Knowledge Acquisition for Life Counseling

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Abstract. In this paper, we explain how highly unstructured domain knowledge can be acquired and integrated in a case-based reasoning system. We apply our approach to the life counseling domain. We introduce the two steps of our knowledge acquisition approach in such unstructured domains. The first step is manual and relies on domain experts. The second step is automatic and uses information extraction techniques. Our approach has the potential to contribute to the formalizing and establishing of an important subset of life counseling terminology. In addition, our approach could serve as an example for comparable weak theory domains.

1 Introduction

Case-Based Reasoning (CBR) is a methodology for problem solving based on the fact that previously experienced knowledge can be used to solve new problems [1]. It has been successfully applied in different domains like for example medicine [2], help-desk [3] or technical diagnosis [4]. The needed knowledge used in a CBR system is stored in the so-called knowledge containers (vocabulary, similarity measures, adaptation knowledge and the case base) [5]. The amount of knowledge available for each container depends on the application domain. For application domains, in which a certain level of formalization is already achieved, it might be easier to fill the vocabulary and similarity measures containers. Whereas it might be easier to fill the case base container in unformalized and/or unstructured application domains.
Our application SeBaPort (Portal for counseling, in German Seelsorge- und Beratungsportal) deals with life counseling. Life counseling deals with the wellbeing of humans. Life counselors conduct converstions with consulters, give advices and help them to help themselves. Counselors often rely on past expriences for the counseling. The goal of SeBaPort is to help counselors by providing them with counseling cases (depending on their requests), which they can learn from. This makes CBR an ideal methodology to process the knowledge used in that domain.
Life counseling is a domain which is highly unstructured. This makes it very difficult to develop a CBR system for life counseling and be able to provide knowledge in the previously mentioned knowledge containers. For this application domain, we would have to develop an initial set of vocabulary and similarity

measures, and also find a methodology to process the available (unstructured) cases and store them in our case base. SeBaPort does not aim at providing solutions for a given counsel or problem, primarily because the acceptance of the counselors would significantly diminish, if we claim to be able to provide complete solutions to counseling problems.
In order to build a life counseling CBR system, we started by developing an initial CBR model and acquiring structured cases. In this paper, we describe in Section 3 how we designed our initial CBR model and our approach for the acquisition of (structured) cases in Section 4. Afterwards we will present some related work in Section 5 and will conclude the paper in Section 6. In the next section, we will first give an elaborate presentation of the life counseling domain.

2 Life Counseling

Life counseling is concerned with the welfare of human beings, more precisely the thinking, feeling, acting, and also the faith of persons. Life counselors help people deal with their problems and conflicts. They conduct several counseling interviews with the consulters. The main idea is to help people help themselves by having several discussions with them, give them multiple views on their problem and give them basic hints. Life counselors for example give exercises, which are part of a counseling method, to consulters after an interview. During the following interviews, they try to find out, whether it helped the consulter or it should be changed.
In order to do that, counselors themselves mainly rely on their experience in the domain, but also on the methodical knowledge they learned during their formation. They are grouped in small communities to share their experiences. As they do not only build on self-made experiences but also on those from others, they often rely on peer consulting and supervision to critically analyse past cases (and be able to learn from them). Further they contact other colleagues when they need help in an actual or past counseling case. Such help might comprise a whole counseling case or just information about parts or aspects (e.g., the method or exercise that can be used in a given situation) of life counseling.
Our goal is to provide a system that can be used to help life counselors in their work. We want to provide a decision support system that helps the counselors to document and share their experiences. They would also learn new cases from others and be able to find hints and references (e.g., to counseling methods) while looking for help (when they deal with a given case). The intended functionality of our system is presented in figure 1 on the basis of the CBR cycle.

An example of the description of the patient's problem in a documented case is given below.

> Woman, 48 years old, married and 3 children: 12, 15 and 18 years old. She has been working shifts as a full-time midwife for 2 years. She attends counseling because of insomnia due to her often alternating shift work. She has particularly problems with insomnia after night shifts. She

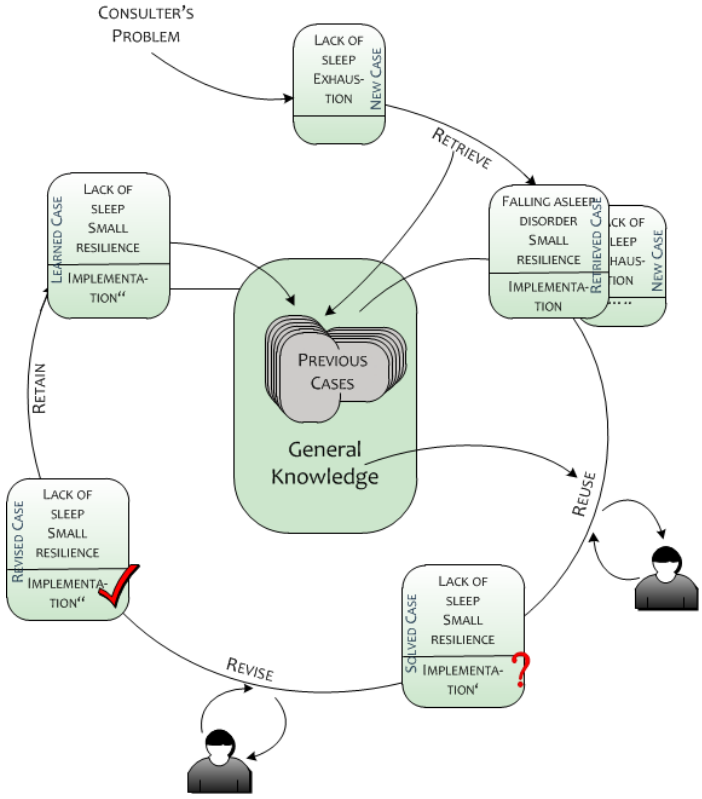

Fig. 1. CBR Cycle in Life Counseling

cannot ignore surrounding noises and she cannot completely darken her bedroom. As a consequence of this, she is often tired, is not able to work under pressure and suffers from headaches.

The documentation of the case also contains the documentation of each interview with for example the applied methods, goal validation and solution interventions.

3 Case Model for Life Counseling

When developing CBR systems, one of the first challenges is to fill the knowledge containers. We have to evaluate which kind of knowledge is availaible in order to know which containers can be filled. In life counseling, the knowledge that is easier to acquire is the experiences made by the experts represented as cases. Due to lack of formalization in the domain, we need to find a way to extract formalized knowledge from the available cases. For that, we want to structure the information contained in cases.

Section	Subsection	Parameters
Anamnesis	Personal data	gender, age, nationality, marital status, children, housing situation, religion, relevant pre-existing illnesses, treatments and therapies, medication,
	Biography	origin family, present family, close persons, life crises, life breach crises, graduation, career, financial security
Relationship		(relations between the consulters, if there were at least two in the counseling session)
Problem review		cause, symptoms, further effects, suffering level, suffering description, first appearance and development, previous approaches, inner resources, outer resources
Mandate		whose idea, who has the problem, expectations, indications for success, counselor's decision
Goal review		primary goal, secondary goal, planning, goal verification, goal restatement
Setting		counseling mode, place, unit length, number of sessions, frequency, recording, global information
History		solution interventions, applied methods, goal validation, past approaches

Fig. 2. Structure of a life counseling case

Most experts have their own way to write down their cases. Furthermore, the cases do not contain the same kind of information, have different levels of detail and elaborateness. It is thus nearly impossible to automatically detect a structure in raw cases.

Our approach to structure the available cases is to get the needed information from the experts. Instead of getting unstructured cases, we want to be able to get semi-structured cases from the experts. For that purpose, we elaborated a structure that should be used by the experts. The used structure has to reflect the way of thinking of life counselors. We thus have to involve experts in order to define such a structure.

Table 2 shows the structure for life counseling cases that we developed. It is based on a preliminary study done with domain experts (i.e. counselors) [6]. We validated the structure by comparing it with a doctor's report used in a clinic for psychotherapy and psychosomatic medicine. It shows that a case can contain a multitude of information. Although a given case must not contain all possible information (i.e. each parameter of the structure must not be filled), it would be very difficult to automatically map the knowledge from a given case to the parameters. We used the defined case structure to develop a CBR model with an initial vocabulary and an initial set of similarity measures. The CBR model is more detailled, so we can have a better description of the cases and also more

precise similarity measures. For example, the medication (in personal data) has following attributes:

- the name of the medication,
- the generic type,
- the active substance,
- the daily dosage, etc.

As another example, the CBR has attributes for the number of children as well as the gender and the age of each children.

4 Two-Step Case Acquisition

Now that we defined a case model, the next challenge is to fill our case base with life counseling cases following the model. Unfortunately, counselors do not have a formal manner to document their cases. This leads to unstructured case descriptions. In order to be able to use those cases in our CBR system, we have to find methods to formalize the existing knowledge (i.e. cases). This is a difficult task because of the diversity of information available in a case, as can be seen in the last section. Our approch for the knowledge acquisition consists of two steps.

The goal of the first step is to organize the available information. This is a manual step in which the available diversified information is mapped to the structure defined in Section 3. We rely on domain experts to cope with this assignment. In SeBaPort, this step is realized by providing experts with web forms, which can be used to enter the cases. At the end of this step, we have a case description that matches the structure defined in Table 2.

The second step of the knowledge acquisition is automatic and consists of using information extraction to obtain structured CBR cases. The complexity of this step depends on the type of information given by the experts in the first step. Some information, like the gender or the nationality of the patients can be easily matched to a formal case model. Other, like the medication or the children, need more effort for the formalization. For example, the way information about medication is given differs from one expert to another and can be more or less expressive. Nevertheless we have to be able to match the natural language description of the medication information to our formal model which contains the additional attributes defined at the end of Section 3. Another example is the attribute children, for which the same holds. From the given description, we have to be able to identify, if given, the number of children, the age and/or gender of each children and so on. In the example given in Section 2, we would identify 3 children and the ages of the children. However, the gender are not documented. We used information extraction techniques provided by the component ANNIE of the framework GATE (see [7]) to tackle this challenge.

Another goal we pursue in SeBaPort, is to be able to learn from the acquired cases in order to formalize the application domain. We thus want to perform a stepwise knowledge formalization for life counseling. This has to be done from

scratch because the domain, as explained earlier, is highly unstructured. We are actually trying to gain the formalized knowledge from the acquired cases. The purpose is to be able to tackle the fact that there are not only several ways to document a counseling case, but also different counseling perspective. The representatives of each perspective often have problems to deal with case documentations from other perspectives. A formaliztion like the one we are targeting would promote the intercommunication between the representatives of the diffent perspectives.

5 Related Work

The idea of using CBR in medical related domains has been explored in the last couple of years. In [2] the authors present four recent CBR applications in different medical domains. The applications deal with:

- Long-term follow-up of oncology patients
- Assistance of type 1 Diabetes patients
- Support of physicians in the domain of end stage renal disease
- Diagnosis and treatment of stress.

There have been many other CBR applications in medical domains. Nevertheless, to our knowledge, SeBaPort is the first one to deal with life counseling.
As for knowledge formalization, there are also other approaches that deal with that topic. One of them is the knowledge formalization continuum presented in [8]. The authors present a process for knowledge development based on a flexible organization of knowledge. The main difference between our aproach and this one (as well as many other knowledge formalization approaches) is that the only initially available knowledge in life counseling are the unstructured case descriptions. That is, our inital information can hardly be used for learning, classification or even formalization.
In [9], the authors present an approach for knowledge extraction from data taken from forums, which are communities of experts. This approach relies on a initial auxiliary data to extract the knowledge and uses the extracted knowledge to improve the knowledge extraction.

6 Conlusion

In this paper, we presented the domain of life counseling and how the available knowledge can be used to develop a CBR system (SeBaPort). SeBaPort will help life counselors to extend their knowledge and learn from past cases. We showed how we are actually extracting the knowledge from available cases and we want to use it for the knowledge formalization. We intend to test our knowledge acquisition by evaluating the similarity measures with the acquired cases. The evaluation is still an ongoing work. Furthermore we will develop an approach to incorporate experts' feedback to our formalization process.

References

1. Aamodt, A., Plaza, E.: Case-based reasoning : Foundational issues, methodological variations, and system approaches. AI Communications **1**(7) (March 1994)
2. Marling, C., Montani, S., Bichindaritz, I., Funk, P.: Synergistic case-based reasoning in medical domains. Expert Systems with Applications (2013)
3. Roth-Berghofer, T.: Learning from homer, a case-based help desk support system. In Melnik, G., Holz, H., eds.: Advances in Learning Software Organizations. Volume 3096 of Lecture Notes in Computer Science. Springer Berlin Heidelberg (2004) 88–97
4. Althoff, K.D.: Machine Learning and Knowledge Acquisition in a Computational Architecture for Fault Diagnosis in Engineering Systems. In Weintraub, M., ed.: Proc. International Machine Learning Conference (ML92), Workshop on "Computational Architectures for Supporting Machine Learning and Knowledge Acquisition". (1992)
5. Richter, M.M.: Fallbasiertes Schließen. In: Handbuch der Künstlichen Intelligenz. Oldenbourg Wissenschaftsverlag Verlag (2003) 407–430
6. Newo, R., Althoff, K.D., Bach, K., Althoff, M., Zirkel-Bayer, R.: Case-Based Reasoning for Supporting Life Counselors. In Cassens, J., Roth-Berghofer, T., Kofod-Petersen, A., Massie, S., Chakraborti, S., eds.: Proceedings of the Workshop on Human-Centered and Cognitive Approaches to CBR at the ICCBR 2011. (Sept 2011)
7. Cunningham, H., Maynard, D., Bontcheva, K., Tablan, V.: GATE: A Framework and Graphical Development Environment for Robust NLP Tools and Applications. In: Proceedings of the 40th Anniversary Meeting of the Association for Computational Linguistics (ACL'02). (2002)
8. Baumeister, J., Reutelshoefer, J., Puppe, F.: Engineering intelligent systems on the knowledge formalization continuum. International Journal of Applied Mathematics and Computer Science (AMCS) **21**(1) (2011)
9. Bach, K., Sauer, C.S., Althoff, K.D.: Deriving case base vocabulary from web community data. In Marling, C., ed.: ICCBR-2010 Workshop Proceedings: Workshop on Reasonng From Experiences On The Web. (2010) 111–120