MATH MATTERS

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The math behind... Online Recommender Systems

Technical terms used:

Machine learning, statistical correlation, singular value decomposition, nearest neighbor

Uses and applications:

Plays an essential role in many e-commerce and entertainment websites such as Amazon, iTunes, YouTube, Pandora, and Netflix

How it works:

When you buy a book from Amazon, watch a video on YouTube, or listen to a piece of music on iTunes, the website recommends a list of items that are likely to match your interests. The construction of systems that support users in their online decision making is the purpose of the field of recommender systems which is a relatively new area of research in machine learning. These systems are handy for customers and also essential for e-commerce activities and businesses.

A wide set of algorithms and techniques have been developed to provide affordable and personal recommendations for the customers. Given a ratings database provided by the users, a very naive approach would simply calculate the average rating for all the books in the database, sort the books by ratings, and suggest the ones with highest average ratings that the user hasn't already seen. A more sophisticated approach called user-based nearest neighbor recommendation relies on the fact that users with similar tastes in the past will have similar tastes in the future. It first identifies other customers that had similar preferences to those of the current user in the past. One common similarity measure is the Pearson correlation coefficient which is the covariance of the two users' ratings divided by the product of their standard deviations. Then, it identifies which users ratings are most similar to the current user and recommends the top books from the most similar customers' lists that the current user hasn't already seen. More sophisticated collaborative model-based approaches heavily rely on advanced matrix factorization methods such as singular value decomposition.

Interesting fact:

In September 2009, online movie-rental company Netflix awarded one million dollars to a research team whose algorithm performed 10% better than the Netflix's own algorithm.

References:

Recommender Systems: An Introduction
Dietmar Jannach, Markus Zanker, Alexander Felfernig, Gerhard Friedrich, 2011

amazon.com

YouTube™

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