

Implementation of forward chaining in tourism recommendation selection expert system based on user preferences

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ARTICLE INFO	ABSTRACT
Article history: Received Oct 22, 2023 Revised Oct 26, 2023 Accepted Oct 29, 2023 Keywords: Expert System; Forward Chaining; Travel Recommendations; User Preferences; User Privacy.	Precise travel recommendations tailored to user preferences are a key element in enriching the travel experience. In this context, the Forward Chaining method in the User Preference-Based Travel Recommendation Selection Expert System offers a powerful and highly personalised approach. This article describes the implementation steps of the Forward Chaining method, which involves identification of user preferences, conversion of preferences to facts, initialisation of knowledge base, Forward Chaining process, evaluation of results, and customised travel recommendations. This method allows the system to dynamically respond to user preferences, generate accurate recommendations, and ensure that users are satisfied with their experience. However, some challenges such as privacy protection, complexity of user preferences, and knowledge base updates must be considered. Therefore, this article also discusses important implications of implementing the Forward Chaining method, including strict privacy protection, regular updates of the knowledge base, as well as the system's ability to learn from user feedback. In conclusion, the Forward Chaining method is a very useful approach in improving travel recommendation services tailored to user preferences, which can enrich the travel experience and result in higher satisfaction for users. <i>This is an open access article under the CC BY-NC license.</i> 

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1. INTRODUCTION

The selection of travel destinations that match users' preferences has become one of the important aspects of the travel industry (Buckley & Cooper, 2021; Chen & Gursoy, 2001; Pizam & Mansfeld, 1999). With the increasing number of destinations and options available, users often face challenges in deciding which destination best suits their preferences (Buhalis & Amaranggana, 2015; Dolnicar, 2022). To address this problem, the Tourism Recommendation Selection Expert System is an attractive solution. The system utilises artificial intelligence and computational methods to provide travel recommendations that are highly customised to individual preferences, allowing users to undergo a more fulfilling travel experience (Alemu et al., 2017; Halkiopoulos et al., 2021; Lucas et al., 2013; Manurung et al., 2022).

In the selection of tourist destinations, user preferences are key. These preferences include various aspects such as the type of travel they are interested in, available budget, travel time, and other specific preferences. Users often choose destinations based on personal preferences, and this is why it is important to integrate these preferences in the recommendation process. The Forward Chaining method, as one of the approaches in expert systems, can effectively generate travel recommendations based on user preferences (Cheng et al., 2023; Grossmann et al., 2019; Islam et al., 2021).

This article will discuss the implementation steps of the Forward Chaining method in the User Preference-based Tourism Recommendation Selection Expert System (Al-Ghuribi & Noah, 2019; Rehman Khan et al., 2021). The steps involve identification of user preferences, conversion of preferences into facts, initialisation of knowledge base, Forward Chaining process, evaluation of results, and provision of highly customised travel recommendations (Coles et al., 2010). Through the application of this method, the system can dynamically respond to user preferences, produce accurate recommendations, and ensure user satisfaction in selecting tourist destinations that match their expectations (Manurung et al., 2023).

However, in developing a Tourism Recommendation Selection Expert System, several challenges need to be considered. Protection of user privacy is one of the crucial aspects that must be integrated in the process of collecting and using preference data (Ackerman et al., 1999; Sanchez et al., 2020). In addition, the varying complexity of user preferences as well as the periodic update of the knowledge base are also factors that affect the effectiveness of this system. In this article, we will discuss how to overcome these challenges and the important implications associated with the application of the Forward Chaining method in a User Preference-based Tourism Recommendation Selection Expert System.

In the era of ever-evolving information technology, users are increasingly demanding a more personalised experience in the selection of tourist destinations. With the Forward Chaining-based Travel Recommendation Selection Expert System, users get recommendations that are more in line with their preferences, helping them save time in travel planning, as well as increasing their level of satisfaction. In a business context, the system also provides additional benefits, namely the opportunity to analyse users' evolving preference patterns and understand ongoing travel trends (Moutinho et al., 2013; Roque & Raposo, 2016).

Challenges around user privacy need to be taken seriously. Personal data protection and privacy policies should be tightly integrated in the collection and use of user preference data. This ensures that users' sensitive data remains safe and secure throughout the recommendation process.

In addition, in the face of the complexity of varied user preferences, the system should have the flexibility to accommodate different, even conflicting, preferences and provide adequate recommendations. The ability of the system to learn from user feedback is also key in improving the quality of recommendations and ensuring that the system is always updated.

The implications of applying the Forward Chaining method in the Tourism Recommendation Selection Expert System are very positive. With this approach, the travel industry can improve services to their customers, increase customer satisfaction, and optimise business results. In addition, it also enables the development of systems that are more intelligent and better able to deeply understand user preferences, which will be one of the key components in the future of the competitive travel industry. With this understanding, it is hoped that this article will provide valuable guidance to practitioners in the development of an effective Travel Recommendation Selection Expert System, and encourage further development of this technology.

2. RESEARCH METHOD

The following is a potential problem-solving expert system for selecting user preference-based tourism recommendations using the forward chaining method (Fink et al., 1985; Hayes-Roth, 1984; Maher, 1986)

1. Identification of User Preferences and Initial Knowledge Base

Collect user preferences related to travel recommendations. For example, information on preferred types of tours, locations of interest, available budget, travel time, and other specific

preferences. Initialise the knowledge base with rules that link user preferences with travel recommendations. These rules should be pre-defined and may include information about the types of tours, available activities, and other factors that influence the recommendations.

2. Converting User Preferences into Facts

Each user preference identified in step 1 should be converted into facts that can be used in the expert system.

3. Initialise the Knowledge Base and Initial Facts

Initialise the knowledge base with initial facts derived from user preferences and predefined rules.

4. Forward Chaining Process

Implement the forward chaining algorithm to start inference. In this step, the system will search for rules that fulfil the existing facts and execute the rules. perform this step iteratively until there are no more rules that can be executed or until the system produces adequate travel recommendations.

5. Evaluate Results and Show Recommendations

Evaluate the results of recommendations generated by the system by considering user preferences, budget, travel time, and other relevant factors. Display travel recommendations that match the user's preferences to the user.

3. RESULTS AND DISCUSSIONS

1. Identifying user preferences can be done by defining the criteria or choices that form the basis for customising travel recommendations. In this context, we will identify two main preferences: tour type and activity.

Type of Tourism

Choice 1: Nature

Users favour destinations that offer natural beauty such as mountains, beaches, and national parks.

Choice 2: History

Users are interested in destinations that have historical value, such as historical sites, museums, or historical cities.

Activities

Choice 1: Adventure

Users are looking for adventurous experiences, including activities such as hiking, snorkelling, or challenging outdoor activities.

Choice 2: Relaxation

Users prefer destinations that offer a relaxing atmosphere, such as beach resorts, spas, or places suitable for chilling out.

2. Rules based on user preferences for preference-based travel recommendation selection expert system

- a. If the User Selects the Tourism Type "Nature" and Activity "Adventure", Then Recommend: Nature destinations that offer adventure activities such as hiking, camping, or nature exploration.
- b. If the User Selects the Tourism Type "Nature" and Activity "Relaxation", Then Recommend: Nature destinations that provide a relaxing atmosphere, such as resorts by the beach, lake, or quiet hilly areas.

- c. If the User Selects the Tourism Type "History" and Activity "Adventure", Then Recommend: Historical tourist destinations with adventure activities, such as visiting historical sites by trekking or exploring historical ruins.
 - d. If the User Selects the Tourism Type "History" and Activity "Relaxation", Then Recommend: Historical tourist destinations with a calm atmosphere, such as art museums or historical cities with classic architectural beauty.
 - e. If the User Selects the Tourism Type "Nature" or "History" and Does Not Select a Specific Activity, Then Recommend: Destinations that offer a mixed experience of nature and history without emphasising any particular activity.
3. Initial facts are information obtained from the user at the beginning of interaction with the system. These facts become the basis for starting the reasoning or recommendation process. In this context, initial facts can include user preferences related to types of tours and activities. Here is an example of an initial fact

User Selects Tour Type

The user expresses a preference for the type of tour. Example: I prefer tourist destinations that offer natural beauty.

User Selects Activity

The user expresses a preference for a particular activity. Example: I like adventure activities like hiking.

Choice of Combination of Tourism Type and Activity

Users can select a combination of tour types and activities. Example: I am interested in historical destinations that also offer relaxation activities.

General Preferences

General information about the user's preferences regarding the holiday or itinerary. Example: I want to spend a relaxing and adventurous holiday.

4. The Forward Chaining process assuming some examples of initial facts and rules that we have created before is

Initial Facts:

User likes nature type of tourism.

User likes adventure activities.

Rule

If the user selects the type of tourism "Nature" and the activity "Adventure", then recommend nature tourism destinations with adventure activities.

Forward Chaining Steps:

Iteration 1

Initialise Working Memory:

Initial Fact: The user likes nature and likes adventure activities.

Rule Evaluation:

Rule 1: If the user chooses the type of tourism "Nature" and the activity "Adventure", then recommend nature tourism destinations with adventure activities. Rule 1 is satisfied because the initial facts match.

Iteration 1 Result: Working Memory: Recommended nature tourism destinations with adventure activities.

Iteration 2:

Working Memory Initialisation:

Initial Facts: The user likes nature tourism and likes adventure activities.

Rule Evaluation:

Rule 1: If the user chooses the type of tourism "Nature" and the activity "Adventure", then recommend nature tourism destinations with adventure activities.

Rule 1 fulfilled (already fulfilled before).

Result of Iteration 2: Working Memory: Recommend nature tourism destinations with adventure activities. In the 2nd iteration, there is no change in Working Memory because the existing rules have been fulfilled before. Therefore, the system does not perform additional iterations.

Final Result:

Based on the forward chaining process, the system recommends nature tourism destinations with adventure activities as the final result. This recommendation is in accordance with the preferences of users who like nature tourism and adventure activities.

By utilising the forward chaining process in the user preference-based travel recommendation selection expert system, we can simulate recommendations based on initial facts and predefined rules. For example, when a user expresses a preference for nature tourism and adventure activities, the system uses the predefined rules, such as "If the user chooses the tourism type 'Nature' and the activity 'Adventure', then recommend nature tourism destinations with adventure activities." The forward chaining process then generates recommendations for nature tourism destinations with adventure activities in response to these preferences. During iteration, the system checks the rules that match the initial facts and builds working memory until it reaches the final recommendation.

Thus, through the implementation of forward chaining, the system can dynamically generate travel recommendations that match the user's preferences. This process allows adaptability to various combinations of preferences, ensuring that the recommendations provided are relevant to the user's wishes and expectations. Furthermore, the system can be continuously evaluated and updated according to user feedback, allowing for the improvement of recommendation suitability over time.

Discussion

The forward chaining process in the user preference-based travel recommendation selection expert system proved its reliability in generating suitable recommendations. With steps such as user preference identification, rule generation, and initialisation of initial facts, the system can effectively evaluate the combination of those preferences and generate relevant recommendations. In the implementation example, when the user favours nature tourism and adventure activities, the forward chaining process with appropriate rules successfully suggests nature tourism destinations with adventure activities as solutions that fulfil those preferences. This approach gives the system the flexibility to customise its recommendations depending on each user's unique preferences.

It is important to note that the success of the system depends not only on the implementation of forward chaining, but also on the system's ability to receive user feedback and adapt to changing preferences. The constant evaluation of the quality of recommendations, along with the updating of rules based on feedback, provides an opportunity to improve the accuracy and relevance of recommendations over time. Thus, the forward chaining process not only provides concrete solutions to user preferences, but also creates a dynamic system that can evolve with the evolution of user preferences and expectations.

4. CONCLUSION

The application of the Forward Chaining method in the User Preference-Based Travel Recommendation Selection Expert System provides a powerful approach to generate travel recommendations that are highly customised to individual preferences. By identifying user preferences, converting them to facts, and going through the Forward Chaining process, the system can provide more accurate recommendations. The implication is that users will have a more satisfying experience in choosing a tourist destination, which can increase their satisfaction. In addition, the system should be integrated with strong privacy practices and have the ability to learn from user feedback to ensure continuously improved recommendations. This conclusion highlights

the potential of the Forward Chaining method in improving user preference-based travel recommendation services. In future research, it is recommended to further explore the integration of artificial intelligence and natural language processing in the Forward Chaining method to improve the system's ability to understand user preferences in a more contextual and nuanced manner. In addition, it is important to develop recommendation mechanisms that can handle situations where user preferences are not always consistent or may change over time. Furthermore, research should focus on developing more sophisticated and adaptive machine learning algorithms to continuously improve the quality of recommendations based on user feedback. In addition, ethical and privacy aspects should remain a major concern in the development of these systems, with an emphasis on user control over their data and strong privacy protection mechanisms. With these measures, future research can bring better innovations in improving user preference-based travel recommendation services.

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