

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

Information Technology Fundamentals

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Web Systems: Recommender System

Module 5: Part 4

Module 5. Main Objectives

1. Review Web System Architecture
2. Explain E-Commerce Business Models
- 3. Review Recommender Systems**
4. Describe Blockchain Systems, Cryptocurrency, and Smart Contracts

Main Reference

Kim Falk. **Practical Recommender Systems**, Manning Publication Co., 2019

SOFTWARE DEVELOPMENT/MACHINE LEARNING

Practical Recommender Systems

Kim Falk

Online recommender systems help users find movies, jobs, restaurants—even romance! There's an art in combining statistics, demographics, and query terms to achieve results that will delight them. Learn to build a recommender system the right way: it can make or break your application!

Practical Recommender Systems explains how recommender systems work and shows how to create and apply them for your site. After covering the basics, you'll see how to collect user data and produce personalized recommendations. You'll learn how to use the most popular recommendation algorithms and see examples of them in action on sites like Amazon and Netflix. Finally, the book covers scaling problems and other issues you'll encounter as your site grows.

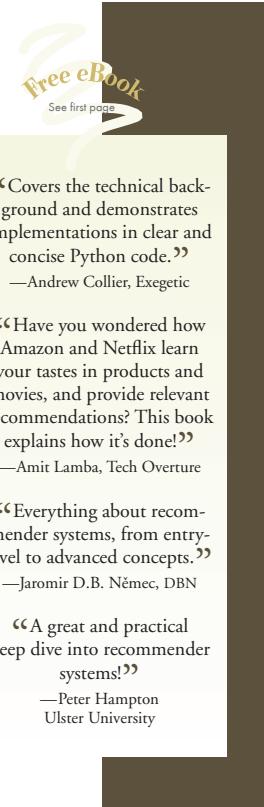
What's Inside

- How to collect and understand user behavior
- Collaborative and content-based filtering
- Machine learning algorithms
- Real-world examples in Python

Readers need intermediate programming and database skills.

Kim Falk is an experienced data scientist who works daily with machine learning and recommender systems.

To download their free eBook in PDF, ePub, and Kindle formats, owners of this book should visit
manning.com/books/practical-recommender-systems



“Covers the technical background and demonstrates implementations in clear and concise Python code.”

—Andrew Collier, Exegetic

“Have you wondered how Amazon and Netflix learn your tastes in products and movies, and provide relevant recommendations? This book explains how it's done!”

—Amit Lamba, Tech Overture

“Everything about recommender systems, from entry-level to advanced concepts.”

—Jaromír D.B. Němc, DBN

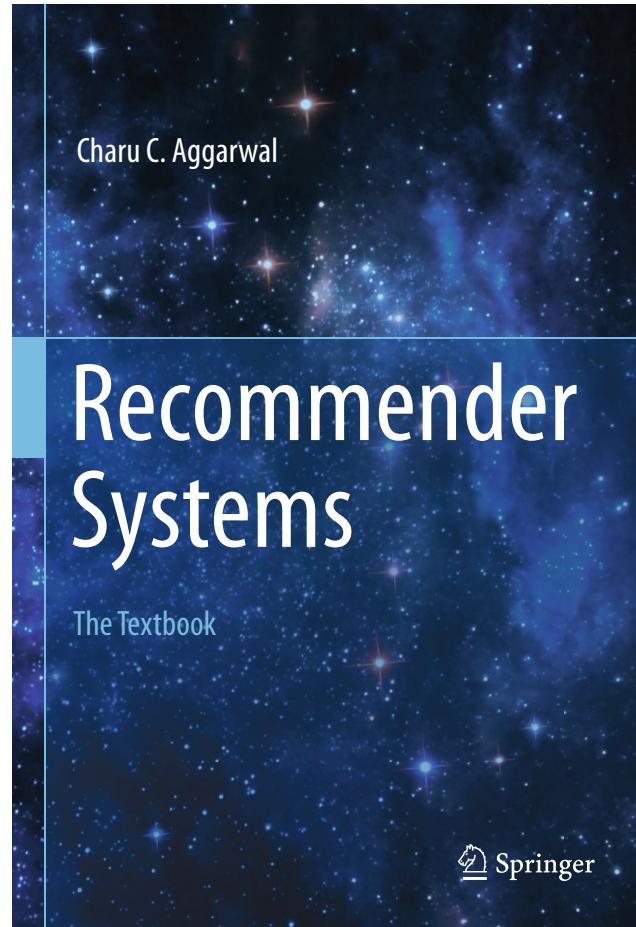
“A great and practical deep dive into recommender systems!”

—Peter Hampton
Ulster University

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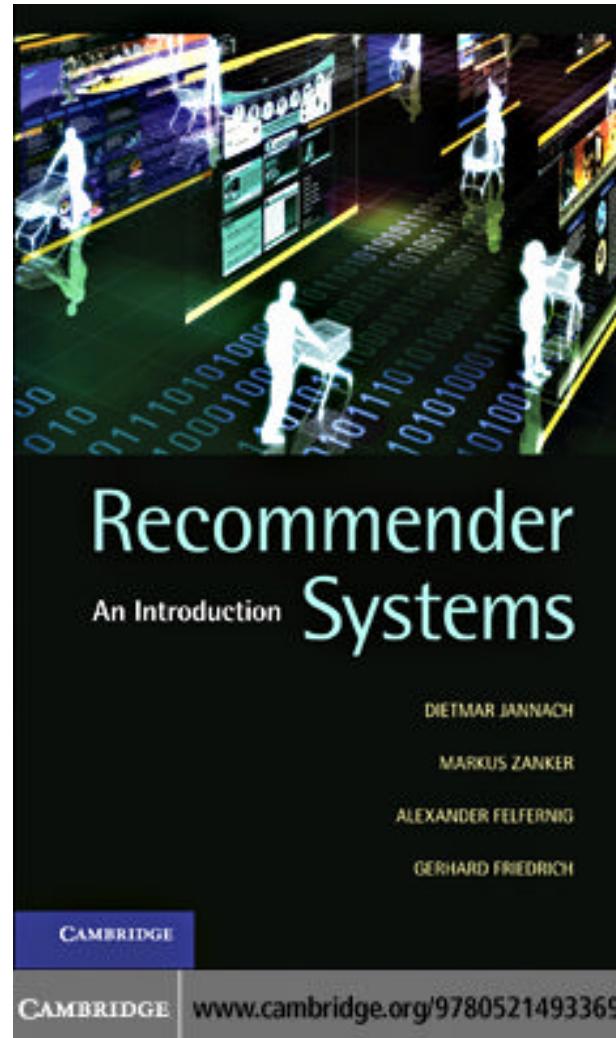
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F. O. Isinkaye, Y. O. Folajimi,
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Recommendation Systems: Principles, Methods and Evaluation, Egyptian Informatics Journal, 2015

Egyptian Informatics Journal (2015) 16, 261–273



REVIEW

Recommendation systems: Principles, methods and evaluation

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KEYWORDS

Collaborative filtering;
Content-based filtering;
Hybrid filtering technique;
Recommendation systems;
Evaluation

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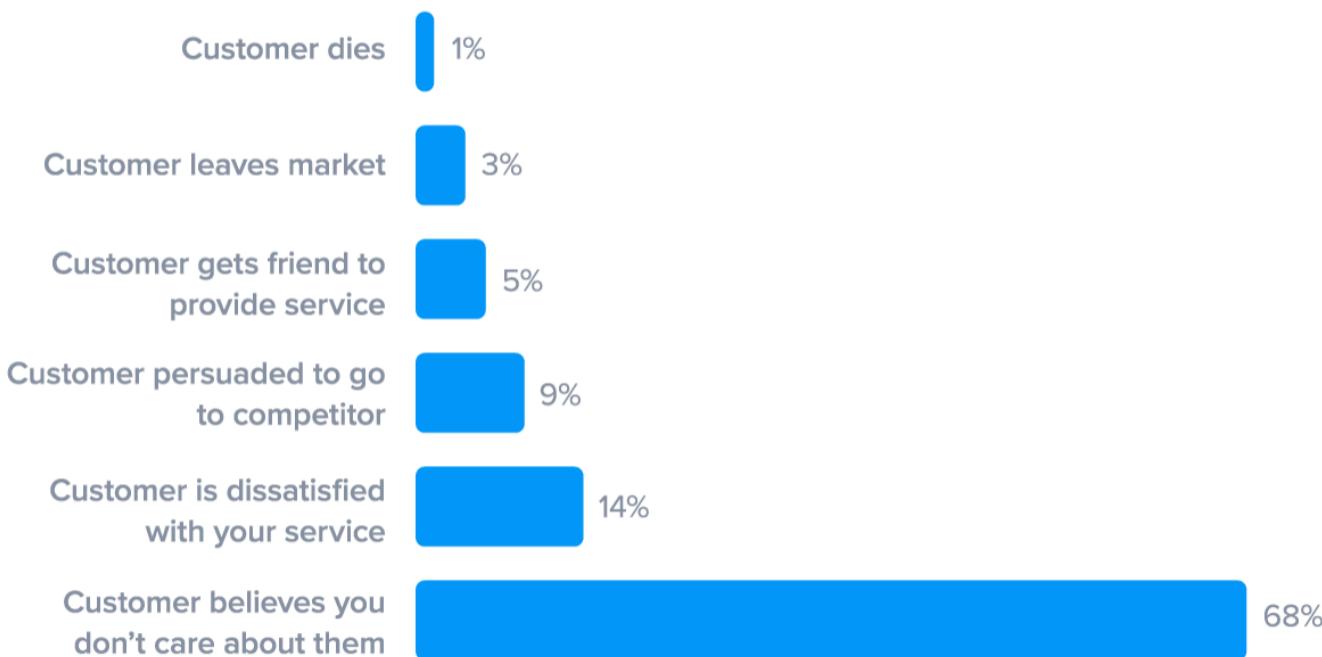
<http://dx.doi.org/10.1016/j.eij.2015.06.005>

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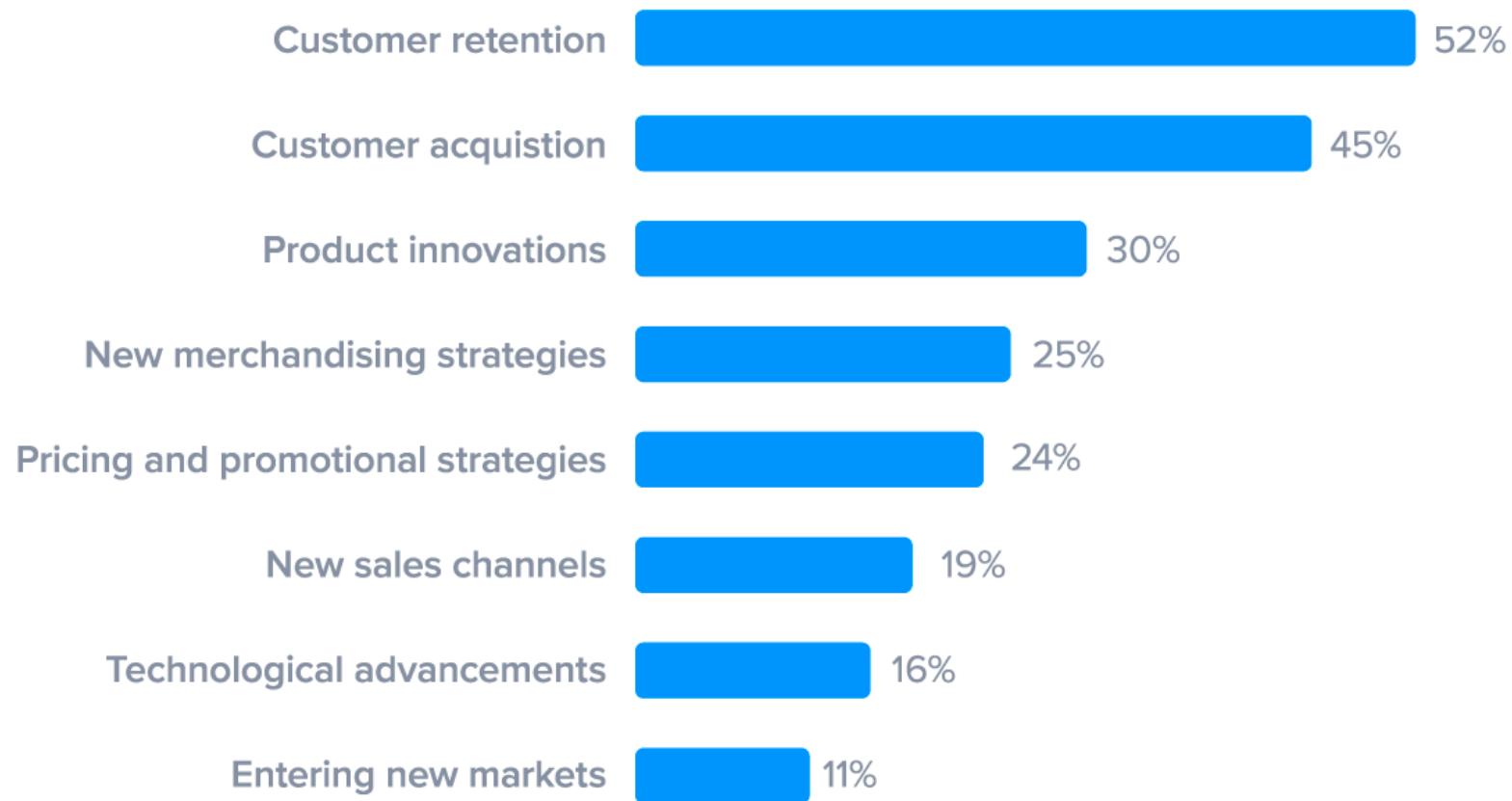
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- **Definition, History, Market, and Motivation**
- Recommender Phases and Popular Tasks
- Recommender System Types and Techniques
- Recommender System Applications
- An Example of Recommender System:
Netflix Review

Why do customers leave a company?



Most Significant Retail Revenue Drivers



Recommender System Definition I

Recommender Systems (RSs) are software tools and techniques that provide suggestions for items that are most likely of interest to a particular user

- “**Item**” is the general term used to denote what the system recommends to users.

Recommender System Definition 2

Recommender System calculates and provides relevant content to the user based on knowledge of the user, content, and interactions between the user and the item.

Global Content Recommendation Engine Market (2019-2025):

- The Content Recommendation Engine market worldwide is projected to grow by **US\$9.2 Billion**, driven by a compounded growth of **32.7%**.
- Poised to reach over **US\$6.9 Billion by the year 2025**, Solution will bring in healthy gains adding significant momentum to global growth.
- Representing the developed world, **the United States will maintain a 36.4% growth momentum.**

Global Content Recommendation Engine Market (2019-2025):

- Within **Europe**, which continues to remain an important element in the world economy, **Germany will add over US\$278.8 Million** to the region's size and clout in the next 5 to 6 years.
- Over **US\$423.9 Million** worth of projected demand in the region will come from the rest of the European markets.
- In **Japan**, Solution will reach a market size of **US\$462 Million** by the close of the analysis period.

Recommendation Engine Market

- The recommendation engine market to grow from **USD 588.9 Million in 2016 to USD 4414.8 Million by 2022**, at a Compound Annual Growth Rate (CAGR) of **40.7%** during the forecast period.
- The major vendors in the global recommendation engine market based on AI, are IBM (US), SAP (Germany), Salesforce (US), HPE (US), Oracle (US), Google (US), Microsoft (US), Intel (US), AWS (US), and Sentient Technologies (US).





Top 10 best selling online Personalized Recommendation Engines

Motivations

Why Companies Implement Recommendation Systems



Improve retention

Continuously catering to users' preferences makes them more likely to remain loyal subscribers of the service



Increase sales

Various research show an increase in upselling revenue ranging from 10-50% caused by accurate "You must also like" product recommendations



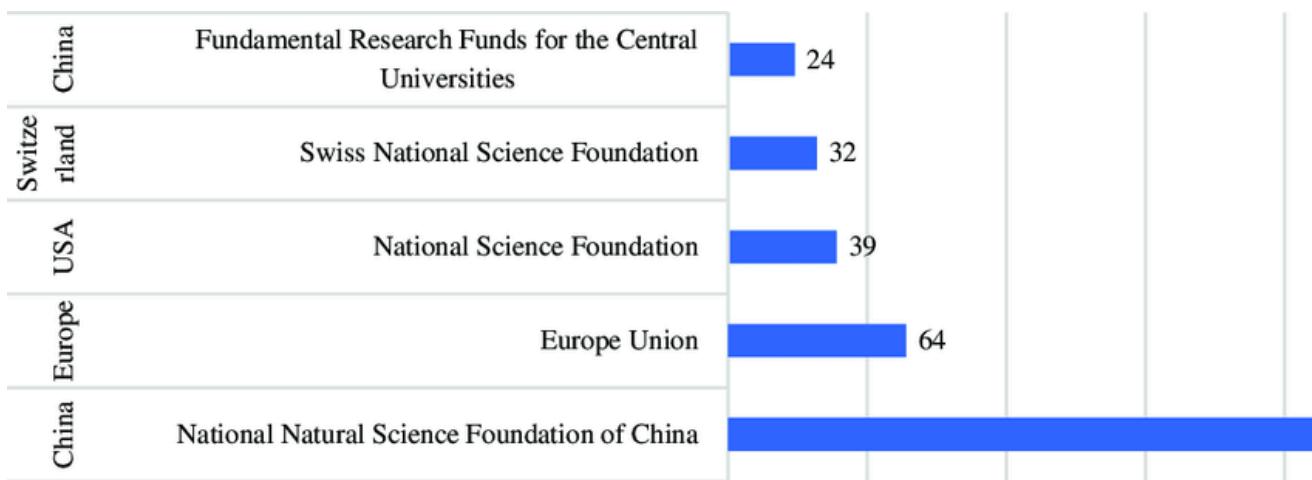
Form habits

Serving accurate content can trigger cues, building strong habits and influencing usage patterns in customers

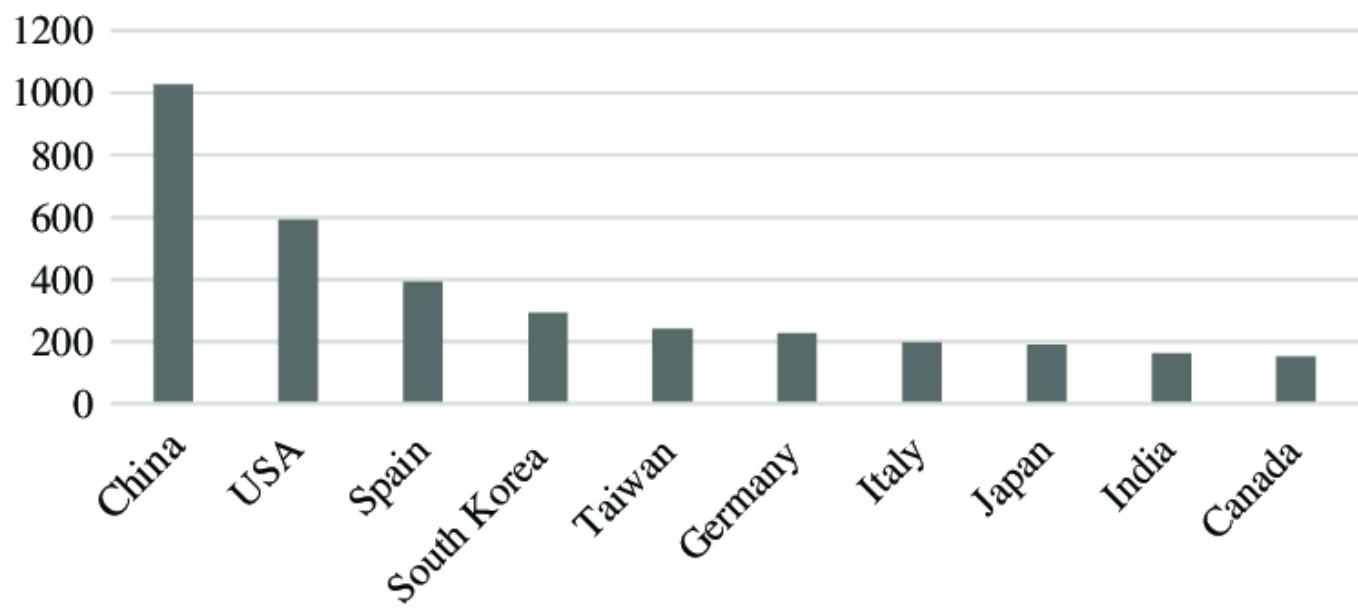


Accelerate work

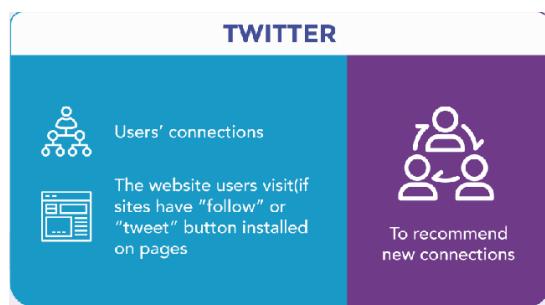
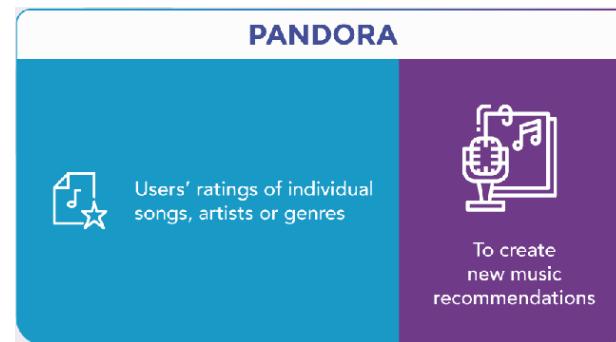
Analysts can save up to 80% time when served tailored suggestions for materials necessary for their further research



Top-five funding agencies for recommender systems research.



Top countries in recommender systems publications.

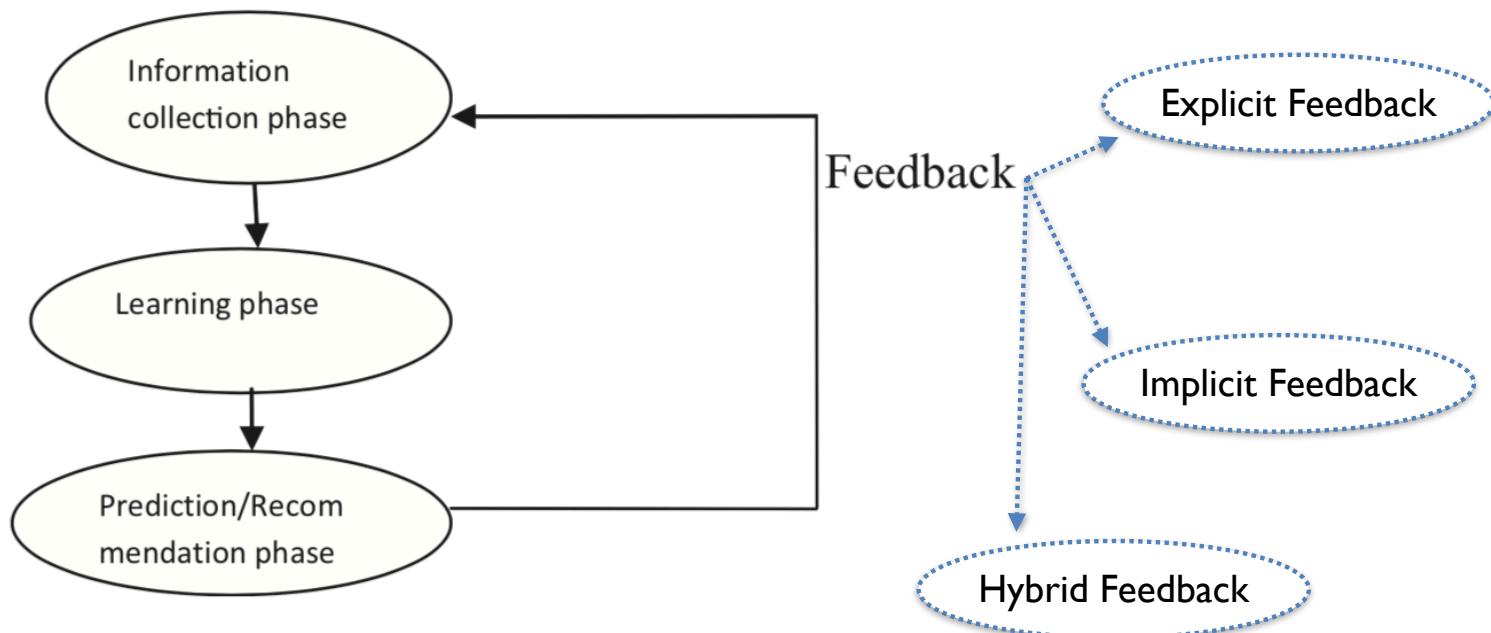


What companies track and how they use it.

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Recommendation Phases



Popular Tasks by RS:

Popular tasks that an RS can assist in implementing:

- Find Some good Items
- Find all good items
- Annotation in context
- Recommend a sequence
- Recommend a bundle
- Just browsing
- Find credible recommender
- Improve the profile
- Express self
- Help others
- Influence others

Data and Knowledge Sources

RSs are information processing systems that actively gather various kinds of data in order to build their recommendations:

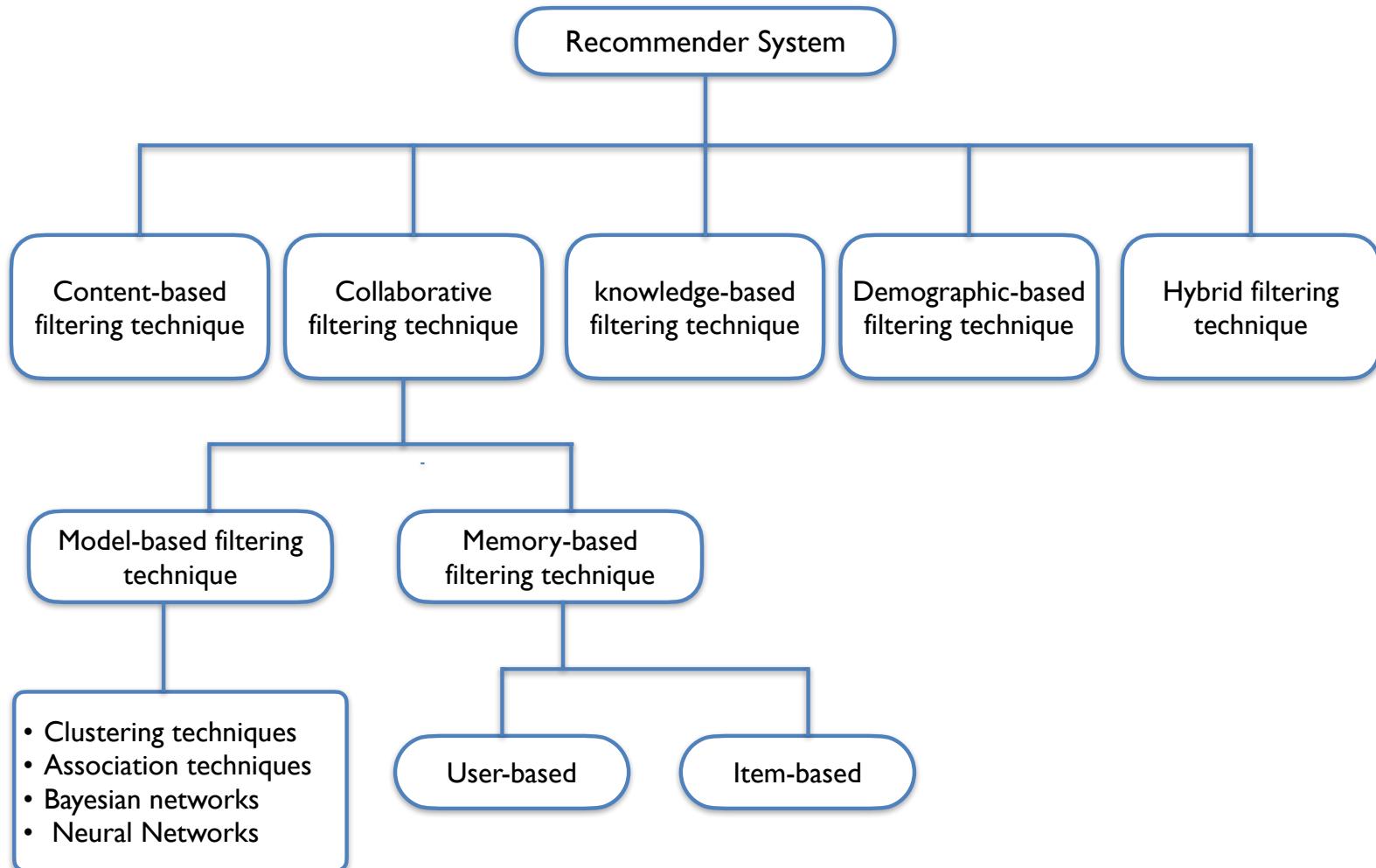
- **Items:** Items are objects that are recommended. Items may be characterized by their complexity and their value or utility
- **Users:** Users of an RS may have very diverse goals and characteristics
- **Transactions:** We generically refer to a transaction as a recorded interaction between a user and the RS

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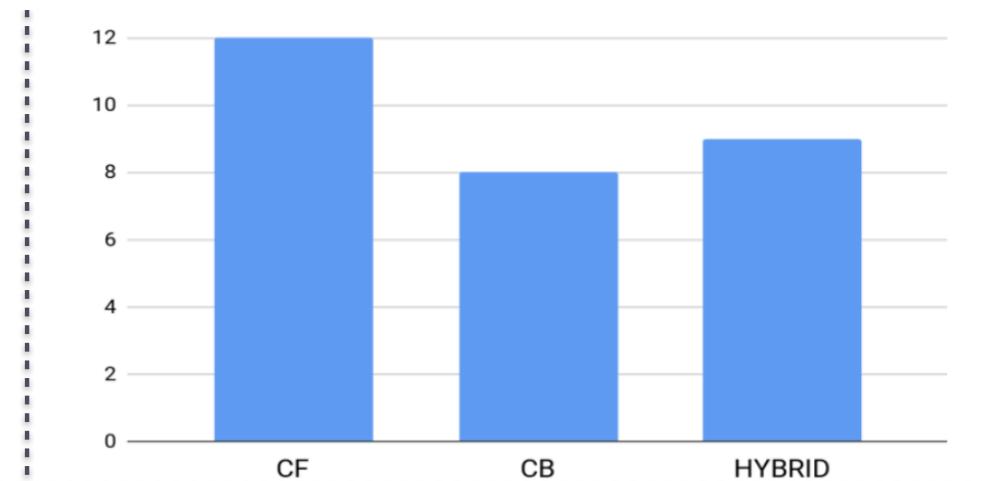
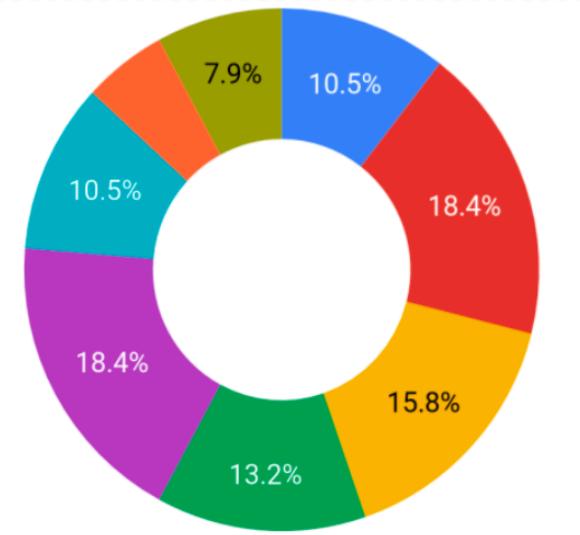
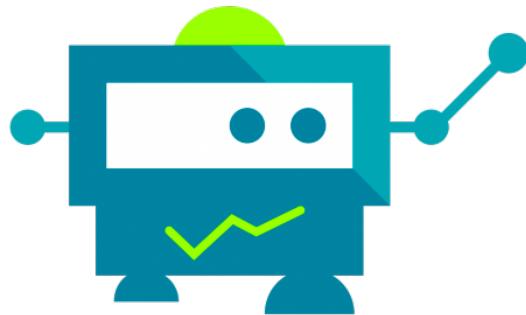
Types of Recommender System

- **Personalized:** takes into consideration users' previous history for rating and predicting items
- **Non-Personalized:** non-personalized recommendation systems recommend what is popular and relevant to all the users which can be a list of top-10 items for every new user.



Recommendation Techniques

- **Content-Based:** The system learns to recommend items that are similar to the ones that the user liked in the past.
- **Collaborative Filtering:** The original and most simple implementation of this approach makes recommendations to the active user based on items that other users with similar tastes liked in the past.
- **Demographic:** This type of system recommends items based on the demographic profile of the user.
- **Knowledge-Based:** Knowledge-based systems recommend items based on specific domain knowledge about how certain item features meet users' needs and preferences and, ultimately, how the item is useful for the user.
- **Hybrid Recommender Systems:** These RSs are based on the combination of the above mentioned techniques.



- Association Rules
- Probabilistic
- Matrix Factorization
- Nearest Neighbor
- Clustering
- Regression
- Neural Network
- Ontology



Filtering Techniques and Algorithms Studied in Research Papers

Recommender Systems Evaluation

- Evaluation approaches are classified into **off-line**, **on-line**, and **user-centric**.
 - Which research designs are applicable for evaluating recommender systems?
 - How can recommender systems be evaluated using experiments on historical datasets?
 - What metrics are applicable for different evaluation goals?
 - What are the limitations of existing evaluation techniques, in particular when it comes to the conversational or business value aspects of recommender systems?

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- Recommender System Applications, Goals
and Challenges
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Recommender Systems

Applications

- **Entertainment**—recommendations for movies, music, games, and IPTV.
- **Content**—personalized newspapers, the recommendation for documents, recommendations of webpages, e-learning applications, and e-mail filters.
- **E-commerce**—recommendations of products to buy such as books, cameras, PCs, etc. for consumers.
- **Services**—recommendations of travel services, the recommendation of experts for consultation, the recommendation of houses to rent, or matchmaking services.
- **Social**—recommendation of people in social networks, and recommendations of content social media content such as tweets, Facebook feeds, LinkedIn updates and others.

Challenges

- Preference Acquisition and Profiling
- Interaction
- New Recommendation Tasks



Goals of Recommender Systems

The primary goal of a recommendation system is to increase revenue for the merchant, this is often achieved in ways that are less obvious than might seem at first sight:

- Relevance
- Novelty
- Serendipity
- Increasing recommendation diversity

Contents

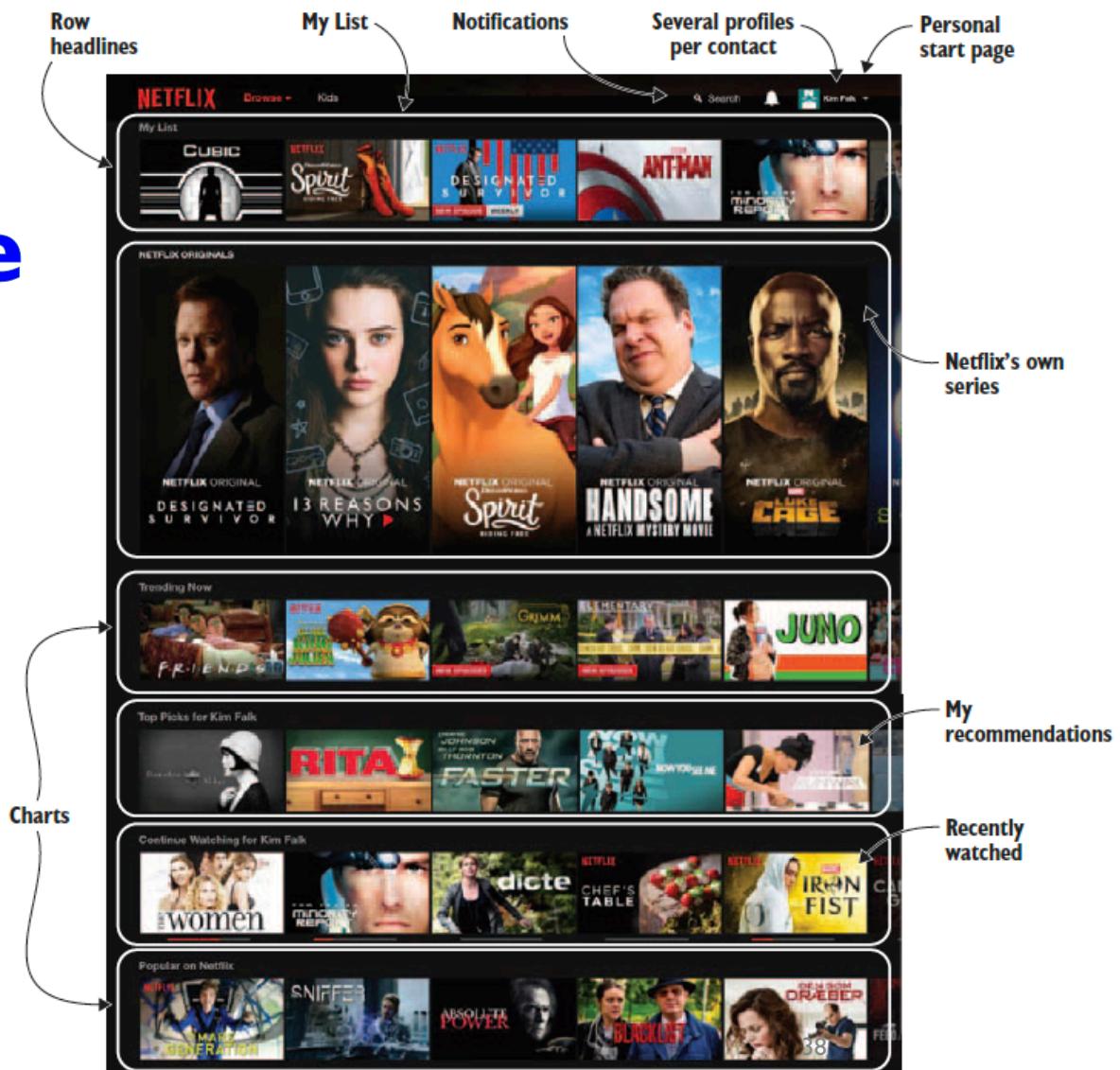
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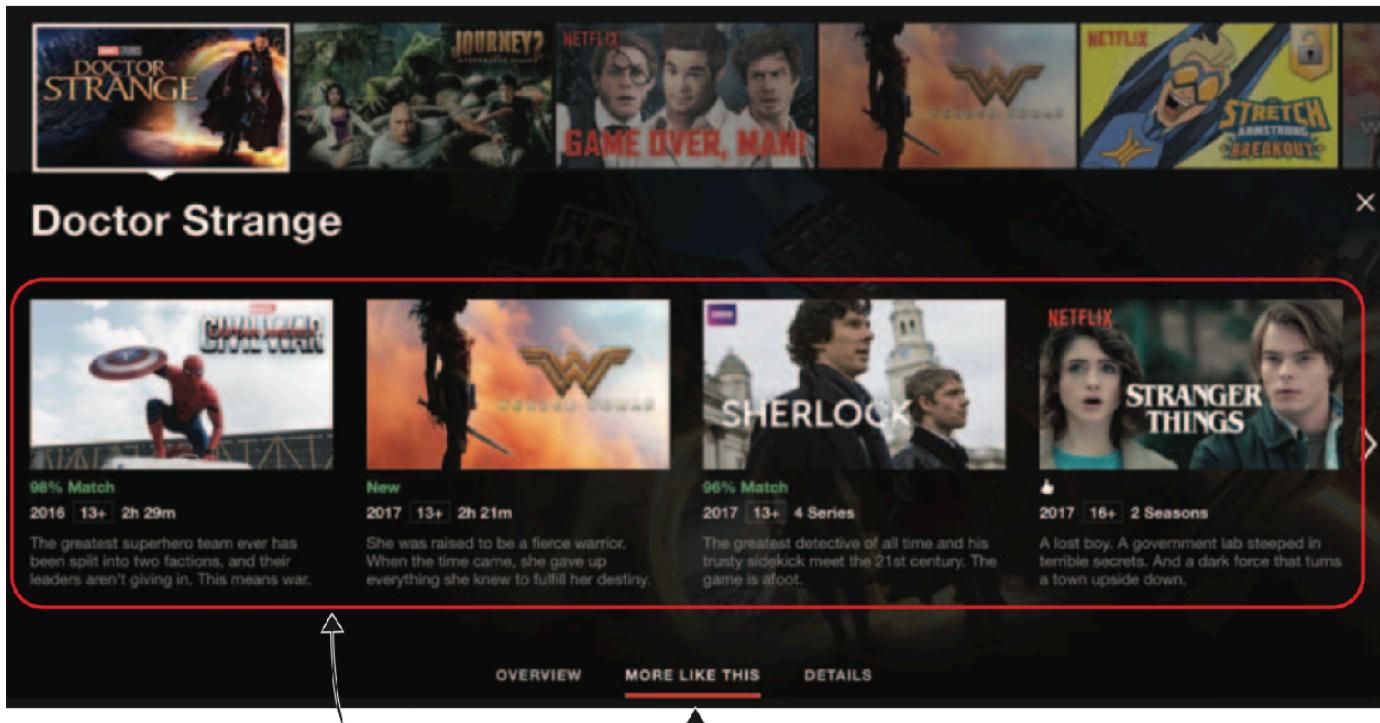
RECOMMENDER SYSTEM: NETFLIX REVIEW

Examples of products recommended by various real-world recommender systems



Netflix Start Page

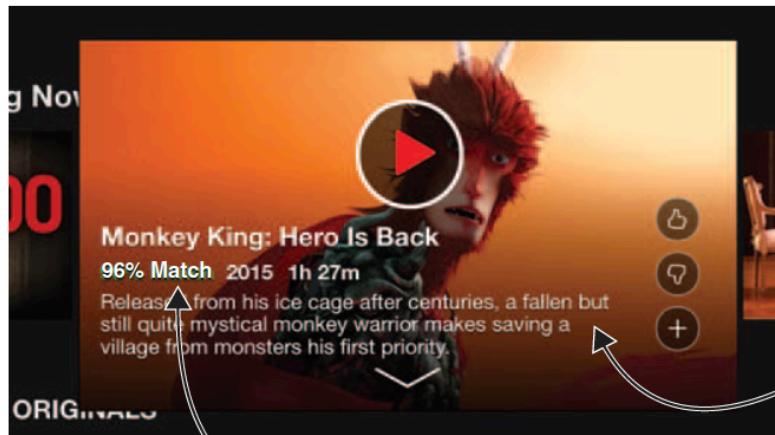




In Netflix you can get ***More Like This*** recommendations, which is probably found by calculating similarity.

More Like This personalized recommendations on Netflix based on the TV series The Flash

Predicted Matches



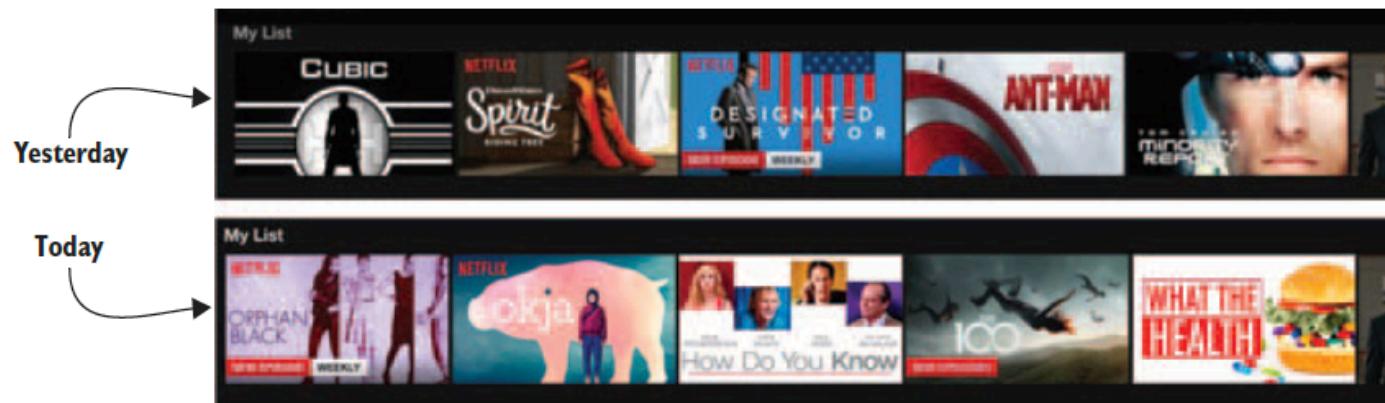
By hovering over an item, a description appears.

Netflix previously estimated a rating, now it provides you a percentage of how well this item matches your taste

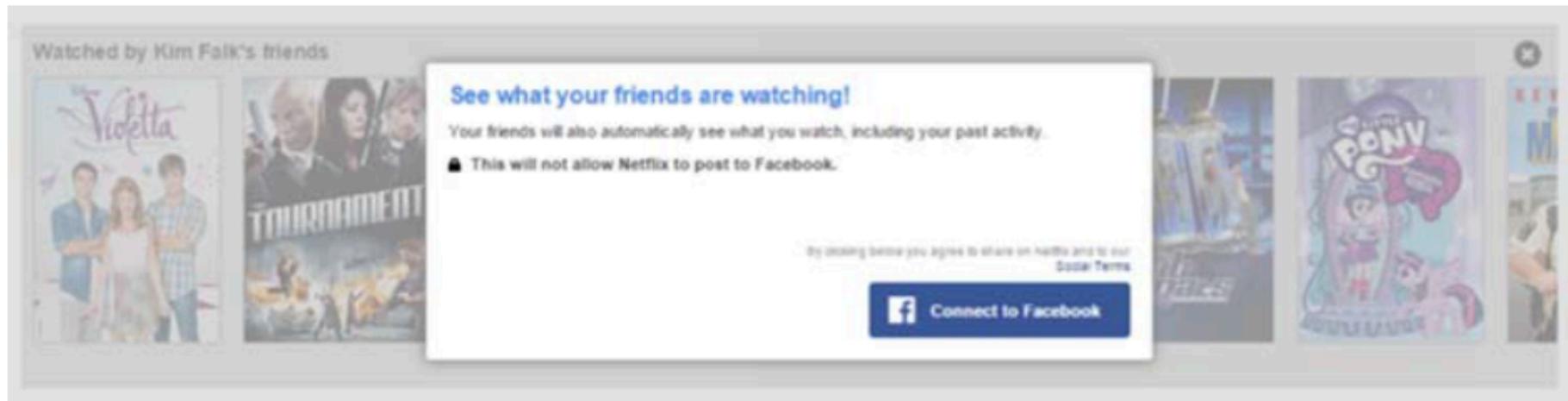


Low-predicted match between the Top Picks

Order Lists



Social Media Connection



Black Box and White Box Recommender

Netflix *black box* recommender. No explanation for their recommendations

Amazon *white box* recommender. Explains that Amazon predicts that this book is interesting to me because I bought another similar book.

Top Picks for Kim Falk

NETFLIX ORIGINAL DREAMWORKS TROLL-HUNTERS — GUILLERMO DEL TORO

94% Match 2016 KIDS OK 1 Part

Part 2 Coming on 15 December

After uncovering a mysterious amulet, an average teen assumes an unlikely destiny and sets out to save two worlds. Created by Guillermo del Toro.

Starring: Kelsey Grammer, Anton Yelchin, Ron Perlman, Charlie Saxton, Lexi Medrano

Creator: Guillermo del Toro

Genres: TV Programmes, Kids' Programmes, TV Cartoons

OVERVIEW EPISODES TRAILERS & MORE MORE LIKE THIS DETAILS

Hands-On Machine Learning with Scikit-Learn and TensorFlow by Aurelien Geron (24 Mar. 2017) Average Customer Review: ★★★★☆ (19) In stock RRP: £39.99 Price: £24.03 9 used & new from £22.56 Add to Basket Add to Wish List

I own it Not interested Rate this item

Recommended because you said you owned Deep Learning and more (Fix this)

Recommender System Definition

Term	Netflix example	Definition
Prediction	Netflix guesses what you'll rate an item.	A prediction is an estimate of how much the user would rate/like an item.
Relevancy	Orders all rows on the page (for example, Top Picks and Popular on Facebook) according to applicability.	An ordering of items according to what's most relevant to the user right now. Relevance is a function of context, demographics, and (predicted) ratings.
Recommendation	Top Picks for me.	The top N most relevant items.
Personalization	The row headlines in Netflix are an example of personalization.	Integrates relevancy into the presentation.
Taste profile		A list of characterizing terms coupled with values.