Learning to Cope with Critical Situations - An Agent based Approach

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Abstract. How does someone react when he faces a critical situation in his life? In this paper we present an initial initial implementation architecture based on a simulation model described in [10] In our model we mainly consider the interactions between a person concerned and factors like his environment and his own abilities. Using the empolis information access suite, we currently implement our model by means of a multiagent system approach, realized by distributed knowledge-based systems with a specific focus on case-based reasoning technology.

1 Introduction

In our everyday life, we consistently face situations which pose more or less immense challenges. Examples can be the breakup with a partner, the loss of a job, an illness or even the death of a relative. As different as those challenges can be, the reactions of the persons who are facing the same kind of challenges can be very different as well. The problem consists in finding out, how someone reacts when he/she faces up a given challenge. The problem being a psychological one, there have been many research groups in psychology working in that direction, beginning in the early 1980s. They developed psychological models and paradigms in order to represent and analyse people's behaviours as well as theories, sotware-based models, and simulation approaches.
In this paper, we present an agent-based approach for the representation and simulation of human behaviours in critical situations. For this purpose we developed - in cooperation with Werner Greve (Institute of Psychology, University of Hildesheim[1]) - the SIMOCOSTS (SImulation MOdel for COping STrategy Selection) model. In the SIMOCOSTS project we are actually aiming at a threefold goal, namely (1) developing a research software tool for supporting psychologists, who are working on cognitive modelling and learning as roughly described above, in their research work, (2) realizing what we call "collaborative multi-expert-systems" (CoMES; see below), and (3) instantiating the SEASALT software architecture we developed in our research lab as a first step towards realizing CoMES. In this paper, we elaborate on how we currently intend to implement our simulation while focussing on the representation of the needed

[1] http://www.uni-hildesheim.de/psychologie/mitglieder/werner_greve.htm

knowledge.
In the next section, we will shortly introduce CoMES and SEASALT and discuss related work. We describe the SIMOCOSTS model, its functionality, the developed knowledge representation and processing in Section 3, and the status of its implementation in Section 4. Finally in Section 5 we give a short outlook on relevant future work.

2 Background and related work

In this section we shortly explain the underlying CoMES approach and its first instantiation via the SEASALT architecture. Related work from the areas of cognitive architectures, coping processes, and other related psychological areas can be found in [10] and [9].

2.1 Collaborative Multi-Expert-Systems

Collaborative Multi-Expert-Systems (CoMES, see also [2]) denote a new research approach that is both, a continuation of the well-known expert system approach and a research direction based on the ideas of case factory and knowledge-line [3]. In the Knowledge-line concept we systematically apply the software product-line approach [11] from software engineering to the knowledge of knowledge-based systems. This enables the necessary "knowledge level modularization" for building potential variants in the sense of software product-lines. The modularization can be achieved by making use of multi-agent systems [6, 12] as a basic approach for knowledge-based systems. An intelligent agent - as a first approximation - is implemented as a case-based reasoning (CBR) system [1], which, besides case-specific knowledge, can also include other kinds of knowledge. Each CBR agent is embedded in a case factory [3] that is responsible for all necessary knowledge processes like knowledge inflow, knowledge outflow as well as knowledge analysis.

While many early (and also some current) expert systems had the problem of acquiring and maintaining their knowledge, the underlying idea in CoMES is to "develop CoMES where knowledge is produced". Another idea is to keep the resulting learning scenarios/tasks as simple as possible, thus having more agents and having each one learning in a rather simple way.

2.2 Sharing experience using an agent based system architecture layout

A first step towards realizing the CoMES approach is the SEASALT (Sharing Experience using an Agent based System Architecture LayouT) architecture. The architecture can be vertically split in two parts as can be seen in Figure 1. On the left hand side the knowledge provision and on the right hand side the knowledge acquisition. For the current stage of the SIMOCOSTS project we focus on the knowledge provision part only (a more detailed description of

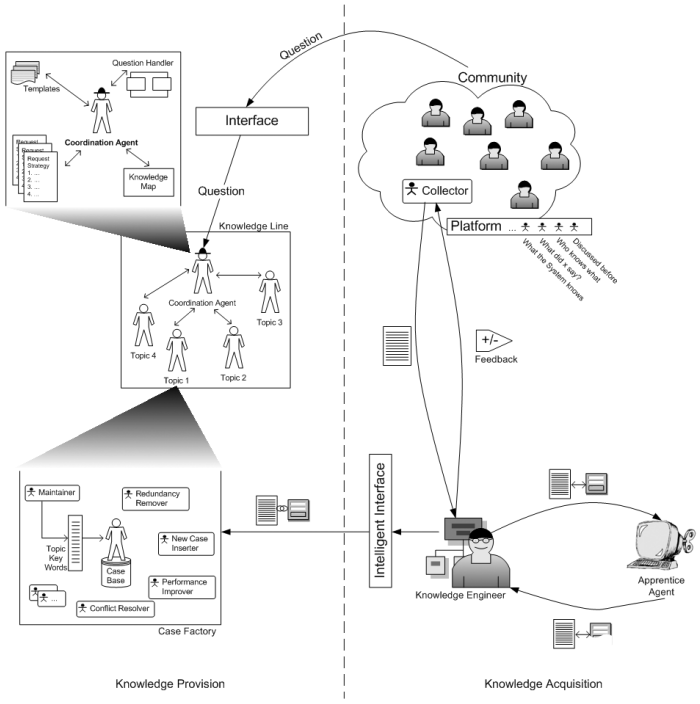

Fig. 1. The SEASALT Architecture

SEASALT is given in [4]). If a user enters a question using the Interface, it passes the question on to the Coordination Agent. The Coordination Agent analyzes the question, looks up the matching Topic Agent(s) and sends its requests to them. A response based on the existing case base is created by each Topic Agent and passed back to the Coordination Agent. Finally, the response of the Topic Agents is used by the Coordination Agent to compile an answer.

3 A Simulation Model for Coping Strategies

SIMOCOSTS (SImulation MOdel for COping STrategy Selection) is the underlying model for our simulation. The model is based on the psychological theories developed by Brandstädter and Greve [5]. One main difference between our simulation approach and other ones consists in the fact that all the other view the respective persons as agents. But we intend to represent a person with many agents while following the holonian concept [8] in order to have a detailled and agent-based representation of each individual. A detailled picture and description of the model can be found in [9] and [10]

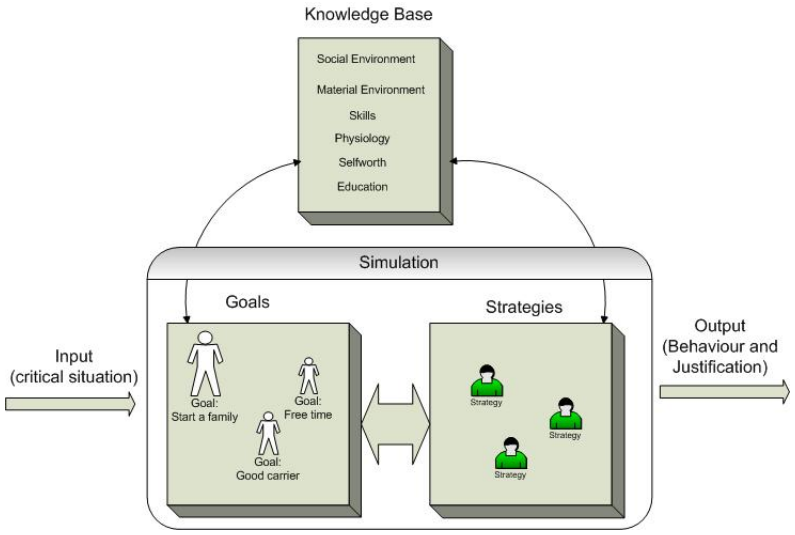

Fig. 2. The Implementation Architecture of SIMOCOSTS

4 An Implementation Architecture for the Simulation of Coping Strategies

We developed the model mentioned in the previous Section with a main focus on the processes needed for the simulation. The main drawback of that model is that it is not suitable for an (initial) implementation. We thus present in this Section the implementation architecture of our simulation tool. We want to start with a rather simple architecture which will be later expanded, because of the complexity of the task. The main idea of our architecture is based on the fact that each person has some goals that he wants to achieve (see [10]). In our scenario, a critical situation occurs when there exist some facts that prevent the person from reaching those goals.
As we know, human acts (especially while loosing problems) is mostly based on past experiences. For our purpose, the achievement of goals as well as the general knowledge that will be used for the achievement of the goals will be based on past experiences. That is why we will make use of the case-base reasoning technology in our implementation. Furthermore, we will implement the goals by using the so called practical reasoning agents paradigm [13], which is based on the Belief-Desire-Intention (BDI) principle.
Our architecture (see Figure 2) consists of the three main following parts.

Knowledge Base The knowledge base consists of all the general knowledge, that can be helpful while loosing the problem. That knowledge include skills, material and/or social environment, etc. We plan to use many differents case

bases for the different case bases for the distinct parts of the general knowledge needed (e.g. skills).

The Strategies In our architecture, the strategies represent the actions (in analogy to BDI agents) that can be used for the computation of the plan in the means-ends reasoning stage. These actions mostly have an impact on the knowledge base defined earlier (e.g. the acquisition of a new skill) as well as on the internal goals (i.e. adaptation of the goals). We plan to implement those strategies as rules in a case-base reasoning system.

The (internals) Goals The initial goals of the person are the initial beliefs of the agents which are used for the computation of the intentions when a critical situation occurs. Each agent is responsible for analyzing if its goals are still reachable (i.e. there is no critical situation). , we will implement the goals as cases in a case-base reasoning system.
When a situation is judged as critical, each affected goal try to find out how it can be achieved. The achievement is done by using the strategies, which are based on the general knowledge of the person. Actually we started to build, using CBR, a knowledge base needed for a specific example (i.e. breakup of a partner). This has to be very sound in order to have a plausible simulation. We plan to use the Information Access Suite of empolis [7] GmBH for the realization of our architecture, because it is a powerful tool which gives us the possibility to handle case bases as well as rules.

4.1 Classification of the Architecture

Our Architecture follows the principle of the CoMES approach introduced in Section 2.1 and leans on the SEASALT architecture which we presented in Section 2.2. We have a knowledge line in our implementation architecture which contains the three parts presented above. In fact, the knowledge line in our architecture can be seen as all the informations needed to represent a person. We thereby achieve the reusability which is important while developing a knowledge line in terms of CoMES.
As for the similarities with the SEASALT architecture, we will also have a community which will consist of experts in the area of psychology. The goals can be seen as the topic agents in SEASALT and we also a knowledge engineer whose task will be the acquisition of the information needed for a person. We also have a distributed architecture because it is based on the CoMES approach.

5 Outlook and Conclusion

In this paper, we presented an architecture for the implementation of the simulation of coping processes. After the introduction of the CoMES approach and the SEASALT architecture, we presented our an implementation architecture

based on the SIMOCOSTS model. Our implementation will be based on two main technologies, namely case base reasoning and multi-agent systems, while following the CoMES approach.
Further work include an accurate specification of the knowledge base an its implementation as well as the implementation of strategies and goals for given examples.

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