Conversational recommender system for laptops using ontology

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September 16, 2025

Abstract

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1 Introduction

In the era on internet and technology evolution in many aspects of our lives, such as doing works, study, communicating with others. Ever since, laptops have been an essential devices, but choosing a suitable laptop from variety of functionality and specifications is an obstacle to many people, especially with one who is not familiar with technology. Therefore, they need support in determining a laptop that suitable for their daily needs (Baizal et al., 2016), recommend system is playing crucial role in solving this problem.

Recommender systems play a vital role in suggesting items to users, employing a variety of approaches. Content-Based Filtering (CBF) leverages information from items previously liked by a user, but it often suffers from overspecialization and lacks the ability to capture diverse user interests. Collaborative Filtering (CF), on the other hand, relies on similarities between user profiles, yet it struggles with cold-start and sparsity problems when sufficient user data is unavailable. Ontology-based methods attempt to address these issues by incorporating domain knowledge and semantic relationships between items, but they face challenges such as the complexity of ontology construction and the difficulty of adapting to dynamic user preferences. Hybrid methods combine these techniques, among others, to deliver more accurate and reliable recommendations.

To address the limitations of ontology-based methods, a hybrid approach can be employed to enhance the accuracy of item recommendations. In this study, we propose the development of a Conversational Recommender System (CRS) that integrates ontology-based techniques with collaborative filtering (CF), aiming to achieve higher accuracy and deliver an improved user experience.

2 Related Works

Currently, numerous recommend systems have been developed to provide laptop suggestions tailored to user needs. These systems illustrate different approaches to handling user requirements, ranging from content-based and collaborative filtering methods

to ontology-based models. As a result, a considerable body of prior research exists in this domain, offering valuable insights and serving as important references for ongoing and future studies.

Bahramian and Abbaspour (2015) developed an ontology-based tourism recommend system that applied a spreading activation model to enhance personalization. Their system represented both user preferences and points of interest (POIs) through an ontology, dynamically adapted recommendations with feedback, and addressed cold-start and sparsity problems. The results showed improved diversity and relevance in recommendations.

Ayundhita et al. (2019) investigated a laptop recommend system using an Ontology-Based Conversational Recommend System (CRS). Their approach integrated ontological reasoning with interactive questioning to capture user requirements more effectively. Experimental evaluation showed that the system achieved an accuracy of 84.6% when tested with functionality requirement questions.

Putra and Baizal (2024) proposed a hybrid laptop recommend system that combined ontology-based filtering with collaborative filtering in a conversational framework. The ontology component mapped functional requirements to technical specifications, while collaborative filtering introduced diversity by leveraging similar user preferences. Their system achieved 93.33% accuracy, outperforming earlier ontology-only approaches.

Based on previous studies, we will develop an ontology-based recommend system incorporating the Collaborative Filtering (CF) method to recommend laptops based on daily user needs.

Ontology-Based Recommend System

An ontology-based recommend system is a type of recommend system that utilize ontology - formal representations of knowledge within a specific domain. Such systems are particularly advantageous in domains like the Semantic Web (SW), Artificial Intelligence (AI), and Systems Engineering (SE), where complex relationship must be analyzing and modeling. Implementing an Ontology-Based Recommend system involves developing an ontology related to a particular domain or topic, involving concepts, relations, and rules. Researchers evaluate the similarity between user preferences and ontology by using it to model user preferences

Collaborative Filtering

Recommend system provides personalize recommendations to users base on their interest. One of most popular type of such system is Collaborative Filtering (CF), operating the prediction based on the known user ratings of items (Zhang et al., 2014). Collaborative filtering techniques generate recommendations by analyzing user behavior patterns, without relying on external information about items or users (Koren et al., 2022).

In collaborative filtering, user similarity is commonly assessed through advanced measures such as cosine similarity and Pearson correlation, which enable detailed analysis of shared preferences. Conversely, item-based collaborative filtering identifies items with attributes resembling those that a user has previously valued or interacted with. In this approach, similarity between items is computed from user interaction patterns, thereby enhancing the depth of preference modeling and supporting the generation of more relevant recommendations.

Although this approach is strong for most case, some users may find it difficult to get their satisfied recommendations due to their unique desire. Furthermore, the cold-start

problem presents a significant challenge, as new users or items lack sufficient historical data to generate accurate recommendations. Therefore, it is essential to combine multiples techniques to accomplish decent accuracy and effectiveness for recommend system.

Conversational Recommend System

A conversational recommend system(CRS) is an interactive software designed to help users navigate effectively through the items and make recommendations by identifying their needs through feedback mechanisms (Christakopoulou et al., 2016). At present, CRS can be classified into two categories: those that emphasize an item's technical specifications and those that prioritize its functionality (Ayundhita et al., 2019).

Technical specification approach focus on characteristics of items, such as weight, color, material. While functionality approach operating on the benefits, or functions of items. Both are required to interact with users to gain theirs feedback to provide accurate and effective recommendations.

Ontology design

Below is our proposed ontology-design based on RDF/OWL standard and ontology building using Protégé software. In ontology-building, four main components are involved: classes, property objects, data properties, and individuals.

User Preference Modelling

User preference modeling plays a critical role in recommender systems (Ayundhita et al., 2019). Its primary aim is to formulate appropriate questions and construct user profiles from the feedback provided. Through various data processing techniques, researchers are able to capture and analyze user preferences more precisely, thereby facilitating a deeper understanding of user needs. Commonly discussed cases include the following:

a) **Empty User.** This case arises when no user profile has been established and there is no available information regarding the user's preferences or needs. The recommended strategy is to initiate the interaction by posing preliminary questions and gradually constructing the user profile (Ayundhita et al., 2019).

b) **Abundance of Product Choices.** This situation occurs when users are presented with a wide range of products, making the decision process more time-consuming. In such cases, users may opt for multiple recommendations. The suggested strategy involves asking questions that emphasize the distinguishing features of each product (Ayundhita et al., 2019).

c) **Absence of Suitable Recommendations.** Here, users struggle to identify a product that meets their functional requirements. The proposed solution is to first elicit functional requirements at the current level and then revisit any unmet operational requirements from the previous level (Ayundhita et al., 2019).

d) **Unmet Requirements.** This case highlights situations where the initial requirement definitions fail to produce appropriate recommendations. The strategy involves refining the inquiry by requesting more specific functional requirements at the next level (Ayundhita et al., 2019).

e) **No Product Matches the User Profile.** In this scenario, the defined requirements are insufficient to generate relevant recommendations. The proposed approach is to revise the requirements and request more specific functional details at the next level (Ayundhita et al., 2019).

3 Method

4 Result

References

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