Case based Reasoning Shell Frameworkas Decision Support Tool

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Abstract

Background/Objectives: This paper presents Case-Based Reasoning (CBR) shell framework as a decision support tool for a general category problems concerning any diagnosing field. This research attempts to investigate the utilization of Genetic Algorithm (GA) in the CBR shell framework, methodologies, processes and techniques to bring a new research dimension. Methods/Statistical Analysis: CBR manipulates GA operators' selection in three scenarios: complete available information, the available information is not enough to give complete operators implementation cycle and no information available. All the possibilities of operators' selections will be considered and the sequence of the operators with optimal solution will only be considered and retained in the case base. The CBR shell framework will help the users to build their own systems easily and efficiently through automatic and friendly expert interface associated with a powerful help system. Findings: The findings outcome from this study have shown that: (1) A comprehensive listed of active CBR shell framework as a decision support method; (2) Identified and established an evaluation criteria for CBR shell framework as a decision bolster toolfor a general category problems; (3) Highlight the methods, based on Genetic Algorithm, for selecting the best diagnosing (4) Attempt to suggest a proposed system that is the first of its kind to make a decision to choose the best solution that is based on CBR technology. In addition, the use of association rules algorithms. It also provides the necessary structure for system building in knowledge base. This applies also to the time factor that has been reduced slightly based on the rate of reduction in the general category problems concerning any diagnosing field. Application /Improvement: The importance of the research based on the proposed system is that it is the first framework as a decision support tool for a general category problems concerning any diagnosing field. However, CBR has been selected as a tool for the shell framework in order to create, capture and share knowledge to be applied in a particular organizationin order to increase the productivity and building competitive advantage for the organization.

Keywords: Case-based Reasoning, CBR Technology, Decision Support Tool, Diagnosing Field, Genetic Algorithm

1. Introduction

Case-Based Reasoning (CBR) is an Artificial Intelligence (AI) strategy that has the thinking capacity by recalling beforehand experienced cases. For PC thinking purposes, CBR has been formalized into four primary strides: Retrieve, Reuse, Revise and Retain. All the four stages are used to control information stream of the CBR to create contemplated result. It records and archives cases and afterward seeks the fitting cases to decide their helpfulness in settling new cases exhibited to the user. In a time where organizational success is,Case-Based Reasoning (CBR) is an method for learning and for critical thinking in light of past experience. A past affair is put away as tackled issues ("cases") in an alleged case base. Another problem is settled in view of adjusting arrangements of known comparable problems (see figure 1).

Case-based thinking (CBR) is the way toward taking finish of new problems in view of the arrangements of comparable past situations. In 1977 the work of Schank

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Figure 1. Case-Based Reasoning (CBR) Cycle^{3.}

and Abelson is comprehensively alluded to be the causes of CBR. They turned out with recommendations that the general learning about circumstances is recorded as scripts that give us the psychological capacity to set up desires and perform inductions (inescapable conduct in ordinary human critical thinking). Scripts were then recommended as a structure for calculated memory portraying data and information about stereotypical events, for example, heading off to an eatery or going by a specialist. CBR is a critical thinking technique or thinking model whose center procedures rotate around four primary strides, wwhich are retrieve, reuse, revise, and retain (as shown in figure1 The following gives brief descriptions of the steps¹⁻³

- **Step1-Retrieve:** Retrieve the most comparative case or gathering of cases.
- **Step2-Reuse:** Reuse the data, learning, and arrangement all things considered to solve of the current issue if there is an impeccable match.
- **Step3-Revise:** Revise and adjust the most comparable case or gathering of cases as fitting if an immaculate match is not found.
- **Step4-Retain:** Retain or storage the new experience or case for future recoveries and problem solution, and the case base is redesigned by sparing the recently learned case.

This procedure gives CBR capacity to learn and make another solution and another case that ought to be added to the case base. It ought to be noticed that the retrieve procedure in CBR is not quite the same as the procedure in a database.if the user want to check or test data, the database just recovers a few data utilizing a correct coordinating while a CBR can retrieve information utilizing a approximate matching.In any case, this cycle once in a while happens without human mediation that is generally required in the retain step. In the mean time various improvement techniques and approaches of how to enhance CBR frameworks have been introduced. The techniques utilized for case base plan incorporate the meaning of the destinations and the particular branches of knowledge fundamental the CBR framework to be produced. Moreover, all situations concerned with the case base must be recognized. In light of this data, the case base conceptualization is definite (see Figure 2).

In this research, the objectives of the CBR shell framework are as follows:

- To propose a CBR shell framework as a decision support tool for a general category problems concerning any diagnosing field.
- To propose a framework that can give Genetic Algorithm Case Based Reasoning (GACBR) approach based on the application use reviewed.
- The proposed architecture enables the CBR to select the best sequence of GA operators by referring to the already collected and stored information in the case base and the new solved incidences by the system.
- The research attempt to suggest a proposed system that is the first of its kind to make a decision to choose the best solution that is based on CBR technology. In addition, the use of association rules algorithms. It also provides the necessary structure for system building in knowledge base.



Figure 2. Developing the Conceptual Structure for a CBR System⁴.

CBR as a field manages both hypothetical and practical problems to pass on dependable and conceivable thinking. It has been influenced by various different fields, for example, intellectual science, knowledgebased systems, machine learning, databases, data recovery, fuzzy logic and neural networks ⁴. CBR is an infinity domain for incorporating and consolidating different sorts of strategies. It is more right to say that numerous hybrid systems join the utilization of CBR. CBR has every one of the possibilities of a total AI system by being able to effortlessly embrace other AI strategies in its reasoning cycle. It can manage both computational and learning base problem solving^{1,3}.

The defference between CBR and AI approaches in the following milestones:

- 1. Traditional AI approaches rely on upon general information of an episode space and have a tendency to illuminate occurrences on a first-guideline while CBR frameworks fathom new episodes by using particular learning of past learning.
- 2. CBR bolsters incremental and maintained learning. After CBR solves an occurrence, it will make the episode accessible for future episodes.
- 3. The best utilization of CBR is as counseling and meeting frameworks that depend on the client's execution estimation and adjustment.

2. CBR Applications

CBR can be used in many various real life applications, the following subsections describe some of those applications:

2.1 Using CBR in Bank Help Desk System

The bank takes responsibility for help desk agent specialist called the primary level support (PLS) which goes about as more than only an interface for interior usersvand external users. Thus, IT benefit work area as a second level support (SLS) will resolve the doled out episodes from the FLS by guaranteeing that the occurrence is in the outsourcing degree and still possessed, followed and observed for the duration of its life cycle. During the time spent determining the episode viably, using AI technique (e.g. CBR, ANN, GA, Expert System and FL) as a Knowledge Management (KM) tool.

2.2 Applications in Reservoir Engineering

A CBR framework decides the closeness to looking for analogs on fundamental of matching properties that

are not precisely comparative. Stores attributes are not precisely matched. In 2002, ⁵ used CBR to internationally search supply analogs as an essential stride in arranging new fields. An knowledge sharing method was produced, called the Smart Reservoir Prospector (SRP).

2.3 Applications in Petro Physics

To give petrographic investigations, the framework accomplishes its thinking power through the arrangement of past cases consolidated with some other wellspring of learning about a specific area. Data to construct cases was given through optical and electronic magnifying lens investigation, isotopic and substance examination and petro material science. The CBR was connected in one kind of repository rocks i.e., sandstone. An intriguing expansion of this work is decipher different sorts of store rocks⁵.

2.4 Applications in Diagnosis

CBR have many used was applied in the diagnosis applications that including fault diagnosis and disease diagnosis, notwithstanding the classification or recognition errand, the job of selecting the best test(s) to procure the missing data as inexpensively, quick and safely as would be possible. real cases are fault detect of an auto engine or disease medical diagnosis^{2.5.6}.

2.5 Applications in Decision Support

Decision Support Processes should be adapt to (more explorative) issues where the order objective is characterized amid the problem solving stages(dynamic target definition). Cases are searching for a house to purchase, searching for a very late excursion without plainly characterizing the area and the sort of travel, and searching for an appropriate utilized or another truck for an organization^{5,7}.

3. Materials and Methods

CBR shell framework describing how to deal with CBR as a decision support tool for a general category problems concerning any diagnosing fieldthat can be used in building and keeping up CBR systems. The CBR framework is a final result of the looked into conceivable problems concerning any diagnosing of CBR that were analyzed to locate the best coordination for each of the applications in the CBR framework. The proposed shell framework includes the beginning, building a knowledge base that includes all the cases that will be data questwithin it and search of the best solution, where it is the process of search and matching using a CBR technique, to build this rule we must search for questions that require answersand store all the solutions of each case. After that decisionmaking process begins by the customer by answering the same questions with the development of the importance of each question,therefore problems are evaluated based on the question importance of the user and availability of the solution. This process will continue down to the last stage, where the user selects the detailed functional requirements. Figure 3 presents the generic framework of a CBR shell.

Numerous scientists and specialists see CBR innovation as a standout amongst the best AI advancements, for example, the utilization of Fuzzy Logic (FL) in CBR cycle. The conceivable work of FL in the CBR framework can happen as follows:

- In case representation: Fuzzy representation of the plan case helps with developing exact components to the cases from the gave data, thus the retrieve stage⁸⁻¹⁰.
- In case indexing and retrieval: Assigning level of participation to the cases' components to be chosen in light of particular criteria^{11,12}.
- In case adaptation: Fuzzy rules can be used to circulate the result in a manner that can prompt issue determination¹³. The membership functions of FL are in charge of playing out the adjustment by controlling



Figure 3. Generic Framework of CBR^{3.}

the estimations of the particular parameters of the retrieved $cases^{9,11,14}$.

• In revision: Providing answers for dubious or fragmented cases¹⁵⁻¹⁸.

According to³ Artificial Neural Network (ANN) provide performs superior to CBR particularly when it is hard to express information in a typical representation, ANN can be utilized to extricate new learning from the current one to be abused by CBR. All things considered, the ANN qualities of parallelism, flexibility, generalization and strength to deficient information taking care of are basically utilized¹⁹. The accompanying are conceivable uses of ANN in CBR frameworks.

- In case retrieval: ANN is exceptionally tolerant in managing deficient information with a satisfactory execution in retrieval. For better execution be that as it may, the scope of the ANN area must be thorough amid the learning stage. In perspective of these focal points, ANN and CBR incorporation collaborate to handle difficult issues.
- Performing adaptation: Since, CBR adjustment capacity disintegrates if there are no correct comparable cases, ANNs, for example, MLP and RBF can be connected in the CBR adjustment. In²⁰ for example, ANN is utilized for parameter adjustment to foresee answers for new cases. In like manner, MLP with one hidden layer was produced for this reason utilizingback-propagation algorithm for learning^{15,21,22}.
- Case feature weighting: the ANN can be used to take in the worldwide element weights (i.e. doling out weights to the case highlights)²³. This can help with case likeness units in the retrieve and reuse steps. Fundamentally, feature weights demonstrate need/ significance and in this manner, the connection of the accessible elements²⁴.

Genetic Algorithm (GA) combination in CBR framework is for enhancement purposes, which can be used in various aspects. A portion of the conceivable uses of GA in the CBR framework are as the following²⁵⁻²⁷:

• Indexing and retrieval optimization: For the case likeness estimation, GA can be utilized to produce and appoint weights to the cases' elements³. This can help in deciding elements and case choice and retrieval with a base prescient mistake¹. Likewise, occasion choice results from this procedure by lessening the search space and observing the ideal cases to be retrieved²⁸.

- Case adaptation enhancement: numerous comparative case results, GA can be used to choose the best case among them or it can choose the best elements from the offered cases to be introduced as another case to be utilized (i.e. case feature discretization)⁵. Another procedure is proposed by¹¹, the GA populace is started from the retrieved mutation and crossover operators are used to produce the required populace and the fitness value assesses the created result²⁵.
- General purpose: It is more advantageous to empower the GA to take a shot at more than one part of the CBR than one specific issue (e.g. 3,25,29). GA is used to produce helpful instances of the proposed CBR module. Furthermore, it additionally handles different strides of the CBR module, for example, assessment and retrieval, adjustment and learning for refining the module execution. For case evaluation and retrieval upgrade, a wellness measure of a case that is construct not just in light of the blend of its components values, additionally on it being an individual from the case base is proposed³⁰.

3.1 Stages of CBR Shell Framework Application

CBR is an method for learning and for critical thinking in light of past experience. A past affair is put away as tackled issues ("cases") in an alleged case base. Another problem is settled in view of adjusting arrangements of known comparable problems. For computer thinking purposes the CBR framework has been formalized into four fundamental strid: Retrieve Reuse, Revise and Retain¹⁻³.

Case Retrieval:this stage will describe the problem and find nearest cases for new cases therefore including many departments as:

- Problem Description.
- Find Similarities between cases for new cases.
- Select a best similarity case.

Case Reuse: in this stage the reuse of knowledge process that considering the differences between the old cases and the new cases, some parts of old cases can be moved to new cases, there are two ways to reusing these operations:

- Solution Copy: Copy solution of the old case to be a solution for the new case.
- Solution Adapt: Use old case solutions in the new case after creating conducting operations on it. These

processes relate to the differences between the old and new cases, which are form of stored rules.

Case Revision:this stage will test solution for new cases and correct it in the event of failure, this phase consists of two steps:

- Evaluation of the solution: Evaluation of the solution will be through in fact applied, or asking by the expert.
- Error Repair: The errors are discovered and change the solution to be adapted to remove the errors.

Case Retain:In this case;store the new case in the knowledge base to be used in the future, therefore CBR represent inference process, knowledge inferenceand problems solving through reuse of previous experience.

3.2 CBR Decision Selection Making

Knowledge base represents a group of users having specific featuresat which each user's request representsa case, the solution conclusion is obtained by applying the previous steps for CBR technologythrough restoration of stored cases process, calculate the percentage of similarity between them and the new situationand finally choose the most similar case without storing a new case because it represents a user, not a problem. The new case is gradually built by asking the customer or the user, representing the specifications requirements in the application and evaluating stored cases, to find any similarities between them and the new cases at every question. Finally, the choice of the nearest case. Also the system allows the customer to know the differences between the request and the nearest case specification $\frac{31.32}{2}$.

3.3 Knowledge Base Building

The building of a knowledge base through answering group of questions includes two parts: The first one is the independent part that is randomly concern the organization work environment. The second part is a detailed part that includes detailed requirement to be obtained. It is worth to mention that the knowledge base will be built independently from the other parts of the CBR in order to have a general (shell) CBR.

3.4 Answer Options Selection

The objective of applying CBR is in the interest of shell system. CBR manipulates GA operators' selection in

three scenarios. If there is available information, the case base in what operators must be selected to find optimal solution, the system only use the proposed type and order of these operators. If the available information is not enough to give complete operators implementation cycle, some of the operators will be proposed by the system to complete the cycle. Finally, if there is no information available, the system has to start from scratch. All the possibilities of operators' selections will be considered and the sequence of the operators with optimal solution will only be considered and retained in the case baseas shown in figure 4.

The retain step in the proposed structure has a case base upkeep framework. This framework can be taken care of by various strategies, for example, GA. The explanation for applying such framework is to decrease stockpiling excess and in addition enhance retrieval productivity 2,3. The revised case is to be checked and learned by retaining it for the situation base. As a piece of case base upkeep, the less valuable case is to be killed amid the unlearning time frame. Less helpful case choice is made in view of the case likeness estimation that is held between the modified case and the accessible cases.



Figure 4. The Proposed CBR Shell Framework.

The trend begins using heuristic, especially genetic algorithm (GA) to find a good solution for the complex problems, particularly, when the other searches have failed to find an optimal solution ²⁵. It is efficient to find a solution when solution space is large and when linear programming cannot find the theoretical solution in proper time, deal with multi-constraints problems, solve a problem when there is limited time or resources of the problem, find approximate solution and handle a problem when there is no exact or known algorithm exists to solve it^{7.25,26,29,33-36}.

Based on the motivation of this paper, a comparison of the CBR shell framework of this study was carried out with the one that is conducted in Salamh et al as they proposea new development module which can be used in numerous applications that requires Computational Intelligence (CI) results. The system proposed is worked under the ideas of SC where FL, ANN and GA are consider to perform delicate case-based thinking errands.

4. Conclusions

been utilized for CBR The GAtechnique has applicationstoimprove the various determination criteria handling, case retrieval exactness and framework adjustment capacity. Utilization of the choice pattern in the retrieve step upgrades case choice. The fuse of GA prompts better speculation by abusing its learning favorable circumstances which improves the execution of case adjustment. The proposed framework is a decent alternative for complex frameworks that may have nonlinear, timevariation or potentially badly characterized cases. Also, its handiness is in circumstances where the choice of the numerical model is either excessively troublesome, making it impossible to encode, does not exist and additionally is excessively confused and costly, making it impossible to be made effectively. General zones that need this sort of system envelop:optimization ,classification,data mining, prediction, scheduling, control and decision support.

The focus of this paper is to investigation the speculation made on appropriation of the CBR shell framework. As a major aspect of its analysis, with a specific end goal to get objectivity, the study has proposed a structure for a CBR shell framework. In light of the study completed it has given a few suggestions which should be considered all in all while doing such transitions. To validate our framework system with benchmark study we showed the differ and the enhancement based on the motivation of this paper, a comparison of the CBR shell framework of this study was carried out with the one that is conducted in Salamh et al. Our CBR shell framework as a decision support tool for a general category problems concerning any diagnosing field is clearly differing than the one that is produced by Salamh et al., as out CBR shell is more flexible and general, which gives the users the freedom in designing their own CBR systems.

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