DATA ANALYTICS

Unit 4: Introduction to Recommendation System

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Recommendations:

- Introduction to recommendation systems
- Collaborative filtering
- Knowledge based filtering using KNN
- Decision trees – CART,
- Ensemble methods and Random Forest
- Brief review of other classifiers: SVM, ANN and data driven approaches
- Brief review of unsupervised learning – clustering algorithms – DBSCAN
- Content based analysis – dealing with textual data
- Text classification and clustering
- Market basket analysis (Apriori algorithm)
- Generation and evaluation of association rules from frequent item sets
- Case Study

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Recommendations:

Recommendations: What and Why?

What are Recommendations?

How does YouTube know what video you might want to watch next?
How does the Google Play Store pick an app just for you? Magic?
No, in both cases, an ML-based recommendation model determines how similar videos and apps are to other things you like and then serves up a recommendation.

Two kinds of recommendations are commonly used:

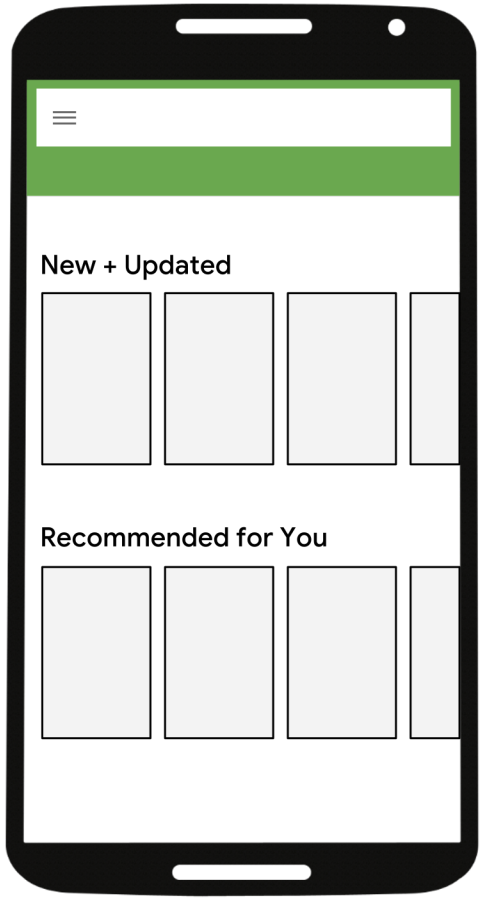
- **Home page recommendations**
- **Related item recommendations**

Homepage Recommendations

Homepage recommendations are personalized to a user based on their known interests. Every user sees different recommendations.
If you go to the Google Play Apps homepage, you may see something like this:

Related Item Recommendations

As the name suggests, **related items** are recommendations similar to a particular item



Introduction to Recommendation system

- Recommendation system - problem of information filtering

- Enhance user experience
  - Assist users in finding information
  - Reduce search and navigation time

- Recommender systems are the most popular applications of data science today, to Increase productivity, Increase credibility.

- They are used to predict the “rating” or “preference” that a user would give to an item.

- Amazon uses it to suggest products to customers.

- YouTube uses it to decide which video to play next on auto play, and,

- Facebook uses it to recommend pages to like and people to follow.

- Most of the companies business model and its success revolves around the potency of their recommendations.

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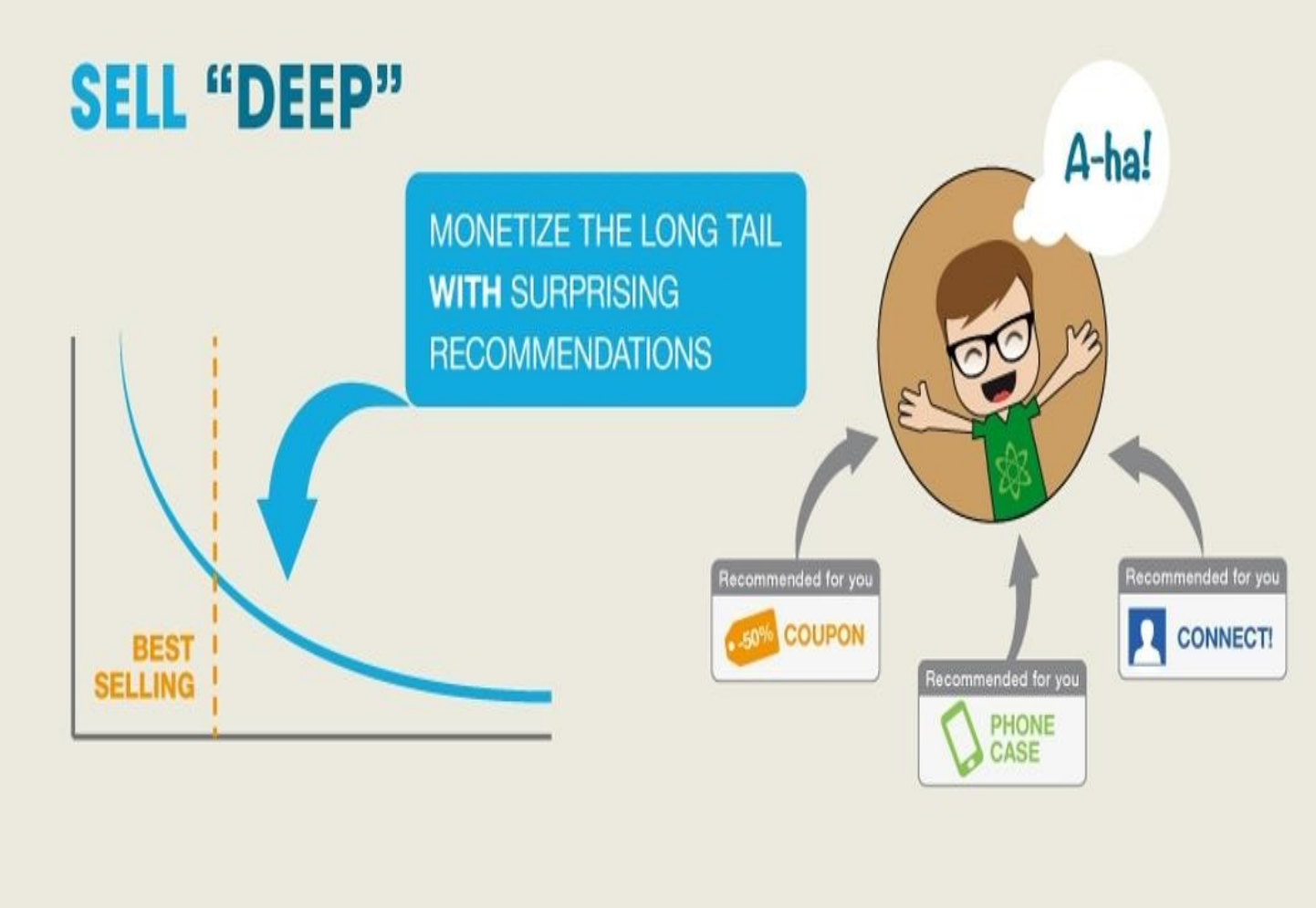
Why Recommendation Systems?



"We are leaving the age of information and entering the age of recommendation"

-Chris Anderson in "The Long Tail"

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Age of Recommendation

Search:

User ➡ Items

Recommend:

Items ➡ User

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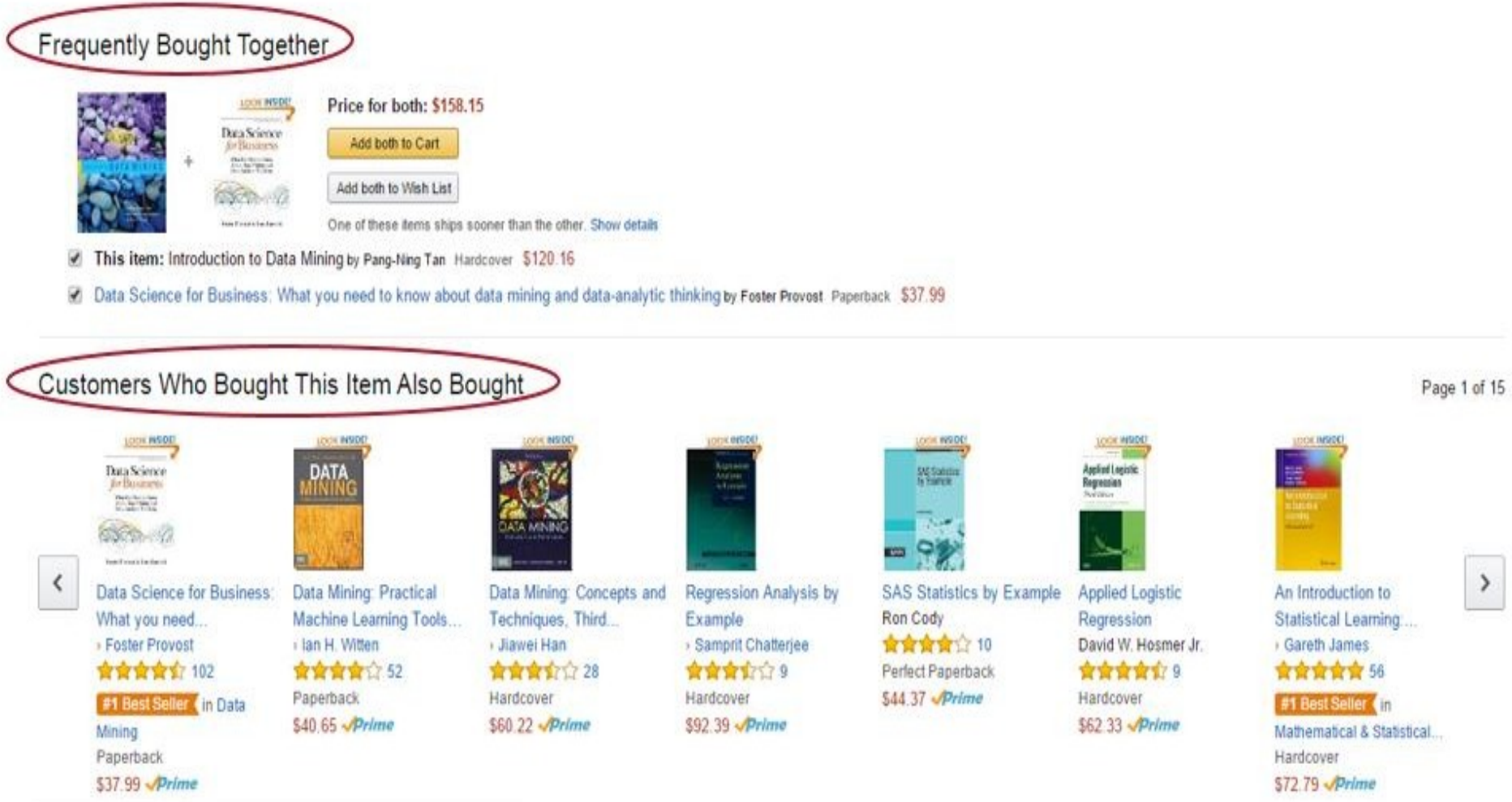
Amazon A personalized online store



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Amazon A personalized online store

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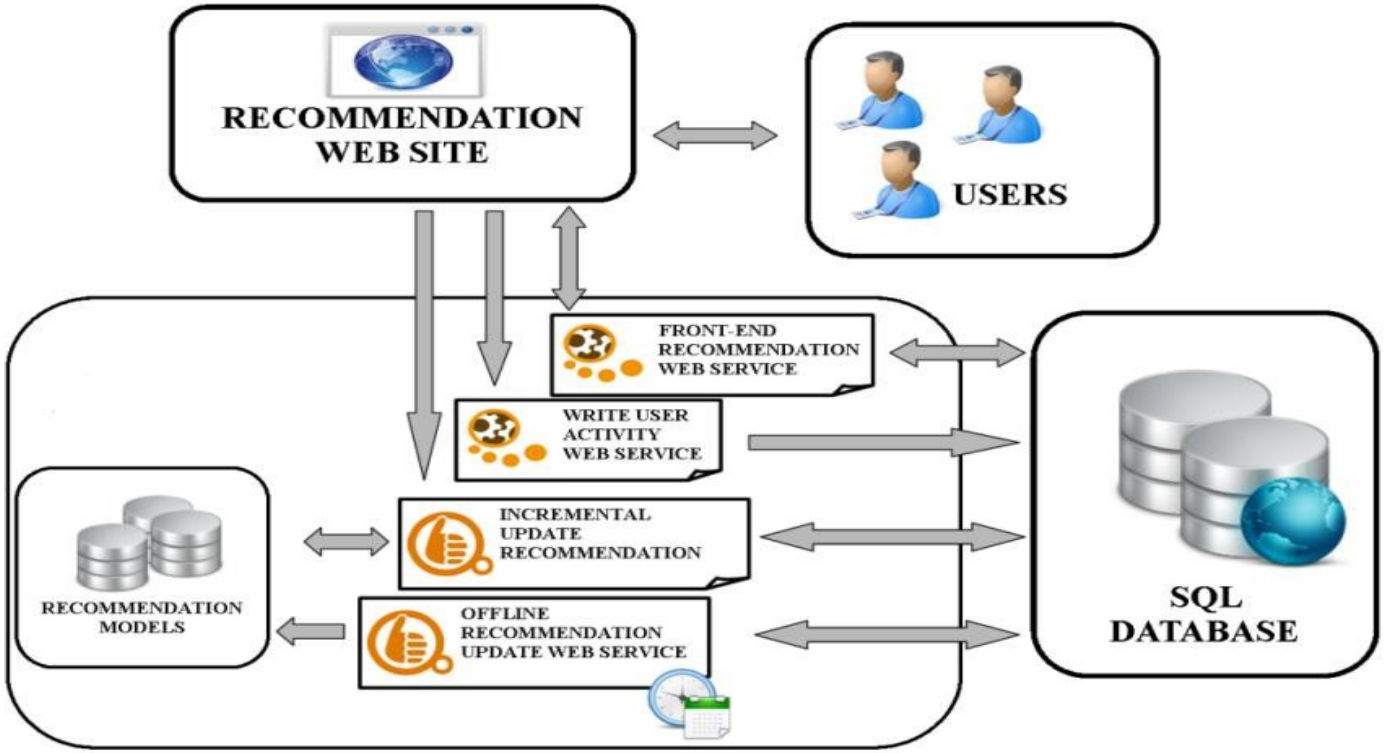
Amazon's solution

1. Amazon Recommendation Engine: Amazon's model that implements recommendation algorithm. Recommendation algorithm is designed to personalize the online store for each customer.

2. Recommendation Engine Workflow:



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Recommender Problem

A Good recommender

- Show programming titles to a software engineer and baby toys to a new mother
- Don’t recommend items, which user already knows or would find anyway.
- Expand User’s taste without offending or annoying him/her..

Challenges

- Huge amounts of data, tens of millions of customers and millions of distinct catalog items.
- Results are required to be returned in real time.
- New customers have limited information.
- Customer data is volatile.

Goals of Recommender Systems

1. **Prediction version of problem:** the first approach is to predict the rating value for a ***user-item*** combination. It is assumed that training data is available, indicating user preferences for items. For m users and n items, this corresponds to an incomplete mxn matrix, where the specified values are used for training.

2. **Ranking version of problem:** In practice, it is not necessary to predict the ratings of users for specific items in order to make recommendations to users. ***The determination of the top-k items is more common than the determination of top-k users.***

Goals of Recommender Systems Contd.

In order to achieve broader business-centric goal of increasing revenue, the operational and technical goals of recommender systems are as follows

1. **Relevance**: Users are more likely to consume items they find interesting, rating value for a user-item combination.
2. **Novelty:** Recommender systems are truly helpful when the recommended item is something that the user has not seen in the past. For example, Popular movies of a preferred genre would rarely be novel to the user.
3. **Serendipity:** The items recommended are somewhat unexpected, and therefore there is a modest element of lucky discovery. Recommendations are truly surprising to the user. It leads to sales diversity or beginning a new trend of interest in the user.
4. **Increasing Recommendation Diversity:** It has the benefit of ensuring that the user does not get bored by repeated recommendation of similar items.

Goals of Recommender Systems Contd.

- Aside from these concrete goals, a number of soft goals are also met by the recommendation process both from the perspective of the user and merchant.
- The broad diversity of recommender systems that were built either as research prototype, or are available today as commercial systems in various problem settings

1. GroupLens Recommender System
2. Amazon.com Recommender System
3. Netflix Movie Recommender System
4. Google News Personalization System
5. Facebook Friend Recommendations

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The Spectrum of Recommendation Applications

1. Collaborative Filtering Models
   - i) Memory - based collaborative filtering
     a) User-Based collaborative filtering
     b) Item-based collaborative filtering
   - ii) Model-Based Methods
     a) Types of Ratings: Implicit and Explicit Ratings
     b) Relationship with missing values.

2. Content-Based Recommender systems

3. Knowledge-Based Recommender Systems
   - i) Constraint-based recommender systems
   - ii) Case-based recommender systems

4. Demographic Recommender systems

5. Hybrid and Ensemble-Based Recommender Systems

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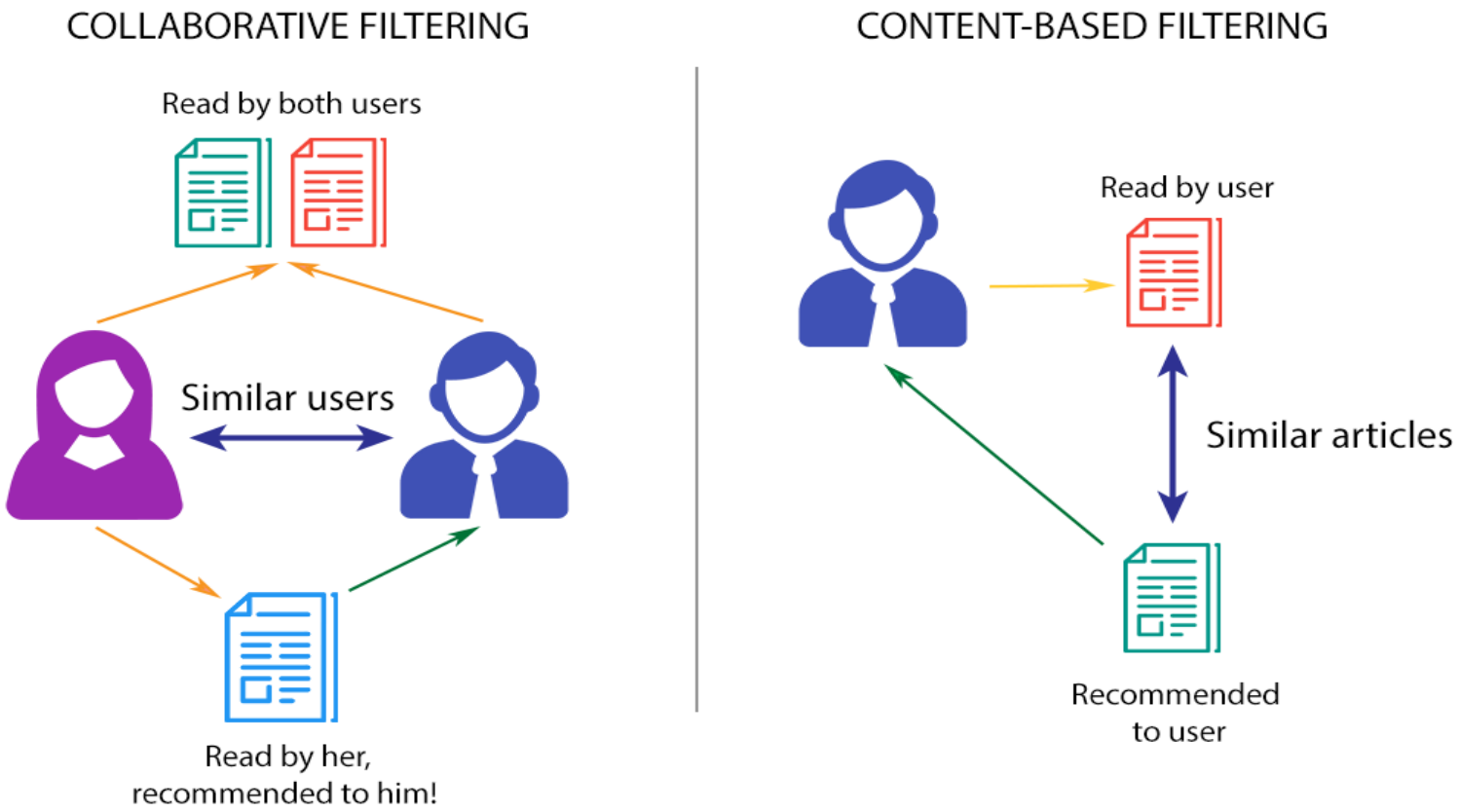
Collaborative Filtering Models and Content-Based Recommender systems



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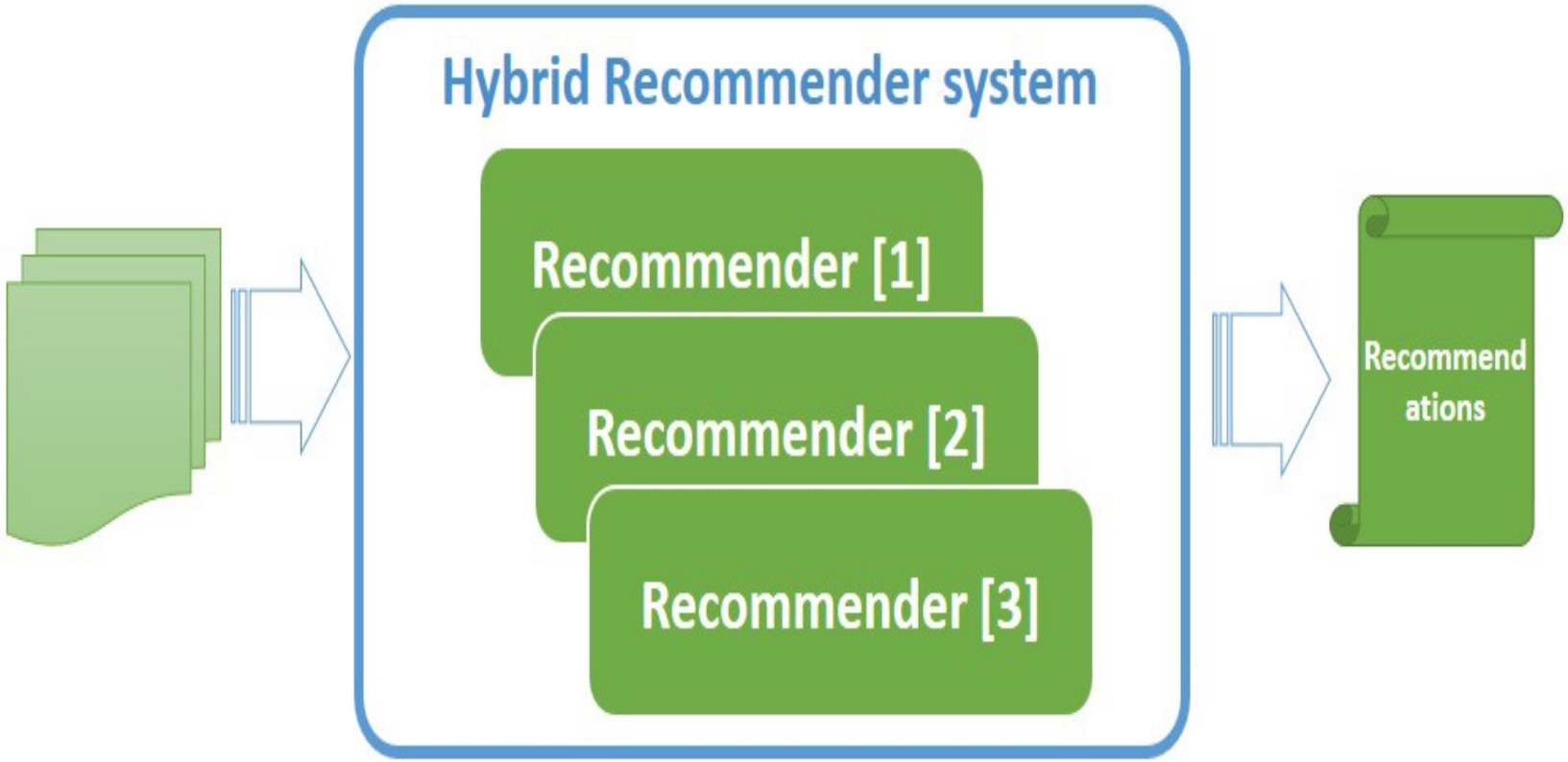
Hybrid Recommender systems



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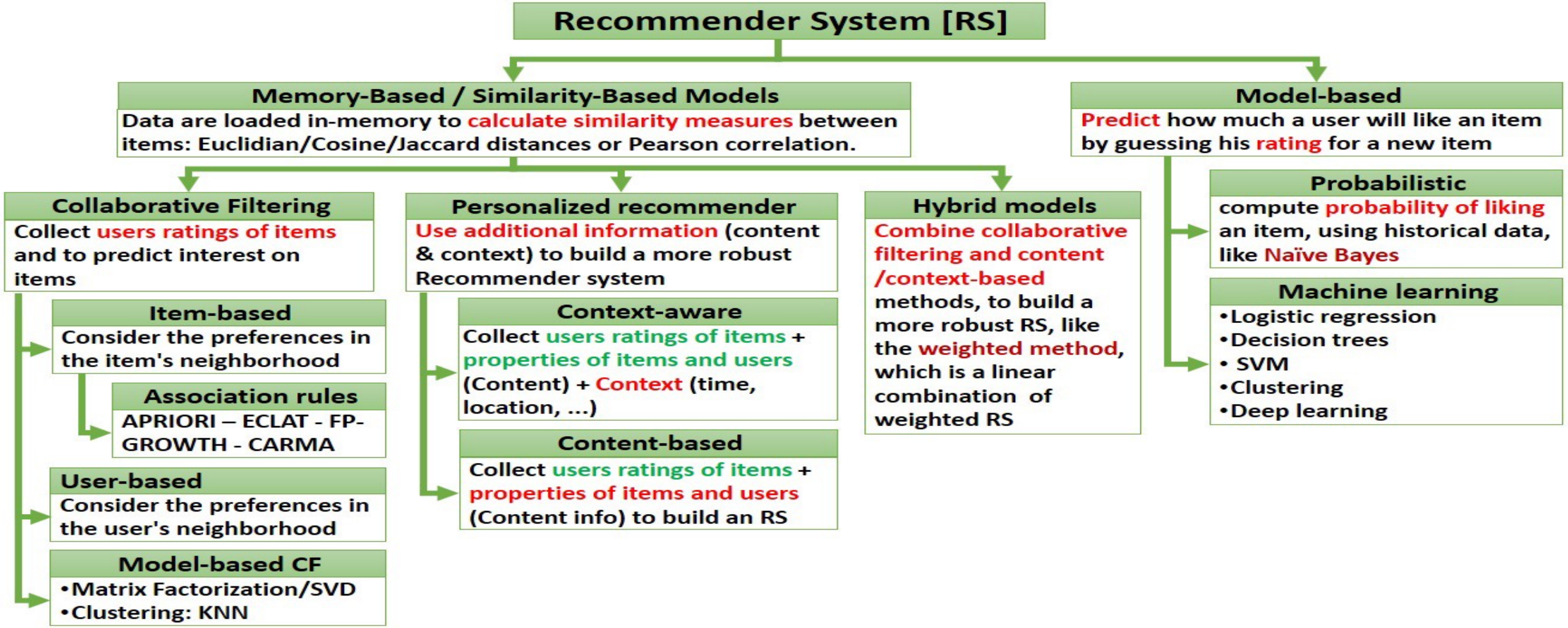
The Spectrum of Recommendation Applications



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What are input data of Recommender system ?

Input Data for Recommendation system		
Customer/prospect behavior	**Item details**	**Context information**
• Transactions • Usage • Interests Examples: • Website: page/product views, clicks, search queries, cart actions • Banking: loans & services subscriptions, simulation demands & information request • Retail: purchases (with/without fidelity card) • Telecom: purchases & services subscriptions, usage(recharge, calls, SMS, data), info request	• Features & attributes •Product: Type /family /subfamily, brand, price range,dimensions •Person: Appearance, Preferences, Sex, Race, Age, Religion •Video & Music: Category, topic, language, location • Ratings •Views – Orders - Feedbacks • Availability & Inventory info	• Time: season/month, day/hour/week-end, holidays,... • Location: region, country, climate, language, ... • Persona: reluctant, receptive, impulsive, stingy, spendthrift, Average Spenders ... • Social Media: likes, shares, feedbacks, recommendation, ...

Gathering Ratings

Types of Ratings : Explicit and Implicit

1. Explicit
   - Ask people to rate items
   - Doesn’t scale: only a small fraction of users leave ratings and reviews

2. Implicit
   - Learn ratings from user actions
   - E.g., purchase implies high rating
   - What about low ratings?

https://realpython.com/build-recommendation-engine-collaborative-filtering/

Domain-specific Challenges in Recommender Systems

1. **Context-Based Recommender Systems:**

   It could include time, location, or social data.

   I. For example, the types of clothes recommended by a retailer might depend both on the season and location of the customer.

   II. Even particular type of festival or holiday affects the underlying customer activity.

2. **Time-Sensitive Recommender Systems**:

   i. The rating of an item might evolve with time, as community attitudes evolve and the interests of users change over time. User interests, likes, dislikes, and fashions inevitably evolve with time.

   ii. The rating of an item might be dependent on the specific time of day, day of week, month, or season.

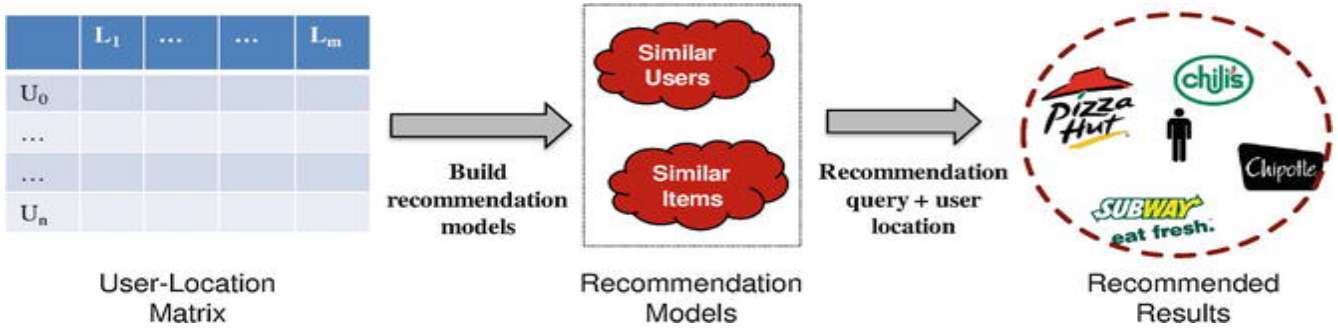
   iii. For example, it makes little sense to recommend winter clothing during the summer, or Raincoats during the dry season.

Domain-specific Challenges in Recommender Systems

3. Location-Based Recommender Systems

i) User-Specific Locality

ii) Item-specific Locality



4. Social Recommender Systems

i) Structural Recommendation of Nodes and Links

ii)Product and Content Recommendations with social influence.

iii)Trustworthy Recommender Systems

iv) Leveraging Social Tagging Feedback for Recommendations

References

Text Book:

"Business Analytics, The Science of Data-Driven Decision Making", U. Dinesh Kumar, Wiley 2017

"Recommender Systems, The text book, Charu C. Aggarwal, Springer 2016
Section 1.

Image Courtesy

https://www.scribd.com/presentation/414445910/CS548S15-Showcase-Web-Mining

https://towardsdatascience.com/image-recommendation-engine-_leverage-transfert-learning-ec9af32f5239
https://towardsdatascience.com/the-magic-behind-recommendation-systems-c3fc44927b3c

https://www.youtube.com/watch?v=1JRrCEgiyHM

www.amazon.com

http://elico.rapid-i.com/recommender-extension.html
https://developers.google.com/machine-learning/recommendation
https://medium.com/@fenjiro/recommender-systems-d0e597424a98

THANK YOU

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