

Interpreting User Inaction in Recommender Systems

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Recommender Systems

- » Most prior research focuses on
 - Learning from user action feedback
- » This work is about
 - Interpreting user inaction feedback

Action and Inaction in MovieLens.org

MovieLens recommends these movies

top picks

view: filters: more sort by: recommended

The Godfather 1972 R 175 min Add into a wishlist

The Big Short 2015 R 130 min

Spotlight 2015 R 128 min

The Martian 2015 PG-13 141 min

Scott Pilgrim vs. the World 2010 PG-13 112 min

American History X 1998 R 119 min

Hotel Rwanda 2004 PG-13 121 min

Seven Pounds 2008 PG-13 123 min

Limitless 2011 PG-13 105 min

Fight Club 1999 R 139 min

Snatch 2000 R 103 min Not interested

The Empire Strike Back 1980 PG 124 min

Memento 2000 PG 113 min

Predestination 2014 R 97 min

Schindler's List 1993 R 195 min

Gran Torino 2008 PG 116 min Click to see details

Zootopia 2016 PG 108 min

Raiders of the Lost Ark 1981 PG 115 min

Inside Out 2015 PG 94 min

Scarface 1983 R 170 min

How to Train Your Dragon 2010 PG 98 min

50/50 2011 R 100 min

Silver Linings Playbook 2012 R 122 min

Law Abiding Citizen 2009 R 109 min

Rating

Action and Inaction in MovieLens.org

What about other items?

The image shows a screenshot of the MovieLens.org website's "top picks" section. The interface includes a header with search and filter options, a main grid of movie cards, and a footer with rating scales.

- Add into a wishlist:** A red circle highlights the "Add" button for "The Godfather".
- Not interested:** A red circle highlights the "X" button for "Catch-22". Below it, a message says "this movie will not appear in most search results" with a "undo" button.
- Click to see details:** A red circle highlights the "GRAN TORINO" movie card.
- Rating:** Two red circles highlight the rating scales for "Zootopia" (5 stars) and "Inside Out" (4 stars).

MovieLens recommends these movies

top picks

view: filters: more sort by: recommended

The Godfather 1972 R 175 min | The Big Short 2015 R 130 min | Spotlight 2015 R 128 min | The Martian 2015 PG-13 141 min | Scott Pilgrim vs. the World 2010 PG-13 112 min | American History X 1998 R 119 min | Hotel Rwanda 2004 PG-13 121 min | Seven Pounds 2008 PG-13 123 min

Limitless 2011 PG-13 105 min | Fight Club 1999 R 139 min | Catch-22 2000 R 103 min | The Empire Strikes Back 1980 PG 124 min | Memento 2000 PG-13 113 min | Predestination 2014 R 97 min | Schindler's List 1993 R 195 min | Gran Torino 2008 PG 116 min

Zootopia 2016 PG 108 min | Raiders of the Lost Ark 1981 PG 115 min | Inside Out 2015 PG 94 min | Scarface 1983 R 170 min | How to Train Your Dragon 2010 PG 98 min | 50/50 2011 R 100 min | Silver Linings Playbook 2012 R 122 min | Law Abiding Citizen 2009 R 109 min

Action and Inaction in MovieLens.org

MovieLens recommends these movies

top picks

view: filters: more sort by: recommended

Why do users skip them?

The page shows a grid of movie recommendations. Red annotations include:

- A red circle highlights the "Add to wishlist" button for "The Godfather".
- A red circle highlights the "Not interested" button for "Watch". A tooltip says "this movie will not appear in most search results" with a "undo" button.
- A red circle highlights the "Click to see details" link for "Gran Torino".
- Two red circles highlight the rating stars for "Zootopia" and "Inside Out", which are partially filled.
- A red circle highlights the rating stars for "Scarface", which are also partially filled.

Add into a wishlist

Not interested

Click to see details

Rating

Movie	Year	Rating	Length
The Godfather	1972	R	175 min
The Big Short	2015	R	130 min
Spotlight	2015	R	128 min
The Martian	2015	PG-13	141 min
Scott Pilgrim vs. the World	2010	PG-13	112 min
American History X	1998	R	119 min
Hotel Rwanda	2004	PG-13	121 min
Seven Pounds	2008	PG-13	123 min
Limitless	2011	PG-13	105 min
Fight Club	1999	R	139 min
Watch	2000	R	103 min
The Empire Strike Back	1980	PG	124 min
Memento	2000	PG	113 min
Predestination	2014	R	97 min
Schindler's List	1993	R	195 min
Gran Torino	2008	R	116 min
Zootopia	2016	PG	108 min
Raiders of the Lost Ark	1981	PG	115 min
Inside Out	2015	PG	94 min
Scarface	1983	R	170 min
How to Train Your Dragon	2010	PG	98 min
50/50	2011	R	100 min
Silver Linings Playbook	2012	R	122 min
Law Abiding Citizen	2009	R	109 min

WHY INACTION?

Amazon

The screenshot shows the Amazon homepage with a dark header. On the left, the Amazon logo and 'Try Prime' button are visible. A search bar with 'All' and a magnifying glass icon is in the center. To the right, there's a link to 'Discover small & medium businesses'. The main navigation menu includes 'Deliver to New York 10028', 'Your Amazon.com', 'Today's Deals', 'Gift Cards', 'Registry', 'Sell', language selection 'EN', and account links 'Hello, Sign in' and 'Account & Lists'. A shopping cart icon with '0' items is on the far right.

echo dot
\$49⁹⁹ \$39⁹⁹

Limited-time offer

A black Echo Dot smart speaker is displayed prominently in the center. It has a circular design with a blue light ring around the top edge and a small display screen showing a smiley face. The word 'amazon' is printed at the bottom of the device.

Again and Again.

A screenshot of the Amazon website homepage. At the top, the navigation bar includes the Amazon logo, a search bar with the placeholder "All", a magnifying glass icon, and a link to "Discover small & medium businesses". Below the search bar are links for "Delivery to New York 10028", "Your Amazon.com", "Today's Deals", "Gift Cards", "Registry", "Sell", "EN", "Hello. Sign in", "Account & Lists", "Orders", "Try Prime", and a shopping cart icon with "0" items. The main content area features a large promotional image of an Echo Dot smart speaker. The speaker is black with a blue light ring around its top edge and a small "amazon" logo at the bottom. To the left of the speaker, the text "echo dot" is displayed in large, lowercase letters, followed by the original price "\$49.99" and the discounted price "\$39.99". Below this text is the phrase "Limited-time offer". On the far left and right edges of the promotional image are small, semi-transparent arrow icons pointing left and right respectively.

YouTube

YouTube Search

Recommended

Peppa Pig English Full Episodes Compilation #116 Peppa Pig English 4.3M views • 4 months ago	We Are the Princesses Humpty Dumpty +More Kids... Little Angel: Nursery Rhymes &... 14M views • 10 months ago	MOANA: How Far I'll Go Song (2016) KinoCheck International 11M views • 1 year ago	Frozen - Best Moments Captain Kevin 1.9M views • 3 weeks ago	Peppa Pig Full Episodes - George the Dinosaur... Peppa Pig - Official Channel 27M views • 1 year ago
Peppa Pig English Episodes Peppa Pig's Magical Castle ... Peppa Pig Asia 104K views • 1 week ago	Moana Full Movie in English - Disney Animation Movie HD DUA TV 174K views • 1 week ago	Peppa Pig English Season 2 Episode 24 George Catches... Peppa Pig English 1.5M views • 1 week ago	✓ Peppa Pig 109 ▲ The Camper Van Peppa Pig English 15M views • 7 months ago	Peppa Pig English Episodes Peppa's Magical Castle! ... Peppa Pig - Official Channel 9.8M views • 4 weeks ago

Interested in two of them

The image shows a YouTube search results page for the query "Peppa Pig English". The results are organized into two main sections: "Recommended" and "Search results".

Recommended Section:

- Peppa Pig English Full Episodes Compilation #110** (Peppa Pig English) - 4.3M views • 4 months ago
- We Are the Princesses | Humpty Dumpty +More Kids...** (Little Angel: Nursery Rhymes &...) - 14M views • 10 months ago
- MOANA: How Far I'll Go Song (2016)** (KinoCheck International) - 11M views • 1 year ago
- Frozen - Best Moments Captain Kevin** (Frozen - Official Channel) - 1.9M views • 3 weeks ago
- Peppa Pig Full Episodes - George the Dinos...** (Peppa Pig - Official Channel) - 27M views • 1 year ago

Search results Section:

- Peppa Pig English Episodes | Peppa Pig's Magical Castle |...** (Peppa Pig Asia) - 104K views • 1 week ago
- Moana Full Movie in English - Disney Animation Movie HD** (DUA TV) - 174K views • 1 week ago
- Peppa Pig English Season 2 Episode 24 George Catches...** (Peppa Pig English) - 1.5M views • 1 week ago
- Peppa Pig 109 ▲ The Camper Van ▾** (Peppa Pig English) - 15M views • 7 months ago
- Peppa Pig English Episodes | Peppa's Magical Castle! |...** (Peppa Pig - Official Channel) - 9.8M views • 4 weeks ago

Two specific video thumbnails are highlighted with red circles: the first one in the "Recommended" section (Peppa Pig English Full Episodes Compilation #110) and the third one in the "Search results" section (MOANA: How Far I'll Go Song (2016)).

Watch one of the two

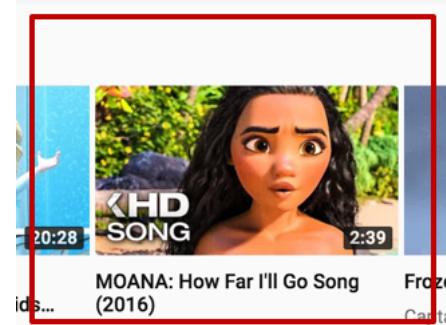
The image shows a YouTube search results page. At the top, there is a search bar with the placeholder "Search". Below the search bar are several icons: a menu icon, the YouTube logo, a magnifying glass for search, a grid icon, a message icon, a bell icon, and a profile picture of a person with glasses.

The main content area displays two video thumbnails:

- Video 1:** A thumbnail for a Peppa Pig episode. It shows Peppa Pig and a rabbit character standing on a grassy field under a blue sky with rain. The video is at 0:03 / 1:02:59. The video controls include play, volume, and a progress bar. Below the video, the text reads "Peppa Pig English Full Episodes Compilation #116".
- Video 2:** A thumbnail for a Baby Shark Dance video. It features the "Baby Shark" song characters. The video is at 27:18. The video controls include a play button, volume, and a progress bar. Below the video, the text reads "BABY SHARK DANCE" and "Pinkfong! Kids' Songs & Stories".

On the right side of the screen, there is a message box that says "Ad closed by Google". Below the video thumbnails, there is a section labeled "Up next" which lists another Peppa Pig video: "Peppa Pig English NEW EPISODES 2018 #7". This video has 5.6M views and is at 27:18. To the right of this section is an "AUTOPLAY" toggle switch, which is turned on (blue). There is also a three-dot menu icon in the bottom right corner of the screen.

Back to home page... ?

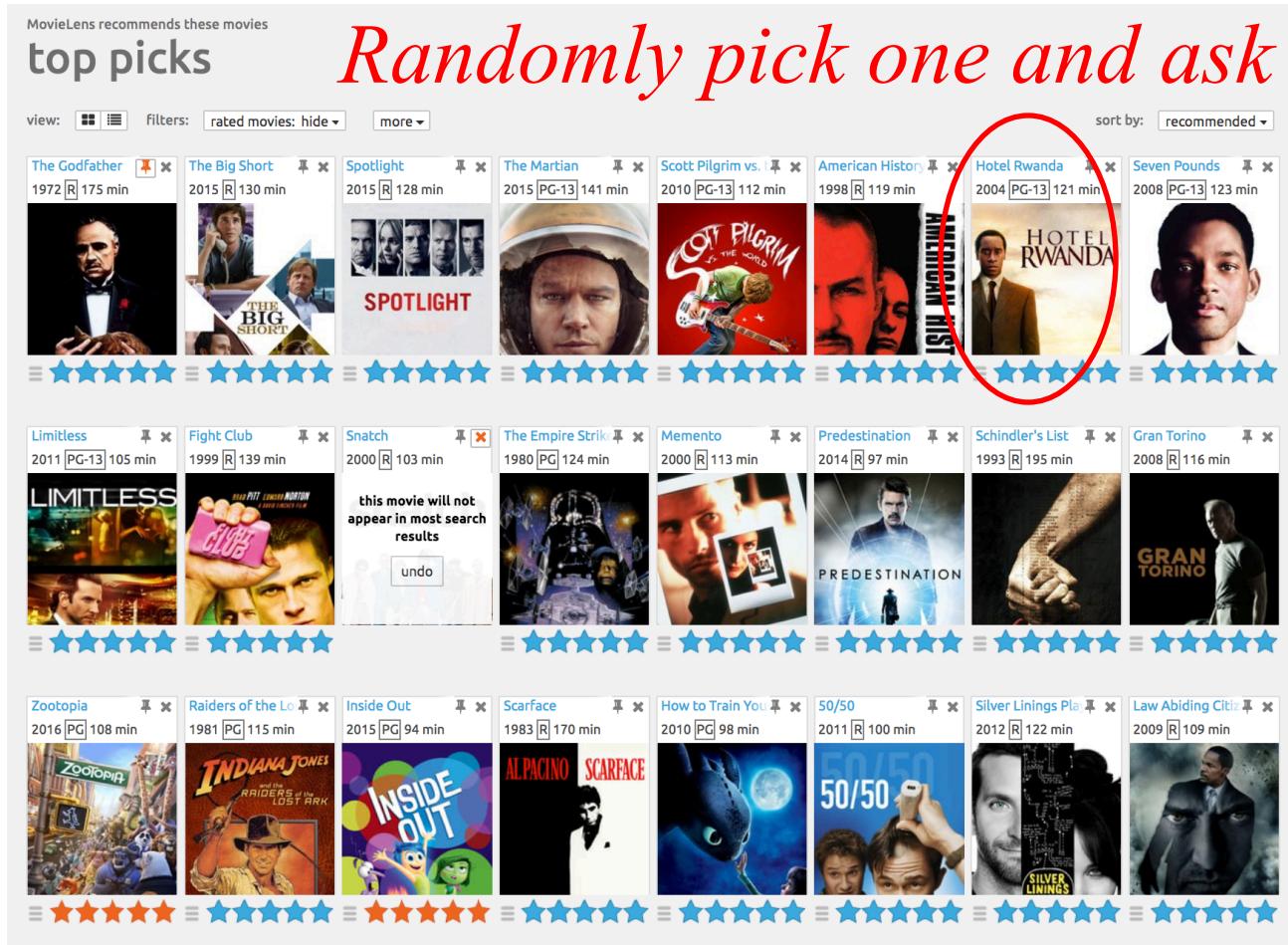


YouTube Search

Recommended

Peppa Pig English Full Episodes Compilation #88 Peppa Pig English 2.6M views • 6 months ago	Super Birthday Cake! Talking Tom Shorts Episode.. Talking Tom 19M views • 1 month ago	Peppa Pig English Episodes The Fire Engine #PeppaPig Peppa Pig - Official Channel 176K views • 20 hours ago	Peppa Pig English Season 2 Episode 27 The Long Grass Peppa Pig English 960K views • 6 days ago	Peppa Pig English Full Episodes #5 Compilation 1... Peppa Pig English 3.6M views • 7 months ago
Peppa Pig Episodes - Peppa and George's Trip to... Peppa Pig - Official Channel 24M views • 1 year ago	Peppa Pig English Episodes Parachute Jump #PeppaPig Peppa Pig - Official Channel 15M views • 3 months ago	Peppa Pig English Episodes Peppa Pig Goes to London... Peppa Pig - Official Channel 2.5M views • 2 weeks ago	Peppa Pig English Full Episodes Compilation #106 Peppa Pig English 1.9M views • 5 months ago	Peppa Pig English Episodes Peppa's Magical Castle! ... Peppa Pig - Official Channel 9.8M views • 4 weeks ago

How to interpret user inaction?



Randomly pick one and ask users.

Data Collection: Field Survey

- » July 2017 to March 2018
- » 3,206 users gave 3,923 responses for which the user inaction category can be determined.

7 Categories of User Inaction

Not Noticed

Did not notice it (38.6%)

Watched

Noticed but watched it before (14.6%)

Would not enjoy it (5.8%)

WouldNotEnjoy

Others are better (9.5%)

OthersBetter

Noticed and have
not watched it yet
(46.8%)

Okay but not now (18.2%)

NotNow

Plan to explore it soon (6.9%)

ExploreLater

Have decided to watch it (5.8%)

DecidedToWatch

Inaction → Future Preference

» “*Should MovieLens continue recommending this movie to you in the future?* ”

- Rather Not
- Maybe
- Definitely

Inaction → Future Preference

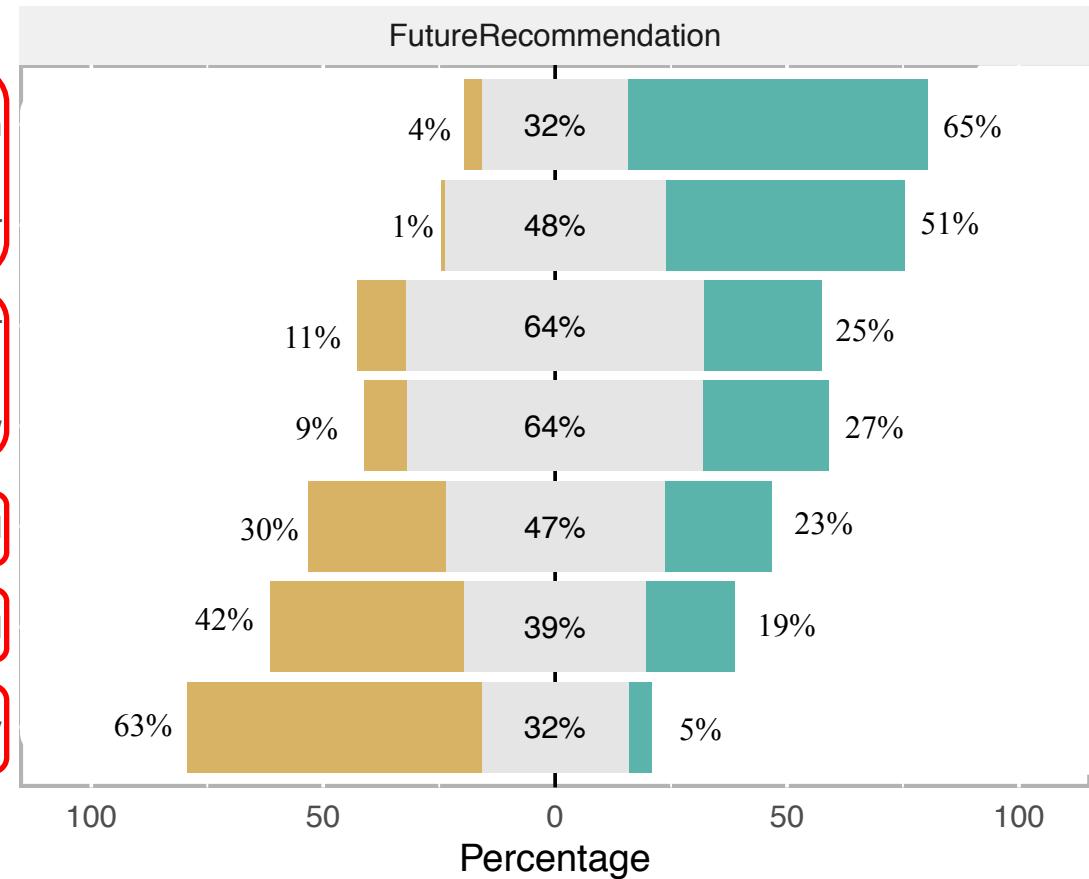
most
preferred

DecidedToWatch
ExploreLater

OthersBetter
NotNow

least
preferred

NotNoticed
Watched
WouldNotEnjoy



Response RatherNot Maybe Definitely

In Practice

- » We can't ask users all the time.
- » We need inaction classification models.

Predictors

- » Item attributes (popularity)
- » Display factors (position etc.)
- » User activities
 - On the page
 - In the session
 - In the user history
- » Predicted rating value and action probabilities
 - clicking, rating, adding to the wishlist

Accuracy (GBDT)

The best model's classification accuracy: 48.5%
better than (***(p<0.001))

Majority class NotNoticed: 39.9%

Predicting Action → Inferring Inaction

» Predictor Effects (examples)

- The higher the estimated *rating* probability is, the more likely that the reason for inaction is Watched.
- The higher the estimated *wishlisting* probability is, the more likely the reason for inaction is DecidedToWatch.

Can we improve recommender systems utilizing the user inaction model?

- » utilizing the inferred class or
- » utilizing the inferred 7-class probabilities

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Improve Recommendation

- » Preference estimation? (e.g., rating prediction)
- » Action prediction?
- » Recommendation timing?

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Improve Action Prediction

- » Given a user and an item, what's the item's probability of engaging the user or not? (for re-ranking etc.)
 - Was it shown to the user before?
 - If yes, was it an inaction item?
 - If yes, what are the inferred 7-class probabilities?
 - this information can help

Improve Action Prediction

Goal	Model	Metric
action prediction (predict whether action or not when displayed)	MF: user ID + item ID	AUC: 0.774
	FM: user ID + itemID + <i>(predicted probabilities for 7 inaction classes)</i>	AUC: 0.787

MF: matrix factorization, FM: factorization machine

Message 1

- » There is important information in user inaction feedback that significantly affects future recommendation strategies.

Message 2

- » There are 7 categories of user inaction reasons and 5 levels of significantly different future recommendation preferences.

Message 3

- » Predicted user action probabilities can be used to infer the reasons of user inaction.

Message 4

- » Initial evidence suggests that modeling user inaction can help with recommendation.

Acknowledgments

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Thanks! Questions?

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