Recommender Systems: The Power of Personalization

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ACM Learning Center
(http://learning.acm.org)

- 1,300+ trusted technical books and videos by leading publishers including O’Reilly, Morgan Kaufmann, others

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- Learning Webinars on big topics (Cloud Computing/Mobile Development, Cybersecurity, Big Data)

- ACM Tech Packs on big current computing topics: Annotated Bibliographies compiled by subject experts

- Learning Paths (accessible entry points into popular languages)

- Popular video tutorials/keynotes from ACM Digital Library, Podcasts with industry leaders/award winners
A Bit of History

• Ants, Cavemen, and Early Recommender Systems
  – The emergence of critics
• Information Retrieval and Filtering
• Manual Collaborative Filtering
• Automated Collaborative Filtering
• The Commercial Era
A Bit of History

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Information Retrieval

- **Static content base**
  - Invest time in indexing content

- **Dynamic information need**
  - Queries presented in “real time”

- **Common approach: TFIDF**
  - Term frequency inverse document frequency
    - Rank documents by term overlap
    - Rank terms by frequency
Full text of every article ever published by ACM and bibliographic citations from major publishers in computing.

- Using the ACM Digital Library
- For Consortia Administrators

Announcements

- Information Systems Category Editor Needed for Computing Reviews
  Computing Reviews, the post-publication review and comment journal of ACM, is seeking a volunteer interested in serving as a category editor in the information systems area. Please see the Information Systems Call for more information.

- New Journal: ACM Transactions on Interactive Intelligent Systems
  ACM Transactions on Interactive Intelligent Systems (TIIS) publishes research on the design, realization, or evaluation of interactive systems that incorporate some form of machine intelligence. Applications include user interface technologies; recommender systems and information retrieval; automated usability testing; human-robot interaction; semantic technologies; gaming; and mobile and ubiquitous computing. See the first issue's table of contents in the Digital Library.

Recently loaded issues and proceedings:

- ACM Computing Surveys (CSUR)
  Volume 44 Issue 4

- ACM Transactions on Asian Language Information Processing (TALIP)
  Volume 11 Issue 3

- ACM Transactions on Database Systems (TODS)
  Volume 37 Issue 3

- ACM Transactions on Embedded Computing Systems (TECS)

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Browse by the ACM Computing Classification System

The Encyclopedia of Computer Science
"...is the definitive reference in computer science and technology..."
1. The information cost of manipulation-resistance in recommender systems
   Paul Resnick, Rahul Sami
   October 2008 RecSys '08: Proceedings of the 2008 ACM conference on Recommender systems
   Publisher: ACM  Request Permissions
   Full text available: Pdf (347.06 KB)
   Bibliometrics: Downloads (5 Weeks): 9, Downloads (12 Months): 105, Downloads (Overall): 487, Citation Count: 0
   Attacker may seek to manipulate recommender systems in order to promote or suppress certain items. Existing defenses based on analysis of ratings also discard useful information from honest raters. In this paper, we show that this is unavoidable and ...
   Keywords: information loss, manipulation-resistance, recommender systems, shilling

2. Prototyping recommender systems in jcolibri
   Juan A. Recio-Garcia, Belén Díaz-Aguado, Pedro A. González-Calero
   October 2008 RecSys '08: Proceedings of the 2008 ACM conference on Recommender systems
   Publisher: ACM  Request Permissions
   Full text available: Pdf (1.33 MB)
   Bibliometrics: Downloads (5 Weeks): 11, Downloads (12 Months): 102, Downloads (Overall): 522, Citation Count: 0
   Our goal is to support system developers in rapid prototyping recommender systems using Case-Based Reasoning (CBR) techniques. In this paper we describe how jCOLIBRI can serve to that goal. jCOLIBRI is an object-oriented framework in Java for building ...
   Keywords: case based reasoning, recommender systems, template based design

3. The value of personalised recommender systems to e-business: a case study
   M. Benjamin Dias, Dominique Locher, Ming Li, Wael El-Deredy, Paulo J.G. Lisboa
   Oslo, 2008 RecSys '08: Proceedings of the 2008 ACM conference on Recommender systems
   Publisher: ACM  Request Permissions
   Full text available: Pdf (1.33 MB)
   Bibliometrics: Downloads (5 Weeks): 11, Downloads (12 Months): 102, Downloads (Overall): 522, Citation Count: 0
   This paper presents the value of personalized recommender systems to e-business. The case study is based on the cooperation between a leading e-business and a research laboratory. The main objective is to understand how personalized recommendations can enhance customer satisfaction and increase sales. The study is based on a comprehensive analysis of customer data, including purchase histories, preferences, and demographics. The results show that personalized recommendations lead to a significant increase in customer satisfaction and sales. The study also highlights the importance of integrating recommender systems with e-business strategies and the potential benefits of personalized recommendations.
Information Filtering

• Reverse assumptions from IR
  – Static information need
  – Dynamic content base

• Invest effort in modeling user need
  – Hand-created “profile”
  – Machine learned profile
  – Feedback/updates

• Pass new content through filters
Dear Joseph A Konstan,

I'm sending you your monthly ACM Technical Interest Service email, providing access to highlights of current ACM activities and information matching your interests.

This edition features the three most recent and three most popular articles in the ACM Digital Library matching your profile.

You can refine your profile to get the best results in future mailings by visiting: https://campus.acm.org/public/ProfQJ/profsurvey.cfm?code=%27%2A%2CW%2CP%3CO%2530%20%20%0A&tick=F05A2FADB5F6C672283592D85609C11E

I hope you find this information useful, and please feel free to contact me at anytime with any questions or concerns you may have about your membership or any of ACM's Products and Services.

Best regards,
Nanette Hernandez
ACM Customer Service Representative
hernandez_rep@acm.org

*** 3 Recently Published ACM Articles Relating to your Technical Interests ***

Predatory scholarly publishing
Communications of the ACM
Volume 55, Issue 7 July 2012
Moshe Y. Vardi
http://dl.acm.org/tipsvc.cfm?id=2209250&code=%27%2A%2CW%2CP%3CO%2530%20%20%0A&tick=F05A2FADB5F6C672283592D85609C11E
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Collaborative Filtering

• **Premise**
  - Information needs more complex than keywords or topics: quality and taste

• **Small Community: Manual**
  - Tapestry – database of content & comments
  - Active CF – easy mechanisms for forwarding content to relevant readers
A Bit of History

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- Automated Collaborative Filtering
- The Commercial Era
Automated CF

• The GroupLens Project (CSCW ’94)
  – ACF for Usenet News
    • users rate items
    • users are correlated with other users
    • personal predictions for unrated items
  – Nearest-Neighbor Approach
    • find people with history of agreement
    • assume stable tastes
Usenet Interface

xrn - version 8.01-beta-3

11007 Cream Brulee
11098 Mop Sauce
11099 Banana Cream Pie
11110 Baked Potato Soup
11111 XMinestrone
11112 XHopie Pandowdy
11113 XLaabkuchen
11114 XPlum Chutney
11115 XSwedish Flatbread

Operations apply to current selection or cursor position

Quit Next unread Next Prev Catch up Post Gripe Next group

From: "Art Poe" <apoe@unicom.net>
Subject: Cream Brulee
Organization: Unicom

MasterCook export: Cream Brulee

* Exported from MasterCook *

Creme Brulee

Recipe By: Food and Wine - Dec86
Serving Size: 8 Preparation Time: 1:00
Categories: Desserts

<table>
<thead>
<tr>
<th>Amount</th>
<th>Measure</th>
<th>Ingredient</th>
<th>Preparation Method</th>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>Cups</td>
<td>Heavy Cream</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Pinch</td>
<td>Vanilla bean</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Pinch</td>
<td>Salt</td>
<td></td>
</tr>
<tr>
<td>1/3</td>
<td>Cup</td>
<td>Egg yolks</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Tablespoons</td>
<td>Sugar</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Tablespoons</td>
<td>Brown sugar</td>
<td></td>
</tr>
</tbody>
</table>

Preheat the oven to 300F. In a heavy medium saucepan, combine the cream, vanilla bean and salt. Warm over moderate heat until the surface begins to shimmer, about 5 minutes. In a large bowl, stir the egg yolks and sugar until blended. Pour in the hot cream and stir gently to avoid forming air bubbles. Strain the custard into a large measuring glass and skim off and surface air bubbles. (Rinse the vanilla bean and reserve for future use.) Place 8 3/4-cup ramekins in a roasting pan. Pour the custard into the ramekins, filling them up to the rim. Place the roasting pan in the oven and pour in enough warm water to reach halfway up the sides of the ramekins. Cover loosely with foil and bake for 1 1/4 hours, or until the custard is firm around the edges. (It may still be wobbly in the center but it will firm up as it chills.) Remove the ramekins from the

This article is great, I'd like to see more like this one!

Save Reply Forward Followup Followup & Reply Cancel Rot-13 Translate

Toggle header Print artRate1 artRate2 artRate3 artRate4 artRate5
Does it Work?

- Yes: The numbers don’t lie!
  - Usenet trial: rating/prediction correlation
    - rec.humor: 0.62 (personalized) vs. 0.49 (avg.)
    - comp.os.linux.system: 0.55 (pers.) vs. 0.41 (avg.)
    - rec.food.recipes: 0.33 (pers.) vs. 0.05 (avg.)
  - Significantly more accurate than predicting average or modal rating.
  - Higher accuracy when partitioned by newsgroup
It Works Meaningfully Well!

• Relationship with User Behavior
  – Twice as likely to read 4/5 than 1/2/3

• Users *Like* GroupLens
  – Some users stayed 12 months after the trial!
A Bit of History

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“Dream Team by Jack McCallum is the story of the American men’s basketball team that swept through the 1992 Olympics in a successful quest to obtain gold medals.”

David Pruette | 26 reviewers made a similar statement

“Overall this is a very good book well worth reading especially if you are a multi-generation basketball fan.”

Joseph Landes | 30 reviewers made a similar statement

“Well done Mr. McCallum, a very informative and entertaining job.”

J. Benvignati | 11 reviewers made a similar statement

Most Helpful Customer Reviews

19 of 22 people found the following review helpful

★★★★☆ A collection of immortals that won't be duplicated July 7, 2012

By Barry Sparks | Vine Voice

Format: Hardcover | Amazon Vine Review (What's this?)

The 1992 USA Olympic basketball team was dubbed “Dream Team.” And, why not? The team featured the golden trio of Michael Jordan (perhaps the most famous person in the world at the time), Magic Johnson and Larry Bird as well as Patrick Ewing, Charles Barkley, David Robinson, John Stockton, Karl Malone, Clyde Drexler, Chris Mullin, Scottie Pippen and Christian Laettner (the only college player). Chuck Daly was the coach. Author Jack McCallum describes the team as "a collection of immortals gathered in one place at one time."

The 1992 Olympics in Barcelona marked the first time professional athletes could compete. The challenge, however, was to convince the NBA's best players to sacrifice their summer, compete as a team and to do it essentially for free.

McCallum, who covered the NBA and the Dream Team for Sports Illustrated, details how the Dream Team was selected and profiles each player. He also writes about the efforts to keep Isiah Thomas off the team. Jordan, who wielded immense power, despised Thomas and didn't want him on the team. And, it was more important to make Jordan happy than any thing else. Even though Thomas was the best player on the Detroit Pistons, who had won back-to-back NBA championships, he was not a Dream Team member.
Recommenders

- Tools to help identify worthwhile stuff
  - Filtering interfaces
    - E-mail filters, clipping services
  - Recommendation interfaces
    - Suggestion lists, “top-n,” offers and promotions
  - Prediction interfaces
    - Evaluate candidates, predicted ratings
Historical Challenges

• Collecting Opinion and Experience Data
• Finding the Relevant Data for a Purpose
• Presenting the Data in a Useful Way
Recommender Application Space
Scope of Recommenders

- Purely Editorial Recommenders
- Content Filtering Recommenders
- Collaborative Filtering Recommenders
- Hybrid Recommenders
Recommender Application Space

• Dimensions of Analysis
  – Domain
  – Purpose
  – Whose Opinion
  – Personalization Level
  – Privacy and Trustworthiness
  – Interfaces
  – <Algorithms Inside>
Domains of Recommendation

- Content to Commerce
  - News, information, “text”
  - Products, vendors, bundles
Searched the web for **google pagerank**. Results 1 - 10 of about 31,600. Search took 0.44 seconds.

Category: Science > Biology > Microbiology > Directories

**Google Web Directory - Health > Conditions and Diseases > ...**
... Institute (54) Web Pages. Viewing in **Google PageRank** order View in alphabetical order. Amgen's Neupogen ...
directory.google.com/Top/Health/Conditions_and_Diseases/Cancer/ 15k - Cached - Similar pages

**Google Web Directory - Science > Biology > Microbiology**
... Micropaleontology (24) Web Pages. Viewing in **Google PageRank** order View in alphabetical order. CELLS alive ...
directory.google.com/Top/Science/Biology/Microbiology/ 23k - Cached - Similar pages
[ More results from directory.google.com ]

**welcome to nathan arora's page @ uw**
... Etude) using **Google's** (www.google.com) patented search engine technology. One of the reasons **Google** works so well is their patented **PageRank** TM technology. ...
etude.uwaterloo.ca/~nathan/search.html - 3k - Cached - Similar pages

**Geek** google accused of rigging **PageRank** for Yahoo!
[Date Prev][Date Next][Thread Prev][Thread Next][Date Index][Thread Index]
Geek google accused of rigging **PageRank** for Yahoo!
www.monkey.org/geeks/archive/0009/msg00030.html - 4k - Cached - Similar pages

**FoRK Archive: google accused of rigging **PageRank** for Yahoo!**
google accused of rigging **PageRank** for Yahoo! From:
Karl Anderson (kra@monkey.org) Date ...
xent.ics.ucl.edu/FoRK-archive/sept00/0277.html - 4k - Cached - Similar pages
Hello, riedl@cs.umn.edu.

My Recommendations

**Exile** - Paperback
Buy it for $1.10 (Save 94%)

**Homeland** - Paperback
Buy it for $0.75 (Save 99%)

Show me more Recommendations

---

**Sex and the City Season 4 (DVD) - $32.49 or less!**

---

**My Account**

5 transactions awaiting Feedback
Earn up to $150.91 by selling your past purchases... Learn how!

Go to My Account

---

**Hot Buys!**

**Sex and the City: The Complete Fourth Season (DVD)**

$32.49 Save 35%

---

**In Computers**

**Dell Desktop Bargain - 6 Month Warranty**

$223.00

You'll pay only $229 for a D5111, 250MB, 900MHz Dell Desktop with DVD drive. Buy today with a 6 month warranty.

**Sony Style in a Flat Panel Monitor**

$299.00

Treat yourself to a 15-inch SONY LCD Flat Panel Monitor for just $299. Brand New with a 3 year warranty.

---

**In Electronics**

**Upgrade from VHS to DVD - under $59**

$49.99

Panasonic makes it easy to make the move to DVD with this bargain priced, single-disc player. Comes with a 90 day...
Purposes of Recommendation

- The recommendations themselves
  - Sales
  - Information

- Education of user/customer

- Build a community of users/customers around products or content
Lexar Media's high-speed JumpDrive will revolutionize the way you store, transfer and carry your files. Moving files from one computer to another has never been easier. With cross platform capabilities, the JumpDrive allows you to effortlessly store and transfer files via the USB port on your computer with no driver installation...

Our customers rated this item: ***** Based on 16 reviews  Write a review

Product Description

Lexar Media's high-speed JumpDrive will revolutionize the way you store, transfer and carry your files. Moving files from one computer to another has never been easier. With cross platform capabilities, the JumpDrive allows you to effortlessly store and transfer files via the USB port on your computer with no driver installation...

more
The 2000 Sienna is now offering fewer option packages in comparison to last year's model. The dual......

Member Opinions

**Toyota Sienna: Try to Find a better minivan**
by **JMB623** (Aug 30 '99)
Product rating: ★★★★★
We bought the 1998 Sienna, knowing that it's usually sheer stupidity to buy the first year release of most vehicles. But Toyota R & D'd this one...

**Quiet, comfortable ride**
by **jstrickl** (Dec 22 '99)
Product rating: ★★★★★
My husband and I bought this vehicle because we were ready to give ourselves and our almost teenage boys more room on trips. We have an SUV and love...

**a great mini-van**
by **dannela** (May 16 '00)
Product rating: ★★★★★
When we were shopping for a mini-van, we had a lot of input from friends. I have owned 2 Toyota Camry's and I was very satisfied with the quality...
OWL Tips

- **EditFind**: Use Find more to search for text in file
- **EditDeleteWord**: Learn the shortcut keys to delete words
- **FormatUnderline**: Try using underlining for formatting text
- **FileClose**: Try different ways to close your file
- **EditReplace**: Use Replace more for finding and replacing text
- **ViewZoom**: Learn how to enlarge or reduce the display
- **ViewShowAll**: FYI-more than average use for Show All command
- **FormatBulletsAndNumbering**: Learn how to automatically add bullets and number
- **ToolsWordCount**: Use Word Count to look up statistics on files
- **ViewPage**: Use Page Layout to view files before printing

User: M06375
OWL Version: 5.0c
Whose Opinion?

- “Experts”
- Ordinary “phoaks”
- People like you
Casa Lapostolle

1997 Casa Lapostolle Cabernet Sauvignon, Rapel Valley, Chile

Lapostolle’s 1997 Cabernet Sauvignon is quite ripe and delicious, showing the soft tannins and easy-drinking profile needed to pair with everything from meatloaf to spaghetti and meatballs.

$9.95

Peter’s Tasting Chart

intensity: delicate - very powerful
dry or sweet: bone dry - dessert
body: light body - very full body
acidity: soft, gentle - very crisp
tannin: none - heavy tannins
oak: none - heavy oak
complexity: direct - very complex

Casa Lapostolle, a partnership between French and Chilean winemaking families, is one of the newer wineries in Chile but they clearly know how to make fine wine. A red that rewards regular visits, Casa Lapostolle’s 1997 Cabernet Sauvignon is so juicy, easy to drink, and affordable that you may want to buy it by the case. Ripe flavors of cassis and plum fruit are aligned within a delicate frame of oak and a long silky-tannic finish that’s perfect for everyday home-style comfort foods. The tannins are soft enough and the fruit is ripe enough to work well with any kind of food.
People Helping One Another Know Stuff

Freq "Together, we know it all." Phceedback
Recency Top Posters


Frequently Mentioned Resources

<table>
<thead>
<tr>
<th>Resource Title</th>
<th>Distinct Posters</th>
<th>Click on Bars for Message Context(s) *</th>
</tr>
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<tbody>
<tr>
<td>1) Bob Dylan - Bob Links</td>
<td>23</td>
<td></td>
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<tr>
<td>2) Bob Dylan Chords</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>3) RemarQ - The Internet's Best Collaboration...</td>
<td>8</td>
<td></td>
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<tr>
<td>4) bobdylan.com: Bob Dylan</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>5) CDNOW</td>
<td>6</td>
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<tr>
<td>6) Mailing List WWW Gateway</td>
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<tr>
<td>7) Deja.com</td>
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<td>8) LC Z39.50 Server Soft Reference</td>
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<td>9) Resource at <a href="http://www.cs.umass.edu">www.cs.umass.edu</a></td>
<td>4</td>
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<tr>
<td>10) Sidewalk</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

* Note: each square represents the posting of one resource (e.g., URL) by one person. The lighter the square, the more recent the post. Click on a square to view messages where this resource was mentioned. Posting a web resource does not necessarily imply endorsing that resource. Sometimes it may actually mean the opposite. Consult the relevant netnews messages to obtain context.
Personalization Level

- **Generic**
  - Everyone receives same recommendations
- **Demographic**
  - Matches a target group
- **Ephemeral**
  - Matches current activity
- **Persistent**
  - Matches long-term interests
It makes looking good look easy.

The slimming Faille Tankini – just $58!

AS SEEN ON TV!

The magic word is Faille (say it "file"). It's a revolutionary ribbed fabric that feels slimming and comfortable.

With a liberating – yet discreet – 2-piece style, our Faille Tankini works its magic at a very down-to-earth price: $58.

Want a pile of faille? See all of our slimming Faille favorites.

Let Swim Finder locate your perfect suit!

Quickly sorts through hundreds of Suits by:
• Body Shape • Anxiety Zones • Leg Height • Bra Style • 18W–26W • Mastectomy • and more!

It's fast...it's fun! Try Swim Finder today! Or, visit Swim HQ to see new styles, swim separates, and more.
Reviews

*Advance praise for Dream Team*

"The Dream Team was one of a kind, and so is this fascinating account of the best basketball team of all time. Jack McCallum, the consummate basketball insider, lures you into the back rooms, living rooms, and locker rooms of this volatile group of superstars with revealing, colorful anecdotes that will make you laugh, cheer, and gasp. This is a terrific read by an all-star journalist."—Jackie MacMullan, New York Times bestselling co-author of When the Game Was Ours

"Perfect book, perfect subject, perfect writer. Dream Team is one of the best sports books I have ever read—a riveting inside look at a once-in-a-lifetime squad at a once-in-a-lifetime moment in time. Jack McCallum has pieced together a masterpiece."—Jeff Pearlman, New York Times bestselling author of Sweetness and Boys Will Be Boys

"Jack McCallum is one of my favorite writers on the NBA. If Jack writes it, even if I know the story, I want to read it. He reflects the best of his longtime residence in the glory days of Sports Illustrated: You can see the event, but you still want to know what the reporter has to say about it. Dream Team is a wonderful look back at what will live on not only as one of the NBA’s greatest times but as a summary of its golden era. Jack beautifully blends what happened then with who are they now? anecdotes, taking you behind the locker-room door with the greatest names of their era. This is a wonderful read, you can’t help but smiling."—Sam Smith, New York Times bestselling author of The Jordan Rules
Album Advisor™

Tell us what you like and we'll make several recommendations. Great for buying gifts or broadening your musical horizons.

To start, enter the names of up to three artists below and click on the Recommend button.

gordon bok
enya

Recommend
Ace Of Base

*Cruel Summer*

List $16.97

>Add to Cart $12.99

Listen

"Cruel Summer"

Real Audio

Windows Media

---

Fantasia 2000

*Score*

List $17.97

>Add to Cart $13.99

Listen

"Symphony No.5"

Real Audio

See complete track list and more album info.

---

Erasure

*Abba-Esque*

List $6.97

>Add to Cart $6.89

Listen

"Lay All Your Love On Me"

Real Audio

Windows Media

See complete track list and more album info.

---

Vangelis

*Opera Sauvage*

List $11.97

>Add to Cart $11.49

Listen

"Hymne"

Real Audio

See complete track list and more album info.
Privacy and Trustworthiness

• Who knows what about me?
  – Personal information revealed
  – Identity
  – Deniability of preferences

• Is the recommendation honest?
  – Biases built-in by operator
    • “business rules”
  – Vulnerability to external manipulation
Interfaces

• Types of Output
  – Predictions
  – Recommendations
  – Filtering
  – Organic vs. explicit presentation
    • Agent/Discussion Interface Example

• Types of Input
  – Explicit
  – Implicit
Wide Range of Algorithms

- Simple Keyword Vector Matches
- Pure Nearest-Neighbor Collaborative Filtering
- Machine Learning on Content or Ratings
Collaborative Filtering: Techniques and Issues
Collaborative Filtering Algorithms

- Non-Personalized Summary Statistics
- K-Nearest Neighbor
- Dimensionality Reduction
- Content + Collaborative Filtering
- Graph Techniques
- Clustering
- Classifier Learning
Teaming Up to Find Cheap Travel

- **Expedia.com**
  - “data it gathers anyway”
  - (Mostly) no cost to helper
  - Valuable information that is otherwise hard to acquire
  - Little processing, lots of collaboration
Minneapolis, MN (MSP) to Las Vegas, NV (LAS)

Choose your departure date

How this works:
The calendar shows the best prices recently found by Expedia customers. Learn more
Prices are:
- Roundtrip (including all taxes and fees)
- Per adult
- Based on e-ticket purchase
- The lowest roundtrip price(s) recently found
  - Click Price in the calendar to search for updated prices
Expedia Fare Compare #2

Minneapolis, MN (MSP) to Las Vegas, NV (LAS)

<table>
<thead>
<tr>
<th></th>
<th>All Results</th>
<th>Sun Country Airlines</th>
<th>Northwest</th>
<th>US Airways</th>
<th>Midwest Airlines</th>
<th>Frontier Airlines</th>
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<tr>
<td>Nonstop</td>
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<td>from $265</td>
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</tr>
<tr>
<td>1 stop</td>
<td>from $269</td>
<td>---</td>
<td>from $269</td>
<td>from $279</td>
<td>from $283</td>
<td>from $286</td>
</tr>
<tr>
<td>2+ stops</td>
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Did not find what you were looking for? [Return to Fare Comparison Calendar]

*Note: The prices shown below are for the flight only; they are e-ticket prices and include all flight taxes and fees. If your itinerary requires paper tickets there will be an additional charge. These results cover a metro area with several airports. Review your choices carefully.*

1. Choose a departing flight or view complete roundtrips

Booking online is a snap -- or call (800) 434-2370.
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<th>Neighborhood</th>
<th>Cuisine</th>
<th>Type</th>
<th>Food</th>
<th>Decor</th>
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<td>Ouderkerk aan de Amstel</td>
<td>Eclectic / Int'l, French</td>
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<td>28</td>
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<td>Van Vlaanderen</td>
<td>Leidseplein (up to Amstel)</td>
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<td>18</td>
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<td>E</td>
</tr>
</tbody>
</table>
Yamazato

Hotel Okura
Ferdinand Bolstraat 333
Amsterdam, Netherlands 1072 LH
020-678-8351

Map & Directions

For real Japanese food, this is the place to be in the Netherlands" say fans of this "absolute treat" in the Pijp's Hotel Okura that serves "fresh", "fabulous presentations" of "some of the best sushi in Europe" along with other "outstanding" offerings, all backed up by an "extensive sake list"; "alas", some say, it's a "shame the decor doesn't quite meet the same level", but "excellent service" from the "trilingual staff" more than compensates -- "be prepared" for the bill, though, as it's definitely "costly."

Add Your Review

Share Your Reviews With Other Zagat.com Users!
Rate each category on a scale of 0-3 and add your review, or see review instructions. Submissions that do not follow our community guidelines will not be posted.

Your review will also be your official contribution to Zagat Survey's official Rating and Review of the establishment

Food: 27
Decor: 19
Service: 25
Cost: VE

Payment:
Accepts Major Credit Cards

Hours:
Mon: - 9:30PM
Tues: - 9:30PM
Wed: - 9:30PM
Thurs: - 9:30PM
Fri: - 9:30PM
Sat: - 9:30PM
Sun: - 9:30PM

Operations:
Full Bar
Year Opened: 1971

Meals Served:
Breakfast
Dinner
Lunch

Features:
Prix Fixe Menu:
Dinner
Lunch
View

Cuisine:
Japanese

Neighborhood:
Pijp

Website:
www.okura.nl

Discuss:
Add to My Favorites
Add / View Notes
E-mail a Friend
Printable View
Zagat: Is Non-Personalized Good Enough?

• What happened to my favorite guide?
  – They let you rate the restaurants!

• What should be done?
  – Personalized guides, from the people who “know good restaurants!”
Collaborative Filtering Algorithms

- Non-Personalized Summary Statistics
- **K-Nearest Neighbor**
  - user-user
  - item-item
- Dimensionality Reduction
- Content + Collaborative Filtering
- Graph Techniques
- Clustering
- Classifier Learning
CF Classic: K-Nearest Neighbor User-User
CF Classic: Submit Ratings

C.F. Engine

Ratings
Correlations
CF Classic: Store Ratings

C.F. Engine

ratings

Ratings

Correlations
CF Classic: Compute Correlations

C.F. Engine

pairwise corr.

Ratings

Correlations
CF Classic: Request Recommendations

C.F. Engine

Ratings

Correlations

request
CF Classic: Identify Neighbors

C.F. Engine

find good …

Ratings

Correlations

Neighborhood
CF Classic: Select Items; Predict Ratings

C.F. Engine

Predictions
Recommendations

Ratings
Correlations

Neighborhood
## Understanding the Computation

<table>
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<tr>
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<th>Hoop Dreams</th>
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Welcome to MovieLens!

Advanced Search now allows you to search for movies by director and/or actors in addition to its other features: Multiple genres, exclude genres, date ranges, language, hide predictions, and more! Check it out.

Also, don't forget about the new publish feature that lets you publish predictions in HTML/RSS 2.0 format. This and other info about recently added features is available in our archived announcements.

Did you know...? 4909 people joined MovieLens the same day you did.

<table>
<thead>
<tr>
<th>New movies</th>
<th>New DVDs</th>
</tr>
</thead>
</table>
Welcome riedl@cs.umn.edu
You've rated 205 movies.
You're the 31st visitor in the past hour.

Welcome to MovieLens!

Advanced Search now allows you to search for movies by director and/or actors in addition to its other features: Multiple genres, exclude genres, date ranges, language, hide predictions, and more! Check it out.

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New movies
★★★★★ Shrek 2 (2004)
★★★★★ Anchorman (2004)
★★★★★ Man on Fire (2004)
★★★★★ Mean Girls (2004)

New DVDs
★★★★★ Great Escape, The (1963)
★★★★★ Miracle (2004)
★★★★★ Boat, The (Das Boot) (1981)
★★★★★ Field of Dreams (1989)
★★★★★ Suddenly (1954)
Welcome riedl@cs.umn.edu
You've rated 206 movies.
You're the 31st visitor in the past hour.

Found 71 movies, sorted by Prediction
Genres: Sci-Fi | Exclude Genres: None
Dates: 2000s | Domain: All | Format: All | Language: All
Show Printer-Friendly Page | Download Results | Suggest a Title

<table>
<thead>
<tr>
<th>Predictions for you</th>
<th>Your Ratings</th>
<th>Movie Information</th>
<th>Wish List</th>
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<tr>
<td>★★★★★ Not seen</td>
<td>Eternal Sunshine of the Spotless Mind (2004) info</td>
<td>Comedy, Drama, Romance, Sci-Fi</td>
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<tr>
<td>★★★★★ Not seen</td>
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<td>Drama, Mystery, Romance, Sci-Fi</td>
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<td>★★★★★ Not seen</td>
<td>Spider-Man (a.k.a. Spiderman)</td>
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</table>
Welcome riedl@cs.umn.edu
You've rated 206 movies.
You're the 31st visitor in the past hour.

You've searched for titles matching: matrix

Show Printer-Friendly Page | Download Results | Suggest a Title

Page 1 of 1

<table>
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<th>Predictions for you</th>
<th>Ratings</th>
<th>Movie Information</th>
<th>Wish List</th>
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<td><strong>4.5 stars</strong></td>
<td>Matrix Reloaded, The (2003) DVD, VHS, info</td>
<td>imdb Action, Sci-Fi, Thriller</td>
<td>□</td>
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<tr>
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<td>imdb Action, Sci-Fi, Thriller</td>
<td>□</td>
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<tr>
<td><strong>5.0 stars</strong></td>
<td>Matrix, The (1999) DVD, VHS, info</td>
<td>imdb Action, Sci-Fi, Thriller</td>
<td>□</td>
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</table>

Create a shortcut to this search!

Enter a name then press "Create!"

What are shortcuts?
Found 4511 movies, sorted by **Prediction**
Genres: All | Exclude Genres: None
Dates: All | Domain: **DVD Releases** | Format: All | Language: All

Buddy Search with: **Joe, Maureen**
Results restricted to movies that have predictions for each buddy.

Page 1 of 301 | Go to page: 1...60...120...180...240...300...last

<p>| Combined | You | Joe | Maureen | Your | Movie | Wish |</p>
<table>
<thead>
<tr>
<th>Preds</th>
<th></th>
<th></th>
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<th>Ratings</th>
<th>Information</th>
<th>List</th>
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<td>Decade Under the Influence, A (2003) DVD, VHS, info</td>
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<td>Miracle Worker, The (1962) DVD, VHS, info</td>
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<td>4.5</td>
<td>Not seen</td>
<td>Enter the Dragon (1973) DVD, VHS, info</td>
<td>imdb</td>
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**Advanced Search**

**Select Buddies**
- Joe
- Maureen

What are buddies?
User-User Collaborative Filtering

Weighted Sum
A Challenge: Sparsity

- Many E-commerce and content applications have many more customers than products
- Many customers have no relationship
- Most products have some relationship
Another challenge: Synonymy

- Similar products treated differently
  - Have skim milk? Want whole milk too?
- Increases apparent sparsity
- Results in poor quality
Item-Item Collaborative Filtering
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Item Similarities

\[ s_{ij} = ? \]

Used for similarity computation
Item-Item Matrix Formulation

Target item

5 closest neighbors

Raw scores for prediction generation

Approximation based on linear regression

weighted sum regression-based

1st 2nd 3rd 4th 5th
Item-Item Discussion

- Good quality, in sparse situations
- Promising for incremental model building
  - Small quality degradation
    - *Nature* of recommendations changes
  - Big performance gain
Collaborative Filtering Algorithms

- Non-Personalized Summary Statistics
- K-Nearest Neighbor
- Dimensionality Reduction
  - Singular Value Decomposition
  - Factor Analysis
- Content + Collaborative Filtering
- Graph Techniques
- Clustering
- Classifier Learning
Dimensionality Reduction

- Latent Semantic Indexing
  - Used by the IR community
  - Worked well with the vector space model
  - Used Singular Value Decomposition (SVD)

- Main Idea
  - Term-document matching in feature space
  - Captures latent association
  - Reduced space is less noisy
The reconstructed matrix $R_k = U^*_k S_k V_k'$ is the closest rank-$k$ matrix to the original matrix $R$. 
SVD for Collaborative Filtering

1. Low dimensional representation
   \( O(m+n) \) storage requirement

2. Direct Prediction
Singular Value Decomposition

Reduce dimensionality of problem
- Results in small, fast model
- Richer Neighbor Network

Incremental Update
- Folding in
- Model Update

Trend
- Towards use of probabilistic LSI
Collaborative Filtering Algorithms

- Non-Personalized Summary Statistics
- K-Nearest Neighbor
- Dimensionality Reduction
- Content + Collaborative Filtering
- Graph Techniques
  - Horting: Navigate Similarity Graph
- Clustering
- Classifier Learning
  - Rule-Induction Learning
  - Bayesian Belief Networks
Resources

• Survey Articles

• Books

• Software Tools
  – LensKit – http://lenskit.grouplens.org
  – MyMedia – http://www.mymediaproject.org
  – Mahout – http://mahout.apache.org
ACM: The Learning Continues

• Questions about this webinar? learning@acm.org

• ACM Learning Center: http://learning.acm.org

• ACM SIGCHI: http://www.sigchi.org

• ACM Conference on Recommender Systems http://recsys.acm.org