Simulated Assessment of Ripple Round Rules

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Abstract. A new Ripple Down Rules based methodology which allows for the creation of rules that use classifications as conditions has been developed, and is entitled Multiple Classification Ripple Round Rules (MCRRR). Since it is difficult to recruit human experts in domains which are appropriate for testing this kind of method, simulated evaluation has been employed. This paper presents a simulated evaluation approach for assessing two separate aspects of the MCRRR method, which have been identified as potential areas of weakness. Namely, “Is the method useful in practice?” and “Is the method acceptable, computationally?” It was found that the method appears to be of value in some, but not many, “traditional” multi-class domains, and that due to computational concerns with one aspect of the method it is considered unsuitable for domains with a very large number of cases or rules. These issues are discussed and solutions are proposed.

Keywords: ripple, down, rules, multiple, classification, round, configuration, knowledge acquisition, simulated, expert, assessment.

1 Introduction and Previous Work

Knowledge based systems are notoriously difficult to evaluate objectively for several reasons. Particularly, it is difficult to get experts to give their time to the training of the project and it is virtually impossible to make them train the same system multiple times. Furthermore, it is difficult to get a true gauge of how correct or optimal the system really is, as it is difficult to convince the expert or other independent experts to verify the results of the system after the fact. To compound these problems further still, different experts will have different opinions as to what correct is, and are likely to perform somewhat inconsistently from one train of a system to the next. Because of these features, multiple experts should really be assessed and contrasted multiple times each. Since experts are - virtually by definition - scarce, and their time valuable, this kind of assessment is very rare [1]. To overcome this problem, simulated experts have been previously employed for the task of evaluating new expert systems methodologies, particularly in Ripple Down Rules (RDR) related studies, such as this one [2-4].

Having developed a new RDR based method, and having very limited access to human experts with appropriate domains to evaluate, it was considered necessary to again employ simulated experts to evaluate the method. However, the particular
characteristics of the method required some modifications to the existing simulated expert evaluation process.

2 Ripple Down Rules

The RDR methodology makes use of a true-false binary tree structure in order to ensure that rules are always added in context [5, 6]. An example of this structure is shown in Figure 1.

Using this same sample knowledge base we can also consider the inference process that is used in the RDR methodology. If we consider a sample case in which we have \([X=5, Y=5, Z=10]\) then we will consider rule 1 initially and find that \(X>4\) is true, so rule 2 will be considered. \(Y<3\) is false, so rule 7 must be considered. The condition \(Z<9\) is also false, but as there is no false branch deriving from rule 7 we have hit a dead end and as such will simply fire the last considered true statement, which results in rule 1 firing [4].

![Fig. 1. A sample RDR knowledge base where arrows pointing upwards indicate the TRUE path while arrows heading downwards indicate FALSE paths](image)

RDR, as described thus far, still encounters problems with maintainability. The addition of a new rule may cause previously considered cases to become misclassified, however, this problem was easily solved. When creating a new rule, the system would store the current case against that new rule as a “cornerstone” case, a copy of the case as it existed when the rule was created. Later, when creating further rules, the system will detect if this new rule caused a conflict with the past cornerstone. That is, did the new rule change the cornerstone’s classification? If so, then at this stage the expert was required to select a relevant difference between the current case and the cornerstone case [7, 8]; this process is often called the validation and verification stage of RDR.

The RDR method as described is unsuitable for multiple classification tasks, since it would require the use of either multiple knowledge bases or compound classifications, which can cause an undesirable explosion in the amount of knowledge required [1].

To extend this method to multiple classification tasks, Kang altered the underlying knowledge representation structure to that of an n-tree, altered the cornerstone case