Recommender Systems
Filtering Approaches

Professor Robin Burke
Spring 2019

Thanks to Yong Zheng, IIT, for some materials

Contextual filtering

- Sparsity
  - Reduces the data set to only those items with ratings in the current context
- Avoidable only by
  - Aggregating significantly
  - But reduces the benefit of using context

Example

User	Movie	Time	Location	Companion	Rating
U1	*Titanic*	Weekend	Home	Girlfriend	4
U2	*Titanic*	Weekday	Home	Girlfriend	5
U3	*Titanic*	Weekday	Cinema	Sister	4
U1	*Titanic*	Weekday	Home	Sister	?

- Contextual filtering
  - Combination {Home, Sister} has no matches
- What to do?

Context relaxation

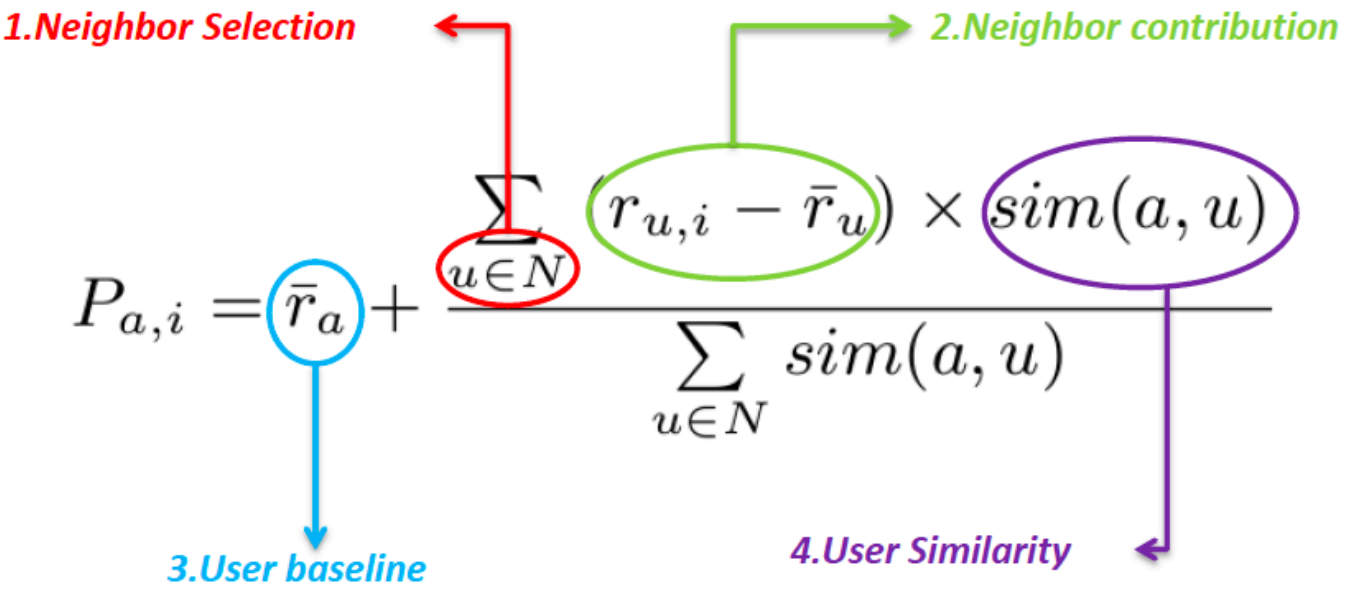
- Context relaxation
  - Pick a subset of the dimensions {Time, Location}
  - But do this for each recommendation problem, not the same for the whole dataset
- Could also use generalization
  - Sister -> Relative
  - Wednesday -> Weekday

Context weighting

- Use all profiles but weight their contribution by context similarity
- Ratings given in the most similar contexts
  - Get the most weight in recommendation

Differential context modeling

- Treat the different aspects of the recommendation computation as separate applications of context



Algorithm components

- Neighbor selection
  - Filter/weight peers so that they have rated the target item in the right context
- Neighbor contribution
  - Filter/weight the ratings of peers over which the mean is computed
- User baseline
  - Filter/weight the ratings of the user used for the baseline
- User similarity
  - Filter/weight the ratings of the user used to compute similarity
- These can all be different
  - Filtering neighbors on time, compute similarity on location, calculate user baseline with companion

Optimization problem

- Not convex!
- Need non-linear optimization
  - Particle-swarm
  - Genetic algorithm
  - Etc.
- No non-NP way to optimize if generalization is allowed
- Compute the error for many combinations of subsets / weights
  - Try to avoid local minima

	1	2	3	4	5	6	7	8	9	10	11	12
DCR	1	0	0	0	1	1	1	1	0	1	1	1
DCW	0.2	0.3	0	0.1	0.2	0.3	0.5	0.1	0.2	0.1	0.5	0.2

1st 2nd 3rd 4th

Differental context modeling

- Assumes a memory-based technique
  - User / item kNN
- Computational complexity of optimization
  - Especially for weighting
  - But this modeling step should be rare and offline