Rule-based system for staff management using Forward Chaining Technique

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Abstract

This paper is intended to implement the Rule-based system for staff management. There are many rules in the system. These rules are predefind rule.The system works with If- THEN rules and with input data provided by the user in an aspect of forward chaining control strategy. Forward chaining is the general concept of data-driven reasoning that is, reasoning in within an agent to derive conclusions from incoming precepts often without a specific query in mind. The system implements a rule-based system for making decision the position of staff by using the forward chaining inference engine.

1. Introduction

Rule-based systems are a relatively simple model that can be adapted to any number of problems. As with any AI, a rule- based system has its strengths as well as limitations that must be considered before deciding if it's the right technique to use for a given problem. Rule-based systems are really only feasible for problems for which any and all knowledge in the problem area can be written in the form of if then rules and for which this problem area is not large[5]. In a rule-based system, the knowledge base consists of a set of rules that represents the knowledge that the system has. The database of facts represents input to the system that is used to derive conclusions, or to cause actions. The interpreter, or inference engine, is the part of the system that controls the process of deriving conclusions. If use the rules and facts, and combines them together to draw conclusion [1]. Rule-based systems are gaining an increased popularity in various domains, including business, engineering, the military, and medicine. This system is recommended for management of public work's engineers.

In this paper, we explain how rule-based system can solve for management of public work's Engineer. The rest of this paper is defined as follows, Section 2 explain Rule-based system using Forward Chaining System. Section 3 presents proposed system design and implementation of the system is described in section 4. Finally, we conclude the paper in section 5.

2 . Background Theory

The rule engine can solve the thousands of concurrent facts which can influence the outcome of important decisions. Those decisions can be difficult or impossible to program by using procedural or imperative programming techniques.

Knowledge is represented as a set of rules and data is represented as a set of facts. The rule engine compares each rule in the knowledge based (the rules) with the facts. If a rule matches a fact (conditions is for filled) the rule is said to "fire", and the "then" action (consequence) is executed [4]. There are two ways in which rules are executed forward chaining and backward chaining. Forward chaining is data-driven reasoning , it starts with the available data and uses the rules to extract more data until it has reached its goal, which is opposite to backward chaining that is goal-driven, where the system has a goal and uses the rule engine to try to find the evidence to prove it[3].

2.1 Rule-based System

The system has a list of rules which determine what should be done in different situations. These rules are initially designed by human experts. The rules are called production rule [9].Each rule has two parts, the condition-actions pair:

Condition: What must be true for the rule to fire?

Action: What happens when the condition is met?

There are many ways of describing the heuristics for a decision making process, but the one that has proven the most effective and efficient is the IF/THEN rule. This is a rule where there is an if parts that can be tasted to be true or false based on the data for a specific case or situation. Where the if part is true, this is how a basic rule is written:

IF < It is raining>
THEN < You should were raincoat>

2.1.1 Rules

The basic structure of a rule and several key concepts can be broken down into the following basic units: rule structure, patterns (condition), and actions.

2.1.2 Rules Structure

The basic structure of a rule is IF-THEN. Typically, these are referred to as the Left Hand Side (LHS) of a rule.

The LHS contains conditions in the form of patterns and RHS contains actions-things the rule should do if all the conditions on the LHS have been met.

2.1.3 Rule Condition

The LHS of a rule is composed of a set of conditions, or patterns. Each pattern is matched, if possible, with one or more objects in working memory. More precisely, a pattern comprises tests than are applied to each object in working memory, and object is said to match the pattern when it passes these tests successfully.

2.1.4 Actions

The RHS of rule said to execute of fire when all of the conditions on the LHS have been met. There are many actions that a rule might perform. Depending upon the requirements of the application, a rule may add an object to or remove and object to or remove and object from working memory, modify and object, or execute a method on the objects. Rule-Based system represents knowledge in term of a bunch of rules that tell you what you should do or what you could conclude in different situation. It starts with a rule-based, which contains all of the appropriate knowledge encoded into if –then rules, and a working memory, which may contain information used by the system to decide which of the condition-action rules, is able to be fired.

2.2 Methods of Rule-based System

Rule –based refers to the resulting from a match of user profile with content profile based on rules. Rule-based approach generates many rules and involves complex rule maintenance, In logic the programmer represent knowledge in declarative, static way as some facts and rules that are true [2].

Two many kinds of Rule-based systems are:

1. Forward chaining
2. Backward chaining

2.2.1 Forward chaining

Forward chaining is the data-driven approach. In this approach it starts from available information as it comes in, or from basic idea, then tries to draw conclusions. The computer analyzers the problem by looking for the facts that match the IF portion of its IF-THEN rules. The answer depends on the purpose of the search space. A forward chaining process expands this space as it searches for a sequence of actions that transform to a state (or sequence of states) satisfying the goal [7].

Forward chaining process treat the classify problem use a rule-based and search problem. It has proved itself to be a very fruit full basic for implementing high-performance. It provided complete information about the current state and that information can provide powerful guidance for search. The forward chaining search space still suffers from the problem that it is not goal directed, and in many of our test domains user have found that some of the search control information he added was designed to recapture goal-directedness[6]. Forward chaining inference engine is a rule interpreter. The interpreter is based on a cycle of activity, repeated until some specific goal is satisfied or until no more rules are fired(no new facts are derived). The forward chaining procedure is show in fingure 1.

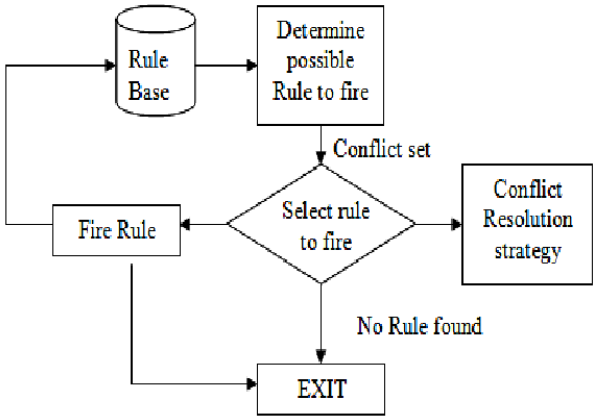


Fig 1. Forward chaining procedure

2.2.2 Conflict Resolution Strategy

Conflict resolution strategy is used in production system to help in choosing which production rule to fire[10]. The need for such a strategy arises when the conditions of two or more rules are satisfied by the currently known facts. It is fall into three main categories

1. Specificity: If all of the conditions of two or more rules are satisfied, choose the rule with the most specific conditions . (e.g. " it is hot and smoky" rather than "it is hot"). Also

referred to as " degree of specialization".

2. Recency: Facts are usually tagged to show how recently they were added. When two or more rules could be chosen, favour the one that matches the most recently added facts. This helps to utilize the most recently relevant facts.
3. Refractoriness: If a rule's conditions are satisfied, but the same facts, ignore the rule .This helps to avoid the system from entering infinite loops.

2.3 Backward chaining System

Backward chaining is a goal-driven search strategy. It begins with the goal and works backward to the initial conditions. The process start with a hypothesis, a search is then launched to find and verify the necessary supporting facts. The process ends with the acceptance or rejection of the hypothesis [8].

The program starts with a goal to be verified as either true or false. Then it looks for a rule the premise of that rule in an attempt to satisfy this rule. It then checks the assertion base first. If the search there fails, the expert system look for another rule whose conclusion is the same as that of the promise of the first rule. An attempt is them made to satisfy the second rule. The process continues until all the possibilities that apply are check or until the first rule is satisfied. This approach is most useful when all the initial facts will be known, but it does not have idea what the conclusion might be.

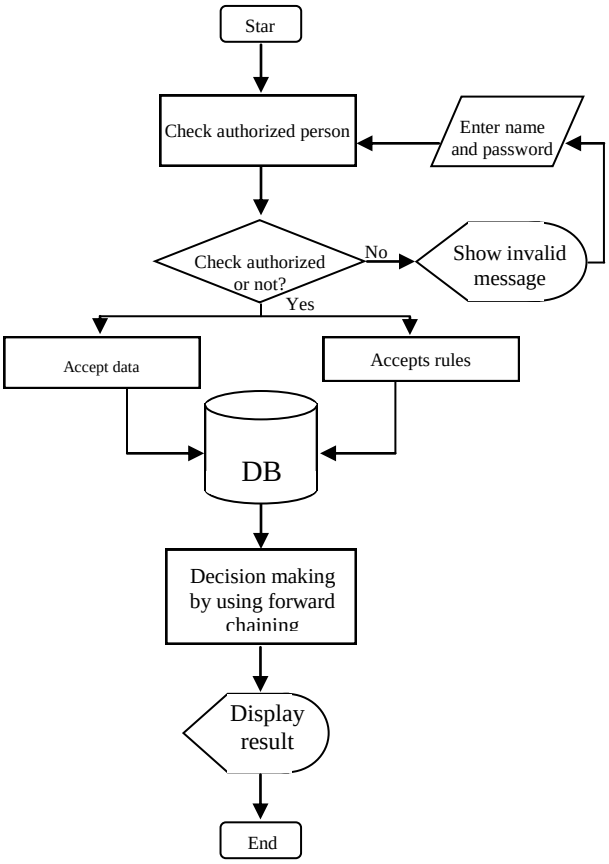
3. Proposed System

The proposed system is designed based on rule-based system. It mainly performs accept rules, stores personal data, and checks and displays the information of promotion, transfering and discharging cases for the Public Work's Engineer. According to the ranks and appointments, the Public Work's Engineer has the following ranks.

1. Junior Engineer-(4)
2. Junior Engineer-(3)
3. Junior Engineer-(2)
4. Junior Engineer-(1)
5. Assistance Engineer
6. Executive Engineer
7. Deputy Superintending Engineer
8. Superintending Engineer
9. Deputy Chief Engineer
10. Chief Engineer
11. Deputy Managing Director
12. Managing Director

In this system, there are two types of users such as the administrator and the users. The administrator is an authorized officer who can perform the function such as the rules accept and inserting the personal facts of public work's engineer for prmotion, transferring and discharging. Administrator can add promotion rules, transfer rules and discharge rule. Then, these rules are used when promotion, transfer and discharge case of public work's engineer are checked.

The administrator can edit existing rules and delete existing rules. And hence, the administrator can add exam mark for each employee. Administrator can make the suitable decision concerned with the promotion, transfer and dicharge. The user can be see his/her own profile. And then, he/she can check about the facts that concern with his/her rank. This process will search the match rules for his profile.To do these decisions, this system uses forward chaining inference.



Finger 2. System Flow Diagram

4. Implementation of the system

The system is implemented by using Java programming language. The system applies forward chaining Rule-based system for staff management system. As this system concerns with staff management, the promotion, transfer and pension of the staff can be tested by means of rules. This system uses predefined rules. Predefined rule are inserted in knowledge based. The input from users is also started in working memory. By matching predefined rule in knowledge based and input data in working memory, inference engine can give the definite result. This system uses forward chaining inference engine to give a reasonable decision of staff's promotion, transfer and pension. This rules based on current-rank, total service, educational-level, medical-category, active-offence, promotion exam, current-rank service and age In working memory, the data of public works' engineers are stored. If the staffs want to get promotion, it is needed to decide whether he or she can get promotion. To do this, it is required to check the data of the staff which is stored in working memory with the condition of each rule in rules-set. If the data of the staff is matched with the rules, the decision to give promotion can be received. If one of the data is not match with the rules, the message for not matching the condition can be delivered.

The knowledge is stored mainly in the form of rules, as are the problem-solving procedures. The types of rule are condition-action rule, knowledge rule and inference rule. Condition-action rule is also called a production or production rule, is a rule of the form if condition then action. Knowledge declarative rules state all the facts and relationships about a problem. Inference procedural rules advice on how to solve a problem, given that certain facts are known. This system uses condition-action rules. The following describes some rules which concern with Public Work's engineer as an example.

4.1. Rule of promotion for Junior Engineer (4) to Junior Engineer (3)

If current-rank is "Junior Engineer (4)"
AND total service is "two years and more"
AND educational- level is "BE or AGTI"
AND medical-category is "A"
AND active-offence is "clear"
AND request-for-release is "NO"
AND promotion exam is "Pass"
AND current-rank-service is "two years and more"
THEN promotion is Junior Engineer (3).

4.1 Rule for Transfer Position

If current-unit-service is "three years and more"
AND active-offence is "clear"
AND current-attending-course is "no"
AND request-for-release is "no"
AND medical-category is "A"
THEN transfer is "yes"

4.1.3 Rule for discharge (Junior Engineer (4))

If current-rank is "Junior Engineer (4)"
AND medical-category is "B"
AND request-for-release is "yes"
AND active-offence is "clear"
THEN discharge is "Junior Engineer (4) with disability pension"

OR

If current-rank is "Junior Engineer (4)"
AND total-service is "greater than equal 30"
OR current-rank-service is "greater than equal 10"
OR age is "greater than equal 60"
AND request-for-release is "yes"
THEN discharge is "Junior Engineer with service pension"

4.2 Rank's of promotion from one particular post to another

The following table 1 describes the promotion prospects from one particular post to another. For emample: if the staff whose post is Junior Engineer(4) wants to promote to Junior Engineer(3) it needs to check whether the personal data is match with the condition of the rule or not. If it is match, he or she can get promotion. If it is not, he or she can not get promotion. In this case forward chaining interpreter is used to infer the appropriate result.

Table 1.Rank's of promotion from one particular post to another

N0	Rank From	Rank To
1	Junior Engineer(4)	Junior Engineer(3)
2	Junior Engineer(3)	Junior Engineer(2)

3	Junior Engineer(2)	Junior Engineer(1)
4	Junior Engineer(1)	Assistance Engineer
5	Assistance Engineer	Executive Engineer
6	Executive Engineer	Deputy Superitinding Engineer
7	Deputy Superitinding Engineer	Superitinding Engineer
8	Superitinding Engineer	Deputy Chief Engineer
9	Deputy Chief Engineer	Chief Engineer
10	Chief Engineer	Deputy Managing Director
11	Deputy managing Director	Managing Director

5. Conclusion

The system is developed as a rule based system and forward chaining is used to inference rules. The system takes the user input as facts and finds rules according to the result of forward chaining. This system can give a definite result only if staff's data is match with the data in knowledge based. If not the system can give the error message.

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