Hybrid Critiquing-based Recommender Systems

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Recommender Systems

- E-commerce applications
- Recommend products or services that may interest a user
  - Collaborative filtering
  - Content-based
  - Preference-based
Find the best Digital Camera for you.

<table>
<thead>
<tr>
<th>How much do you want to spend?</th>
<th>$ \text{min} \to $500</th>
</tr>
</thead>
<tbody>
<tr>
<td>How important is Resolution?</td>
<td>slightly important</td>
</tr>
<tr>
<td>How important is Optical Zoom?</td>
<td>very important</td>
</tr>
<tr>
<td>How important is Brand?</td>
<td>most important</td>
</tr>
<tr>
<td>How important is Compact Size?</td>
<td>not important</td>
</tr>
</tbody>
</table>

Instant Results: Your Top 10 Digital Cameras based on the sliders above. [Reset]

Your Rank

1. **Fujifilm FinePix S8000 Digital Camera**
   - USER RATING: NA
   - 8 Megapixel Digital camera - SLR-style - 10.7X Optical Zoom - 2X Digital Zoom - CompactFlash, XD-Picture Card, Microdrive
   - $497 - $999.99 - compare prices

2. **Fujifilm FinePix S9800 Digital Camera**
   - USER RATING: ★★★★★ (10 reviews)
   - 8 Megapixel Digital camera - SLR-style - 10.7X Optical Zoom - 2X Digital Zoom - CompactFlash, XD-Picture Card, Microdrive
   - $499 - $1799.95 - compare prices

3. **Nikon Coolpix 8800 Digital Camera**
   - USER RATING: ★★★★★ (20 reviews)
   - 8 Megapixel Digital camera - 10X Optical Zoom - 4X Digital Zoom - 1.8 in LCD Screen Size - CompactFlash, Microdrive
   - $759.95 - $1099.99 - compare prices

4. **Nikon Coolpix 8700 Digital Camera**
   - USER RATING: ★★★★★ (38 reviews)
   - 8 Megapixel Digital camera - 8X Optical Zoom - 4X Digital Zoom - 1.8 in LCD Screen Size - CompactFlash, Microdrive
   - $449 - $929 - compare prices

Check at least 2 products to compare side by side.

- Compare Fujifilm FinePix S8000 Digital Camera
- Compare Fujifilm FinePix S9800 Digital Camera
- Compare Nikon Coolpix 8800 Digital Camera
- Compare Nikon Coolpix 8700 Digital Camera
Users are usually unable to accurately state their preferences up front!

**Step 1:** user preferences

**Step 2:** the system recommends items

*K-best items are displayed as the recommended set*

**Step 3:** user picks the final choice
Critiquing-based Recommender Systems

Step 1: user preferences

Preference Model

Step 2: the system recommends items

Space of all options

K-best items are displayed as the recommended set

Step 3: user critiques the current recommendations

Step 4: user picks the final choice
Hello, I would like to buy a digital camera which is light and not expensive!

Ok, so how about this one, $180, 130g weight, 4 million pixels, ……?
Thanks, but do you have one with higher resolution and more memory?
Tradeoff navigation increases users’ decision accuracy up to 57% (Pu and Chen EC’05)

I have this camera with 5 million pixels and 32MB memory, but a bit more expensive.

Thanks, but do you have one with higher resolution and more memory?
Research Focus

How to **effectively** support users to make critiques?
- Natural language dialog
- Graphical user interfaces

Improve users’ **objective decision performance & subjective perceptions**
Hybrid Critiquing-based Recommender System

- System-proposed critiques
- User self-motivated critiquing support
System-proposed Critiques

FindMe (Burke et al. 1997)

This apartment is OK, but make it...

bigger  cheaper  nicer  safer

This neighborhood could be more...

convenient  conservative  dynamic
Dynamic critiquing (McCarthy et al. IUI’05)

Explanation facility

Acceleration of decision process

unit critiquing

compound critiquing

We have more matching cameras with the following:
1. Less Memory and Lower Resolution and Cheaper
2. Different Manufacturer and Less Zoom and Lighter
3. Lighter and Smaller and Different Case
User Self-motivated Critiquing

Example critiquing (Pu and Kumar EC’04)
### User control

Support of different critiquing types

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**Example critiquing**  
(Chen and Pu AAAI’06)

To find similar products with better values than this one

**Canon PowerShot S2 IS Digital Camera**

$424.15  
Canon, 5.3 M pixels, 12x optical zoom, 16 MB, 2.97 in thickness, 404.7 g weight.  
[detail](#)

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**Would you like to improve some values?**

<table>
<thead>
<tr>
<th></th>
<th>Keep</th>
<th>Improve</th>
<th>Take any suggestion</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Manufacturer</strong></td>
<td>Canon</td>
<td>Sony</td>
<td></td>
</tr>
<tr>
<td><strong>Price</strong></td>
<td>$424.15</td>
<td>less expensive</td>
<td></td>
</tr>
<tr>
<td><strong>Resolution</strong></td>
<td>5.3 M pixels</td>
<td>$100 cheaper</td>
<td></td>
</tr>
<tr>
<td><strong>Optical Zoom</strong></td>
<td>12x</td>
<td>$200 cheaper</td>
<td></td>
</tr>
<tr>
<td><strong>Removable Flash Memory</strong></td>
<td>16 MB</td>
<td>more memory</td>
<td></td>
</tr>
<tr>
<td><strong>LCD Screen Size</strong></td>
<td>1.8 in</td>
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<td></td>
</tr>
<tr>
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<td>2.97 in</td>
<td>thinner</td>
<td></td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>404.7 g</td>
<td>lighter</td>
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</table>

[Show Results]  
[Reset]
Comparative user study (Chen and Pu AAAI’06)

System-proposed critiques

- More Intuitive
- Easier to use
- Motivating to think of tradeoff decisions
- Some matching users’ intended criteria

User self-motivated critiquing

- Having more freedom
- Feeling in control
- More flexible
- With more critiquing options
- More confident in choice

Rigid
No control
Limiting in critiquing options

Warm-up needed
Time consuming
Hybrid Critiquing Interface
(System-proposed *plus* User self-motivated)

- Intuitive
- Easy to use
- Motivating to think about tradeoff decisions
- Some matching users’ intended criteria
  
  + Having freedom
  + Feeling in control
  + Flexible
  
- More critiquing options
- More confident in choice
# Hybrid Critiquing

To find similar products with better values than this one

## Canon PowerShot S2 IS Digital Camera
$424.15
Canon, 5.3 M pixels, 12x optical zoom, 16 MB memory, 1.8 in screen size, 2.97 in thickness, 404.7 g weight. [detail](#)

### We have the following

1. Less Optical Zoom and Thinner and Lighter Weight
   - Explain
   - Show Products

2. Different Manufacturer and Lower Resolution and Cheaper
   - Explain
   - Show Products

3. Larger Screen Size and More Memory and Heavier
   - Explain
   - Show Products

### OR would you like to improve some value(s) by yourself?

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<td>□ Sony</td>
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<tr>
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[Show Results](#)  [Reset](#)
Recommender Systems

Critiquing-based Recommender Systems

Hybrid Critiquing-based Recommender Systems

User Evaluation

Conclusion
Hybrid Critiquing Interface

- System-proposed critiques
- User self-motivated critiquing support

- How frequently do users apply?
- Users’ decision accuracy?
- Decision effort (objective and subjective)?
- Subjective opinions (decision confidence, trusting intentions)?
Hybrid Critiquing Interface

- System-proposed critiques
- User self-motivated critiquing support

vs.

System-proposed critiquing interface

vs.

User self-motivated critiquing support
Hybrid Critiquing Interface vs. System-proposed critiquing interface

- System-proposed critiques
- User self-motivated critiquing support
Experiment Setup

- 36 participants
- Between-group design
- Online experiment
- User task: “Please find a product that you would purchase if given the opportunity!”
## Materials

### Hybrid Critiquing Interface

<table>
<thead>
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**We have the following**

1. Less Optical Zoom and Thinner and Lighter Weight
2. Different Manufacturer and Lower Resolution and Cheaper
3. Larger Screen Size and More Memory and Heavier

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**Show Results**

### System-proposed Critiquing Interface

<table>
<thead>
<tr>
<th>The product found according to your preferences</th>
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**Adjust your preferences to find the right camera for you**

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<th>Value</th>
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**We have more matching cameras with the following:**

1. Less Optical Zoom and Thinner and Lighter Weight
2. Different Manufacturer and Lower Resolution and Cheaper
3. Larger Screen Size and More Memory and Heavier

**Show Results**

---

(Dynamic Critiquing plus Example Critiquing)
Critiquing Application

During 76% critiquing cycles, 88.90% users ended their session by making the self-motivated critiquing.

During 57% critiquing cycles, 44.40% users ended their session by making the self-motivated critiquing.

Application of system-proposed critiques significantly correlated with higher application frequency of user self-motivated critiquing.
Application of System-proposed Critiques

- 83.30%
- 44.40%

System-proposed critiquing interface vs. Hybrid critiquing interface
Hybrid Critiquing Interface

System-proposed critiques

User self-motivated critiquing

- Less frequently applied when the user self-motivated critiquing support was present
- More likely applied during the earlier cycles
- Motivating users to compose critiques more often

- Actively applied
- Likely leading to users’ final choice
Decision Accuracy

200% improvement
\[ p < 0.05 \]

System-proposed Critiquing interface: 33.33%

Hybrid Critiquing interface: 66.67%
Interaction Effort

![Graph showing the interaction effort comparison between the System-proposed Critiquing interface and the Hybrid Critiquing interface. The graph indicates a 64% reduction in interaction cycles with a p-value of 0.01.]
Completion Time

The chart shows the completion time for two different critiquing interfaces:

- **System-proposed Critiquing interface**: Completion time is 5 minutes.
- **Hybrid Critiquing interface**: Completion time is 5.5 minutes.

The statistical significance of the difference is indicated by $p = 0.63$. This suggests that there is no statistically significant difference in the completion times between the two interfaces.
Subjective Effort

Perceived Effort (from 1 to 5)

- System-proposed Critiquing interface: 2.67
- Hybrid Critiquing interface: 2.06

$p = 0.03$
Decision Confidence

- Decision Confidence (from 1 to 5)
  - System-proposed Critiquing interface: 3.50
  - Hybrid Critiquing interface: 4.00

$p = 0.01$
Trusting Intentions

Intention to purchase: $p = 0.34$
Intention to return: $p = 0.03$

- Intention to purchase: $p = 0.34$
- Intention to return: $p = 0.03$

System-proposed Critiquing interface:
- Trusting Intentions (from 1 to 5): 3.17

Hybrid Critiquing interface:
- Trusting Intentions (from 1 to 5): 3.44
- Purchase intention: 4.06

Legend:
- Purchase intention
- Return intention
Discussion

Hybrid Critiquing Interface

- System-proposed critiques
- User self-motivated critiquing support

Decision accuracy
Interaction Effort
Subjective effort
Decision confidence
Intention to return

Significantly and positively affect
Recommender Systems

Critiquing-based Recommender Systems

Hybrid Critiquing-based Recommender Systems

User Evaluation

Conclusion
Hybrid Critiquing Interface vs. System-proposed critiquing interface

- System-proposed critiques
- User self-motivated critiquing support

- Decision accuracy
- Interaction & subjective effort
- Decision confidence
- Trusting intentions
Hybrid Critiquing Interface

System-proposed critiques

User self-motivated critiquing support

Future Work

User self-motivated critiquing interface

Diversity of users (gender, age, profession, nationality, online shopping experience, .......)
Thank you for your attention!!