Travel Agent

CBR Independent Study 2023

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Thirteen weeks ago, I started working on the case-based reasoner project with a sense of curiosity and a willingness to learn about this AI methodology. As the weeks passed, I gradually understood some of the fundamentals of case-based reasoning and the nuances required to implement it. Despite facing initial challenges and the seemingly daunting nature of the project, I found that every obstacle became a valuable learning opportunity. The iterative process of refining my understanding and adapting to unforeseen intricacies highlighted the dynamic and evolving nature of AI.

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1 Introduction

In my own words, case-based reasoning is a method of making recommendations based on previous data, utilizing similar cases to strengthen the suggested course of action. Initially, I held the misconception that case-based reasoning always involved a neural network and dataset training, but I was mistaken. As I delved deeper into the subject, I discovered that case-based reasoning can be adaptable to various scenarios, challenging my initial assumptions. Moreover, I found examples of how adaptations of case-based reasoning have been employed in practical applications. For instance, Google Maps utilizes a form of case-based reasoning to recommend routes based on historical traffic data and user preferences [1]. Customer service has implemented chatbots that use case-based reasoning to address user queries by referring to past interactions and finding solutions that worked in similar situations. These applications showcase the versatility of case-based reasoning beyond my initial understanding.

2 Customer Support - CBR

In constructing a Case-Based Reasoning system with a help-desk dataset, the goal is to generate troubleshooting steps based on the provided input. The system is designed to accommodate a variety of inputs, ensuring its versatility and effectiveness.

Each case in the data set corresponds to a specific problem, documented with details such as *device type, operating system, age, model*, along with resolution steps. The system would identify and present the top 4 matching records, showcasing similarity points for attributes like 'DeviceType,' 'OperatingSystem,' 'DeviceAge,' 'ModelNumber,' and 'IssueDetails'.

The weighing process features involves assigning importance based on their relevance in determining the similarity between cases. For example, in the provided case-based reasoning system, the operating system carries greater weight, given its substantial influence on the troubleshooting process. However, the feature DeviceAge could be seen as the least important feature due to the ModelNumber providing redundant information.

The similarity metric involves computing scores by comparing the input with historical data, emphasizing matching features to contribute to the overall similarity score. The algorithm selects the top 4 cases with the highest similarity scores to recommend as the most relevant cases in the output. This approach provides tailored and accurate recommendations for the user's input, ensuring a nuanced evaluation based on multiple features and their respective contributions.

Adaptation could be implemented through updates to the dataset. This may involve adding new cases adapted from previously known cases. Another option is to design an algorithm that adapts to different issues and preferences. For example, changing the operating system of a previous case from Windows 10 to Windows 11 could lead to a more effective solution. Similarly, when dealing with macOS, adaptations should account for different versions like macOS Monterey and macOS Sonoma. Expanding this adaptability to mobile devices could extend to iOS and iPadOS and the array of different apple products.

3 Customer Support Inputs and Outputs

```
Example Input:
{
    'DeviceType': 'Laptop',
    'OperatingSystem': 'Windows',
    'DeviceAge': '1 year',
    'ModelNumber': 'ABC123',
    'IssueDetails': 'Unable to connect to Wi-Fi',
}

Example Output:
Top 4 Matching Records:
1. Case Number: 5678
   | DeviceType: Laptop |
   | Similarity Points: 0.85 |
   | OperatingSystem: Windows |
   | Similarity Points: 0.9 |
   | DeviceAge: 1 year |
   | Similarity Points: 0.75 |
   | ModelNumber: ABC123 |
   | Similarity Points: 0.8 |
   | IssueDetails: Unable to connect... |
   | Similarity Points: 0.95 |
...
```

4 Travel Agent - CBR

Throughout the development of the travel agent Case-Based Reasoner, I had several challenges. In the initial stages, parsing the data gave me grave complications, handling user input and outputting cases with the highest similarity scores presented its own set of challenges, along with the calculation of similarities. This process proved to be the most challenging due to not understanding the knowledge engineering portion.

For the similarity metric, I evaluated attributes, including recreation, number of persons, region, transportation, duration, season, and accommodation. For numerical attributes like the number of persons and duration, I used Euclidean Distance normalized, which handled the entire range of possible values. The season attribute incorporates a circular similarity calculation to capture the nature of seasons. All the feature weights were one. The overall process is illustrated in Figure 1 and explained in Section 6.

In the adaptation process, the user has more control over their travel package. This adaption runs after providing the four top results output, it gives the user the option to adjust the number of people, the duration of the trip, or both. Then the system recalculates the price based on these modifications, allowing users to tailor their travel package. Challenges during the price recalculation process were attributed to difficulties in utilizing the correct variables for the desired output, despite having the appropriate logic in place. One of the issues that caused a delay in the developmental process was calculating adaptation prices. Subtracting the number of people resulted in a negative package cost. The example of going from five to two people going on the trip, calculating each person as $50, caused the output to be below zero.

Feature weighting in the code is within the numerical attributes like 'NumberOfPersons' and 'Duration' have customized weightings, while categorical attributes such as 'Recreation' and 'Region' use similarity scores.

5 Conclusion

In building the travel agent Case-Based Reasoner, I learned a lot about how flexible and effective this AI method can be. Figuring things out along the way helped me understand that Case-Based Reasoning adapts well and provides specific solutions based on past experiences. Working with it, I realized how it can be implemented in different instances, like Google Maps or implementing a chatbot customer support diagnostic. These are some examples showing that it's more versatile than I initially thought.

6 Travel Agent Flow Chart Explained

Start: The initiation of the CBR system.
Read CSV File: Reads the travel package data from a CSV file.
Parse Data: parsing data such as package number, recreation type, price, number of persons, region, transportation, duration, season, and accommodation.
Get Customer Input: Prompts the user to input their preferences for specific attributes, including recreation type, number of persons, region, transportation, duration, season, and accommodation.
Calculate Similarity Points: The user's input is compared with the historical travel package data to calculate similarity points for each attribute. Numeric attributes like "Number of Persons" and "Duration" are compared based on a span of values, while categorical attributes are compared using predefined similarity scores.
Sort Similarity Points: Calculated similarity points are used to rank the travel packages in descending order of similarity.
Filter Top Records: Filters and selects the top travel package records with the highest total similarity points.
Display Top Records: The top-rated travel packages, along with their details, are displayed to the user for consideration.
Want to Modify? (Decision): Check whether the user wants to make modifications to their preferences or requirements. If the user chooses to modify, the process returns to the "Get Customer Input" step; otherwise, it proceeds to the end.
End: The "End" node signifies the completion of the CBR process.

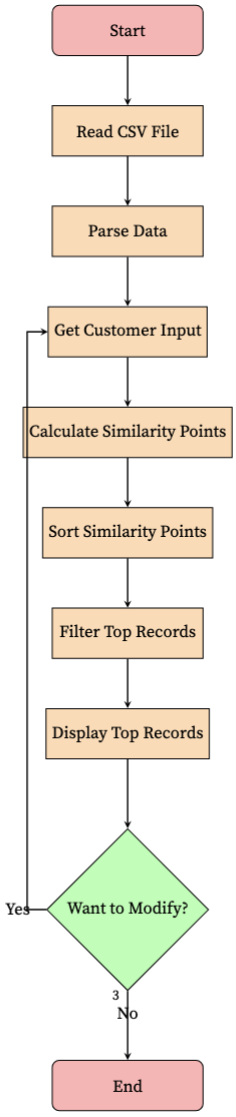

Figure 1: Flow Chart of Travel Agent Process

7 Travel Agent Inputs and Outputs

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Example Input:
{
    'Recreation': 'Bathing',
    'NumberOfPersons': '2',
    'Region': 'Egypt',
    'Transportation': 'Plane',
    'Duration': '14',
    'Season': '2',
    'Accommodation': '3',
}
Example Output:
Top 4 Matching Records:
1. Package Number: 123 - Price: 1200.0
   | Recreation: Bathing |
   | Similarity Points: 0.85 |
   | Region: Egypt |
   | Similarity Points: 0.9 |
   | Transportation: Plane |
   | Similarity Points: 0.8 |
   | Duration: 14 days |
   | Similarity Points: 0.6 |


Top 4 Matching Records:
Customer Input: {'Recreation': 'Bathing', 'NumberOfPersons': '2', '
    Region': 'Egypt', 'Transportation': 'Plane', 'Duration': '14', '
    Season': '2', 'Accommodation': '3'}
1. Package Number: 347 - Price: 485.0
+---------------------------------+
| Matching Package Details:
| Recreation: Recreation |
| Similarity Points: 0.00 |
| Numberofpersons: 2 |
| Similarity Points: 0.82 |
| Region: Holland |
| Similarity Points: 0.00 |
```

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| Transportation: Coach |
| Similarity Points: 0.00 |
| Duration: 3 |
| Similarity Points: 0.83 |
| Season: 1 |
| Similarity Points: -1.00 |
| Accommodation: HolidayFlat |
| Similarity Points: 0.00 |
+---------------------------------+
2. Package Number: 775 - Price: 314.0
+---------------------------------+
| Matching Package Details:
| Recreation: Recreation |
| Similarity Points: 0.00 |
| Numberofpersons: 2 |
| Similarity Points: 0.82 |
| Region: Belgium |
| Similarity Points: 0.00 |
| Transportation: Car |
| Similarity Points: 0.00 |
| Duration: 3 |
| Similarity Points: 0.83 |
| Season: 3 |
| Similarity Points: -1.00 |
| Accommodation: HolidayFlat |
| Similarity Points: 0.00 |
+---------------------------------+
3. Package Number: 679 - Price: 1478.0
+---------------------------------+
| Matching Package Details:
| Recreation: Bathing |
| Similarity Points: 0.00 |
| Numberofpersons: 2 |
| Similarity Points: 0.82 |
| Region: Mallorca |
| Similarity Points: 0.00 |
| Transportation: Plane |
```

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| Similarity Points: 0.00 |
| Duration: 4 |
| Similarity Points: 0.78 |
| Season: 2 |
| Similarity Points: -1.00 |
| Accommodation: FourStars |
| Similarity Points: 0.00 |
+---------------------------------+
4. Package Number: 809 - Price: 339.0
+---------------------------------+
| Matching Package Details:
| Recreation: Active |
| Similarity Points: 0.00 |
| Numberofpersons: 2 |
| Similarity Points: 0.82 |
| Region: Holland |
| Similarity Points: 0.00 |
| Transportation: Car |
| Similarity Points: 0.00 |
| Duration: 4 |
| Similarity Points: 0.78 |
| Season: 3 |
| Similarity Points: -1.00 |
| Accommodation: HolidayFlat |
| Similarity Points: 0.00 |
+---------------------------------+
Do you want to make modifications? (yes/no): yes
Choose what to modify:
 1 - Number of People
 2 - Duration
 3 - Both
Enter your choice (1)(2)(3)): 3
Enter the new number of people: 3
Enter the new duration (in days): 10
Original Price: 485.0
Modified Price: 485.0
Updated Price: 1985.0
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Original Price: 314.0
Modified Price: 314.0
Updated Price: 1814.0

Original Price: 1478.0
Modified Price: 1478.0
Updated Price: 2778.0

Original Price: 339.0
Modified Price: 339.0
Updated Price: 1639.0


Modified Package Details and Price Differences:

Package 347
Changed from 2 people to 3 people. Price difference for people: 50
Changed from 3 days to 10 days. Price difference for duration: 700

Package 775
Changed from 2 people to 3 people. Price difference for people: 50
Changed from 3 days to 10 days. Price difference for duration: 700

Package 679
Changed from 2 people to 3 people. Price difference for people: 50
Changed from 4 days to 10 days. Price difference for duration: 600

Package 809
Changed from 2 people to 3 people. Price difference for people: 50
Changed from 4 days to 10 days. Price difference for duration: 600
```

References

[1] The Decision Lab. *Case-based Reasoning - The Decision Lab*. 2023. URL: https://thedecisionlab.com/reference-guide/philosophy/case-based-reasoning.