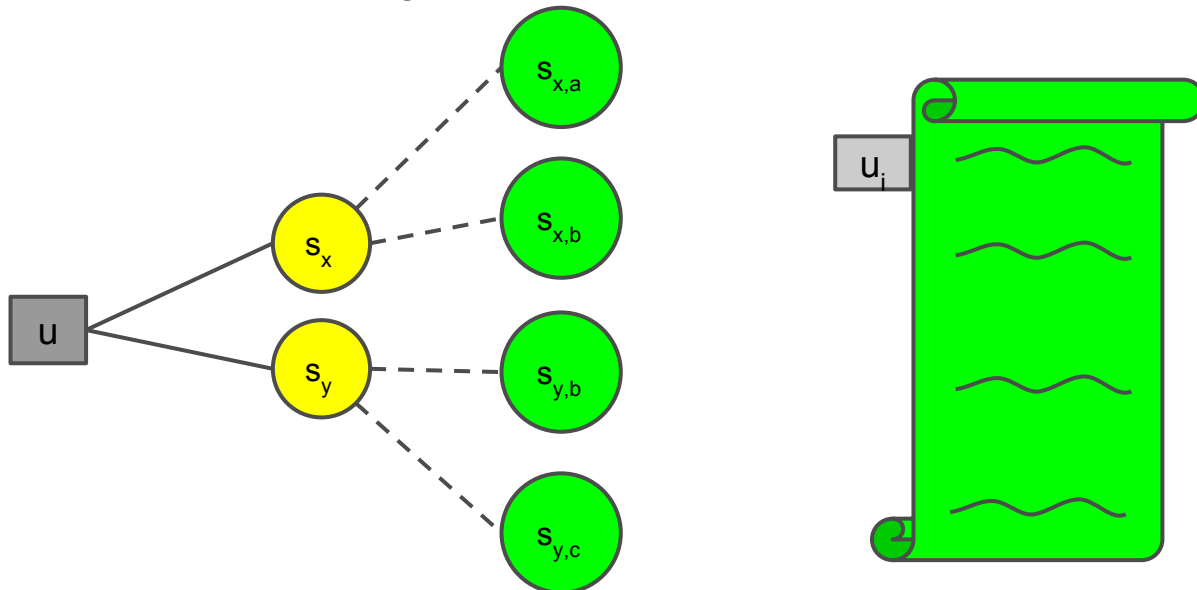
- expand user interactions with candidate list



# Personalized Sound Recommendations

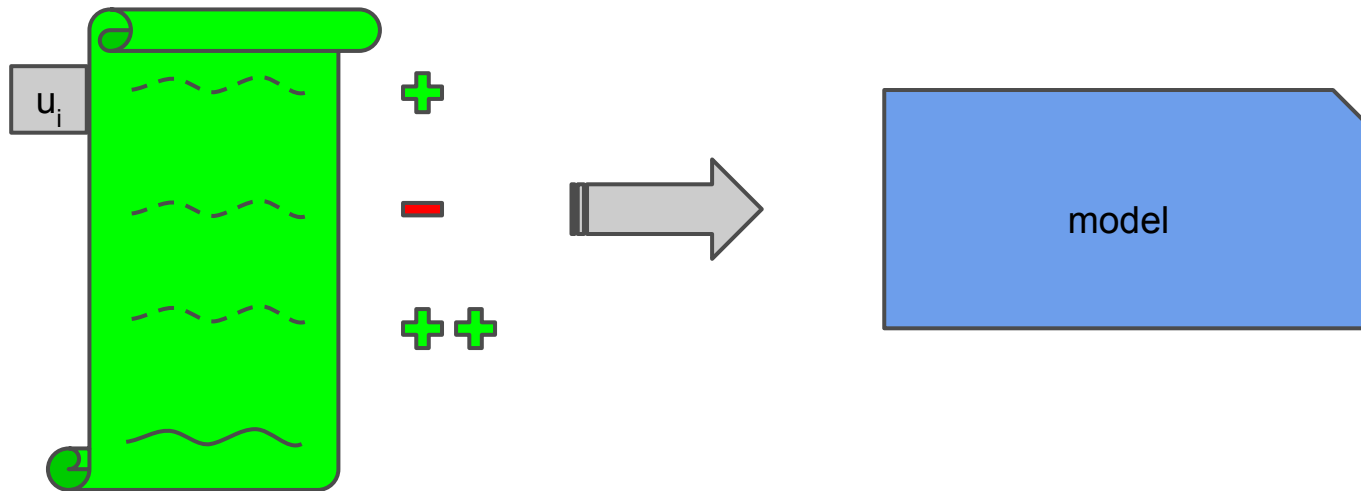
## 3. add additional features

- track similarity, times of interaction, interaction age, track age, same creator, same genre, facebook friends, ...



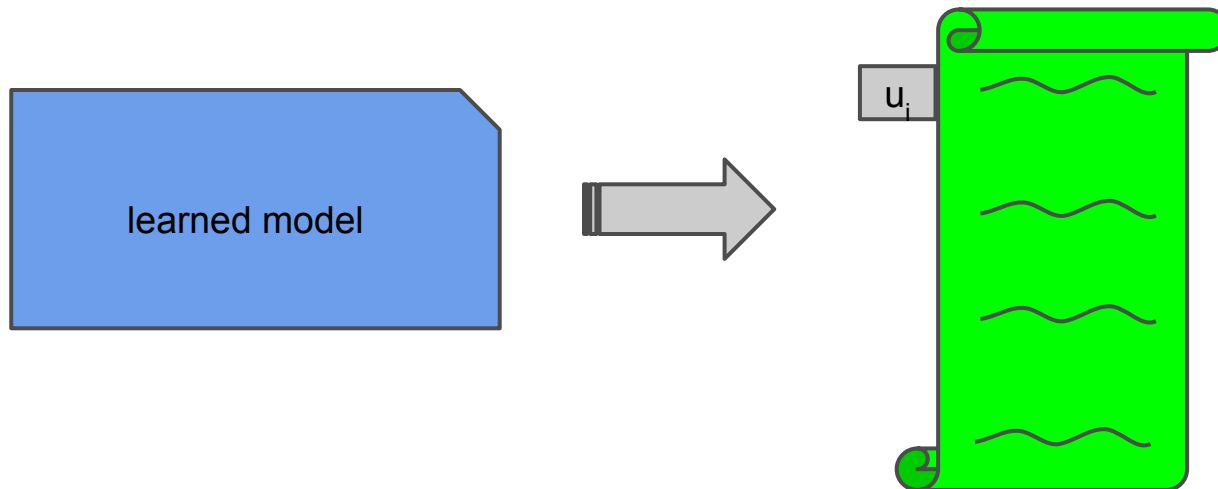
# Personalized Sound Recommendations

- learn model on previous observations
  - kpi: listening time, likes, reposts...



# Personalized Sound Recommendations

5. use model to rank / classify candidates





# Personalized Sound Recommendations

- for ~10m active users
- ~110m recommendations
- updates daily
- [go/seedsound](#)