Modelling Travel Recommendation Sessions in a Case-Based Reasoning Framework

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1 Problem Statement

There is a continuously growing number of web sites that support a traveller in the selection of a travel destination or a travel service (e.g. flight or hotel). The interaction model, which is currently supported, requires the user to input products' constraint or preferences that are matched by the system in an electronic catalogue. All the major eCommerce web sites dedicated to tourism, such as Expedia, Priceline, Biztravel, TISCover, etc, implement this simple and quite effective pattern.

Actually, planning a travel towards a tourism destination is a complex problem solving activity. The term "destination" itself refers to a ``fuzzy'' concept that lacks a commonly agreed definition. Secondly, the `plan' itself may vary greatly, in the structure and content. For instance, some people search for prepackaged solutions (all included) other ``free riders'' want to select each single travel detail independently. There is a vast literature investigating how the travel planning decision process unfolds and the main decision variables and their relationships [8]. Several choice models have been proposed [2,10,6] (only to quote a few). These models identify two groups of factors which impact on the destination choice: personal and travel features. In the first group there are both socioeconomic factors (age, education, income, etc.) and psychological/cognitive (experience, personality, involvement, etc.). In the second group we could list: travel purpose, travel party size, the length of travel, the distance, the transportation mode.

2 Recommender Systems

The major eCommerce web sites dedicated to travel and tourism have recently started to better cope with leisure travel planning incorporating recommender systems, i.e. applications that provide advice to users about products they might be interested in [3]. Recommender systems for travel planning try to mimic the interactivity observed in traditional counselling sessions with travel agents. The two most successful recommender systems triplehop.com and vacationcoach.com can be classified primary as content-based. The user expresses needs, benefits and constraint using the offered language (attributes) and the system matches this description with items contained in catalogue of destinations (described with the same language). Vacationcoach exploits user profiling by explicitly asking the user to classify himself in one profile (``culture creature'', ``beach bum'', ``trail trekker'', etc.) that apparently induces some implicit needs not provided by the user. The matching engine of TripleHop guesses importance for attributes not explicitly mentioned by the user, combining statistics on past user queries and a prediction computed as a weighted average of importance assigned by similar users [5]. None of these systems can support the user in building a composite travel, e.g. a destination, an accommodation and additional attractions (museum, theater,

etc.). Moreover none of these exploit the knowledge contained in previous counselling sessions stored as cases.

3 Case-Based Reasoning and Session Model

Case-Base Reasoning (CBR) is a cognitively appropriate approach for modelling and explaining human problem solving [9], especially in domains where experience play an important role. Thanks to number of its advantages, this technique has been gaining popularity in recommendation applications [3,4,7]. When confronted a new problem, CBR retrieves a set of similar problems from its case case, which provide a set of viable and potentially useful solutions to the new problem. In case these solutions do not fit to the current situation as desired, that is if reuse of these solutions is not suitable, then they can be adapted to the new problem. The final solution, together with its problem, forms a new Case to be stored in the Case Base to ``improve'' future performance of the system.

The ``problem'' part of a case in a Case Based Recommendation system is the need (or the set of needs) of the user, which turns out to be the wishes of the traveller. So, one of the objectives is to capture these wishes and recommend the item (or an aggregation of a set of items) that best meets them. Actually, we classify the objects to be recommended in this domain as ``Travel Items'' and ``Travel Bags''. A travel item is a basic travel asset like a hotel to stay, a destination to visit, an activity to perform, etc., and a travel bag is a bundle (aggregation) of such travel items. That is, a Travel Bag is a complete travel holding destination, accommodation and additional attractions (museum, theater, sport activities, etc.) all together. None of the existing systems in this domain can support the user in building a complete travel and none of those exploit the knowledge contained in previous counselling sessions stored as cases.

The relativity of the concept of complete travel conveys the difficulty of the adaptation of the knowledge, learned from past experiences, one step further. Indeed, adaptation is still considered as the most difficult step in CBR [12]. We consider adaptation as an updating and personalization procedure (updating the products in the retrieved case(s) with respect to the needs of the current user), for which the similar interaction sessions in the case base, i.e. the Reference Set, provide the most valuable information. Retrieval of these similar cases, adaptation, and briefly the recommendation process will be explained in full paper.

To remedy (or at least to make it easier) the difficulty of getting the required personalization knowledge, acquisition of cases should be done in a careful way, where we believe that a ad hoc session model is the core point. CBR has a long tradition of results and techniques, which are relevant to session modelling, and that originates before the advent of the web and eCommerce applications. In this respect, we have modelled a session interaction as the core of the case, and structured cases as summaries of these interaction sessions.

4 Interactivity and Learning

The natural structure of a Case-Based Recommendation system compels it to be in a continuous learning cycle, where the aim is to improve itself by using the lessons learned from past experiences. In [1], this learning cycle is explained in 5 evolution steps:

- 1. *Retrieve:* Given a problem, retrieve a set of stored cases (e.g. problem-solution couples).
- 2. *Reuse:* Apply one or more solutions from these retrieved cases, perhaps by combining them with each other or with other knowledge sources.

- 3. *Revise:* Adapt the retrieved solution(s), as needed, in an attempt to solve the new problem.
- 4. *Review:* Evaluate the outcome(s) when applying the constructed solution to the current problem. If the outcome is not acceptable, then the solution will require further revision.
- 5. *Retain:* Consider adding the new learned case (a new problem + solution couple) to the case base.

The left part of Figure 1, e.g. (a), covers the mentioned classical CBR cycle, plus an extra step ``6. Iterate" that is particular to our approach. Those that are shown in boxes are the points where we introduce some changes to the classical framework, each of which will be detailed in the full paper. The separation between the left and right parts of the figure (e.g. (a) and (b)) underlines one of the main differences of our approach from the classical ones.

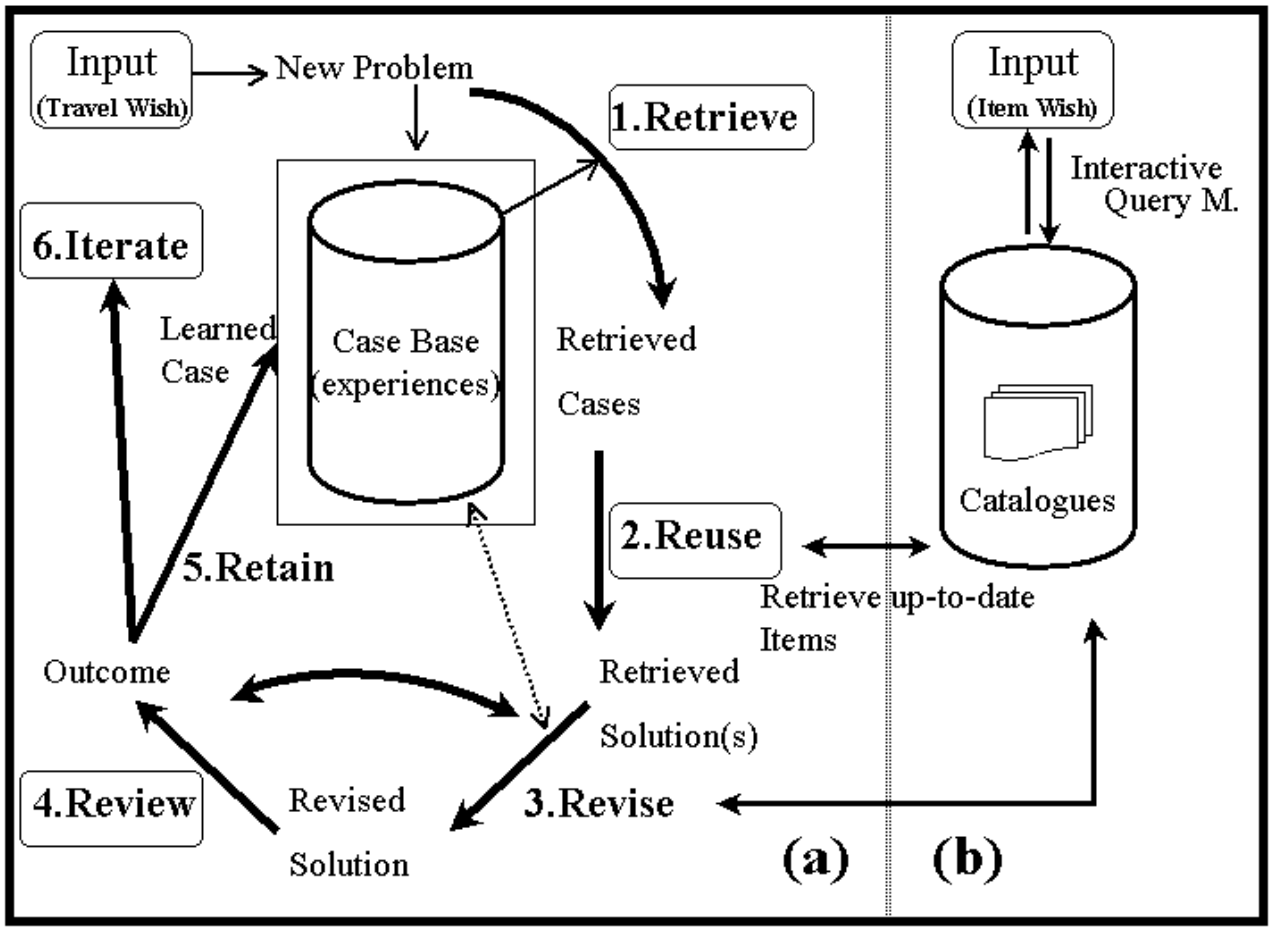

Figure 1: CBR Learning Cycle

The case base contains the structured cases, i.e experienced recommendation sessions. The Travel Items selected in a recommendation session, i.e. the items that forms the Travel Bag are actually pointers to items in catalogues. The case base provides information about good bundling of products and is therefore used for learning this knowledge and for ranking items selected in the catalogues. The catalogues are exploited for obtaining up-to-date information about currently available services. So, both the case base and the catalogues are exploited in our CBR approach for a better personalization and hence user satisfaction performance.

The purpose of this paper is to describe our approach to imposition and exploitation of the session modeling, by which the target is to facilitate and expedite the reuse and adaptation of session

information for the personalization of the recommendation process. With this purpose we will explain a Knowledge intensive session modelling and mixed initiative recommendation process introduced in the CBR framework. The advantages of this technology, with respect to traditional web logs plus Data Mining and statistical tools, are shown. Similarity of sessions is the fuel for personalized recommendations (dynamic reference set computation). The applications of these ideas to an ongoing project are described (DieToRecs IST-2000-29474). Note that the underlined approach, is the extension of the one that has been implemented in an other Case-Based Recommendation system, Intelligent Travel Recommendation System (ITR), details of which can be seen in [11].

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