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Recommender Systems Research

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Quote

"What information consumes is rather obvious: it consumes the attention of its recipients. Hence a wealth of information creates a poverty of attention,and a need to allocate that attention efficiently among the overabundance of information sources that might consume it."

Herbert A. Simon

Recommender Systems

- Select a subset of items based on user preferences
- Underlying algorithms range from simple keyword matching to sophisticated mining of user profiles
- Examples: top-N lists, book and movie recommenders: Amazon.com
- Reduce information overload
- Retain customers
- Increase revenue
- Now believed to be critical to sustaining the Internet economy

Four Main Dimensions

How is the recommender system

1. modeled and designed
   - are recommendations *content-based* or *collaborative*?
2. targeted
   - to an individual, group, or topic?
3. built
4. maintained
   - online vs. offline

Content-based Filtering

'Since you liked *The Little Lisper*,
you may be interested in *The Little Schemer*.'

'Since you liked *Pride and Prejudice*,
you also might like *Sense and Sensibility*.'

Collaborative-filtering

Linus and Lucy like *Sleepless in Seattle*.
Linus likes *You've Got Mail*.

Lucy also might like *You've Got Mail*.

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What about the inherently social aspect of recommendation?

‘Brick and Mortar’ Setting

[Linus and Lucy are at *Bombay Café*, an Indian Restaurant.]

1	**Linus:**	The menu looks enticing.
2	**Linus:**	Since you are a returning patron, what do you recommend?
3	**Lucy:**	Well, since you like spicy dishes, and you’re not a vegetarian, you’ll enjoy the Chicken Vindaloo.
4	**Linus:**	Alright, I’ll try that.

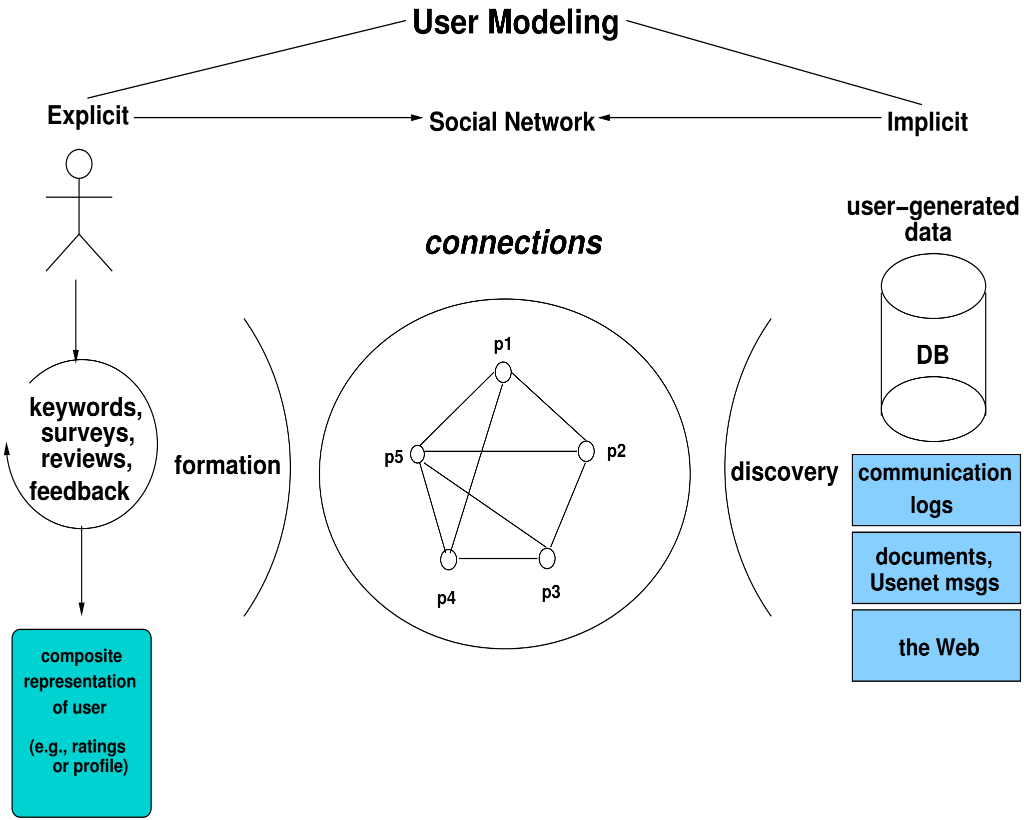
A mutually-reinforcing dynamic ensues:

- Lucy leverages her knowledge of Linus’ interests into the process of recommendation.
- Linus harnesses his knowledge of Lucy’s reputation to evaluate the recommendation.

Inherent Social Aspect

- Recommender systems attempt to emulate and automate this natural social process.
- Predictive utility relies on its representation of the recipient.
- Recommender systems involve *user modeling*.
- User models can be constructed by
  - explicitly soliciting feedback
    - e.g., asking users to rate products or services
  - gleaning implicit declarations of interest
    - e.g., through monitoring usage

A Connection-centric View



Shifts in IS Research

Concept	Modeling Matrix
Information retrieval	(terms × documents)
↓	↓ ↓
Information filtering	(features × documents)
↓	↓ ↓
Content-based filtering	(features × artifacts)
↓	↓ ↓
Collaborative filtering	(people × documents)
↓	↓ ↓
Recommender systems	(people × artifacts)

User Modeling Methodology for CF RSs

sustain

(*exploration* vs. *exploitation*)

user reluctance to rate items (compounded by volume & concern of privacy)

$\downarrow$

sparse modeling matrix (cold-start)

$\downarrow$

$\longrightarrow$ explicit + implicit user modeling (*exploration*)

$\downarrow$

representation of user (ratings, profiles) as basis for connection

$\downarrow$

$\longleftarrow$ deliver recommendations & create connections (*exploitation*)

Explicit User Modeling

- What kind?
  - quantitative (e.g., ratings)
  - qualitative (e.g., reviews)
- What makes it tough?
  - voluminous (and ephemeral) domains (e.g., news)
  - reluctance to evaluate artifacts
  - free-riders
  - cold-start: new user or new item
  - ‘banana’ problem (and converse)
  - users with unusual or highly specific tastes
  - users with similar interests who have rated different artifacts
  - effusivity of ratings

Explicit User Modeling (*contd*)

- Possible solutions?
  - pay-per-use model, subscription services
  - minimum rating constraints
  - incentives
  - default votes
  - agents to rate every artifact
  - user interface approaches
  - rate clusters of items
  - hybrid approaches (collaborative and content-based)
  - use indirection
- Representative projects
  - GroupLens (Pearson's r)
  - Fab (hybrid)

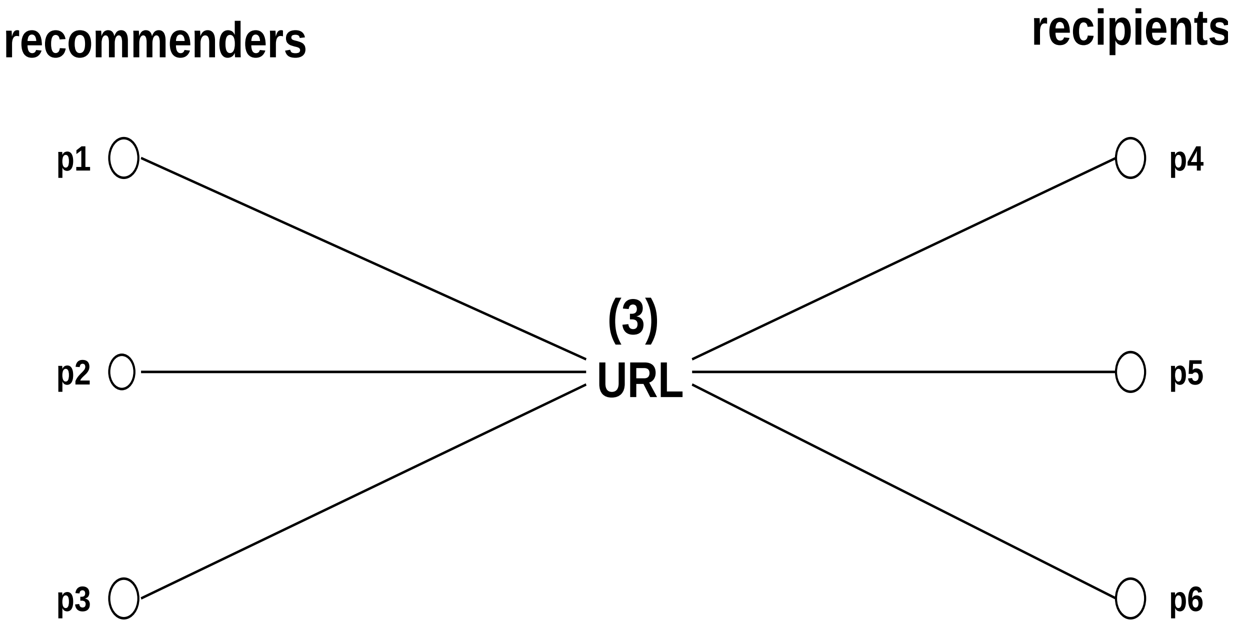
Implicit User Modeling

- Traditional approaches
  - PHOAKS (USENET News)
  - Siteseer (bookmarks)
- Link analysis and cyber-communities
  - Social networks
    * Discovering shared interests
    * Referral Web
- Mining and exploiting structure
  - Jumping connections
  - HITS: Hubs and authorities
- Small-world networks

What are implicit declarations of interest?

- Clickstream data, (web) access logs, ‘footprints’
- Time spent on a product page
- UI events: scrolling, highlighting
- Transaction data, shopping carts
- Hyperlinks
- Bookmarks

PHOAKS



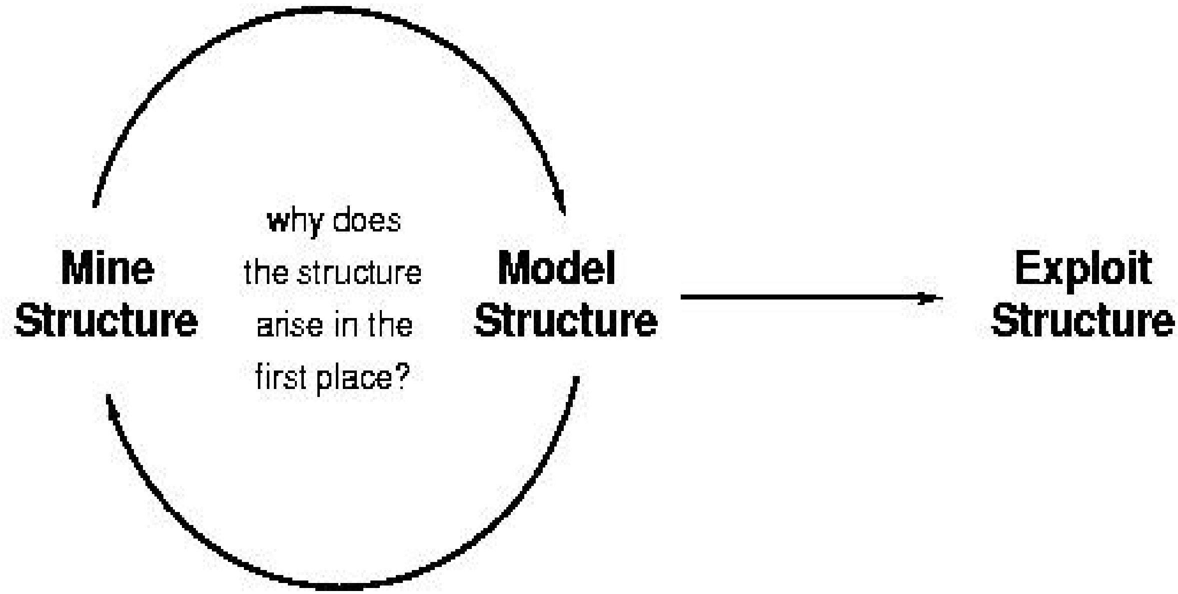
Link Analysis and Cyber-communities

- Discovering shared interests
  - Used e-mail logs to mine connections
  - Closeness

$$InterestDistance\,(n_1, n_2) = \frac{|(C(n_1) \cup C(n_2)) - (C(n_1) \cap C(n_2))|}{|(C(n_1) \cup C(n_2))|}$$

- Referral Web
  - Used close proximity of names in webpages
  - Queries:
    - Referral chains: ‘What is my relationship to Marvin Minsky?’
    - Search for experts: ‘What colleagues of mine, or colleagues of colleagues of mine know about simulated annealing?’
    - Proximity search: ‘List documents on the topic *annealing* by people close to Scott Kirkpatrick.’

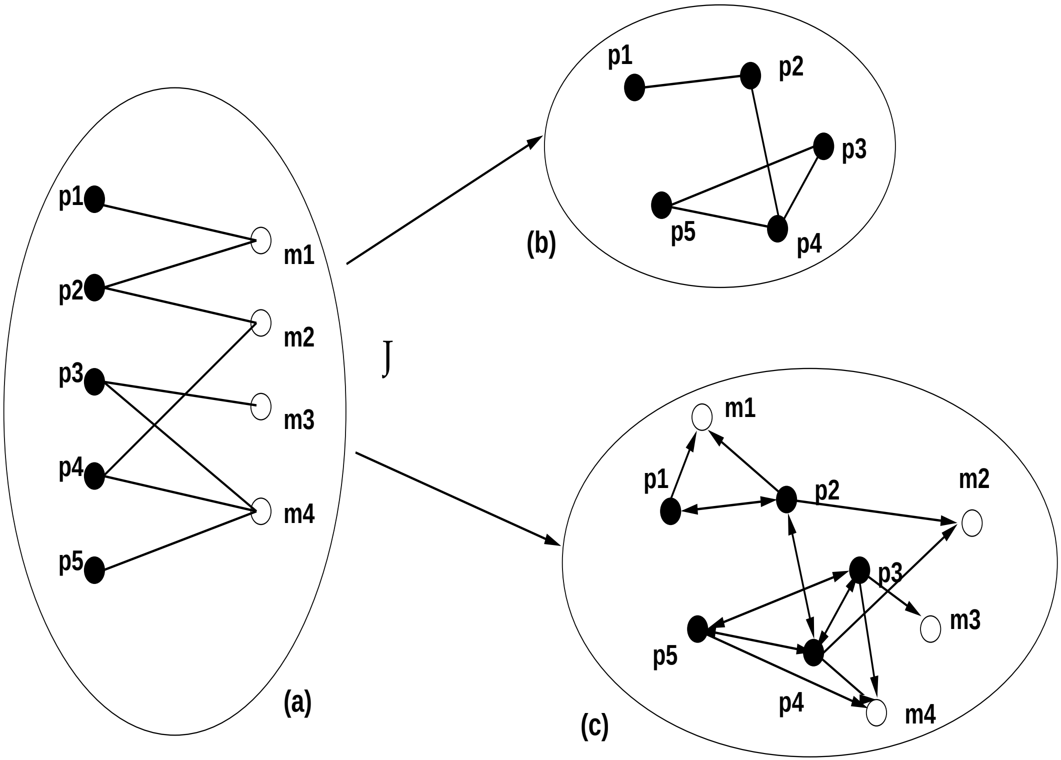
Mining and Exploiting Structure: Theme



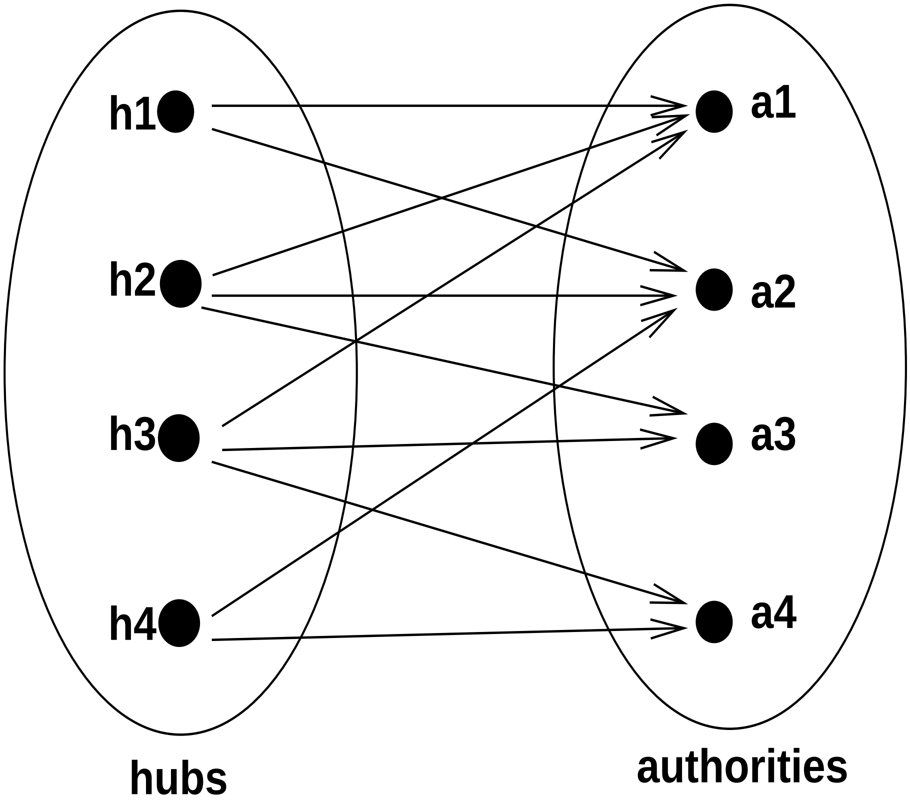
Mining and Exploiting Structure (*contd*)

- Affiliation networks vs. social networks
  - actor-movie collaboration graph
  - author-paper collaboration graph
- What structure can be mined?
  - degree distribution
  - connectivity
- Examples:
  - Jumping Connections
  - HITS: Hubs and authorities

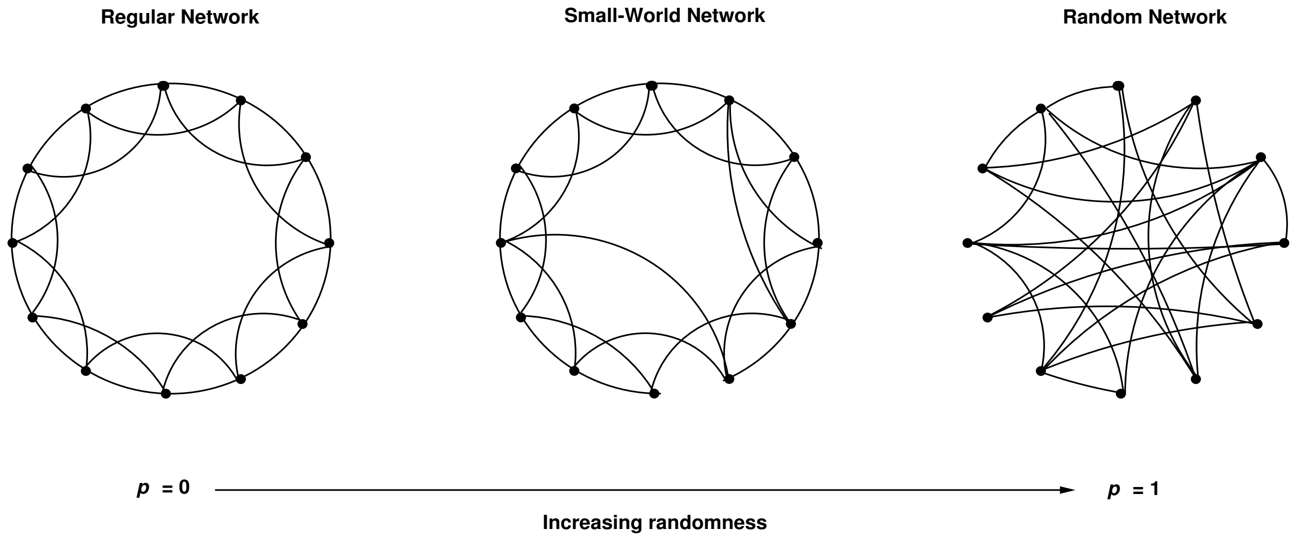
Jumping Connections



HITS: Hubs and Authorities



Small-world Networks



Discovering Social Networks

Concept	Implicit declaration of interest	Algorithm or System
Traditional Approaches to Implicit User Modeling	URLs in Usenet news bookmarks	PHOAKS Siteseer
Link Analysis and Cyber-Communities	e-mail logs web documents	Discovering Shared Interests Referral Web
Mining and Exploiting Structure	movie ratings datasets hits-buffs, half bow-tie web link topology hubs and authorities bow-tie	Jumping Connections PageRank (Google) HITS (CLEVER)
Small-world Networks	actor collaborations author collaborations infectious disease the web	Oracle of Bacon DBLP

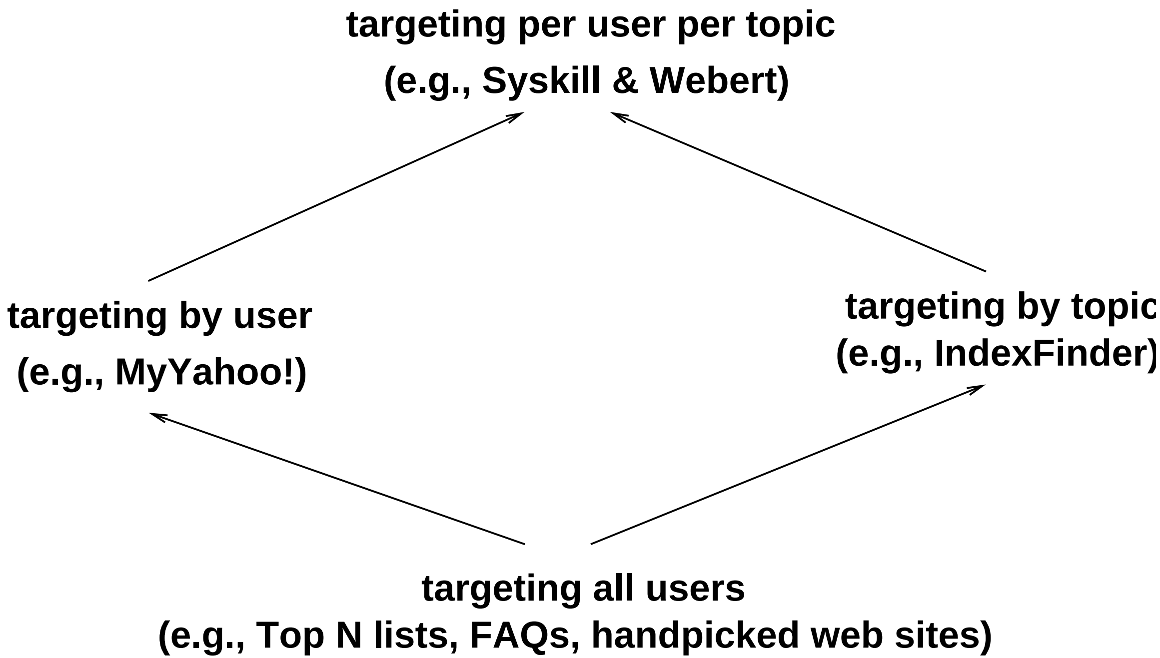
Take away

- Purely structural information can be very instructive.
- These properties are found in nature (self-generating and self-organizing systems) and not merely an artifact of an idealized world.
- In what ways can we exploit these properties for recommendation?

Broadening Issues

- Evaluation
  - Functional vs. human-oriented evaluations
  - Is there something in between?
- Targeting
  - Answers the question 'for whom are we building this system?'
- Privacy and trust
  - Broader than one user and one system
  - Concept of a *weak-tie*
- Shilling
  - Involves inundating the system with data intended to coerce it to artificially recommend the perpetrator's products more often than those of a competitor.
  - Algorithms to detect when a system is being shilled

Targeting


targeting per user per topic
(e.g., Syskill & Webert)
targeting by user
(e.g., MyYahoo!)
targeting by topic
(e.g., IndexFinder)
targeting all users
(e.g., Top N lists, FAQs, handpicked web sites)

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Conclusions

- Recommenders are systems that *connect* people.
- The question is 'do they bring people together by *explicitly* or *implicitly* modeling them?'
- Approaches for discovering self-organizing social networks constitute the primary thrust in current RS research.
- Evaluation is challenging with the human in the loop.
- We are trying to make a science out of recommendation.

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