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Expert Systems-New /Advanced Industrial Engineering Perspective

Expert System Based on Composition of Rule Based and Case Based Resonaing System

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***Abstract*:**

The expert-system-based automated process planning systems are prevalent in Manufacturing and become state of the art tool of successful Industrial Engineers. The author attempted to utilize the concepts of New/advanced Industrial Engineering to apply the capabilities of information technology to redesign business processes in educational institution to improve the cost, time, and quality of its process by embedding the knowledge of its best decision makers/experts in a "Teaching/learning expert system including scholarship authorization" as part of overall Director Academics Software.

In the paper, author proposes a concept of software realization of an expert system by assembling experts experience in Personal Computer as knowledge base on the hypothesis that 'knowledge never dies', once we adopt the knowledge of some experts and use it in our system, it works more efficient than a simple work routine.

Director Academics is a tool designed and created for Head of institutions. Here author explored his work in the field of Expert System development, especially what he experiences by working in the Institute and what he learns while he worked under professors. The proposed paper is based on the Rule Based and Case Based Reasoning. In the last author explored his and his seniors' experiences.

Keywords:- case based; rule based; resoaning; academic; expert system;new/advanced industrial engineering

1 INTRODUCTION

Teams striving to get better the way work is done must begin to apply the proficiencies of information technology to redesign business processes. Currently we are living in the age of dynamic evolution and in this situation the requirement of industries/service organizations changes at a much faster speed. In the present scenario the academic organizations faces more complex problem for conventional approaches. To illustrate it, when we contrast Case Based Reasoning (CBR) with Rule Based System, we see that the methodology for building and

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refining Knowledge Base (KB) is more sophisticated than the syntactic checks performed by the Rule Based method. The augmentation of Rule Based System with Case Based Reasoning allows us to handle exceptions gracefully, without making a rule set overly complicated.

A rule, by definition, is meant to capture generalization; it loses its power if it is heavily qualified. It attempts to handle the problems within the framework of mathematical logic have not yielded practical results. Case Based Reasoning provides a mechanism for domain-dependent inference that fills a gap in our proposed toolkit. In the proposed case, we would demonstrate the strength of CBR and its advantages to integrate the CBR with the present systems prevalent with industry/ service organizations and challenge the status quo that "AI software is mostly platform dependent and implemented in environment that no one outside of AI communities uses". Further this paper presents the Case Based Reasoning, as an alternative approach to the purely rule-based method, to build a decision support system. Software development for the given problem enables the system to tackle problems like high complexity, low experienced new staff and changing industrial/service conditions.

In the present system scenario the purely rule-based method has its limitations like; requirement of explicit knowledge in details of each domain hence takes years to build Knowledge Base (KB). Case Based Reasoning uses facts in the form of specific cases to solve a new problem, and the proposed solution is based on the similarities between the new problem and the available cases. In this paper we present a Case Based Reasoning which provides decision support for all domains unlike rule-based inference models which are highly domain knowledge specific. Experiments with real data clearly demonstrate the efficiency of the proposed method.

The proposed solutions given in this paper is based on Expert Systems (ES), to solve complicated practical problems in the academic sectors of the world are becoming more and more widespread nowadays. Expert systems are being developed and deployed worldwide innumerable applications, mainly because of their explanation capabilities.

2. The New Industrial Engineering: Information Technology and Business Process Redesign

Teams striving to IMPROVE the way work is done must begin to apply the competencies of information technology to redesign business processes. Business process design and information technology are predictable companions, yet industrial engineers have never fully utilized their relationship. The experts argue, in fact, that it has scarcely been exploited at all. But the organizations that *have* used IT to redesign boundary-crossing, customer-driven processes have benefited immensely.

Two new tools are renovating organizations for effectiveness to the degree that Taylorism once did. These are *information technology*–the capabilities offered by computers, software applications, and telecommunications–and *business process redesign*–the analysis and design of work flows and processes within and between organizations. Working together, these tools have the potential to create a new type of industrial engineering, changing the way the discipline is practiced and the skills necessary to practice it.

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2 WHAT IS CASE-BASED REASONING

Case-based reasoning is used to solve problems by remembering a previous similar situation and by reusing information and knowledge of that situation. Let us illustrate this by following block diagram to solve the problem at some typical problem solving situations.

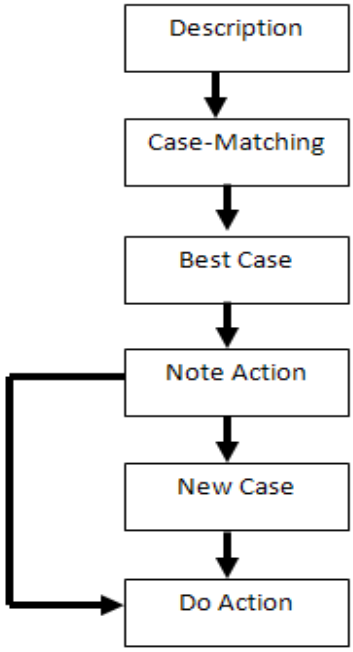

FIG. 1: Flow Diagram for Case-Based Reasoning.

A case-based reasoning (CBR) system generally refers to a computer programmed system that identifies a solution to a current problem by examining the descriptions of similar, previously encountered problems and their associated solutions. Matching the current problem with one or more similar previously encountered problems and using the associated solutions of the matching previously encountered problems to suggest a solution to the current problem. In response to that the receipt of a description of a current problem, a conventional CBR system retrieves the closest matching cases from a case database using a search engine and iteratively asked the user for additional descriptive information until the retrieved case or cases identified by the search engine are sufficiently similar to the current problem to be considered as possible solutions. If a new solution (not previously stored in the case database) is subsequently validated, the validated solution can be stored into the case database and utilized to solve future problems.

3 PREVIOUS WORK

While in present scenario computers are capable of tremendous processing power, their ability to use that processing power for reasoning about complex problems has so far been limited because of the limitation of searching and retrieval power of the system. Generally, before a computer can be used to address a complex problem, such as one which requires the attention of a human expert, it has been necessary to distill the knowledge of that expert into a set of inferential rules (a "rule base") which allow an automated processor to reason in a limited field of application. While this method has been effective in some cases, it has the natural drawback that it often requires a substantial amount of time and effort, by both computer software engineers and experts in the particular field of application, to produce a useful product.

Moreover, rule-based systems of this type present a difficult programming task. Unlike more prosaic programming tasks, constructing a rule base is sometimes counterintuitive, and may be beyond the ability of many application programmers. And once a rule-based system has been constructed based on the knowledge of a human expert, it may be difficult to accommodate Changes in the field

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of operation in which the processor must operate. Such changes might comprise advances in knowledge about the application field, additional tasks which are intended for the processor, or changes in or discoveries about the scope of the application field.

One proposed method of the prior art is to build automated reasoning systems which operate by reference to a set of exemplar cases (a "case base"), to which the facts of a particular situation (the "problem") may be matched. The processor may then perform the same action for the problem as in the exemplar case. While this proposal has been well-received, there have been several obstacles to successful implementation of a case-based reasoning system. One obstacle has been the lack of a feature matching technique which would be successful when applied to a case base of reasonable size. Another obstacle is that case-based reasoning can be relatively inflexible when the case base is insufficiently rich.

4 DIRECTOR-ACADEMICS

The author has designed a Desktop Expert System named Director -Academics, by working closely with IIT Professor Dr. G.S Yadava when he was the Director of an Engineering College on deputation in Faridabad, Haryana-India. Now the author himself is a Director and using the said Expert System based on Case Base Reasoning for Academic Excellence. Although Dr G. S. Yadava is not available physically but his expertise in the form of Expert System is available with the system always, 24 hours 7 days a week.

In current scenario Head of Institutions needs as much documents for different affiliations, like university affiliation, new course offers, NBA (National Board of Accreditation) Certificate etc. As a head of institute the author feels much problem to collect the information from his followers and represent them according to need. In this way the author collects his problems and there prospective solutions as well as his seniors expertise in rule based manner to design an Expert System.

5 WORKING OF DIRECTOR ACADEMICS

(Proposed Expert System)

Director Academics expert system is based on the principles of Case Based and Rule Based Reasoning system. As like others expert system it also stores the cases and corresponding decisions in Knowledge Base (Case Base).

When a problem encounters through the system, the processor may searches the best matching case among the stored cases in Case Base. As per rule of uncertainty, we know that no two problems are same, but it may be similar in some property. The Director Academics system searches the best matching case by Nearest Neighbor Algorithm based on the similar properties of the cases. Which case is almost similar to the encountered case/ problem may be selected and the corresponding decision stored with selected case is taken as the expert advice. In some cases when system did not find the best suitable case for any problem it may update the knowledge base with new case and corresponding decision. The new case and decision may be combination of two or more than two cases stored in the knowledge base.

6 SUPPORT FOR TEACHING LEARNING PROCESS

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In current scenario of getting accreditation and certification from different managing organization is very tough for institution. The accreditation agencies may ask for a lot of documents related to courses running in institute. These documents may include the syllabus, lecture planes with expected date of teaching and actual date of teaching with number of students present in the class.

At the time of accreditation the Head of Department/ Institute requires these documents at a time. Director Academics helps them to get these documents. In the system the faculties may update the course file and lecture planes regularly, so that the head may get the updated information every time when he need.

Director Academics also have the provision of getting feedback of students and faculties time to time. It helps to decide what steps needed to improve the performance of student and faculty. In the feedback system students and faculty submit the course report to the system; feedbacks are based on some specific questioner regarding the subject, teaching methodology of faculty, grasping power of students, course material provided by authority etc. If the feedback will not be satisfactory, the system generates decision may be taken to improve the performance of the same.

7 LEARNING IN CASE-BASED REASONING

Many of the community working in the field of education have put their effort in classroom practices that put students into situations where they must make hypotheses, collect data, and determine which data to use in the process of solving a problem or participating in some kind of realistic analysis or investigation. Research in Case Based Reasoning (CBR), provides a plausible model of learning from problem solving situations, it makes suggestions about education that are consistent with current educational theories and methodologies and provides added concreteness and detail. It shows that how CBR's suggestions can enhance problem-based learning (PBL), which is already a well-worked-out and successful approach to education.

The computational accounts CBR provides of reasoning activities, especially of knowledge access, access to old experiences (cases), and use of old experiences in reasoning, suggest guidelines about materials that should be made available as resources, the kinds of reflection that will promote transfer, qualities of good problems, qualities of the environment in which problems are solved.

8 THE CBR CYCLE

CBR cycle can be represented as the following comparative graph. As we see in the figure 2. given below we can say that when the number of cases is more, the effort for retrieval is also high and vice versa, and ease of adoption is also high when no. of cases are high, or we can say that the effort for retrieval and ease of adoption is directly proportional to the number of cases. But when we see the proportionality between efforts for retrieval and ease of adoption it is reverse, when the Ease of adoption is low effort of retrieval is high and vice versa.

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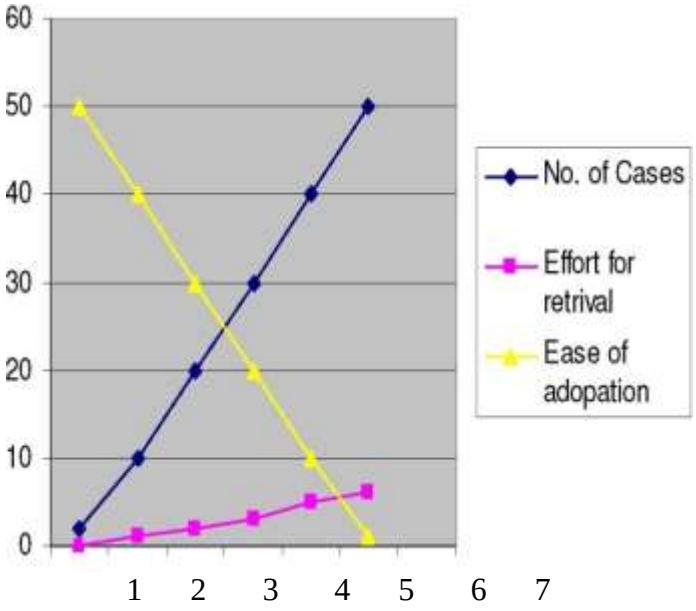

Fig. 2: Proportionality of No. Cases with Ease of adoption and Effort for Retrieval

In the above figure X-axis gives the scale for no. of cases and ease of retrieval and Y-axis gives the scale for effort for retrieval.

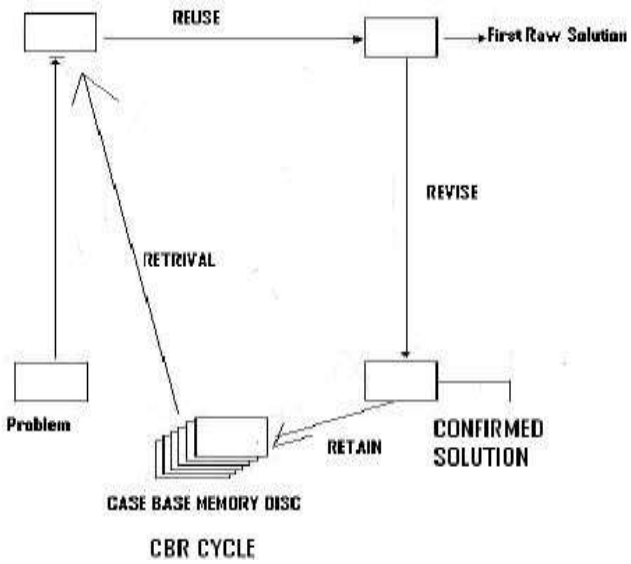

Fig. 3: CBR Cycle.

9 WORKING OF CBR BASED EXPERT SYSTEM

In the beginning CBR process number of cases is limited, most of the times we need to modify the solution but as the experience increases, the probability of similar or near similar case would increase. In normal times, a new problem is analyzed against cases in the Knowledge Base and one or more similar cases are retrieved. A solution suggested by the matching cases is then reused and tested for success. Unless the retrieved case is a close match, the solution will probably have to be revised producing a new case that can be retained.

The CBR cycle presented above occurs without human intervention. For example many CBR tools act primarily as case retrieval and reuse systems. Case revision (i.e., adaptation) is often being undertaken by managers of the Knowledge Base. However, it should not be viewed as weakness of CBR that encourages human collaboration in decision support. The following sections will outline how each process in the cycle can be handled.

A C**ase** is a piece of knowledge representing with experience. It contains the past solution that is the content of the case and the context in which the solution may be used. Typically a case comprises:

- The problem that describes the state of the world when the case occurred,
- The solution which states the derived solution to that problem, and/or
- There is a lack of consensus within the CBR community as to exactly what information should be in a case. However, two pragmatic measures can be taken into account in deciding what should be represented in cases: the functionality and the ease of acquisition of the information represented in the case.

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9.1 Retrieval

The issue of choosing the best matching case has been addressed by research into analogy. This approach involves using heuristics to constrain and direct the search. Several algorithms have been implemented to retrieve appropriate cases, for example: serial search, hierarchical search and simulated parallel search. Case-based reasoning will be efficient for large scale problems only when retrieval algorithms used in the system are efficient at handling thousands of cases. Unlike database searches that target a specific value in a record, retrieval of cases from the Knowledge Base must be equipped with heuristics that perform partial matches, since in general there is no existing case that exactly matches the new case. Some of the well known methods for case retrieval are discussed below:

9.2 Nearest neighbor

This approach involves the assessment of similarity between stored cases and the new input case, based on matching of weighted sum of features. The biggest problem occurred here is that, to determine the weights of the features. The limitation of this approach includes problems in converging on the correct solution and retrieval times. In general the use of Nearest Neighbor method leads to the retrieval time increasing linearly with the number of cases. Therefore this approach is more effective when the case base is relatively small.

A typical algorithm for calculating nearest neighbor matching is the one used by Cognitive Systems Remind software reported in Kolodner [7] where w is the importance weighting of a feature (or slot), *sim* is the similarity function, and f^I and f^R are the values for feature *i* in the input and retrieved cases respectively.

$$\frac{\sum_{i=1}^{n} W_i \times \mathbf{sim}(f_i^I, f_i^R)}{\sum_{i=1}^{n} W_t}$$

9.3 Induction

An induction algorithm determines the best features used for discriminating cases, and generates a decision tree to organize the cases in memory. This approach is useful when a single case feature is required as a solution, and where that case feature is dependent upon others.

9.4 Template retrieval

Similar to SQL-like queries, template retrieval returns all cases that fit within certain parameters. This technique is often used before other techniques, such as nearest neighbor, to limit the search space to a relevant section of the case-base.

9.5 Adaptation

Once a matching case is retrieved a CBR system should adapt the solution stored in the retrieved case to the needs of the current case. Adaptation looks for prominent differences between the retrieved case and the current case and then applies formulae or rules that take those differences into account when suggesting a solution.

An ideal set of adaptation rules must be strong enough to generate complete solutions from scratch, and an efficient CBR system may need both structural adaptation rules to adapt poorly understood solutions and derivational mechanisms to adapt solutions of cases that are well understood. Several

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techniques, ranging from simple to complex, have been used in CBR for adaptation.

10 ADVANTAGES OF CASE BASED REASONING

- It RETRIEVES the most similar case from the galaxy of cases.
- REUSE the problem cases to solve the new problem.
- REVISE/Modify the proposed solution if required and
- RETAIN the new solution as a part of a new case.

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