

Recommender Systems

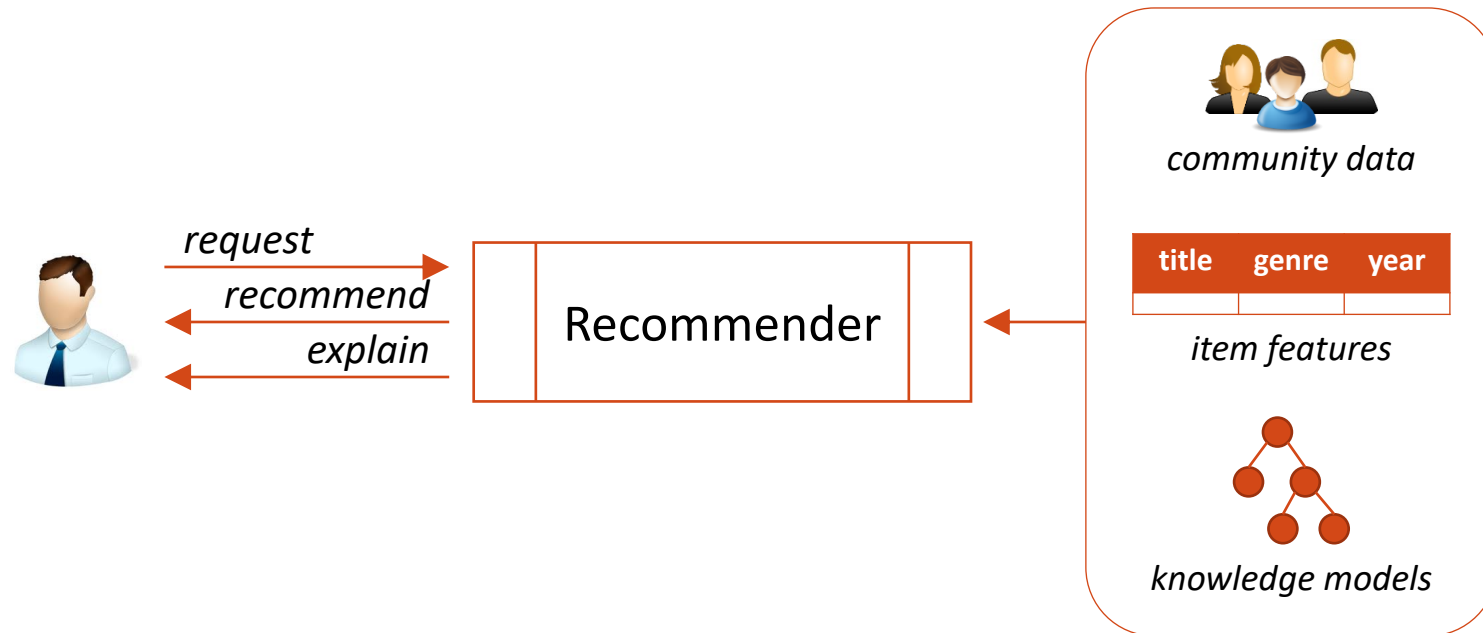
# Explanations

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# Explanations

Recommendation tells you what you may like

- Explanations tell you why



# Explanations

Recommendation tells you what you may like

- Explanations tell you why

Any exchanged communication for...

- Justifying a decision (by the user)
- Influencing a decision (by the system)

# Recommended for you

## Music

Page 1 of 25



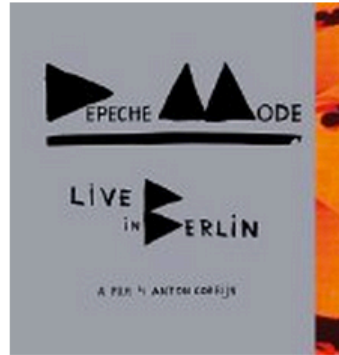
### New Release

The Endless River

➤ Pink Floyd

£9.00

[Why recommended?](#)



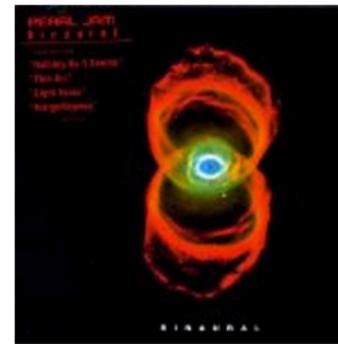
### New Release

Depeche Mode Live In ...

➤ Depeche Mode

£37.99

[Why recommended?](#)



### Binaural

➤ Pearl Jam

★★★★☆ (37)

£13.00

[Why recommended?](#)



### Mother Love Bone

➤ Mother Love Bone

★★★★☆ (22)

£7.99

[Why recommended?](#)



➤ [See all recommendations in Music](#)

***Mother Love Bone?!***

# Recommended for you

## Because you purchased...



[Alice In Chains:  
MTV Unplugged  
\[DVD\] \[2002\]](#)

(DVD)

**DVD** ~ Jerry  
Cantrell



☐ Don't use for  
recommendations



[Pearl Jam:  
Twenty \[DVD\]  
\[2011\] \[NTSC\]](#)

(DVD)

**DVD** ~ Cameron  
Crowe



☐ Don't use for  
recommendations



[Water On The  
Road \[DVD\]  
\[2011\]](#) (DVD)

**DVD** ~ Eddie  
Vedder



☐ Don't use for  
recommendations



Mother Love Bone

➤ Mother Love Bone

★★★★★ (22)

£7.99

[Why recommended?](#)

# Recommended for you



## Mother Love Bone

Rock band

Mother Love Bone was an American rock band that formed in Seattle, Washington in 1988. The band was active from 1988 to 1990. [Wikipedia](#)

**Active from:** 1987

**Origin:** [Seattle, Washington, United States](#)

**Record label:** [Mercury Records](#)

**Albums:** [Mother Love Bone](#), [Apple](#), [Hallucinogenic Recipe](#), [Shine On](#)

### Members



[Andrew Wood](#)  
Piano



[Stone Gossard](#)  
Guitar



[Jeff Ament](#)  
Bass guitar



[Bruce Fairweather](#)  
Lead guitar



[Greg Gilmore](#)  
Drums

### People also search for



[Temple of the Dog](#)



[Green River](#)



[Malfunks...](#)



[Pearl Jam](#)



[Mike McCready](#)

[View 15+ more](#)

# Why explain? [Tintarev, RecSys 2007]

## Transparency

- Disclose the recommendation process  
*“because you purchased”*

## Validation

- Compare required and offered items  
*“10x optical zoom (you requested >5x)”*

# Why explain? [Tintarev, RecSys 2007]

## Trustworthiness

- Reduce the uncertainty in a decision  
*“the best rated camera in its price range”*

## Persuasiveness

- Influence the user’s decision  
*“lightest model” (despite the cheap finish)*



# Why explain? [Tintarev, RecSys 2007]

## Effectiveness

- Help the user make better decisions  
*“best model for your use cases”*

## Efficiency

- Help the user make faster decisions  
*“the only model that fulfills all requirements”*

# Why explain? [Tintarev, RecSys 2007]

## Education

- Educate the user about the item domain  
*“a stabilizer helps you avoid blurred images”*

## Relevance

- Justify need for further feedback  
*“more pixels? may be useful for larger prints”*

# Why explain? [Tintarev, RecSys 2007]

Goals may be interrelated

- More transparency → more trust
- More persuasiveness → less trust

Don't be evil



# How to explain?

Explanations as a communication channel

- Suitability depends on sender and receiver's goals

Can be improved by modeling the receiver

- e.g. the more you know about the user, the better you can explain a recommendation

*expectations*

*domain*

*knowledge*

*demographics*

# Factors to consider

The information to be explained

- Prediction? Recommendation?

The state of communication

- What has been shown thus far?

The goals of the providing agent

- Transparency? Persuasion?

The model of the receiving agent

- What knowledge is available?



# Content-based explanations

Content-based recommenders exploit item features

- $f(\text{features}) \rightarrow \text{prediction}$

Classifiers can be explained by feature importance

- Improves the interpretability of the classifier

Several feature selection techniques

- e.g. minimum redundancy, maximum relevance

# Content-based explanations

Tagsplanations [Vig et al., IUI 2009]



# Knowledge-based explanations

Inspired by expert systems [Shortliffe, ACM Conf. 1974]

- why-explanations

*“Why is more input needed?”*

- how-explanations

*“How is this recommendation advantageous?”*

General solution

- Highlight satisfied and violated requirements



# Knowledge-based explanations

## Example requirements

- *price lower than 200*
- *suited for sports*
  - *video=yes*
  - *wproof=yes*

id	price	m-pixel	zoom	LCD	video	sound	w-proof
P <sub>1</sub>	148	8.0	4×	2.5	no	no	yes
P <sub>2</sub>	182	8.0	5×	2.7	yes	yes	no
P <sub>3</sub>	189	8.0	10×	2.5	yes	yes	no
P <sub>4</sub>	196	10.0	12×	2.7	yes	no	yes
P <sub>5</sub>	151	7.1	3×	3.0	yes	yes	no
P <sub>6</sub>	199	9.0	3×	3.0	yes	yes	no
P <sub>7</sub>	259	10.0	3×	3.0	yes	yes	no
P <sub>8</sub>	278	9.1	10×	3.0	yes	yes	yes

# Knowledge-based explanations

## Example requirements

- *price lower than 160*
- *LCD larger than 2.4"*

*“I care much more  
about the latter”*

id	price	m-pixel	zoom	LCD	video	sound	w-proof
P <sub>1</sub>	148	8.0	4×	2.5	no	no	yes
P <sub>2</sub>	182	8.0	5×	2.7	yes	yes	no
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# Knowledge-based explanations

## Example requirements

- *price lower than 150*
- *video support*

id	price	m-pixel	zoom	LCD	video	sound	w-proof
P <sub>1</sub>	148	8.0	4×	2.5	no	no	yes
P <sub>2</sub>	182	8.0	5×	2.7	yes	yes	no
P <sub>3</sub>	189	8.0	10×	2.5	yes	yes	no
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# Collaborative explanations

Content and knowledge-based recommenders are based on explicit item knowledge

- Collaborative recommenders are item agnostic
- Can't tell whether an item meets requirements

Alternative: explain the underlying process

- More transparency, perhaps more persuasion

# Collaborative explanations

Three main steps

- Feedback acquisition
- Neighbor identification
- Recommendation

# Feedback acquisition

Make it clear ***which*** feedback is exploited

- *“based on your ratings / clicks / purchases”*

Make it clear ***how*** feedback is exploited

- *“because you recently bought a science fiction movie”*

Make it clear ***how influential*** a certain feedback is

- *“because you mostly bought science fiction movies”*

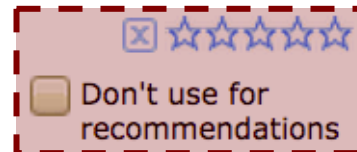
Allow users to rectify it: *“this was a gift”*

# Recommended for you

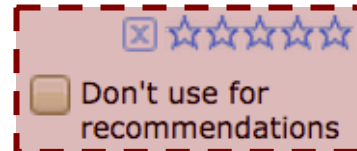
## Because you purchased...



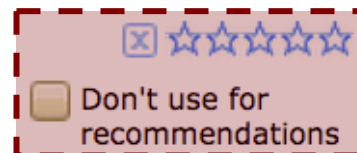
**Alice In Chains:**  
**MTV Unplugged**  
**[DVD] [2002]**  
(DVD)  
**DVD** ~ Jerry  
Cantrell



**Pearl Jam:**  
**Twenty [DVD]**  
**[2011] [NTSC]**  
(DVD)  
**DVD** ~ Cameron  
Crowe



**Water On The**  
**Road [DVD]**  
**[2011]** (DVD)  
**DVD** ~ Eddie  
Vedder



Mother Love Bone  
Mother Love Bone

★★★★★ (22)

£7.99

Why recommended?

# Neighbor identification

Disclose how **neighbors** are selected

- *“based on purchases by similar users”*

## Customers Who Bought This Item Also Bought



Temple Of The Dog

Temple of the Dog

★★★★★ (30)

Audio CD

£6.72



Apple

Mother Love Bone

★★★★★ (8)

Audio CD

£10.48



Dry As A Bone / Rehab Doll

Green River

★★★★★ (2)

Audio CD

£8.78



Binaural

Pearl Jam

★★★★★ (37)

Audio CD

£13.00



# Recommendation

Disclose how **prediction** is made

- *“weighted by neighbor similarity”*



# Assessing interfaces [Herlocker et al., CSCW 2000]

21 explanation interfaces for MovieLens

- Judged on a 1-7 scale as to whether they would make a user watch a recommended movie

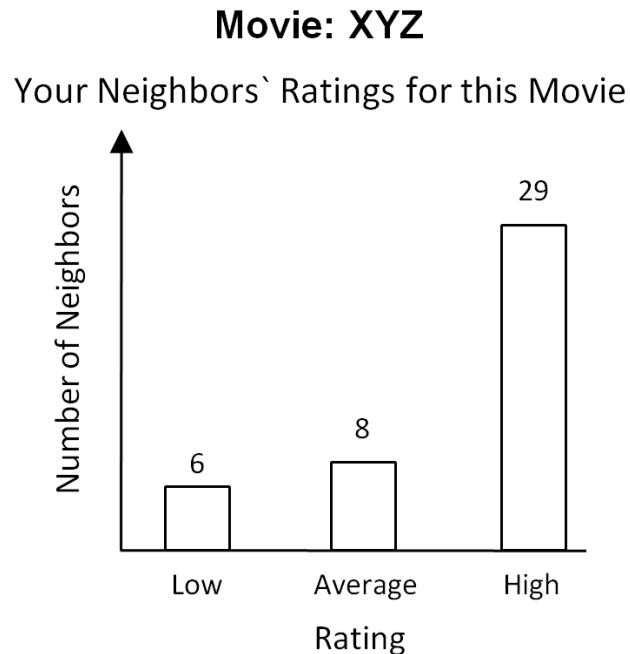
2 baselines

- No explanation at all
- Past performance (“got 80% accuracy in the past”)

# The good [Herlocker et al., CSCW 2000]

Rating-based explanations as top performers

- e.g., histogram or stars breakdown



**Movie: XYZ**

Personalized Prediction: \*\*\*\*

Your Neighbors' Ratings for this Movie

Rating	Number of Neighbors
★	2
★★	4
★★★	8
★★★★	20
★★★★★	9

# The good [Herlocker et al., CSCW 2000]

Rating-based explanations as top performers

- e.g., histogram or stars breakdown

Past performance baseline 2nd best

Content-based arguments highly judged

- e.g. *“features a cast you previously liked”*

## **The bad [Herlocker et al., CSCW 2000]**

Poorly designed explanation interfaces

- Worse than no explanation at all

Too crowded explanation interfaces

- e.g. enriching histograms with neighbor info

Supplementary information from authorities

- e.g. ratings from movie critics

# The aftermath [Herlocker et al., CSCW 2000]

Users appreciate explanations

- Helps persuade them to watch a movie

Doesn't help improve recommendation effectiveness

- Explained movie recommendations were rated no better than non-explained ones

# Summary

There are many types of explanations

- An explanation may achieve many goals

Explanations can be a double-edge sword

- Can help users make wiser buying decisions
- Can be abused to the advantage of the seller only

Explanations are ***crucial*** in sensitive domains!

# References

[Recommender Systems: An Introduction](#) (Ch. 6)

[Recommender Systems Handbook](#) (Ch. 15)