Recommender Systems

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Learning objectives

- Define recommender systems and state why they are important
- List domains where recommender systems are used
- List the goals of recommender systems
- Explain the three common algorithms for recommendation
  - Describe how they differ
  - Give examples of where they are used
  - List the advantages and limitations of each
- Explain the utility matrix of recommender systems

Recommender systems

- Also called recommendation systems
- Predict a user's rating or preference for an item
- Algorithms that suggest relevant items to users
  - Movies to watch, books to read, products to buy
- Aim to predict users' interests; recommend items that users will find interesting
- Use feedback data from likes, ratings, reviews to infer people's interests
- Based on previous interaction between users and items – movies, books etc.

Why recommender systems?

Too many choices. Users can’t see all; they will have a hard time choosing

- A lot of user generated content online
  - Posts on social media, news paper articles
- Online stores have a lot of inventory
  - Amazon is a market place with many sellers with lots of products
  - Netflix has lots of movies. How many?
  - Audible has lots of books
  - Spotify has lots of music etc.
- Too many types of ads.
  - Which should users see?

Goals of recommender systems

- To assist users to find what they want
- To help users make decisions according to needs, interests, and goals
- Relevance
  - Recommend items that are relevant t the user
- Novelty
  - Helpful when recommended item has not been seen by user and is relevant
- Serendipity
  - Surprising, pleasant, beneficial recommendation
- Increasing recommendation diversity
  - Ensures user doesn’t get bored by repeated recommendation of similar items
- Can improve overall user satisfaction and customer loyalty
  - Relevant recommendations can lead to repeat clients

Classic algorithms for recommendation

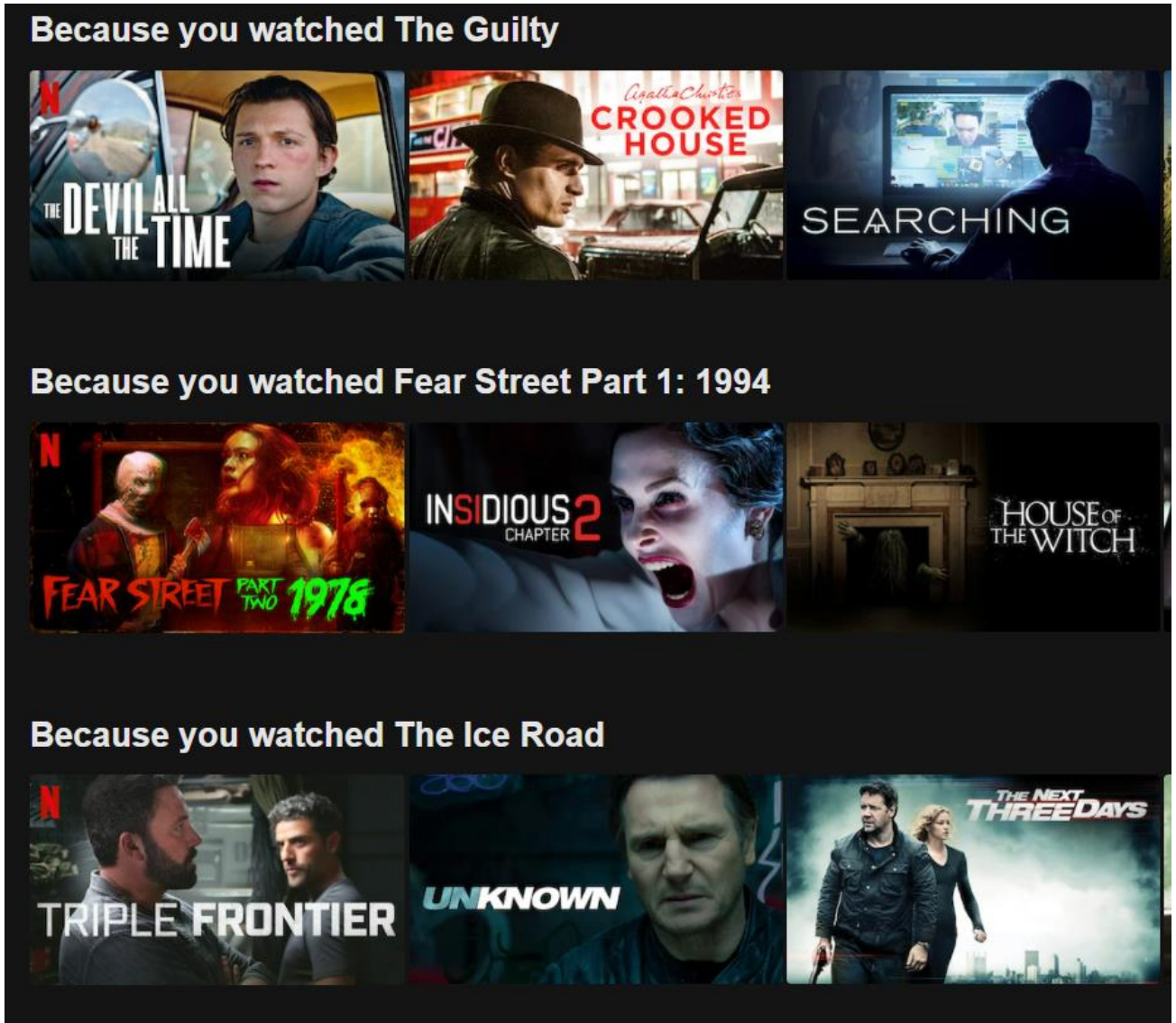
- Feature based (content based)
  - Recommendation is based on the descriptive attributes of the items being recommended
  - Descriptive attributes include movie genre, actors, producers, authors
- Collaborative filtering
  - Recommendation is based on ratings provided by multiple users
  - Example, recommend books that other user have bought before
- Hybrid
  - Feature based + collaborative filtering

Utility matrix

USERS	HP1	HP2	HP3	TW	SW1	SW2	SW3
A	4			5	1		
B	5	5	4				
C				2	4	5	
D		3					3

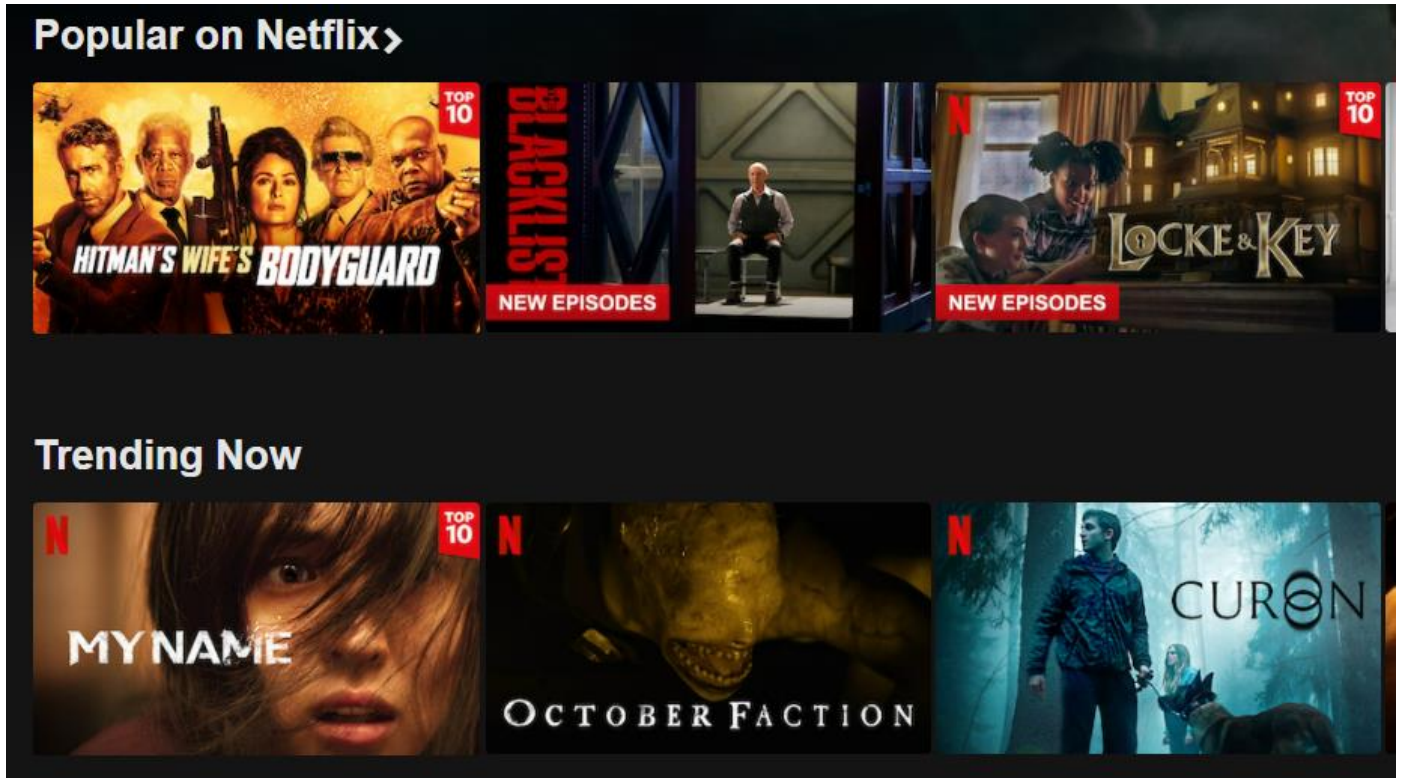
- In recommendation systems, 2 classes of entities: users and items
- The data is represented as a utility matrix; for each user-item pair, a value that represents the degree of preference of the user for the item.
- Values come from an ordered set, e.g., integers 1–5 representing the number of stars that the user gave as a rating for that item
- Matrix is usually sparse with unknow entries; user hasn't rated item yet
- The goal of a recommendation system is to predict the blanks in the utility matrix. For example, would user A like SW2?

Feature/content based filtering – based on attributes of items



Source: Netflix.com

Collaborative filtering – based on ratings of others

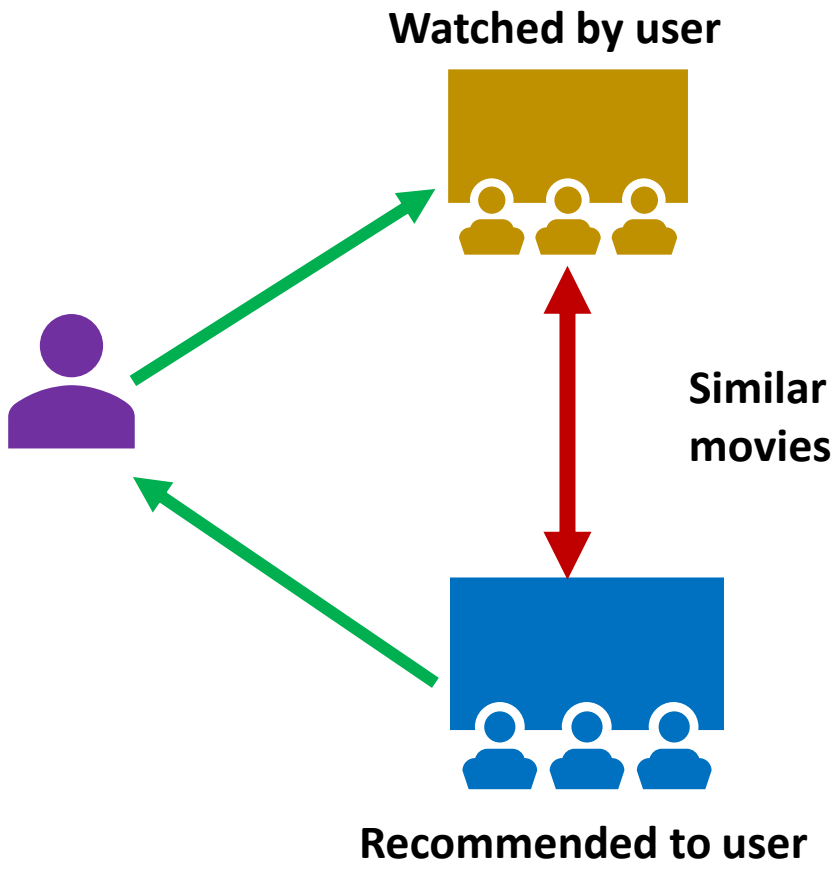


Source:
Netflix.com

- What recommendation algorithm does Facebook use?
- What recommendation algorithm does Amazon use?

Feature based recommendation

- General Idea
  - Given a set of items that user has shown interests before or the preferences explicitly specified by user, find the most similar items that user might be interested in now
- Similarity of items is determined based on features
  - Example: movie's features: genre, director, actors, etc.
  - Example: book features: genre, author, year of publication
- Advantages:
  - Takes into account features of items, easy to explain why a certain item is recommended
  - Similarity of items can be processed offline in advance to save online computation time
  - Recommendation right away based on explicit specification of user's preferences (even works for newcomers)



Feature based recommendation

Limitations:

- Overspecialization, *obvious* recommendation
  - Recommend only items that are similar to those already rated
  - Example: a person with no experience with Greek food would never receive a recommendation for even the greatest Greek restaurant in town
- Limited content analysis
  - Limited by features that are explicitly associated with objects that these systems recommend, normally manually encoded
  - Features depend on context, type of content
  - Example: features of video content cannot be processed automatically
- No wisdom of the group
- What happens to a new user who has never liked/rated/read an item before?

References

- Recommender Systems: The Textbook 1st ed. 2016 Edition, by Charu C. Aggarwal, Springer
- Prof. Julita Vassileva’s lecture notes on social computing