Collaborative Filtering

Lecture 15

Information Filtering recap

- Look at each document's content, and see if it matches user's interests
- Construct user's initial profile
  - Use examples of relevant and irrelevant documents
  - Mine content from home page, job descriptions, etc
  - Learn profile using e.g. relevance feedback
- Match incoming documents to profiles
- Refine profile from user feedback

- Examples: TREC filtering task

Reducing Information Overload

- Filtering is a response to information overload
- Content-based filtering
  - "I only want to read about this topic."
  - "I don't want to read articles by this person."
- But people filter based on other features, too
  - reputation, popularity
  - reliability
  - novelty
  - recommendation from friend or colleague

Collaborative Filtering

- Filtering based on recommendations
  - Find people with similar taste to yours
  - Recommend to you what they've liked
- Automating "word-of-mouth"
  - Computers can consider thousands of items
- Lazy-evaluation filtering
  - Don't examine content directly
  - Wait until someone else recommends it

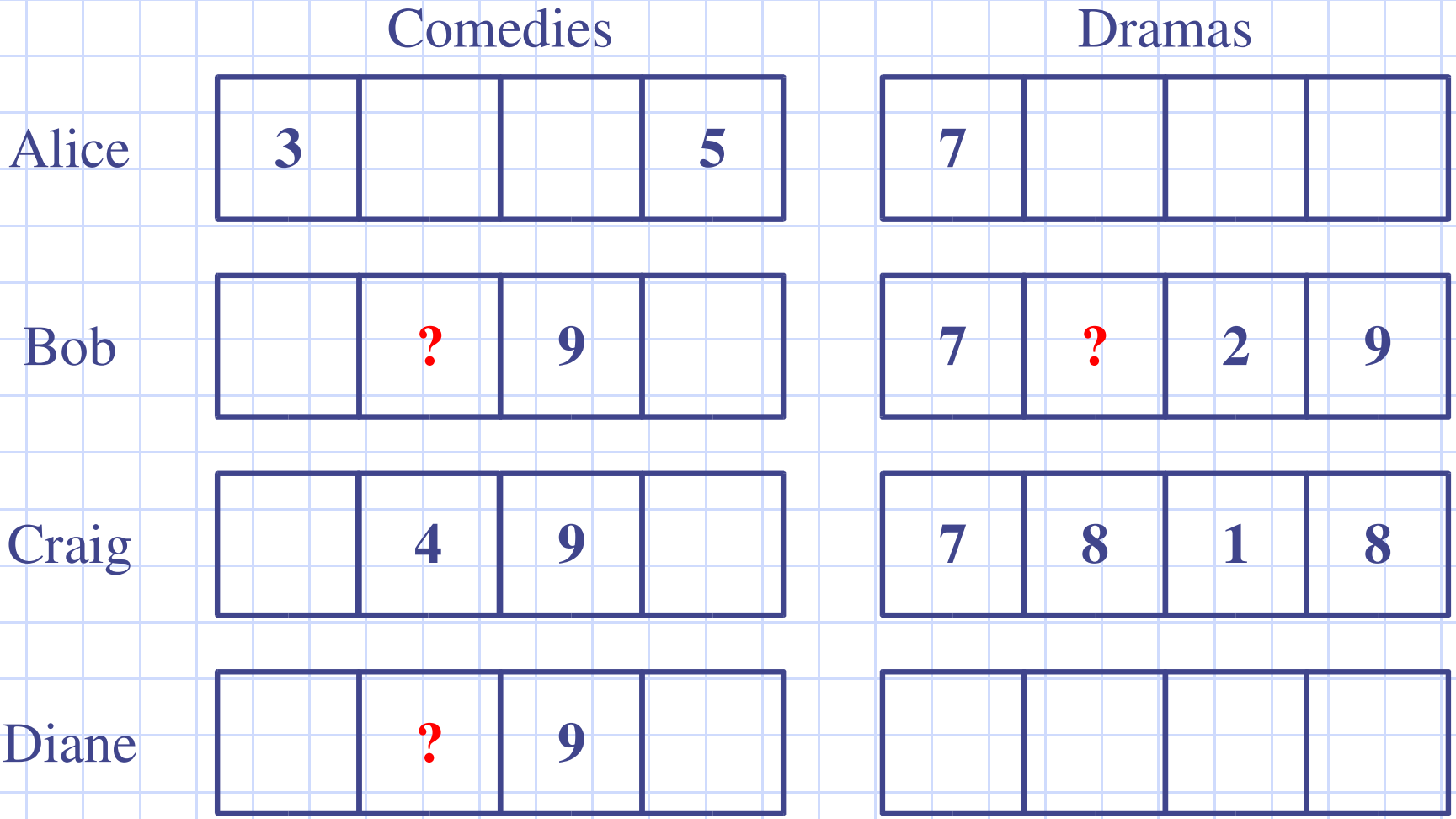
Why Collaborative Filtering?

- Many people are watching the same stream
  - Some of them may have overlapping interests
    - e.g. "US-China relations", "air accidents", "international border disputes"
  - Leverage group effort
- Recommendations capture what content can't
  - quality
  - preference
  - popularity
  - utility

How to filter collaboratively

- Collect ratings of documents from users
  - thumbs up/down
  - five-point response scale
- Identify users who have similar tastes
  - compute correlations of users' ratings
  - user-user similarity measure
- Use the most similar users to predict future ratings

Movie Ratings



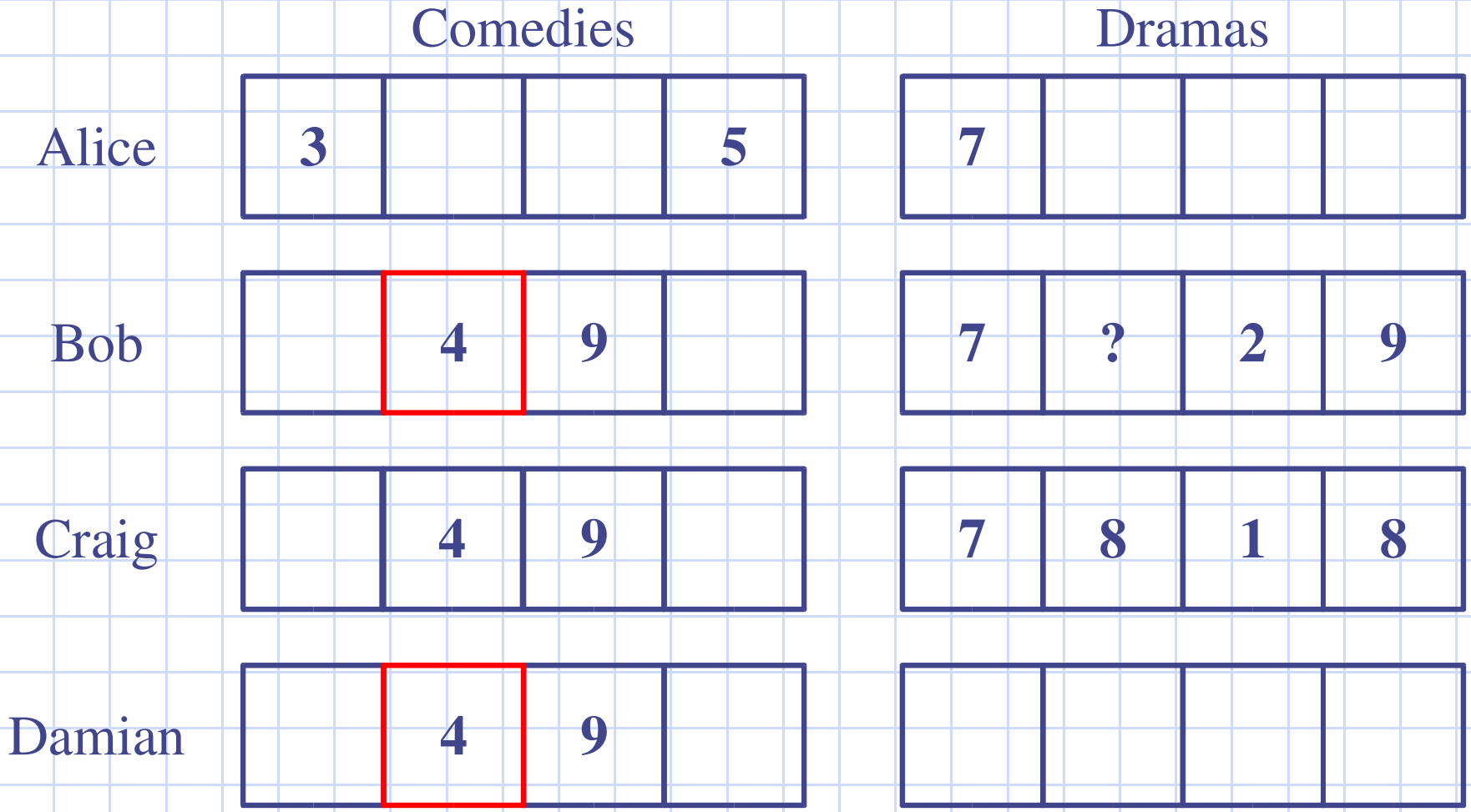
How to do it

- User ratings form a ratings matrix
  - users × documents, where elements are ratings
- Compute correlation coefficients

$$r(u_1, u_2) = \frac{(u_1 - \overline{u}) \cdot (u_2 - \overline{u})}{\|u_1 - \overline{u}\| \|u_2 - \overline{u}\|}$$

- Predicted rating = weighted sum of (rating * correlation coefficient)

How to do it (Part 2)



Tapestry (Xerox PARC, '92)

- Mail and document filtering system
- Both content-based and collaborative
  - users can annotate (endorse) documents
  - filtering on standard fields, as well as 'replied-to-by', 'endorsed-by'
- TQL: an SQL-like, persistent query language

Ringo (MIT, '95)

- Goal: recommend music albums
- Accessible via email or WWW
- Prediction algorithm
  - Initial profile: ratings (1-7 scale) for 125 artists
  - Predictions computed using correlation method
- Interface
  - Recommendation included confidence measure
  - Could suggest artists/albums you would like or hate
  - Could advise regarding a specific album
  - Users can write textual reviews, add artists & albums

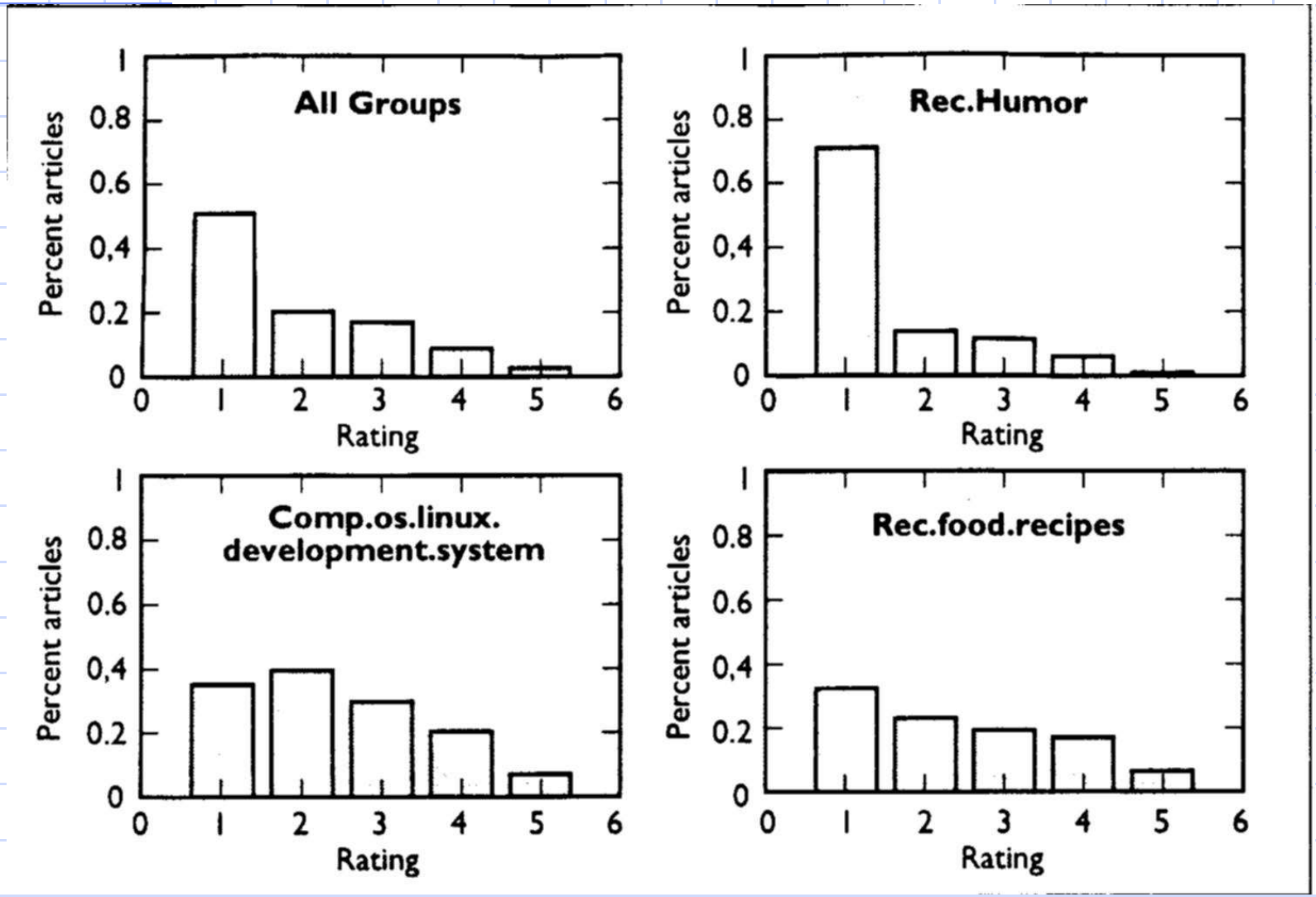
GroupLens (U. Minnesota, '94)

- Goal: recommend USENET articles
- Problem: USENET is distributed!
  - collect ratings at central servers
  - client connects to both NNTP server and GLRB
- Problem: People like their newsreaders
  - augmented existing readers: xrn, tin, gnus
  - worked to make rating a "minimally intrusive" task
  - goal for user is to spend less time reading news

GroupLens Design Goals

- Integrate with existing newsreaders
- Provide fast, current recommendations
  - ~24 predictions/sec (SPARC 5, 32MB, 1997)
  - single key rating input
  - articles are read quickly, then expire
  - 1-day delay in predictions means missing half the users
- Privacy
  - uses pseudonyms with an authentication protocol

Ratings in GroupLens



Konstan et al. 97

Correlation Between Users

Konstan et al. 97

Other GroupLens Applications

- MovieLens: http://movielens.umn.edu/
  - engine and dataset available from http://www.cs.umn.edu/Research/GroupLens
- BeerLens?
- NetPerceptions
  - Amazon.com, CDnow, Wine.com

Yenta: another kind of CF

- A matchmaking tool
  - clusters documents on your computer
  - characterizes clusters by key words
  - finds other people with similar clusters
- Finds people, not documents
  - locate experts and others who share interests

ReferralWeb (AT&T Labs, '96)

- Constructing and searching social networks
  - "Find me a friend of a friend who knows about collaborative filtering."
- Works like a Web spider
  - Searches for documents which mention a person
    - web pages, technical papers, USENET threads, organizational charts
  - Finds names on those pages and searches for them
  - Recurses one or two levels

PHOAKS (AT&T Labs, ’96)

- “People Helping One Another Know Stuff”
- Automatically extracts URLs from USENET articles
  - mentioning URL == recommendation, if
    - message is not crossposted to many groups
    - URL not in .signature
    - URL not in quoted portion of article
    - If it doesn’t look like an advertisement
- Compiles the essential URLs for newsgroups

Pros and Cons of CF

- Can recommend
  - books, movies, CDs, … anything that can be rated
  - based on quality, authority, popularity, utility…
- Limitations
  - can only recommend what has been rated
  - can only recommend to someone who rates
    - sparse ratings or cold start problem
  - Lots of computation and storage